TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL,

DIRECT SUPPORT, GENERAL SUPPORT, AND

DEPOT MAINTENANCE MANUAL

FOR

ANTENNA GROUP

COUNTERMEASURES RECEIVING SET

AN/FLR-9(V7)/(V8)

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F & M SYSTEMS CO.

DEPARTMENT OF THE ARMY

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CHAPTER 1

GENERAL INFORMATION

1-1. Description and Purpose.

a. Scope. The AN/FLR-9(V7)/(V8) Antenna Group of Countermeasures Receiving Set AN/FLR-9(V7)/(V8) includes the antenna system and associated electronic equipment. This group extends to the input maintenance patch panel of the AN/FLR-9(V7)/(V8) Rf Matrix Group (rf matrix group) and AN/FLR-9(V7)/(V8) Df Group (df group). This manual is presented in two volumes; Volume 1 contains the operation and maintenance instructions and Volume 2 contains the parts lists and wire lists.

b. General. Principal items of the antenna group are a passive, circular, high frequency three-band antenna array, rf tuners, directional couplers, rf amplifiers, power dividers, beamformers, and power combiners. The antenna group Intercepts and processes signals In the 1.5 to 30-MHz range with reduced performance between 1.5 and 2.0 MHz. The three-band antenna array receives signals from any azimuth. The electronic equipment processes signals from individual elements so that omnidirectional or directional beam-formed signals are obtained. These signals are forwarded to the rf matrix group and df group. All beams including omnidirectional in all three arrays are simultaneously available at the inputs of the rf matrix group.

c. Equipment Location. (See figure 1-1.) The three-band antenna array consists of three concentric rings of antenna elements with associated reflectors. All electronic equipment used in the antenna group is located in a (circular) central building in the center of the antenna array.

NOTE

For brevity, items that have official nomenclature are generally referred to by their common names in text descriptions. See table 1-30 which contains a cross-reference between common names and official nomenclature.

1-2. Equipment Description.

NOTE

Equipment descriptions in this section begin at the antenna array and follow a typical signal path(s) through the antenna group.

a. Antenna Array. (See figures 1-2 and 1-3.) The antenna array is composed of three concentric rings of antenna elements. Each ring of elements receives rf signals for an assigned portion of the 1.5to 30-MHz radio spectrum. The outer ring normally covers the 2to 6-MHz range (band A), but also provides reduced coverage down to 1.5 MHz. The center ring covers the 6 to 18-MHz range (band B) and the inner ring covers the 18 to 30-MHz range (band C). Band A contains 48 sleeve monopole elements spaced 78.4 feet apart (7.5 degrees). Band B contains 96 sleeve monopole elements spaced 37.5 feet apart (3.75 degrees). Band C contains 48 antenna elements mounted on wooden structures placed in a circle around the central building. Bands A and B elements are vertically polarized. Band C elements consist of two horizontally polarized dipole antenna subelements electrically tied together, and positioned one above the other.

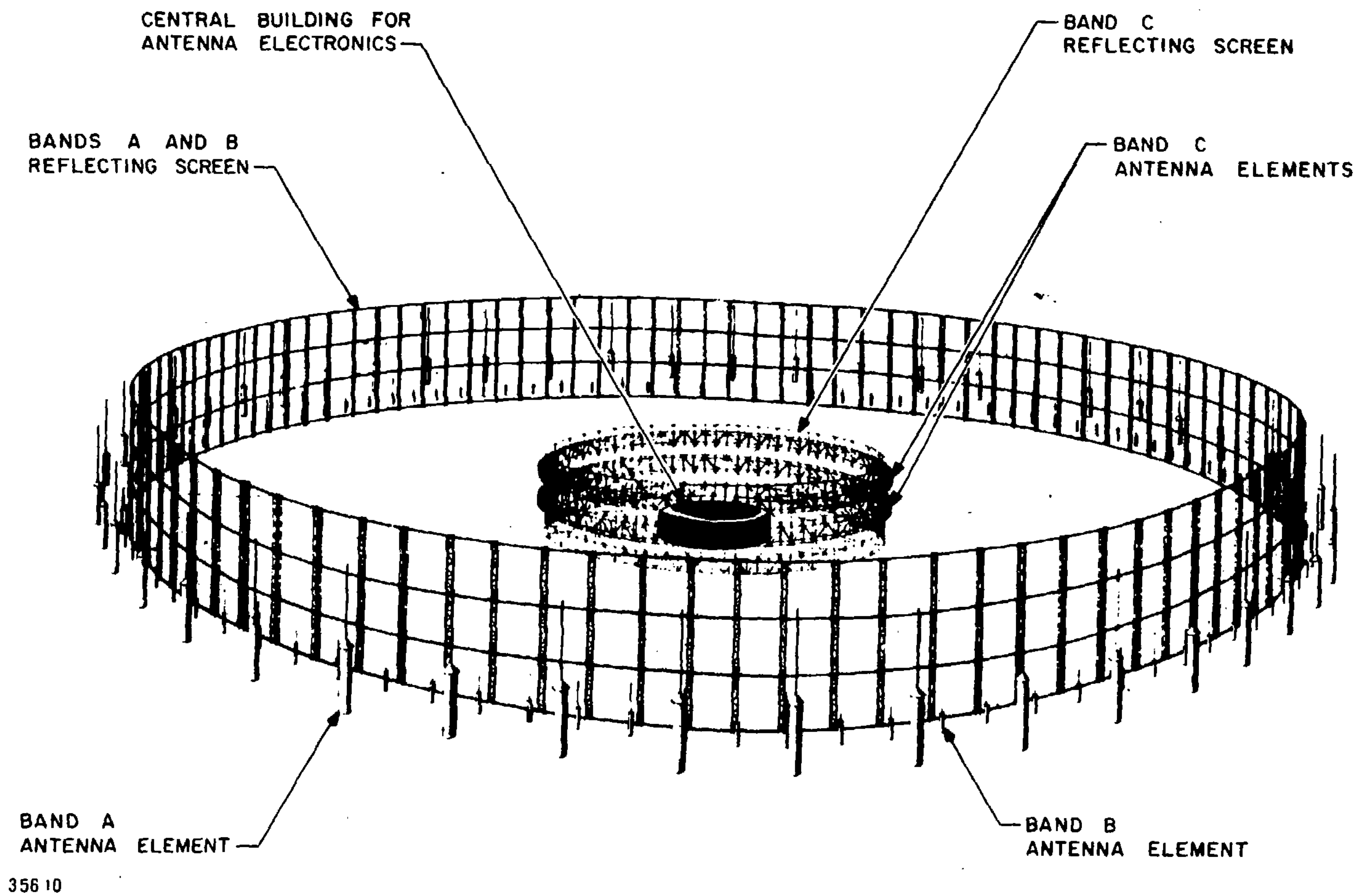

Figure 1-1. Antenna Group (Sheet 1 of 2)

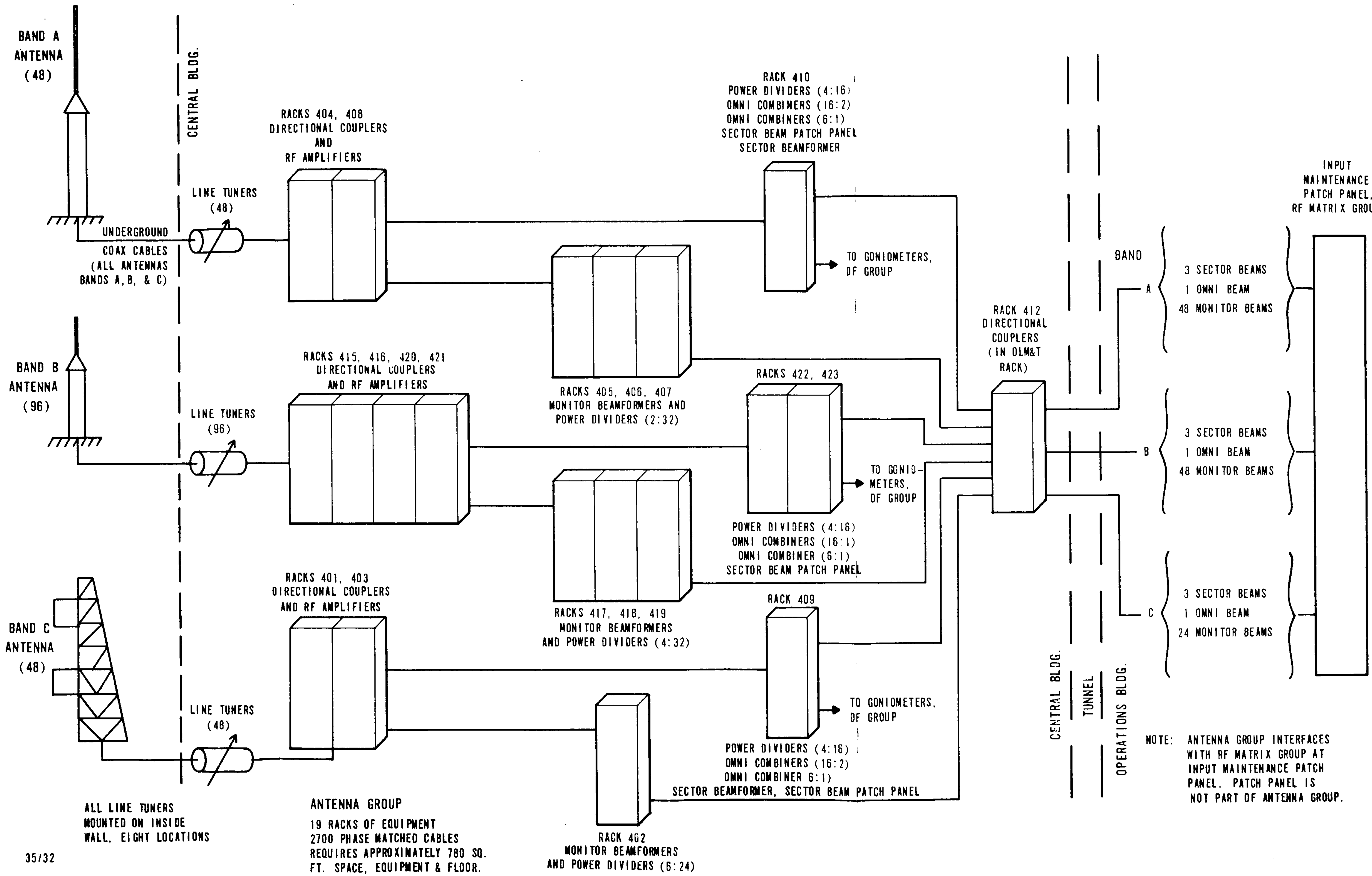

Figure 1-1. Antenna Group (sheet 2 of 2)

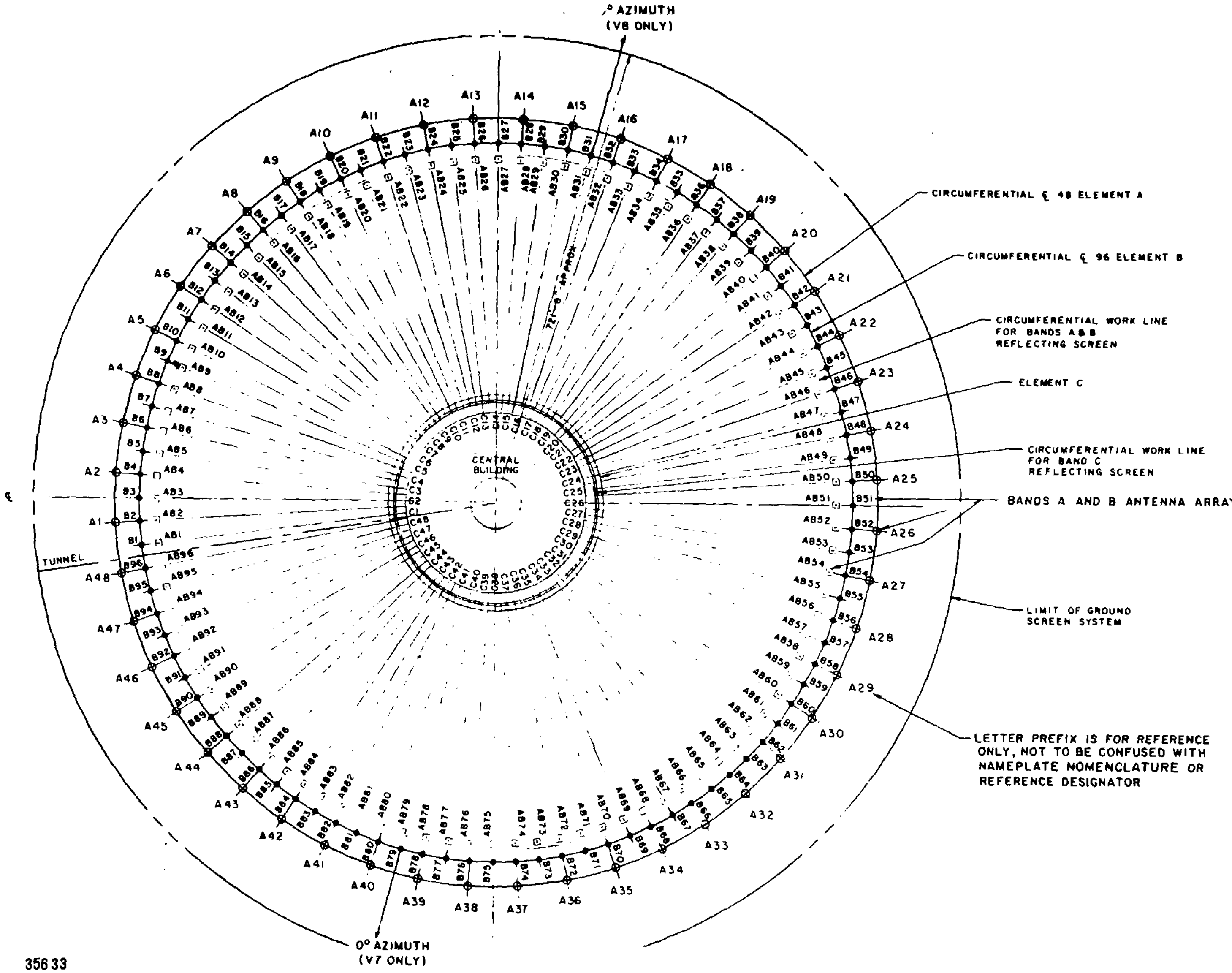

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Figure 1-2. Antenna Array General Arrangement

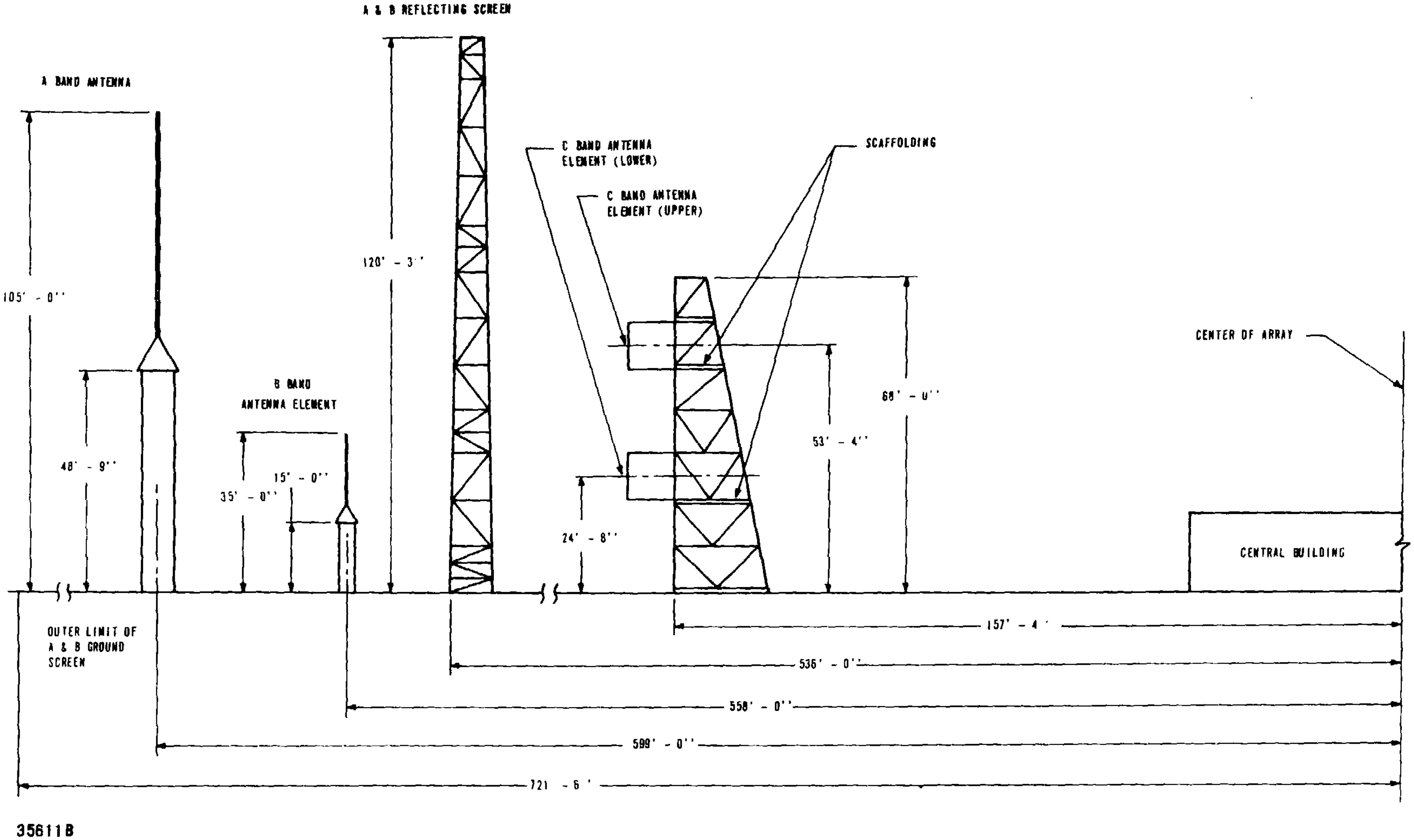


Figure 1-3. Antenna Array Cross-Section

1. Antenna Elements. Bands A and B antenna elements are sleeve monopole antennas. They are large in diameter compared to simple monopole antennas and provide wide bandwidth performance. In both bands, the top of the sleeve is protected from the weather by a conical weather cap. The weather cap is made from fiberglass and polyester resin. The top of the mast is sealed with a welded plate. A door in the sleeve permits entry to make electrical adjustments and inspections. Each band C antenna element consists of two bow-tie planar dipoles placed one above the other on the band C support structure. The bow-tie type of construction also aids in wideband performance of the band C elements. The center lines of the upper and lower dipoles are 53.33 and 24.67 feet above the bottom of the base plate, respectively.

2. Reflecting Screens. The antenna group contains two reflecting screens, one for bands A and B, and one for band C. The screens operate as reflectors to increase the power gain of individual antenna elements and aid in the formation of specific beam patterns. The screen for bands A and B is located inside and concentric to the band B antenna array. The screen is constructed of 1056 vertical steel wires supported by a structure 120.3 feet high. The structure consists of four sets of horizontal timber beams mounted to 96 steel support towers. The beams are equally spaced from top to bottom. The vertical reflecting screen wires are spaced approximately 1.5 feet apart directly in front of each support tower, and are attached to the horizontal beams. On either side of the support towers (between support towers) the wires are spaced approximately 3 feet apart. The support towers are spaced 35.2 feet (3.75 degrees) apart, and form a ring 3375.5 feet in circumference. Each reflecting screen wire is grounded directly to a ground screen and is electrically insulated from the support structure, except at ground level. The steel support towers are grounded directly together by a buried copper wire. Copper-clad ground rods are connected to the copper wire at each tower base, and halfway between each tower. A lightning rod is attached to each support tower for additional protection. An access door in the reflecting screen support structure permits entry of vehicles to the center of the antenna array. The band C reflecting screen supported by the band C antenna support structure consists of 44 galvanized steel wires strung horizontally 1.5 feet apart, with each wire held under spring tension. The lowest wire of the screen is 2.5 feet above the base of the support structure. The screen is grounded at every sixth main truss (vertical wooden support) in band C. See figure 2-2 in Chapter 2. The associated ground rods are imbedded in the ground beneath the support structure. Fortyeight lightning rods, each 102 inches long, are placed along the top periphery of the support structure at equal intervals (one to every main truss). Each lightning rod is connected by wire to a ground rod, and also to a continuous horizontal bus (buried in the ground at the base of the support structure), which acts as a common tie for all the lightning rods. An access gate in the band C support structure permits vehicles to enter the interior of the antenna array assembly.

3. Ground Screen. The antenna group contains a ground screen for bands A and B. The ground screen helps to stabilize the antenna element impedance characteristic, and to provide uniform impedance from element to element, regardless of variation in the electrical properties of the soil. The ground screen for bands A and B consists of prefabricated stainless steel grid wire mats, which are placed along the entire base circumference of the bands A and B reflecting screen. Each mat is 96 feet long and 12 feet wide. The ground screen extends outward from the base of the bands A and B reflecting screen. Wires extend radically for 88 feet from the outside edge of the ground screen, where they are secured to ground rods. Each ground rod is 10 feet long

and is entirely imbedded a minimum of 12 inches below ground level. The antenna elements of bands A and B are connected to the ground screen by wires extending radically from the base of each antenna element. There is no ground screen associated with band C.

b. Central Building. The central building houses 'all antenna group equipment other than the antenna array and feed cables, and also houses components of other equipment groups of the AN/FLR-9(V7)/(V8). The central building is a cylindrical structure situated at the center of the antenna array. The circumference of the central building is approximately 282.7 feet and has a radius of 45 feet. The equipment in the central building is connected to elements of the antenna array by antenna feed cables which enter the building by means of eight cable wells installed at eight points along the circumference of the building. The cables pass through sleeves in the foundation wall of the well; 6 band A cables, 12 band B cables, and 6 band C cables enter through each sleeve. The cable wells are covered by removable access grates. Within the central building, cable trays distribute the cables to the equipment cabinets and racks. There are three levels of cable trays; the second and third level cable trays are arranged along the radius of the building, and the first level trays are arranged circumferentially. Connections are made by cable drops from the trays through the tops of the racks. Electrical connections between the central building and the operations building, situated outside of the antenna array, are made by beam-output cables, which pass through a tunnel connecting the two buildings.

1. The Cable Tunnel. The cable tunnel provides a cable route between the central building and the operations building. Built of reinforced concrete, the tunnel lengths are 1180 feet (V8), 960 feet (V7), 6.5 feet high, and 4 feet wide. The cables lie in brackets mounted on one side of the tunnel.

2. Antenna Feed Cables. The antenna feed cables connect the elements of the antenna array with equipment in the central building. The cables are fabricated from lowloss 7/8 inch, 75-ohm foamed dielectric cable with solid copper inner conductor. Each cable is buried approximately 42 inches below ground level and is imbedded in 1 foot of sand covered with a layer of bricks. The remaining area within the trench is filled with compacted earth. Underground feed cable locations are indicated by white markers located over the trench center line. The nominal lengths of the cables are 603 feet for band A, 567 feet for band B, and 155 feet for band C.

3. Transmission Line Tuners. Transmission line tuners are low-loss coaxial line devices that compensate for variations in electrical lengths of the antenna feed cables. The effective electrical lengths are varied by a mechanical adjustment of the tuner. These tuners are used in all antenna leads. They also provide for electrically compensating apparent cable length variations due to aging and seasonal temperature variations.

4. Directional Couplers. Each antenna lead in all bands contains a directional coupler located between the line tuner and rf preamplifier. The couplers provide a means for injecting test signals toward an antenna element, or in the opposite direction toward a beamformer for the purpose of quickly locating inoperative circuits. These test signals are originated in the AN/FLR-9(V7)/(V8) Monitor and Test Group (monitor and test group) which is computer controlled. A directional coupler is also placed at the output of each beamformer. This coupler directs a test signal (injected in the above couplers) into the monitor and test group equipment. The directional

couplers at the input provide more than 20-dB signal isolation between the desired and undesired direction of the test signal. Those used for receiving the test signal for monitor and test group use provide 10-dB isolation. Refer to the Monitor and Test Group Manual IM 32-4940-201-15 for details of system malfunction detection and isolation.

5. Rf Amplifiers. The input from each antenna element passes through the line tuner and directional coupler to an rf amplifier. These amplifiers have a nominal 19-dB gain for bands A and B and 21-dB gain for band C. This gain compensates for losses in subsequent power divisions and beamforming processes and consequently improves the system noise figure. The amplifiers provide two output jacks for a signal path to the df group and a separate signal path to the monitor beamforming equipment. An rf amplifier assembly is composed of two amplifier subassemblies and a common power supply.

NOTE

The rf amplifiers are capable of performing as a band A, band B, or band C amplifier depending upon the setting of an internal switch which changes the gain from 19 to 21 dB. The 21-dB position is used for band C only. An incorrect switch setting results In degraded performance of the associated circuits..

6. Power Dividers. Output signals from each rf amplifier are fed to two power dividers. One unit (1:4 power divider), referred to as a high-level divider, provides outputs for omnicombiners, sector beam formation, goniometer inputs and a 75-ohm (spare) termination. The other unit (1:16 power divider) provides the signals for monitor beam formation. Refer to paragraph 5-11.

NOTE

The terminology, high-level divider, does not infer a difference in signal level input from the divider described below. Both dividers, in a given band, have the same level input signals. However, the high-level divider divides the signal only four ways and consequently has higher output levels than the 1:16 power divider which provides signals for monitor beams.

7. Outputs. Output signals from each of the three bands are as follows.

	Sector Beams	Omnibeams	Monitor Beams	Goniometer Input Signals
Band A	**6**	1	48	48
Band B	**6**	1	48	96
Band C	**6**	1	24	48

The preceding signals, except for those to the goniometers, are sent via the cable tunnel to the operations building and terminate on the input maintenance patch panel in the rf matrix group. This is the interface boundary between the antenna group and the rf matrix group. Goniometer input signals are routed directly to the goniometers in the central building which is the interface boundary between the antenna group and the df group.

1-3. Leading Particulars. (See table 1-1.)

The leading particulars for all of the components in the antenna group are listed in table 1-1. Data consists of power requirements and the physical characteristics of each component. See also paragraph 1-5. References to appropriate illustrations are included. Leading particulars that include transportability, storage conditions, and setup time are not applicable to this installation. Other pertinent data is included, as applicable.

1-4. Capabilities and Limitations. (See tables 1-2 through 1-29.)

The capabilities and limitations of various components of the antenna group are listed in tables 1-2 through 1-29. Complete capabilities and limitations of the countermeasures receiving set are included in IM 32-5895-231-15 and IM 32-5895-231-15/1 manuals.

1-5. Equipment Supplied.

Equipment supplied is also included in table 1-1. Numbers or statements in parentheses ( ) following an entry indicate quantities over one. Following each rack of electrical equipment listings are the components and assemblies mounted in these racks. Indented component or assembly listings contain quantities for one unit (such as a rack or major equipment not indented). Power requirements, dimensions, and weights listed are for one equipment only. Blank panels and hardware items are not included. F & M Systems Co. part numbers appear as 3300-xxxxx or 3300-xxxxx-x. Numbers (3300xxxxx) without a final -x number indicate a series of racks which are functionally identical, but have only minor mechanical differences. Differences between sites V7 and V8 exist only in monitor beamformers supplied in bands A and B. These differences are indicated in the table. Weights are listed for large items such as racks and antenna components where identifiable. For equipment location, rack identification, and reference designator assignments, see figure 2-5 and table 2-6 in Chapter 2.

1-6. Related Technical Manuals.

The following manual is related to the Amplifier, Radio Frequency AM-6533/FLR-9(V):

CM 32-5895-236-14.

The following manuals contain related interface and automated testing information in that order:

IM 32-5895-232-15
IM 32-4940-201-15.

The following manuals contain Information relating this group to the set:

IM 32-5895-231-15
IM 32-5895-231-15/1.

1-7. Equipment Required But Not Supplied.

Equipment required but not supplied consists of test equipment. See Chapter 6 for test equipment requirements.

1-8. Equipment Supplied Cross-Reference Index. (See table 1-30.)

Only equipment items that carry an official nomenclature are cross-referenced to manufacturer's part number, common name, and the appropriate table of capabilities and limitations.

Table 1-1. Leading Particulars

Item	Power Requirements	Dimensions			Weight (lb)	Figure No.
		Height	Width	Depth		
Bands A and B antenna array 3300-31001 -1 02-720247						1-3
Band A antenna element (48 total) 02-720246-	None	105 feet			16,000	1-3
Sleeve section	None	48 feet, 9 inches	7 feet, 4.5 inches, outside dimensions 7 feet, 4 inches inside dimensions			
Mast section	None	57 feet, 10 inches			1,500	
Band B antenna element (96 total) 02-720248-1	None	35 feet				1-3
Sleeve section	None	15 feet, outside diameter	2 feet, 0 inch, outside dimensions 1 foot, 11 inches inside dimensions			
Mast section	None	22 feet, 4.75 inches	3.5 inches, out-side dimensions 2.3 inches, inside dimensions			

Table 1-1. Leading Particulars (Continued)

Item	Power Requirements	Dimensions: Height	Width	Depth	Weight (lb)	Figure No.
Bands A and B reflecting screen and supporting structure assembly 3300-31000-1 (Note: when re-quired, includes aircraft warning lights.)	None 4800 watts	137 feet, 6 inches (including lightning rod)	1075 feet diameter			1-3
Bands A and B ground screen 81-720001-1	None		1276 feet, outside dimensions; 1075 feet, inside dimensions			1-2 1-3
Band C antenna array (48) 02-720268 -1	None					1-3
Band C antenna structure 00-720203-1	None	68 feet (not includ-ing base or	335.22 feet diameter lightning rod)			
Upper dipole frame (band C) 81-720219-1	None	53.33 feet above ground 10 feet 2.5 inches	6 feet, 11.75 inches	3 inches		

Table 1-1. Leading Particulars (Continued)

Item	Power Requirements	Dimensions Height	Width	Depth	Weight (lb)	Figure No.
Lowker Dipole frame 81-720219-1		24 feet, 8 inches above ground				
		10 feet 2.5 inches	6 feet, 11.75 inches	3 inches		
Band C reflecting screen and lightning rod assembly	None	70 feet, 0 inch (not including lightning rod)	314 feet, 8 inches diameter			
Band C lightning rod assembly	None					
Entire antenna group of electronic equipment when installed in racks. This includes all items listed in the central building portion of figure 1-1, sheet 2.	See requirements for racks containing rf amplifiers. All others: None	Comprises 19 racks of equipment and 2700 phase matched cables for each site, V7 and V8. Requires approximately 780 square feet of floor space, each site. Note: For cabling particulars, see chapter 6 of this manual. For reference designator assignments, see table 2-1.				
Transmission line tuner panel assemblies 3300-40004-1 (total of 8)	None	22 inches	60 inches	2.75 inches		
Transmission line tuners (total of 192)	None	27.5 inches closed, 37.5 inches extended	2 inches	2.5 inches		1-4

Table 1-1. Leading Particulars (Continued)

Item	Power Requirements	Dimensions			Weight (lb)	Figure No.
		Height	Width	Depth		
Electrical equipment rack rf amplifiers (racks 401, 403, 404, 408, 415, 416, 420, 421) 3300-32002-1	1000 watts	83 inches	24 inches	30 inches	740	1-5
NOTE: for directional coupler information, see note at end of this table.						
Amplifier, Radio Frequency AM-6533/ FLR-9(V) (12)	100 watts	3.47 inches	19.0 inches	19.75 inches		1-6
Blower assembly 3300-40015-1	200 watts	6.97 inches	19.0 inches	15.25 inches		1-7
Electrical equipment rack, power dividers and omni sector beam-former, band A (rack 410) 3300-32000-1	None	83 inches	24 inches	30 inches	610	1-8
Coupler-Omni Assembly CU-2054/FLR-9 (V) (3)	None	3.47 inches	19.0 inches	4.75 inches		1-9
Coupler, Omni Assembly CU-2049/FLR-9(V)	None	3.47 inches	19.0 inches	4.75 inches		1-10 and 1-11
Divider Assembly, Power Rf CU-2052/FLR-9(V)	None	1.72 inches	19.0 inches	3.02 inches		1-11 and 1-10

Table 1-1. Leading Particulars (Continued)

Item	Power Requirements	Dimensions			Weight (lb)	Figure No.
		Height	Width	Depth		
Beamformer Assembly TD-1055/FLR-9 (V)	None	3.75 inches	19.0 inches	8.95 inches		1-8
Panel, Patching, Antenna SB-3666/FLR-9 (V)	None	10.47 inches	19.0 inches	inches		1-8
Electrical equipment rack, power dividers and omni/sector beam-formers band B (rack 423) 3300-3200 1-1	None	83 inches	24 inches	30 inches	700	1-12 1-14
Divider Assembly, Power Rf CU-2052/ FLR-9(V) (12)	None	1.72 inches	19.0 inches	3.02 inches		1-11 and 1-10
Coupler, Omni Assembly CU-2049/ FLR-9 (V)	None	3.47 inches	19.0 inches	4.75 inches		1-10 and 1-11
Coupler, Omni Assembly CU-2055/ FLR-9(V) (3)	None	3.47 inches	19.0 inches	4.75 inches		1-13
Panel, Patching, Antenna SB-3663/ FLR-9 (V)	None	10.47 inches	19.0 inches	0.125 inches	1-12	
Electrical equipment rack, power dividers and omni/sector beam-formers band B (rack 422) 3300-32003-1	None	83 inches	24 inches	30 inches	750	1-14

Table 1-1. Leading Particulars (Continued)

Item	Power Requirements	Dimensions Height	Width	Depth	Weight (lb)	Figure No.
Coupler, Omni Assembly CU-2055/ FLR-9(V) (3)	None inches	3.47 inches	19.0 inches	4.75		1-13
Divider Assembly, Power Rf CU-2052/ FLR-9(V) (12)	None	1.72 inches	19.0 inches	3.02 inches		1-11 and 1-10
Beamformer Assembly, TD- 1056/FLR-9 (V)	None	3.75	19.0 inches	8.95 inches		1-14
Panel, Patching, Antenna SB-3664/ FLR-9 (V)	None	10.47 inches	19.0 inches			1-14
Electrical equipment rack, monitor beam-formers, band A (racks 405, 406, 407) 3300-32004-1 3300-32004-2	None	83 inches	24 inches	30. inches	740	1-15
Beamformer Assembly TD- 1052/FLR-9 (V) Site V7 only (8)	None	3.125 inches	19.0 inches	17.5 inches		1-16
Beamformer Assembly TD-1050/FLR-9 (V) Site V8 only 18)	None	3.125 inches	19.0 inches	17.5 inches		1-16
Divider Assembly, Power Rf CU-2050/ FLR-9(V) (8)	None	3.47 inches	19.0 inches	4.75 inches		1-17

Table 1-1. Leading Particulars (Continued)

Item	Power Requirements	Dimensions Height	Width	Depth	Weight (lb)	Figure No.
Electrical equipment rack monitor beam-former, band C (rack 402) 3300-32005-1	None	83 inches	24 inches	30 inches	640	1-18
Beamformer Assembly TD-1054/FLR-9(V) (6)	None	3.125 inches	19 inches	17.5 inches		1-19
Divider Assembly, Power Rf CU-2051/ FLR-9(V) (8)	None	3.47 inches	19.0 inches	4.75 inches		1-20
Electrical equipment rack, monitor beam-former, band B (racks 417, 418, 419) 3300-32006-1 3300-32006-2	None	83 inches	24 inches	30 inches	750	1-21
Beamformer Assembly TD-1053/FLR-9(V) Site V7 only (8)	None	3.125 inches	19.0 inches	17.5 inches		1-16
Beamformer Assembly TD- 105 1/FLR-9 (V) Site V8 only (8)	None	3.125 inches	19.0 inches	17.5 inches		1-16
Divider Assembly, Power RF CU-2053/ FLR-9 (V)	None	3.47 inches	19.0 inches	4.75 inches		1-22
Electrical equipment rack, power dividers, and omni/sector beam-formers band C (rack 409) 3300-32007-1	None	83 inches	24 inches	30 inches	650	1-23

Table 1-1. Leading Particulars (Continued)

Item	Power Requirements	Dimensions Height	Width	Depth	Weight (lb)	Figure No.
Coupler, Omni Assembly CU-2054/ FLR-9(V) (3)	None	3.47 inches	19.0 inches	4.75 inches		1-9
Coupler, Omni Assembly CU-2049/ FLR-9(V)	None	3.47 inches	19.0 inches	4.75 inches		1-10 and 1-11
Divider Assembly, Power Rf CU-2052/ FLR-9(V) (12)	None	1.72 inches	19.0 inches	3.02 inches		1-11 and 1-10
Beamformer Assembly TD-1057/FLR-9 (V)	None	3.47 inches	19.0 inches	10 inches		1-23
Panel, Patching, Antenna SB-3662/ FLR-9 (V)	None inches	10.47	19.0 inches	0.125 inches		1-23

NOTE

All eight electrical equipment racks, rf amplifiers contain directional couplers as follows. All below have dimensions 1 3/4 by 2 by 3/4 inches.

Olektron Part No.	Rack	Band	Quantity Per Rack
T-D4-102-1	404, 408	A	24
T-D4-102-2	415, 416, 420, 421	B	24
T-D4-102- 3	401, 403	C	24

The following directional couplers are located in monitor and test group rack no. 412.

T-D4-101-1	A	55
T-D4-101-2	B	55
T-D4-101-3	C	31

Signals leave antenna group from rack 412 via the tunnel to the operations building.

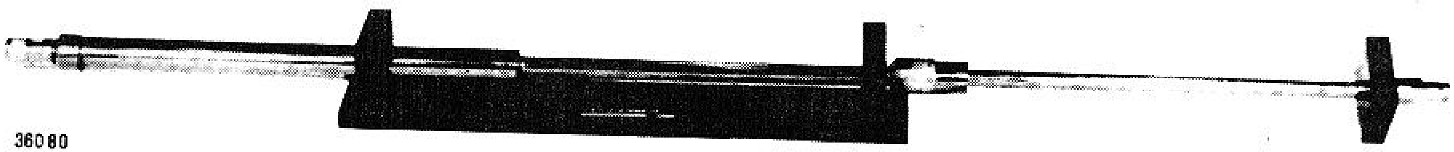
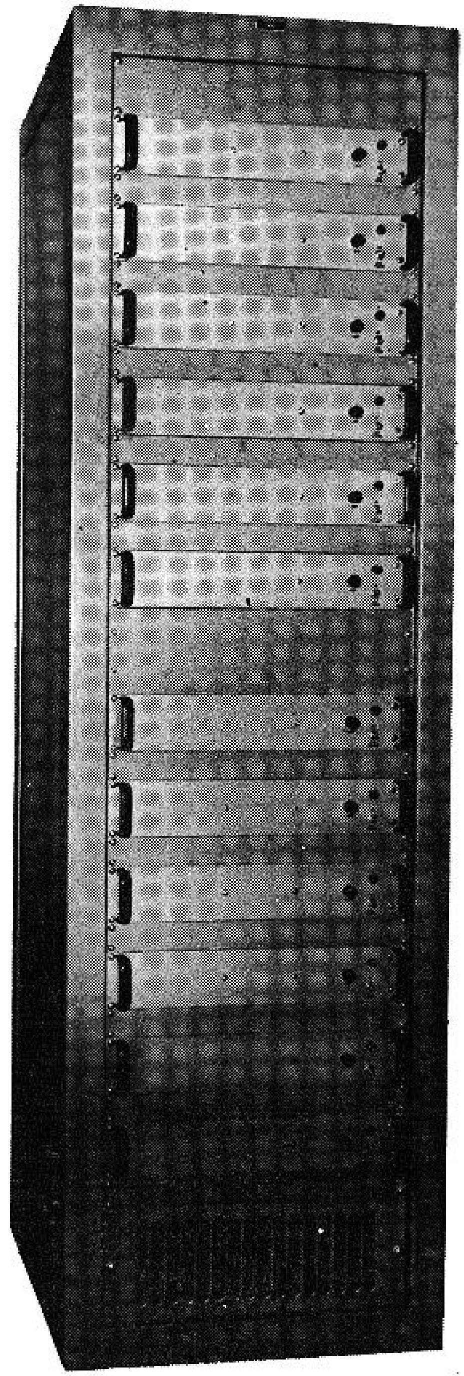
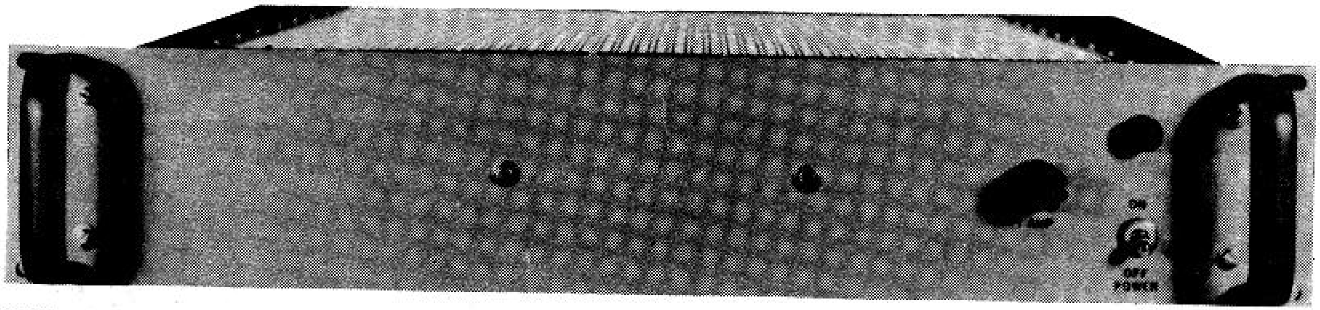


Figure 1-4. Transmission Line Tuner



36130

Figure 1-5. Electrical Equipment Rack, Rf Amplifiers, Typical



36081

Figure 1-6. Amplifier, Radio Frequency AM-6533/FLR-9(V)

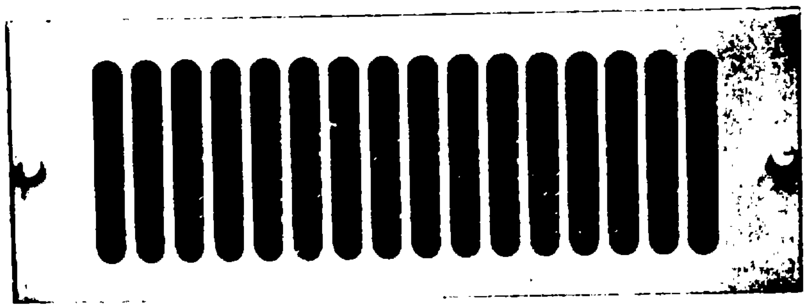


Figure 1-7. Blower Assembly

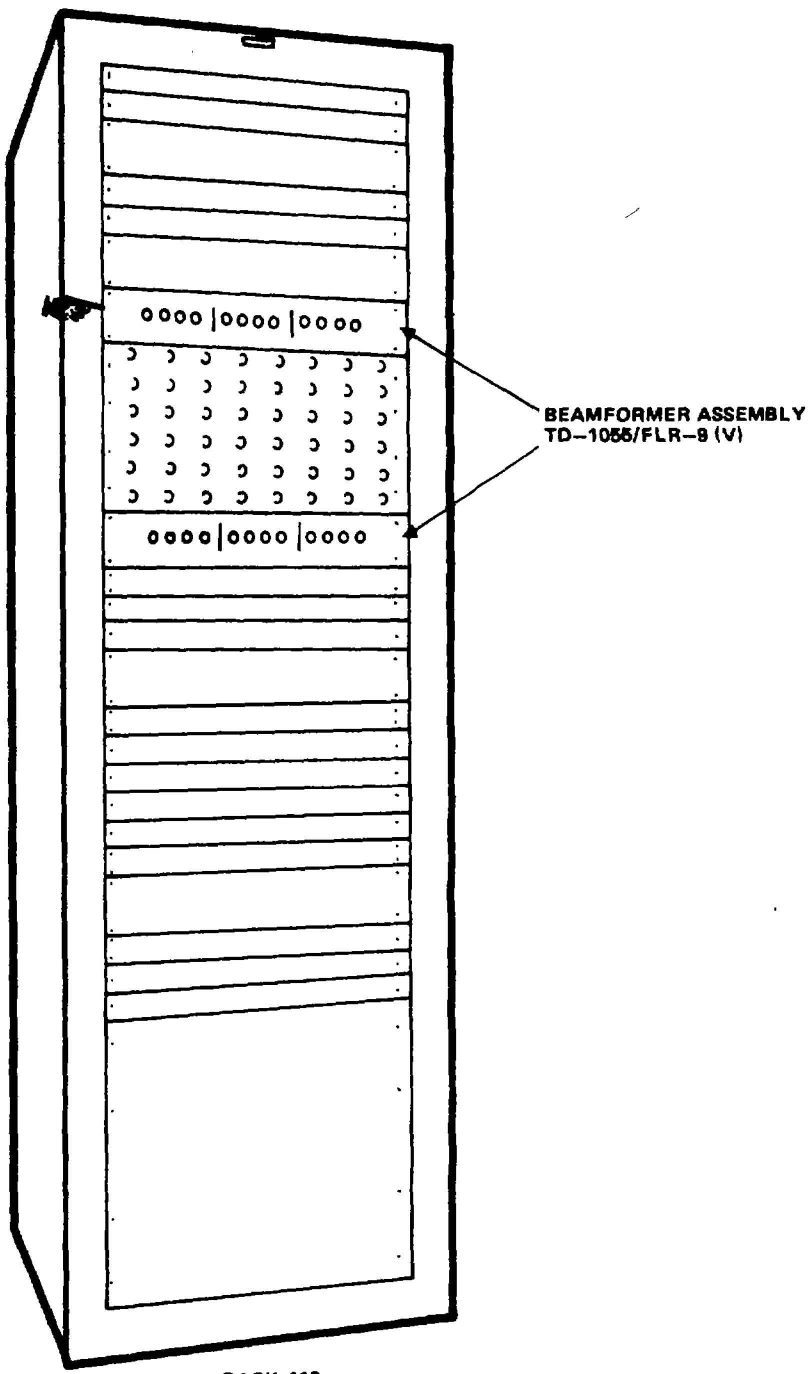
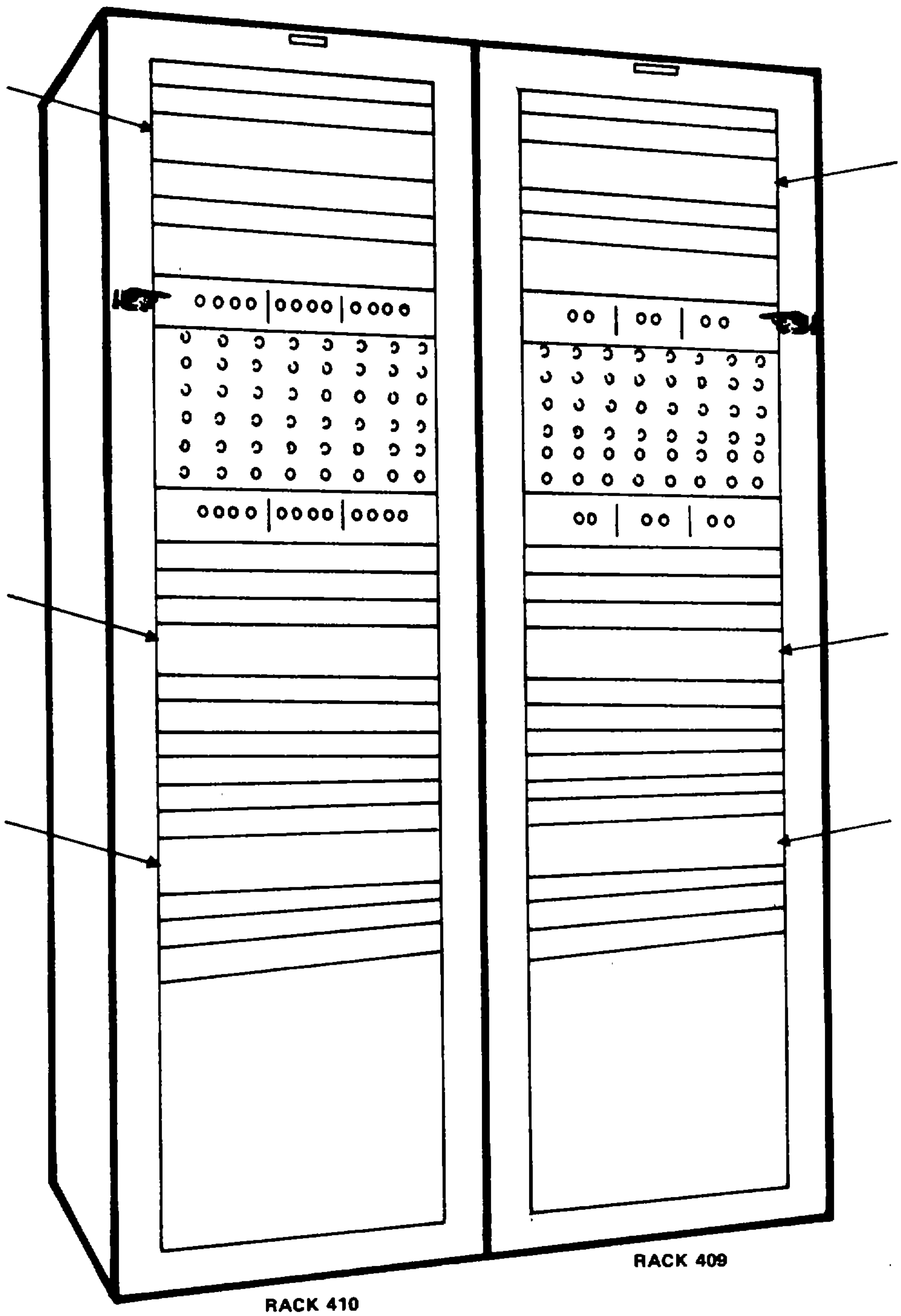


FIGURE 1-8. ELECTRICAL EQUIPMENT RACK, POWER DIVIDERS AND OMNI/SECTOR BEAMFORMERS, BAND A



NOTE: COUPLER OMNI ASSEMBLIES DENOTED BY ARROWS.

FIGURE 1-9. COUPLER OMNI ASSEMBLY CU-2054/FLR-9 (V) LOCATIONS

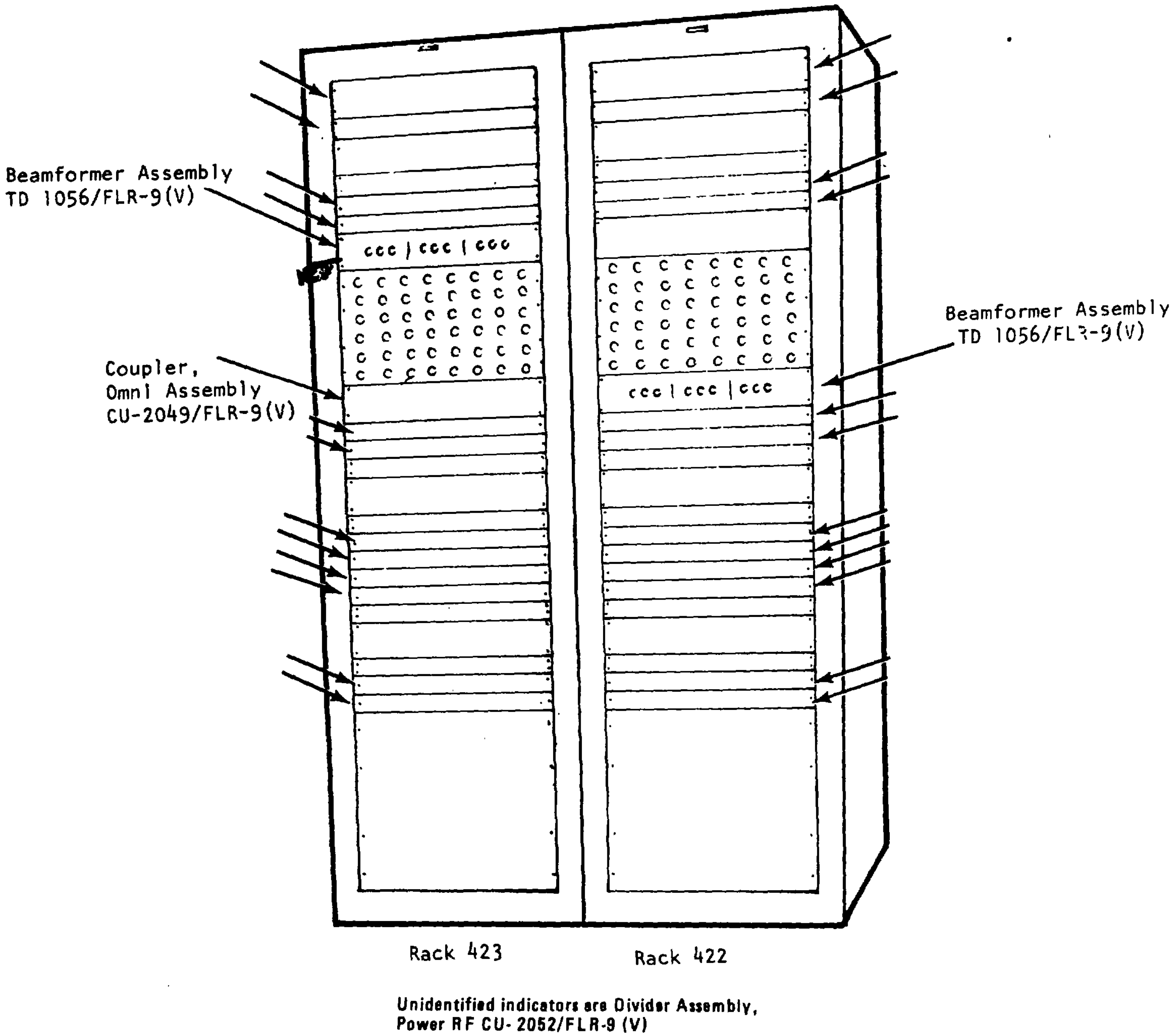


FIGURE 1-10. Equipment Rack, Divider Assembly, Power RF CU-2052/FLR-9 (V), Coupler, Omni Assembly CU-2049/FLR-9 (V),and Beamformer Assembly, TD-1056/FL R-9 (V) Locations

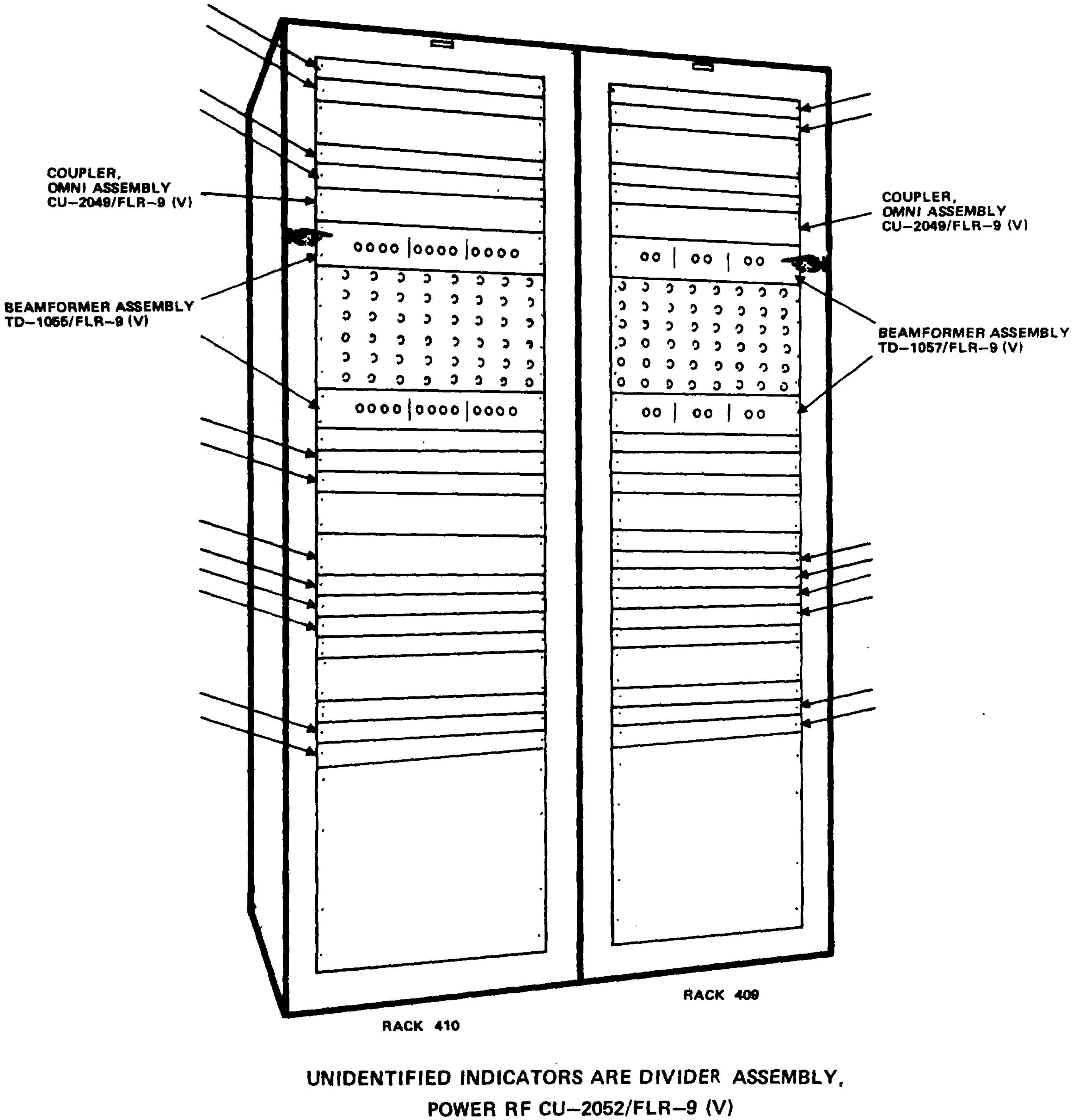


FIGURE 1-11. EQUIPMENT RACK, DIVIDER ASSEMBLY, POWER RF CU-2052/FLR-9 (V) AND COUPLER, OMNI ASSEMBLY CU-2049/FLR-9 (V) LOCATIONS

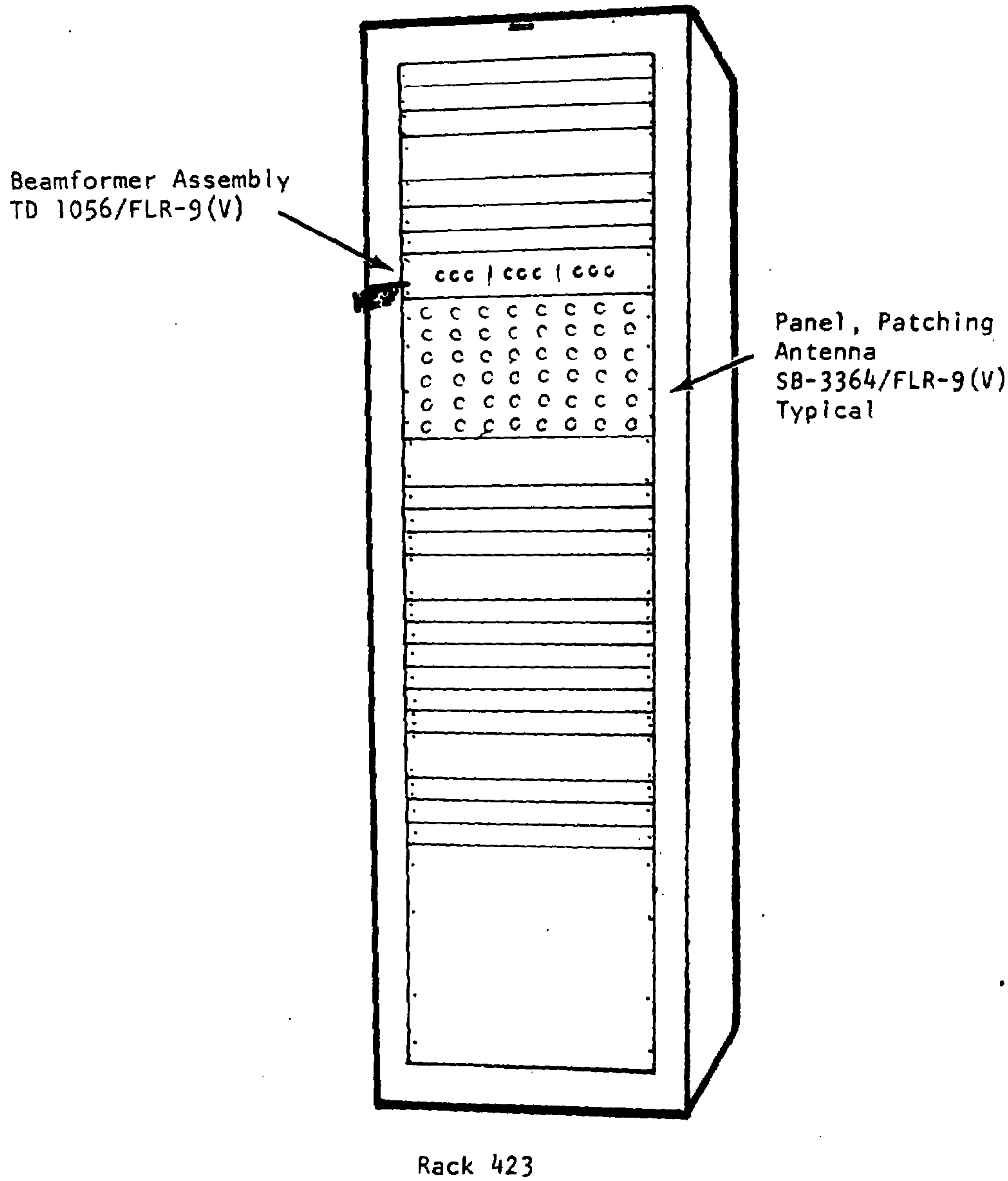


Figure 1-12. Electrical Equipment Rack, Power Dividers and Omni/Sector Beamformers, Band B

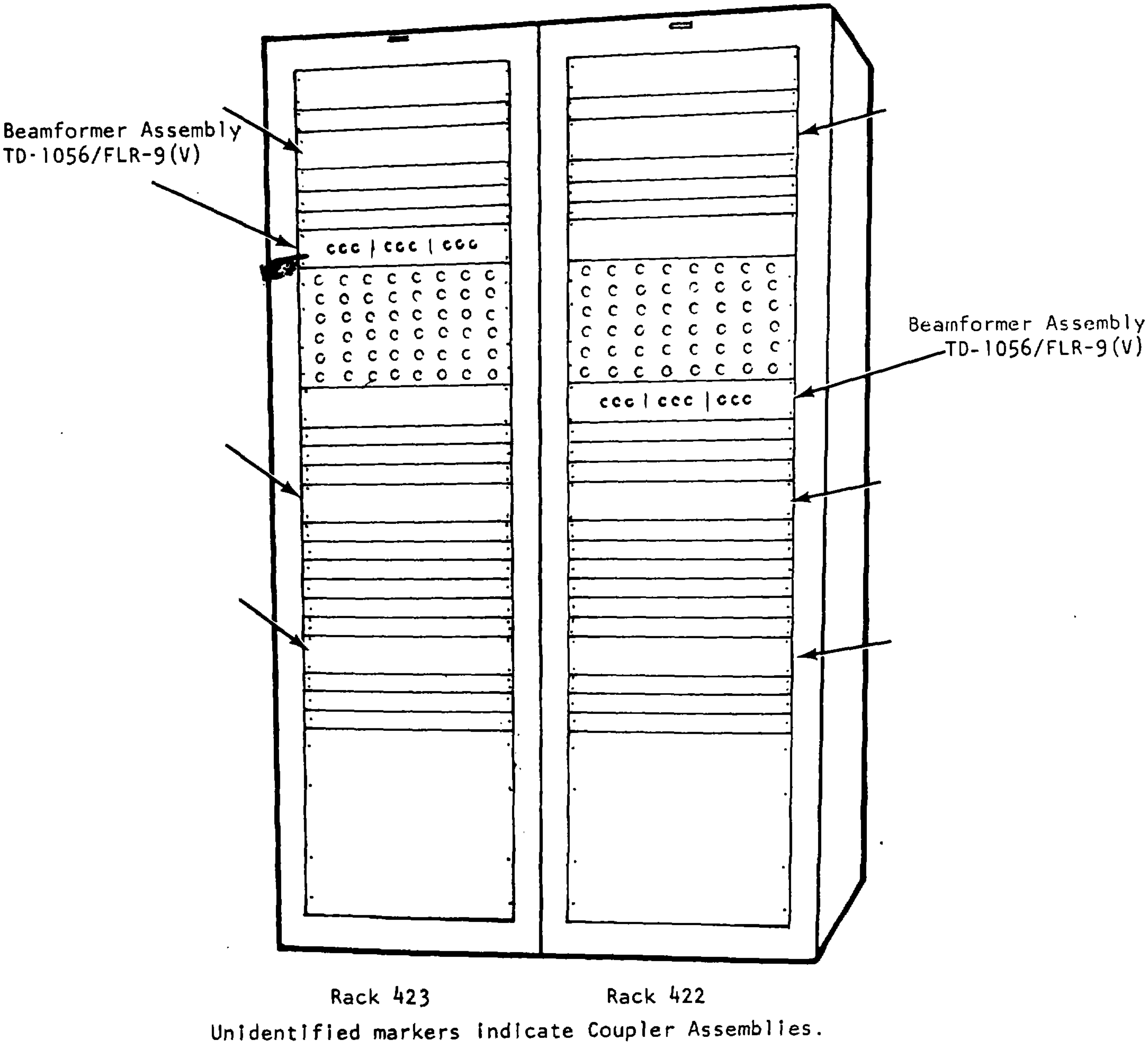


Figure 1-13. Coupler, Omni Assembly CU-2055/FLR-9(V) Beamformer Assembly TD-1056/FLR-9(V) Locations

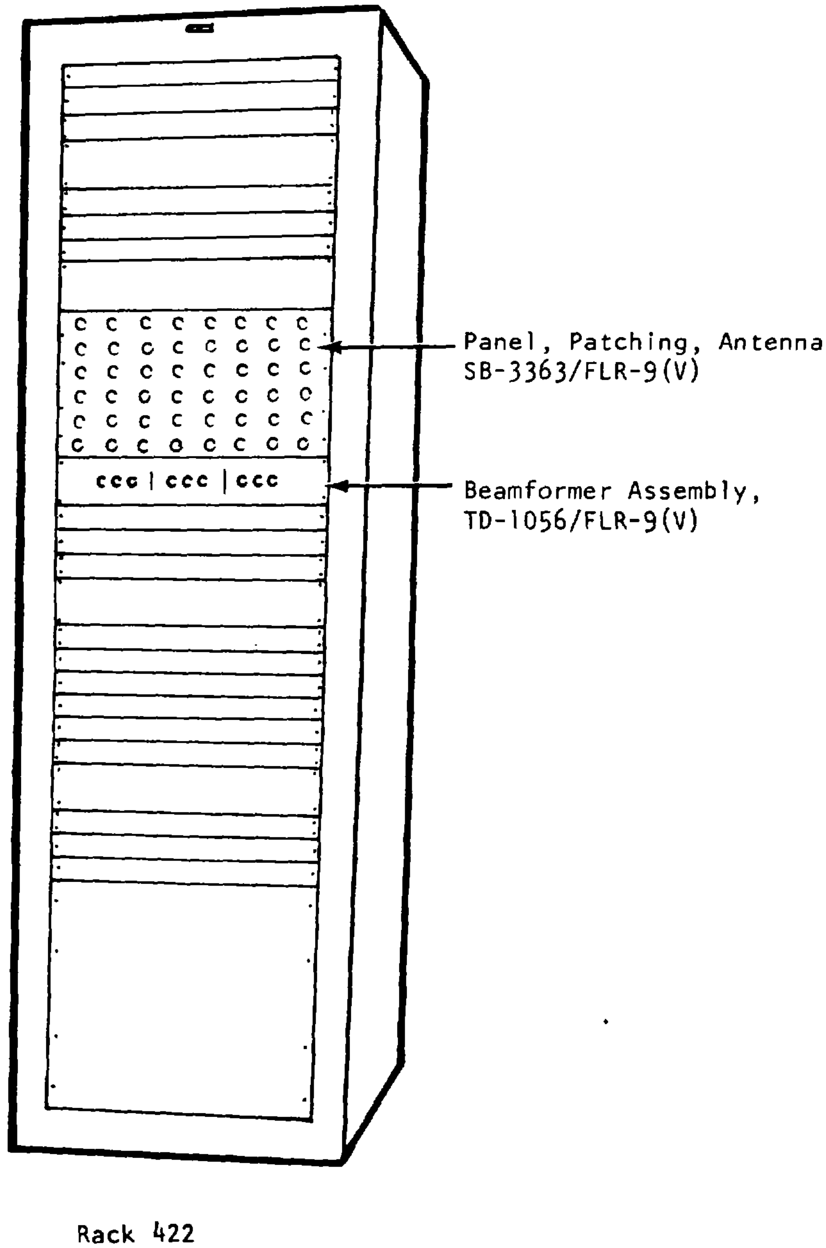
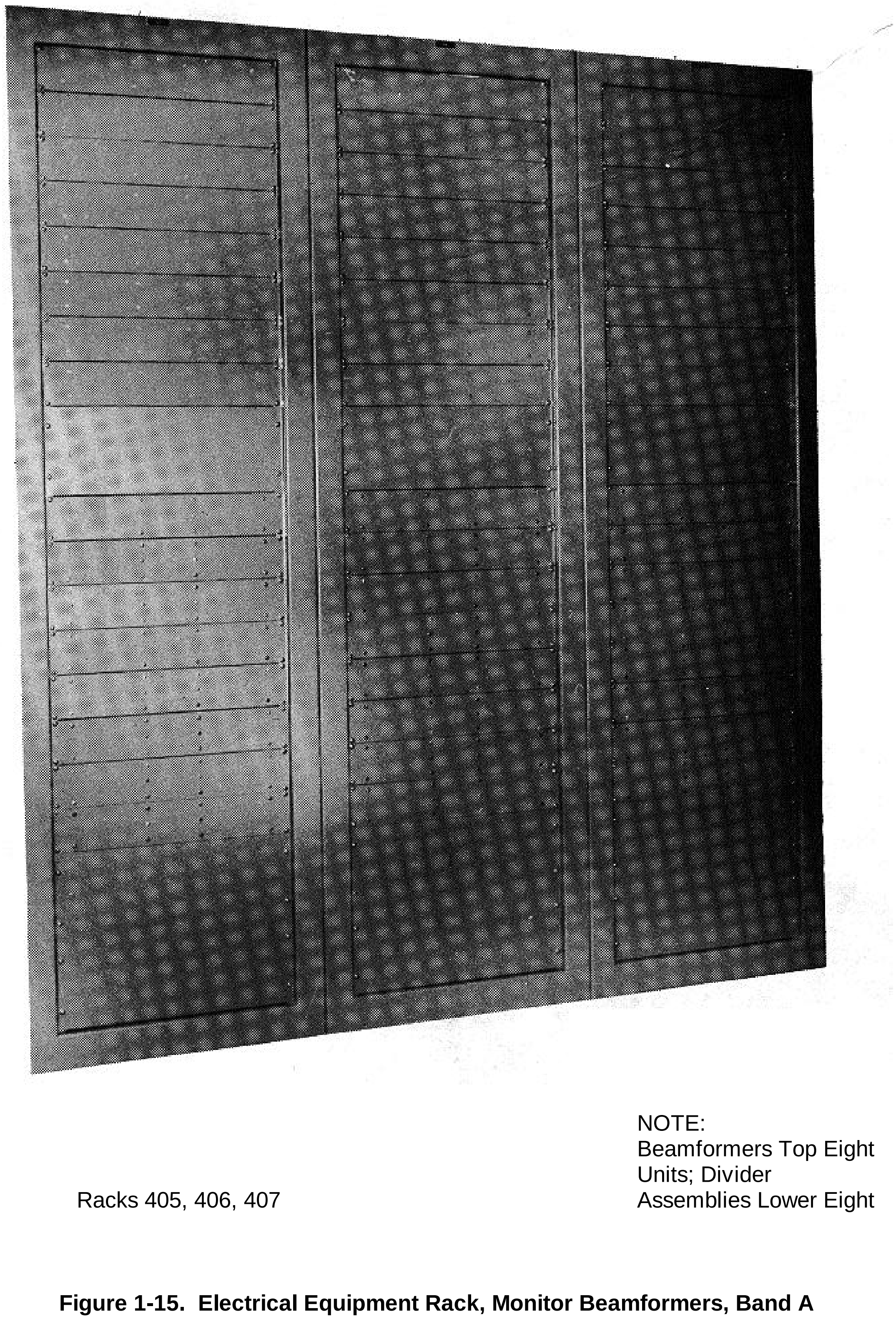


Figure 1-14. Electrical Equipment Rack, Power Dividers and Omni Beamformers, Band B



36082 Racks 405, 406, 407

NOTE:
Beamformers Top Eight Units; Divider Assemblies Lower Eight Units.

Figure 1-15. Electrical Equipment Rack, Monitor Beamformers, Band A

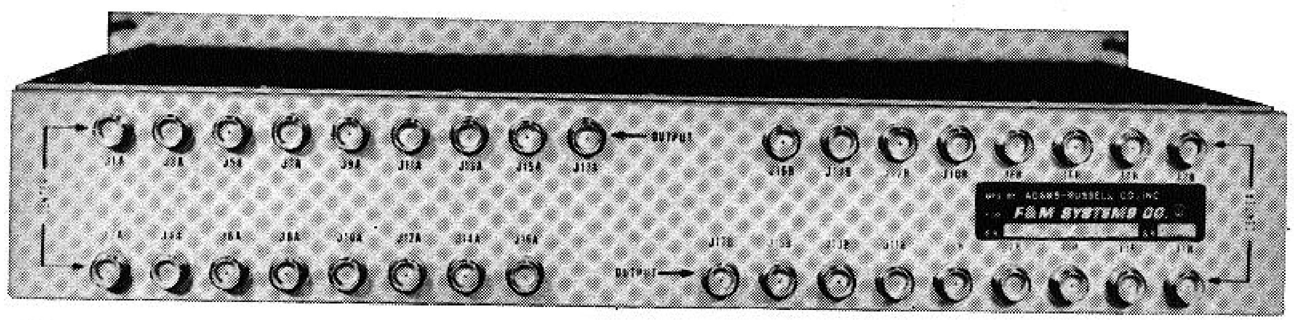


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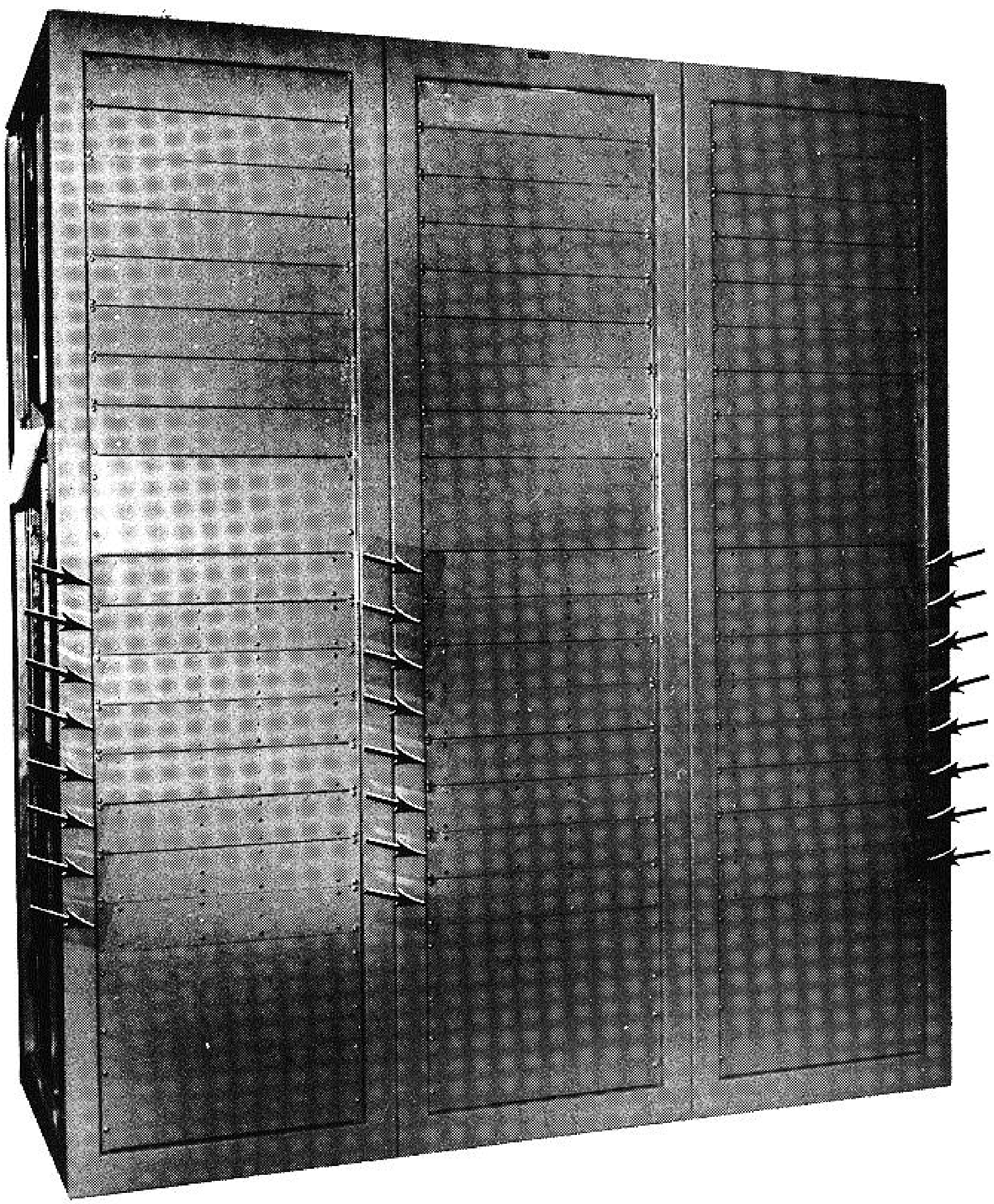
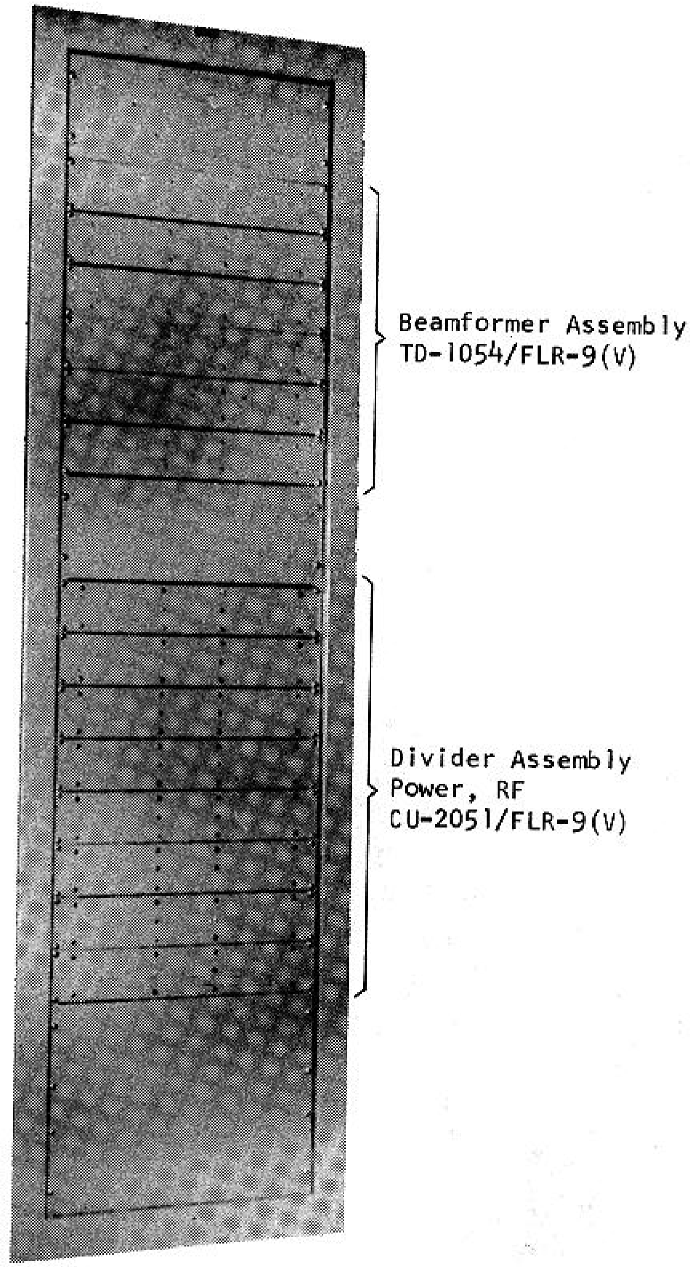
Figure 1-16. Monitor Beamformer, Typical of Bands A and B



36133

Racks: 405, 406, 407

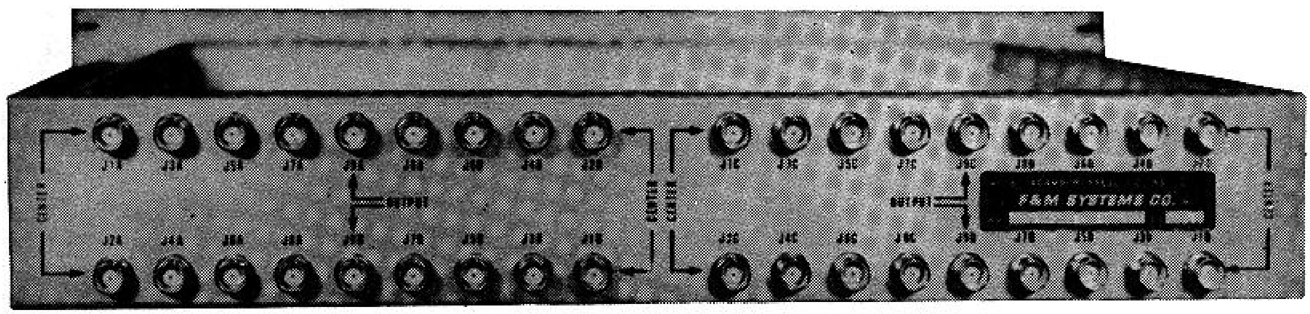
Figure 1-17. Divider Assembly, Power Rf CU-2050/FLR-9(V) Locations



36134

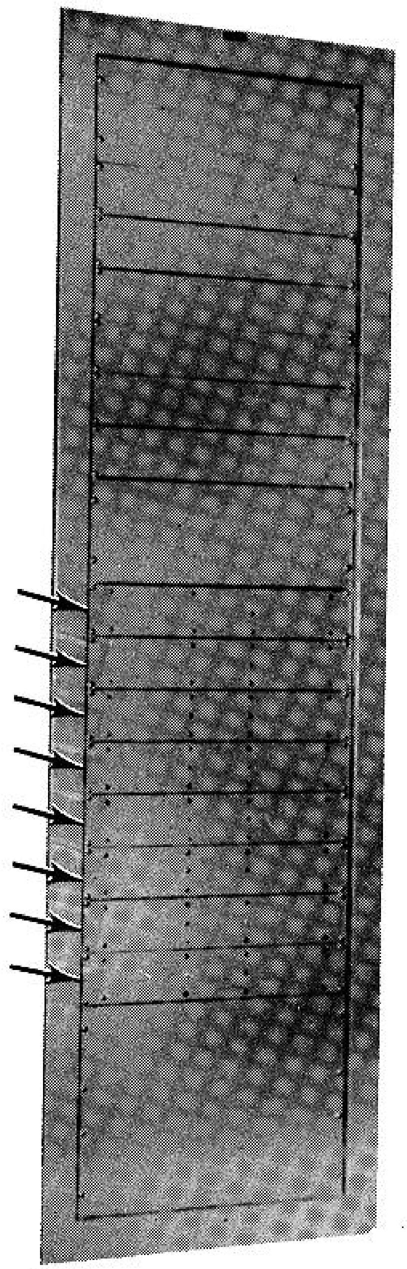
Rack 402

Figure 1-18. Electrical Equipment Rack, Monitor Beamformers, Band C



36078

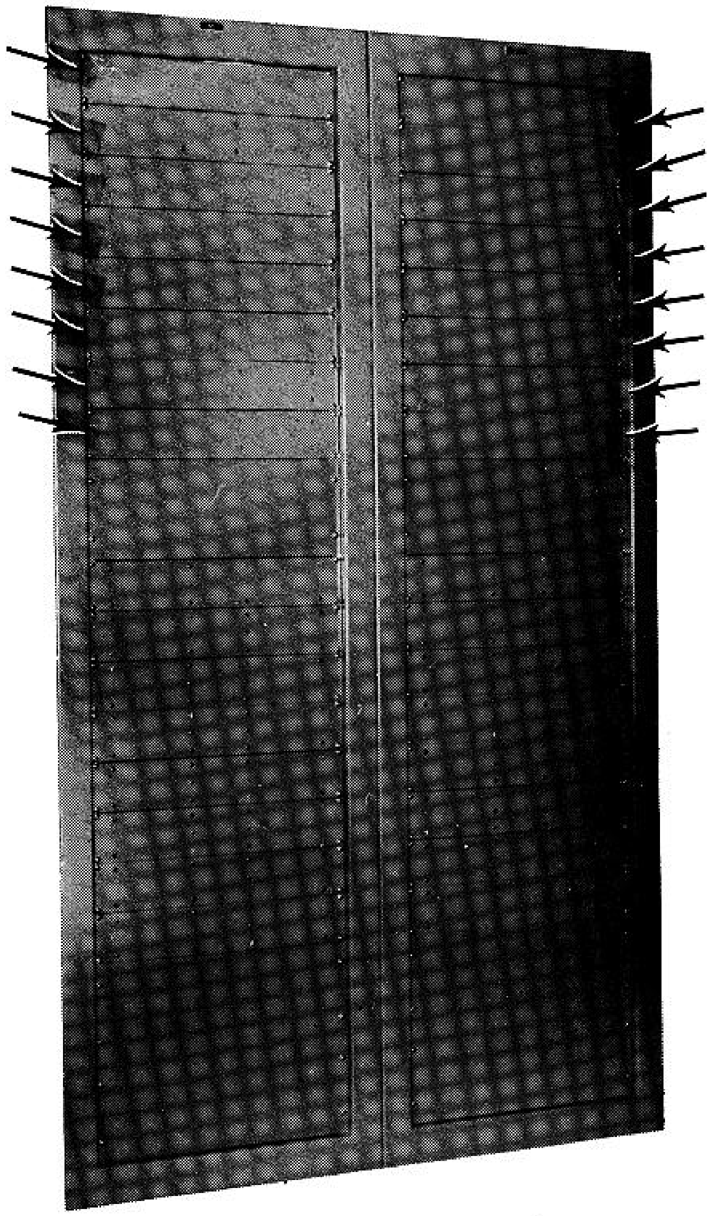
Figure 1-19. Monitor Beamformer, Band C



36135

Rack 402

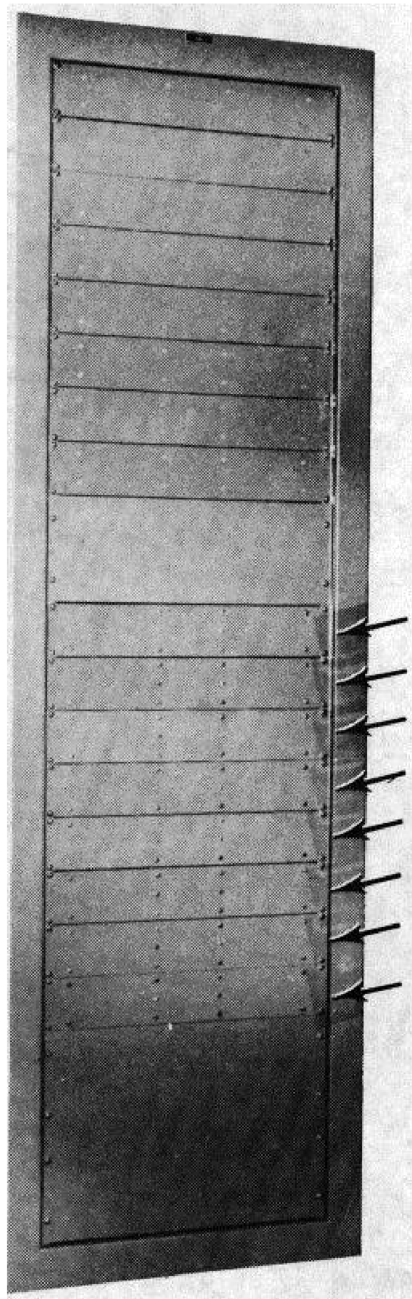
Figure 1-20. Divider Assembly, Power Rf CU-2051/FLR-9(V) Locations



Typical Racks 417, 418, 419

36131

Figure 1-21. Electrical Equipment Rack, Monitor Beamformers, Band B Locations



Typical Racks 417, 418, 419

36136

Figure 1-22. Divider Assembly, Power Rf CU-2053/FLR-9(V) Locations

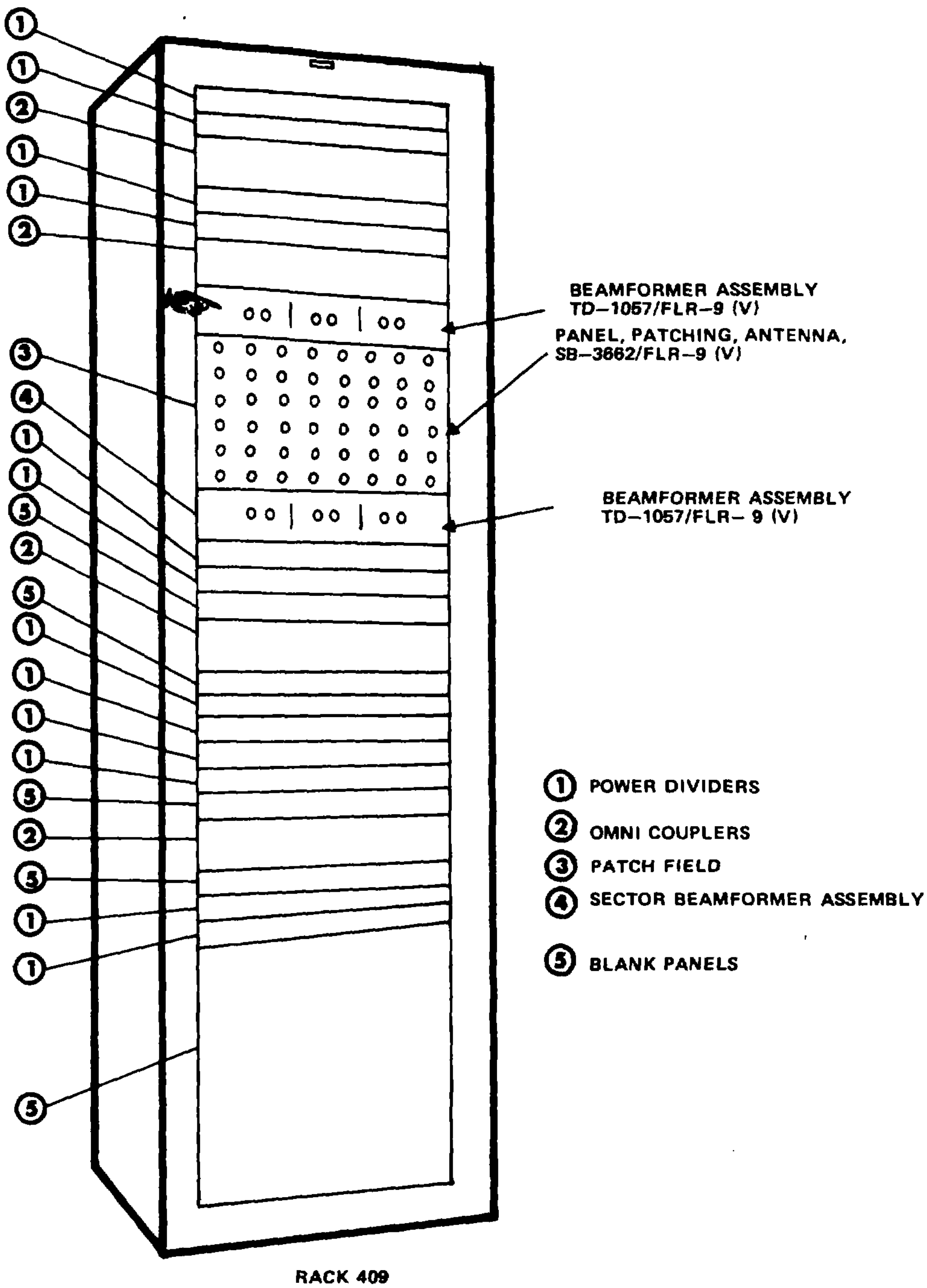


Figure 1-23. Electrical Equipment Rack, Power Dividers and Omni/Sector Beamformers, Band C

Table 1-2. Bands A and B Antenna Array (3300-31001), Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Frequency range	2 to 18 MHz (down to 1.5 MHz with reduced performance)
Detection range	O to 4000 nautical miles
Polarization	Vertical
Azimuth coverage	360 degrees
Directional gain	15 dB minimum (average for monitor beams) 10 dB minimum (at any frequency in band)
Horizontal sidelobes	18 dB minimum (below main beam)
Nominal azimuth beamwldth	11 degrees (band A) 4 degrees (band B)
Nominal elevation angle	Up to 30 degrees (band A) Up to 40 degrees (band B)

Table 1-3. Band A Antenna Element (Sylvania 02-720246) Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Frequency range	2 to 6 MHz
Polarization	Vertical
Vswr	5:1 maximum
Inductance Z_O	172.5 ohms
Inductance length	11.2 feet
Rotation length (Z_O=75 ohms)	19.2 feet
Jumper length	19.5 feet
Shorted shunt stub (Z_O=75 ohms)	31 feet
Temperature range	
Operating	-20 to +125°F (-28.9 to +51.7°C)
Non-operating	-20 to +125°F (-28.9 to +51.7°C)
Relative humidity	95 percent maximum
Barometric pressure	
Operating	31.0 down to 20.58 inches of mercury
Non-operating	29.9 down to 5.54 inches of mercury
Wind and ice loading Operating and non-operating (worst condition)	75 mph, 1-inch radial ice, -0.4°F (-18°C) Survival limits: 150 m8h maximum peak gust wind (no ice), +40 F (4.4°C); 100 mph maximum peak gust, 1.5 inches radial ice, 0.4°F (-18°C); 3 inches radial ice (no wind), -O.4°F (-18°C)
Distance from reflecting screen	61.5 feet
Distance from adjacent elements	
Angular	7.5 degrees
Straight line	78.4 feet
Mast impedance	126 ohms
Output impedance	75 ohms

Table 1-4. Band B Antenna Element (Sylvania 02-720248)
Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Frequency range	6 to 18 MHz
Polarization	Vertical
Vswr	5:1 maximum
Inductance Z_O	175 ohms
Inductance length	6.54 feet
Rotation length (Z_O=75 ohms)	8 feet
Jumper length	3.25 feet
Shorted shunt stub	12.5 feet
Temperature range	
Operating	-20 to +125° F (-28.9 to +51.7°C)
Non-operating	-20 to +125° F (-28.9 to +51.7°C)
Relative humidity	95 percent maximum
Barometric pressure	
Operating	31.0 down to 20.58 inches of mercury
Non-operating	29.9 down to 20.58 inches of mercury
Wind and ice loading Operating and non-operating (worst condition)	75 mph, 1 inch radial ice, -0.4°F (-18°C) Survival limits: 150 mgh maximum peak gust wind (no ice), +40° F (4.4° C); 100 mph maximum peak gust, 1.5 inches radial ice, 0.4°F (-18°C);-3 inches radial ice (no wind), -0.4° F (-18° C)
Distance from reflecting screen	20.5 feet
Distance from adjacent elements	
Angular	3.75 degrees
Straight line	36.5 feet
Mast impedance	126 ohms
Output impedance	75 ohms

Table 1-5. Bands A and B Reflecting Screen (Sylvania 02-720172) Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Wire spacing	3 feet apart (average) (no wires in center of bay)
Polarization	Vertical
Wind and ice loading Operating and non-operating (worst condition)	75 mph, 1 inch radial ice, -0.4°F (-18°C) Survival limits: 150 moh maximum peak gust wind (no ice), +40° F (4.4° C); 100 mph maximum peak gust, 1.5-inch radial ice, 0.4° F (-18° C); 3-inch radial ice (no wind), -0.4°F (-18°C)
Wire tension, each wire	150 pounds

Table 1-6. Bands A and B Ground Screen (Sylvania 02-720247) Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Mesh dimensions	2 feet by 2 feet
Distance from reflecting screen	96 feet

Table 1-7. Band C Antenna Array (Sylvania 02-720268;) (See note at end of table.), Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Frequency range	18 to 30 MHz
Detection range	0 to 4000 nautical miles
Polarization	Horizontal
Cross polarization	-20 dB minimum
Azimuth coverage	360 degrees
Vswr	3:1 maximum
Wire spacing	18 inches

Table 1-7. Band C Antenna Array (Sylvania 02-720268;) (See note at end of table.), Capabilities and Limitations (Continued)

Equipment Characteristics	Capability/Limitation
Wire tension (each wire)	100 pounds
Directional gain	15 dB minimum (for monitor beams) 10 dB minimum (anywhere in band)
Horizontal sidelobes	18 dB minimum (below main beam)
Nominal azimuth beamwidth	15 degrees (half-power points)
Nominal elevation pattern	Up to 26 degrees (low end of band) Up to 17 degrees (high end of band)
Temperature range	
Operating	-20 to +125°F (-28.9 to +51.7°C)
Non-operating	-20 to +125°F (-28.9 to +51.7° C)
Relative humidity	95 percent maximum
Barometric pressure	
Operating	31.0 down to 20.58 inches of mercury
Non-operating	29.9 down to 5.54 inches of mercury
Wind and ice loading Operating and non-operating (worst condition)	75 mgh, I-inch radial ice, -0.4° F (-18° C) Survival limits: 150 mph maximum peak gust wind (no ice), +40 F (4.4°C); 100 mph maximum peak gust, 1.5-inch radial ice, 0.4°F (-18°C); 3-inch radial ice (no wind), -0.4° F (-18°C)
Element distance from reflecting screen	10.3 feet, approximate
Distance from adjacent elements	
Angular	7.5 degrees
Straight line	21 feet, 11 1/8 inches
Impedance	75 ohms

NOTE

Refer also to site installation drawings 3300-31002, 3300-41034, 3300-41035, and 300-41041 (see table 2-4).

Table 1-8. Band A Antenna Feed Cable Assembly (3300-81000),
Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Characteristic impedance	75 +2 ohms
Attenuation	-0.8 dB maximum (at 6 MHz), 68° F (20°C)
Temperature range	
Operating	-65 to +160 F (-54 to +71°C)
Non-operating	-65 to +160 F (-54 to +71°C)
Resistivity	2 maximum at 68°F
Inner- conductor	0.158 ohm-cm/m2 maximum at 68 F (20°C)
Outer Conductor	0.077 ohm-cm/m maximum at 680F (20°C)
Velocity of propagation	82 ±2 percent of free space
Rough cut length	610 feet ±1 foot
Nominal capacitance	17 pf per foot
Dielectric strength	8200 volts peak minimum
Corona extinction point	4000 volts rms minimum
Change in electrical length	0.10 cm/100 ft/°F maximum
Bend radius	9 inches minimum

Table 1-9.. Band B Antenna Feed Cable Assembly (3300-81000),
Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Characteristic impedance	75 ±2 ohms
Attenuation	-1.2 dB maximum (at 18 MHz), 68°F (20°C)
Temperature range	
Operating	-65 to +160°F (-54 to +71°C)
Non-operating	-65 to +160°F (-54 to +71°C)
Resistivity	
Inner conductor	0.158 ohm-cm/m^2 maximum at 68°F (20°C)
Outer conductor	0.077 ohm-cm/m^2 maximum at 68°F (20°C)

Table 1-9. Band B Antenna Feed Cable Assembly (3300-81000), Capabilities and Limitations (Continued)

Equipment Characteristics	Capability/Limitation
Velocity of propagation	82 ±2 percent of free space
Rough cut length	578 feet ±1 foot
Nominal capacitance	17 pf per foot
Dielectric strength	8200 volts peak minimum
Corona extinction point	4000 volts rms minimum
Change in electrical length	0.10 cm/100 ft/°F maximum
Bend radius	9 inches minimum

Table 1-10. Band C Antenna Feed Cable Assembly (3300-81000), Capabilities and Limitations

Equipment Characteristics	Capability/Limitation	
Characteristic impedance	75 ±2 ohms	
Attenuation	-0.6 dB maximum (at 18 MHz), 68°F (20°C)	
Temperature range		
Operating	-65 to +160 F (-54 to +71°C)	
Non-operating	-65 to +160 F (-54 to +71°C)	
Resistivity		
Inner conductor	0.158 ohm-cm/m^2	maximum 68 F (20 C)
Outer conductor	0.077 ohm-cm/m^2	maximum 68 F (20°C)
Velocity of propagation	82 ±2 percent of free space	
Rough cut length	158 ±2 feet	
Nominal capacitance	17 pf per foot	
Dielectric strength	8200 volts peak minimum	
Corona extinction point	4000 volts rms minimum	
Change in electrical length	0.10 cm/100 feet/OF maximum	
Bend radius	9 inches minimum	

Table 1-11. Transmission Line Tuner (3300-40005-1),
Capabilities and Limitations

Equipment Characteristics	Capability/Limitation
Characteristic impedance	75 ohms
Frequency range	1 to 50 MHz
Vswr	1.05 to I maximum
Insertion loss	0.05 dB (at 50 MHz), maximum (fully extended)
Range of adjustment	25 cm minimum
Service conditions	
Operating	+60°F (+15.6°C) to +80°F (+26.7°C) meeting full performance requirements. Temperature extremes with equipment continuing to perform basic function without interruption or causing permanent damage to itself or interconnected unit. Lower limit: +32°F (0°C) to +60°F (+15.6°c) Upper limit: +80 F (26.7 0C to +125° F (+51.7 °C)
Non-operating	-65°F (-54°C) to 160°F (+71°C)
Humidity	95 percent
Altitude	Withstands air shipment at 40,000 feet

Table 1-12. Amplifier, Radio Frequency AM-6533/FLR-9(V),
Capabilities and Limitations

NOTE

Data is for one amplifier; there are two per assembly.

Equipment Characteristics	Band A	Band B	Band C
Frequency range			
In band	2 to 6 MHz	6 to 18 MHz	18 to 30 MHz
Low range	1.5 to 2 MHz		

Table 1-12. Amplifier, Radio Frequency AM-6533/FLR-9(V), Capabilities and Limitations (Continued)

Equipment Characteristics	Band A	Band B	Band C
Gain each channel			
In band	19.25 ±0.2 dB	19.25 ± 0.2 dB	21.25 ±0.2 dB
Low range	19.25 ±1 dB		
Phase tracking			
In band	±5 degrees maximum	±1 degree maximum	± degree maximum
Low range	±5 degrees maximum		
Input impedance	75 ohms	75 ohms	75 ohms
Input signal level (rms)	100 millivolts maximum	100 millivolts maximum	100 millivolts maximum
Input impedance tracking	±1.7 ± j1.1	±2.9 ± j1.4	±2.5 ±j2.5
Output impedance	75 ohms	75 ohms	75 ohms
Vswr			
Input	1.25:1	1.25:1	1.25:1
Output	1.25:1	1.25:1	1.25:1
Number of outputs	2	2	2
Noise figure	7.0 dB maximum	7.0 dB maximum	7.0 dB maximum
Intermodulation distortion at outputs			
2nd order (at least)	-85 dB	-85 dB	-85 dB
3rd order (at least)	-82 dB	-82 dB	-82 dB
Out-of-band frequency rejection	Compared to 1.5 to 30.0 MHz operation, signals below 1.0 MHz and above 60.0 MHz are attenuated at least 35 dB.		
Power requirements, both units	120 ±12 volts, single phase, 48 to 63 Hz, 90 watts		
Miscellaneous service conditions			
Ambient operating temperature for full performance requirements	+60° F to +80°F (15.6°C to 26.7°C)		

Table 1-12. Amplifier, Radio Frequency AM-6533/FLR-9(V), Capabilities and Limitations, (Continued)

Equipment Characteristics	Band A	Band B	Band C
Non-operating temperature	-65°F to -160°F (-54°C to 71°C)		
Altitude	Withstands air shipment at 40,000 feet		

Table 1-13. Directional Couplers (Olektron Corp. TD4-102-1, TD4-102-2, and TD4-102-3; Types I, II, and III), Capabilities and Limitations

Equipment	Capability/Limitation
Frequency range - types	
Type I	1.5 MHz to 6 MHz (band A)
Type II	6 MHz to 18 MHz (band B)
Type III	18 MHz to 30 MHz (band C)
All types Maximum input power level (100-percent duty cycle)	+20 dBm (total power)
Directivity range; power level +20 dBm maximum	More than 25 dB in applicable frequency
Vswr	1.2:1 maximum in applicable frequency range; power level +20 dBm maximum
Intermodulation distortion Two in-band cw signals (arithmetic sum) +20 dBm maximum input	Output intermodulation products power content equal to or less that 100 dB below input power
Single signal harmonic generation	A +20-dBm test signal does not produce harmonic or spurious signal(s) greater that 100 dB below input reference.
Nominal impedance (all ports)	75 ±5 ohms
Unit-to-unit phase angle variation	For all frequencies of 1.5 to 30 MHz and power levels to +20 dBm, the unit-to-unit phase angle variation of $\theta_{1-2'}$ $\theta_{1-3'}$ or θ_{4-2} does not exceed 0.4 degree

Table 1-13. Directional Couplers (Olektron Corp. TD4-102-1, TD4-102-2, and TD4-102-3; Types I, II, and I11), Capabilities and Limitations (Continued)

Equipment Characteristics	Capability/Limitation
Service conditions	
Operating temperature	+60°F (15.6° C) to +80°F (26.7° C)
Non-operating temperature	-65°F (-54°C) to +160°F (71° C)

Table 1-14. Divider Assembly, Power Rf CU-2052/FLR-9(V), Capabilities and Limitations

NOTE

Data is for one unit; there are four per assembly (4:16)

Equipment Characteristics	In Band	Low Range
Frequency range	2 to 30 MHz	1.5 to 2 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input/output vswr	1.25:1 maximum	1.5:1 maximum
Phase tracking	±0.75 degrees	+1.5 degrees maximum
Amplitude tracking	±0.10 dB maximum	±0.3 dB maximum
Single channel insertion loss	6.4 dB maximum (at 2 to 6 MHz) 6.6 dB maximum (at 6 to 30 MHz)	6.6 dB maximum
Number of inputs	1	
Number of outputs	4	
Output-to-output isolation	30 dB minimum	30 dB minimum
Intermodulation distortion (second and third order for two, 2.0-volt rms input signals) (at least)	-95 dB	-95 dB

Table 1-14. Divider Assembly, Power Rf CU-2052/FLR-9(V), Capabilities and Limitations (Continued)

Equipment Characteristics	In Band	Low Range

NOTE

Second and third order intermodulation products at any output are below the output level of either test signal as specified above.

Application: Power divider used in bands A, B, and C.

Equipment Characteristics	In Band	Low Range
Miscellaneous service conditions		
Relative humidity	95 percent	
Operating temperature for full performance requirements	+60°F (15.6°C) to +80° F (26.7°C)	
Non-operating temperature	-65° F (-54°C) to +160° F (+71°C)	
Altitude	Withstands air shipment at 40,000 feet	

Table 1-15. Divider Assembly, Power Rf CU-2050/FLR-9(V), Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range	Low Range

NOTE

Data is for one unit (1:16); there are two per assembly (2:32).

Equipment Characteristics	In Band	Extended Range	Low Range
Frequency range	2 to 6 MHz	2 to 30 MHz	1.5 to 2 MHz
Input impedance	75 ohms	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms	75 ohms
Input/output vswr	1.25:1 maximum	1.25:1 maximum	1.5:1 maximum
Phase tracking	±1.5 degrees maximum	±2.0 degrees maxi mum	± 3.0 degrees maximum
Amplitude tracking	±0.2 dB maximum	±0.2 dB maximum	±0.4 dB maximum

Table 1-15. Divider Assembly, Power Rf CU-2050/FLR-9(V), Capabilities and Limitations (Continued)

Equipment Characteristics	In Band	Extended Range	Low Range
Single channel insertion loss	12.8 dB maximum	13.2 dB maximum	12.8 dB maximum
Number of inputs	1		
Number of outputs	16		
Output-to-output isolation	(30 dB minimum at 20 MHz and below) (26 dB minimum above 20 MHz)		
Intermodulation distortion (second and third order for two, 2.0-volt rms signals) (1.5 to 30 MHz) (at least)	-95 dB	-95 dB	-95 dB

NOTE

Second and third order intermodulation products at any output are below the output level of either test signal as specified above.

Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60° F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65° F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet.

Application: Power divider. band A only,

Table 1-16. Divider Assembly, Power Rf CU-2053/FLR-9(V), Capabilities and Limitations

NOTE

Data is for one unit (1:8); there are four per assembly (4:32).

Equipment Characteristics	Extended Range	In Band
Frequency range	2 to 30 MHz	6 to 18 MHz
Input impedance	75 ohms	75 ohms

Table 1-16. Divider Assembly, Power Rf CU-2053/FLR-9(V), Capabilities and Limitations (Continued)

Equipment Characteristics	Extended Range	In Band
Output impedance	75 ohms	75 ohms
Input/output vswr	75 ohms	75 ohms
Phase tracking	±2.0 degrees maximum	10.0 degrees maximum
Amplitude tracking	±0.2 dB maximum	0.15 dB maximum
Single channel insertion loss	10.0 dB maximum	10.0 dB maximum
Number of inputs	1	1
Number of outputs	8	8
Output-to-output isolation	30 dB minimum	30 dB minimum
Intermodulation distortion (second and third order for two 2.0-volt rms input signals)	-95 dB	-95 dB

NOTE

Levels of -90 dB are acceptable for third order products produced by fundamentals below 6 MHz. Second and third order intermodulation products at any output are below the output level of either test signal as specified above.

Miscellaneous service conditions		
Relative humidity	95 percent	
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)	
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)	
Altitude	Withstands air shipment at 40,000 feet	
	Application: Power divider, band B only.	

Table 1-17. Divider Assembly, Power Rf CU-2051/FLR-9(V), Capabilities and Limitations

Equipment Characteristics	Extended Range	In Band
	NOTE	
	Data is for one unit (1:4); there are six per assembly (6:24).	
Frequency range	2 to 30 MHz	18 to 30 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input/output vswr	1.25:1 maximum	1.25:1 maximum
Phase tracking	±1.0 degrees maximum.	±0.75 degrees maximum
Amplitude tracking	±0.15 dB maximum	±0.1 dB maximum
Single-channel insertion loss	6.6 dB maximum	6.6 dB maximum
Number of outputs	4	4
Number of inputs	1	1
Output-to-output isolation	30 dB minimum	30 dB minimum
Intermodulation distortion (second and third order for two, 2.0-volt rms input signals) (at least)	-95 dB	-95 dB
	NOTE	
	Second and third order intermodulation products at any output are below the output level of either test signal as specified above.	
Miscellaneous service conditions		
Relative humidity	95 percent	
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (26.7°C)	
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)	
Altitude	Withstands air shipment at 40,000 feet.	
	Application: Power divider, band C only.	

Table 1-18. Coupler, Omni Assembly CU-2054/FLR-9(V),
Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range	Low Range
Frequency range 18 to 30 MHz	2 to 6 MHz	2 to 30 MHz	1.5 to 2 MHz
Input impedance	75 ohms	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms	75 ohms
Input/output vswr	1.25:1 maximum	1.25:1 maximum	1.4:1 maximum
Phase tracking	±1.0 degrees maximum	±1.5 degrees maximum	±3.0 degrees maximum
Amplitude tracking	±0.15 dB maximum	±0.2 dB maximum	±0.3 dB maximum
Single channel insertion loss	10.0 dB maximum	10.0 dB maximum	10.0 maximum
Number of inputs	16		
Number of outputs	2		
Output-to-output isolation	30 dB minimum	30 dB minimum	30 dB minimum
Intermodulation distortion (second and third order for two, 2.0-volt rms input signals)	-95 dB	-95 dB	-95 dB

NOTE

Levels of -90 dB are acceptable for third order products produced by fundamentals below 6 MHz. Second and third order intermodulation products at any output are below the output level of either test signal as specified above.

Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet.

Application: Omnicombiner, used in bands A and C.

Table 1-18. Coupler, Omni Assembly CU-2054/FLR-9(V),
Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range	Low Range
Frequency range	2 to 6 MHz, 18 to 30 MHz	2 to 30 MHz	1.5 to 2 MHz
Input impedance	75 ohms	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms	75 ohms
Input/output vswr	1.25:1 maximum	1.25:1 maximum	1.4:1 maximum
Phase tracking	±1.0 degrees maximum	± 1.5 degrees maximum	±3.0 degrees maximum
Amplitude tracking	±0.15 dB maximum	±0.2 dB maximum	±0.3 dB maximum
Single channel insertion loss	10.0 dB maximum	10.0 dB maximum	10.0 dB maximum
Number of inputs	16		
Number of outputs	2		
Output-to-output isolation	30 dB minimum	30 dB minimum	30 dB minimum
Intermodulation distortion (second and third order for two, 2.0-volt rms input signals)	-95 dB	-95 dB	-95 dB

NOTE

Levels of -90 dB are acceptable for third order products produced by fundamentals below 6 MHz. Second and third order intermodulation products at any output are below the output level of either test signal as specified above.

Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet.

Application: Omnicombiner, used In bands A and C.

Table 1-19. Coupler, Omni Assembly CU-2055/FLR-9(V), Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range
Frequency range	6 to 18 MHz	2 to 30 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input/output vswr	1.25:1 maximum	1.25:1 maximum
Phase tracking ±1.5 degrees max i mum	±2.0 degrees max i mum	
Amplitude tracking	0O.15 dB maximum	f0.2 dB maximum
Single channel insertion loss	12.8 dB maximum	13.2 dB maximum
Number of inputs	16	
Number of outputs	1	
Output-to-output isolation	30 dB minimum	30 dB minimum
Intermodulation distortion (second and third order for two, 2.0-volt rms input signals) (at least)	-95 dB	-95 dB

NOTE

Levels of -90 dB are acceptable for third order products produced by fundamentals below 6 MHz. Second and third order intermodulation products at any output are below the output level of either test signal as specified above.

Miscellaneous service conditions Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet
Application:	Omnicombiner, band B only.

Table 1-20. Coupler, Omni Assembly CU-2049/FLR-9(V), Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range
Frequency range	2 to 30 MHz	1.5 to 2 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input/output vswr	1.25:1 maximum	1.4:1 maximum
Phase tracking	±1.0 degrees maximum	± 2.0 degrees maximum
Amplitude tracking	±0.15 dB maximum	±0.3 dB maximum
Single channel insertion loss	10 dB maximum	10 dB maximum
Number of inputs	6	
Number of outputs	1	
Output-to-output isolation	30 dB minimum	30 dB minimum
Intermodulation distortion (second and third order for two, 2.0-volt rms input signals) (at least)	-95 dB	-95 dB

NOTE

Levels of -90 dB are acceptable for third order products produced by fundamentals below 6 MHz. Second and third order intermodulation products at any output are below the output level of either test signal as specified above.

Equipment Characteristics	In Band	Extended Range
Miscellaneous service conditions		
Relative humidity	95 percent	
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)	
Non-operating temperature	-65± F (-54 C) to +160 F (+71°C)	
Altitude	Withstand air shipment at 40,000 feet.	

Application: Omnicombiner, bands A, B, and C.

Table 1-21. Beamformer Assembly TD-1052/FLR-9(V) (V7 Only), Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range
	NOTE Data is for one unit (16:1), there are two per assembly.	
Frequency range	2 to 6 MHz	1.5 to 2 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input vswr	1.25:1	1.25:1
Output vswr	1.25:1	1.25:1
Number of inputs	16	16
Number of outputs	1	1
Maximum insertion loss of zero taper channels (the zero taper channels are the two center antenna channels requiring zero illumination taper)	10.5 dB maximum	10.5 dB maximum
Input-to-input isolation	30 dB minimum	30 dB minimum
Maximum amplitude deviation (from theoretical)	±0.2 dB maximum	±0.3 dB maximum
Amplitude tracking	±0.2 dB maximum	±0.3 dB maximum
Maximum phase deviation	±2 degrees maximum	±5 degrees maximum
Phase tracking	±2 degrees maximum	±3 degrees maximum
Intermodulation distortion (for two, 2.0-volt rms inputs introduced at output of beamformer)	-95 dB maximum with respect to fundamentals	
	Application: Monitor beamformer, band A, site V7 only.	

Table 1-21. Beamformer Assembly TD-1052/FLR-9(V) (V7 Only), Capabilities and Limitations, (Continued)

Channel	Relative Attenuation (In dB)
Channel 1	0
Channel 2	0
Channel 3	-1.1
Channel 4	-1.1
Channel 5	-2.9
Channel 6	-2.9
Channel 7	-5.6
Channel 8	-5.6
Channel 9	-8.7
Channel 10	-8.7
Channel 11	-12.6
Channel 12	-12.6
Channel 13	-13.7
Channel 14	-13.7
Channel 15	-12.1
Channel 16	-12.1

Channel	Required Time Delay, Nanoseconds
Channel 1 and 2 (Center)	194.0
Channel 3 and 4	186.5
Channel 5 and 6	171.7
Channel 7 and 8	149.7
Channel 9 and 10	121.0
Channel 11 and 12	86.1
Channel 13 and 14	45.5
Channel 15 and 16	0
Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet

Table 1-22. Beamformer Assembly TD-1050/FLR-9(V) (V8 Only), Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range
	NOTE Data is for one unit (16:), there are two per assembly.	
Frequency rarge	2 to 6 MHz	1.5 to 2 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input vswr	1.25:1	1.25:1
Output vswr	1.25:1	1.25:1
Number of inputs	16	16
Number of outputs	1	1
Maximum insertion loss of zero taper channels (the zero taper channels are the two center antenna channels requiring zero illumination taper)	10.5 dB maximum	10.5 dB maximum
Input-to-input isolation	30 dB minimum	30 dB minimum
Maximum amplitude deviation (from theoretical)	±0.2 dB maximum	±0.3 dB maximum
Amplitude tracking	±0.2 dB maximum	±0.3 dB maximum
Maximum phase deviation	±2 degrees maximum	± 5 degrees maximum
Phase tracking	±2 degrees maximum	± 3 degrees maximum
Intermodulation distortion (for two, 2.0-volt rms inputs introduced at output of beamformer)	-95 dB maximum with respect to fundamentals	

Application: Monitor beamformer, band A, site V8 only.

Channel	Relative Attenuation (In dB)
Channel 1	0
Channel 2	0

Table 1-22. Beamformer Assembly TD-1O5O/FLR-9(V) (V8 Only), Capabilities and Limitations (Continued)

Channel	Relative Attenuation (In dB)
Channel 3	-1.1
Channel 4	-1.1
Channel 5	-2.9
Channel 6	-2.9
Channel 7	-5.6
Channel 8	-5.6
Channel 9	-8.7
Channel 10	-8, 7
Channel 11	-12.6
Channel 12	-12.6
Channel 13	-13.7
Channel 14	-13.7
Channel 15	-12.1
Channel 16	-12.1

Channel	Required Time Delay, Nanoseconds
Channel 1 and 2 (Center)	155.4
Channel 3 and 4	149.4
Channel 5 and 6	137.5
Channel 7 and 8	119.9
Channel 9 and 10	96.9
Channel 11 and 12	68.9
Channel 13 and 14	36.5
Channel 15 and 16	0
Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet

Table 1-23. Beamformer Assembly TD-1053/FLR-9(V) (V7 Only), Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range
	NOTE	
Data is for one unit (16:1); there are two per assembly.		
Frequency range	6 to 18 MHz	18 to 30 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input vswr	1.25:1	1.4:1
Output vswr	1.25:1	1.4:1
Number of inputs	16	16
Number of outputs	1	1
Maximum insertion loss of zero taper channels (the zero taper channels are the two center antenna channels requiring zero illumination taper)	10.3 dB maximum	11.0 dB maximum
Input-to-input isolation	30 dB minimum	20 dB minimum
Maximum amplitude deviation (from theoretical)	±02. dB maximum	±1.0 dB maximum
Amplitude tracking	±0.2 dB maximum	±0.5 dB maximum
Maximum phase deviation	±2 degrees maximum	±8 degrees maximum
Phase tracking	±2 degrees maximum	±3 degrees maximum
Intermodulation distortion (for two, 2.0-volt rms inputs introduced at output of beamformer)	-95 dB maximum with respect to fundamentals from 6 to 30 MHz	

NOTE

Intermodulation distortion in the frequency range of 1.5 to 6 MHz also is -95 dB with respect to the fundamentals. For this specification the input signal levels are 2.0 volt rms at 6 MHz varying linearly to 0.7 volt rms at 1.5 MHz.

Application: Monitor beamformer, band B, site V7 only.

Table 1-23. Beamformer Assembly TD-1053/FLR-9(V) (V7 Only)
Capabilities and Limitations (Continued)

Channel	Relative Attenuation (In dB)
Channel 1	0
Channel 2	0
Channel 3	-1.1
Channel 4	-1.1
Channel 5	-2.9
Channel 6	-2.9
Channel 7	-5.6
Channel 8	-5.6
Channel 9	-8-.7
Channel 10	-8.7
Channel 11	-12.6
Channel 12	-12.6
Channel 13	-13.7
Channel 14	-13.7
Channel 15	-12.1
Channel 16	-12.1

Channel	Required Time Delay, Nanoseconds
Channel 1 and 2 (Center)	58.59
Channel 3 and 4	56.46
Channel 5 and 6	52.20
Channel 7 and 8	45.85
Channel 9 and 10	37.39
Channel 11 and 12	26.91
Channel 13 and 14	14.43
Channel 15 and 16	0
Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet

Table 1-24. Beamformer Assembly TD-1051/FLR-9(V), (V8 Only)
Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range
	NOTE	
Data is for one unit (16:1); there are two per assembly.		
Frequency range	6 to 18 MHz	18 to 30 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input vswr	1.25:1	1.4:1
Output vswr	1.25:1	1.4:1
Number of inputs	16	16
Number of outputs	1	1
Maximum insertion loss of zero taper channels (the zero taper channels are the two center antenna channels requiring zero illumination taper)	10.3 dB maximum	11.0 dB maximum
Input-to-input isolation	30 dB minimum	20 dB minimum
Maximum amplitude deviation. (from theoretical)	±0.2 dB maximum	±1.0 dB maximum
Amplitude tracking	±0.2 dB maximum	±0.5 dB maximum
Maximum phase deviation	±2 degrees maximum	±8 degrees maximum
Phase tracking	±2 degrees maximum	±3 degrees maximum
Intermodulation distortion (for two 2.0-volt rms inputs introduced at output of beamformer)	-95 dB maximum with respect to fundamentals from 6 to 30 MHz	

NOTE

Intermodulation distortion in the frequency range of 1.5 to 6 MHz is -95 dB with respect to the fundamentals. For this specification the input signal levels will be 2.0 volt rms at 6 MHz varying linearly to 0.7 volt rms at 1.5 MHz.

Application: Monitor beamformer, band B, site V8 only.

Table 1-24. Beamformer Assembly TD-1051/FLR-9(V) (V8 Only)
Capabilities and Limitations (Continued)

Channel	Relative Attenuation (In dB)
Channel 1	0
Channel 2	0
Channel 3	-1.1
Channel 4	-1.1
Channel 5	-2.9
Channel 6	-2.9
Channel 7	-5.6
Channel 8	-5.6
Channel 9	-8.7
Channel 10	-8.7
Channel 11	-12.6
Channel 12	-12.6
Channel 13	-13.7
Channel 14	-13.7
Channel 15	-12.1
Channel 16	-12.1

Channel	Required Time Delay, Nanoseconds
Channel 1 and 2 (Center)	41.29
Channel 3 and 4	39.79
Channel 5 and 6	36.79
Channel 7 and 8	32.30
Channel 9 and 10	26.35
Channel 11 and 12	18.96
Channel 13 and 14	10.17
Channel 15 and 16	0
Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60° F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet

Table 1-25. Beamformer Assembly TD-1054/FLR-9(V), Capabilities and Limitations

Equipment Characteristics	In Band	Extended Range
	NOTE	
	Data is for one unit (8:1); there are four per assembly.	
Frequency range	18 to 30 MHz	6 to 18 MHz
Input impedance	75 ohms	75 ohms
Output impedance	75 ohms	75 ohms
Input vswr	1.25:1	1.25:1
Output vswr	1.25:1	1.25:1
Number of inputs	8	8
Number of outputs	1	1
Maximum insertion loss of zero taper channels (the zero taper channels are the two center antenna channels requiring zero illumination taper)	8 dB maximum	8 dB maximum
Input-to-input isolation	30 dB minimum	30 dB minimum
Maximum amplitude deviation (from theoretical)	±0.2 dB maximum	±0.3 dB maximum
Amplitude tracking	±0.2 dB maximum	±0.3 dB maximum
Maximum phase deviation	±2 degrees maximum	±3 degrees maximum
Phase tracking	±2 degrees maximum	±3 degrees maximum
Intermodulation distortion (for two, 2.0-volt rms inputs introduced at output of beamformer)	-95 dB maximum with respect to fundamentals	

NOTE

Intermodulation distortion in the frequency range of 1.5 to 6 MHz is -95 dB with respect to the fundamentals. For this specification the input signal levels are 2.0 volt rms at 6 MHz varying linearly to 0.7 volt rms at 1.5 MHz.

Application: Monitor beamformer, band C.

Table 1-25. Beamformer Assembly TD-1054/FLR-9(V), Capabilities and Limitations (Continued)

Channel	Relative Attenuation (In dB)
Channel I	0
Channel 2	0
Channel 3	-2.0
Channel 4	-2.0
Channel 5	-6.6
Channel 6	-6.6
Channel 7	-7.9
Channel 8	-7.9
Channel	**Required Time Delay, Nanoseconds**
Channel 1 and 2 (Center)	16.12
Channel 3 and 4	13.39
Channel 5 and 6	7.99
Channel 7 and 8	0
Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet

Table 1-26. Beamformer Assembly TD-1055/FLR-9(V), Capabilities and Limitations

Equipment Characteristics	In Band

NOTE

Data is for one unit (4:1); there are three per assembly.

Frequency range	1.5 to 6 MHz
Input impedance	75 ohms
Output impedance	75 ohms

Table 1-26. Beamformer Assembly TD-1055/FLR-9(V),
Capabilities and Limitations (Continued)

Equipment Characteristics	In Band
Input vswr	1.25:1 maximum
Output vswr	1.25:1 maximum
Number of inputs	4
Number of outputs	1
Insertion loss balance	0.2 dB maximum
Input-to-input isolation	30 dB minimum
Phase difference	1 degree maximum
Intermodulation distortion (for two, 2.O-volt rms inputs introduced at output of beamformer)	-95 dB maximum with respect to fundamentals

Application: Sector beamformer, band A.

Channel	Relative Insertion Loss
Channel 2 JI to J5	0
Channel 3 J2 to J5	0
Channel 1 J3 to J5	8.5 ±0.2 dB
Channel 4 J4 to J5	8.5 ±0.2 dB

NOTE

The insertion loss of channels 2 and 3 and that of channels 1 and 4 is balanced within 0.2 dB. The maximum insertion loss of channels 2 and 3 is 6.5 dB.

Channel	Required Time Delay, Nanoseconds
Channel 2 and 3 (Center	9.3
Channel 1 and 4	0

NOTE

The phase delay must be within 1.0 degree of the amount specified above at any frequency between 1.6 and 6 MHz.

Table 1-26. Beamformer Assembly TD-1055/FLR-9(V), Capabilities and Limitations (Continued)

Channel	Required Time Delay, Nanoseconds
Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet

Table 1-27. Beamformer Assembly TD-1056./FLR-9(V), Capabilities and Limitations

Equipment Characteristics	In Band
NOTE Data is for one unit (3:1); there are three per assembly.	
Frequency range	6 to 30 MHz
Input impedance	75 ohms
Output impedance	75 ohms
Input vswr	1.25:1 maximum
Output vswr	1.25:1 maximum
Number of inputs	3
Number of outputs	1
Insertion loss balance	0.2 dB maximum
Input-to-input isolation	30 dB minimum
Phase difference	1 degree maximum
Intermodulation distortion (for two, 2.0-volt rms inputs introduced at output of beamformer)	-95 dB maximum with respect to fundamentals
Application: Sector beamformer, band B	

Table 1-27. Beamformer Assembly TD-1056/FLR-9(V) Capabilities and Limitations (Continued)

Channel	Relative Insertion Loss
Channel 1 J2 to J4	11 ±0.2 dB
Channel 3 J3 to J4	11 ±0.2 dB
Channel 2 J1 to J4	0

NOTE

The insertion loss of channels I and 3 must be balanced within 0.2 dB; the maximum insertion loss of channel 2 is 3.5 dB.

Channel	Required Time Delay, Nanoseconds
Channel 2 (Center)	1.2
Channels I and 3	0

NOTE

The phase delay must be within 1.0 degree of the amount specified above at any frequency between 6 and 30 MHz.

Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet

Table 1-28. Beamformer Assembly TD-1057/FLR-9(V), Capabilities and Limitations

Characteristics	In Band
NOTE Data is for one unit (2:1); there are three per assembly.	
Frequency range	6 to 30 MHz
Input impedance	75 ohms
Output impedance	75 ohms
Input vswr	1.25:1 maximum
Output vswr	1.25:1 maximum
Number of inputs	2
Number of outputs	1
Maximum insertion loss of either channel	3.5 dB
Insertion loss balance	0.2 dB maximum
Input-to-input isolation	30 dB minimum
Phase difference	1.0 degree maximum
Intermodulation distortion (for two 2.0-volt rms inputs introduced at output to beamformer)	-95 dB maximum with respect to fundamentals
Miscellaneous service conditions	
Relative humidity	95 percent
Operating temperature for full performance requirements	+60°F (+15.6°C) to +80°F (+26.7°C)
Non-operating temperature	-65°F (-54°C) to +160°F (+71°C)
Altitude	Withstands air shipment at 40,000 feet
Application: Sector beamformer, band C.	

Table 1-29. Directional Couplers (Olektron TD4-101-1, TD4-101-2, and TD4-101-3; Types I, II, and III) Capabilities and Limitations

Characteristics	Capability/Limitation
Frequency range - types:	
Type I	1.5 MHz to 6 MHz (Band A)
Type 11	6 MHz to 18 MHz (Band B)
Type I1	18 MHz to 30 MHz (Band C)
All types	
Maximum input power level (100-percent duty cycle)	+20 dBm (total power)
Directivity range; power level +20 dBm maximum	More than 25 dB in applicable frequency
Vswr range; power level +20 dB maximum	1.2:1 maximum in applicable frequency
Intermodulation distortion	
Two in-band cw signals (arithmetic sum) +20-dBm maximum input	Output intermodulation products power content equal to or less than 100 dB below input power.
Single signal harmonic generation	a +20-dBm test signal does not produce harmonic or spurious signal(s) greater than 100 dB below input reference.
Nominal impedance (all ports)	75 ±5 ohms
Unit-to-unit phase angle variation	For all frequencies of 1.5 to 30 MHz and power levels to +20 dBm, the unit-to-unit phase angle variation of θ_{1-2}, θ_{1-3}, or θ_{4-2} does not exceed 0.4 de1gee.
Service conditions	
Operating temperature	+60°F (15.6°'C) to +80°F (26.7° C)
Non-operating temperature	-65°F (-54°C) to +160° F (71° C)

Table 1-30. Equipment Supplied Cross Reference Index

Official Nomenclature	Common Name	Manufacturer's Part No.	Code Ident.	Capabilities and Limitations Table Ref. No.
Amplifier, Radio Frequency AN -6533/FL R-9 (V)	Rf amplifier	3300-42899-1	15770	1-12
Divider Assembly, Power Rf CU-2052/FLR-9(V) A, B, and C	Power divider, high level (1:4) bands	3300-42840-1	15770	1-14
Divider Assembly, Power Rf CU-205 1 /FL R-9 (V)	Power divider (6:24) band C	3300-42841-1	15770	1-17
Divider Assembly, Power Rf CU-2053/FLR-9(V)	Power divider (4:32) band B	3300-42842-1	15770	1-16
Divider Assembly, Power Rf CU-2050/FLR-9	Power divider (2:32) band A	3300-42843-1	15770	1-15
Panel, Patching, Antenna SB-3666/FLR-9(V)	Sector beam patch panel, band A	3300-42000-1	15770	None
Panel, Patching, Antenna SB-3664/FLR-9(V)	Sector beam patch panel, band 8	3300-42002-2	15770	None
Panel, Patching, Antenna SB-3663/FLR-9(V)	Sector beam patch panel, band B	3300-42000-3	15770	None
Panel, Patching, Antenna SB-3662/FLR-9(V)	Sector beam patch panel, band C	3300-42000-4	15770	None
Coupler, Omni Assembly CU-2054/FLR-9(V)	Omnicombiner, (16:2) bands A and C	3300-42844-1	15770	1-18
Coupler, Omni Assembly CU-2049/FLR-9(V)	Omnicombiner, (6:1) bands A, B, and C	3300-42845-1	15770	1-20

Table 1-30. Equipment Supplied Cross-Reference Index (Continued)

Official Nomenclature	Common Name	Manufacturer's Part No.	Code Ident.	Capabilities and Limitations Table Ref. No.
Coupler, Omni Assembly CU-2055/FLR-9(V)	Omnicombiner, (16:1) band B	3300-42846-1	15770	1-19
Beamformer Assembly TD- 1050/FLR-9(V) (site V8 only)	Monitor beamformer A	2165-8000	11556	1-22
Beamformer Assembly TD-1052/FLR-9(V) (site V7 only)	Monitor beamformer A'	2165-8001	11556	1-21
Beamformer Assembly TD-1051/FLR-9(V) (site V8 only)	Monitor beamformer B	2165-8002	11556	1-24
Beamformer Assembly TD-1053/FLR-9(V)	Monitor beamformer B' (site V7 only)	2165-8003	11556	1-23
Beamformer Assembly TD- 1054/FLR-9 (V)	Monitor beamformer C	2165-8004	11556	1-25
Beamformer Assembly TD-1055/FLR-9(V)	Sector beamformer A	2176-8000	11556	1-26
Beamformer Assembly TD-1056/FLR-9(V)	Sector beamformer B	2176-8001	11556	1-27
Beamformer Assembly TD-1057/FLR-9(V)	Sector beamformer C	2176-8002	11556	1-28

Manufacturer	Code Identification
F & M Systems Co. 2525 Walnut Hill Lane Dallas, Texas 75220	15770
Adams-Russell Co., Inc. 280 Bear Hill Road Waltham, Massachusetts 02154	11556

CHAPTER 2

INSTALLATION

SECTION I. INSTALLATION LOGISTICS

2-1. Scope.

This chapter contains unpacking, inspection, location, and installation data for the electronic and electrical equipment of the antenna group. Equipment covered by this manual is delivered to the user installed as a complete group. The information presented is to support installation in the event of site relocation. The circular antenna array is, in general, not subject to relocation as most of the components would become scrap material (ground screen, reflecting screens, feed cables, timbers, etc).

2-2. Unpacking.

Upon receipt of the unit, Inspect the shipping container for damage. Check that the container is upright, then carefully remove the contents.

2-3. Inspection. (See table 2-1.)

After the shipping containers have been unpacked, visually inspect the cabinet and all assemblies for defects listed in table 2-1. Repair or replace all defective items before placing unit in operation.

Table 2-1. Installation Inspection

Inspection Item	Procedures
Antenna elements	Check for bends, dents, and cracks Check for rust or corrosion and cracked or chipped paint
Cabinets and racks	Check for bent or cracked frame, rust or corrosion, cracked or chipped paint, dented or warped panels or doors, and cracked or otherwise damaged hinges
	Check all connectors for damage
	Check for damaged or missing parts and mountings
	Check for damaged or missing nameplates
Cables	Check foamed dielectric cables for cuts, perforations, or abrasions of the polyethylene jacket or deformations which may have caused denting of the aluminum outer conductor

Table 2-1. Installation Inspection (Continued)

Inspection Item	Procedures
	Check coaxial cables for kinks and other deformation or damage to insulation Check all other cables for cut or otherwise damaged insulation or evidence of broken conductors
Capacitors	Check for defective solder connections, discoloration, splits, or bulge
Chassis	Check for bent or dented frame and front panel Check for rust or corrosion, and cracked or chipped protective finish
	Check for damaged, loose, or missing parts and mountings
	Check for marred or otherwise damaged front and rear panel nomenclature
	Check for damaged or missing nameplates
Connectors	Check for bent, broken, or missing pins, distorted barrels and damaged threads, broken or discolored inserts, and damaged potting compound
	Check for loose mountings
Controls	Check for damaged, loose, or missing knobs and for bent shafts
Interconnecting rf cables	Check for cut or abraded cable jacket, looseness of cable connections, absence or looseness of center contact pins, and missing or damaged cable marker bands
Resistors	Check for defective solder connections, discoloration, and cracks
Slides	Check for loose mountings and ease of operation
Switches	Check for loose mountings, ease of operation, detent or return action, and signs of arcing or overheating
Terminal boards	Check for loose, damaged, and missing terminal screws or posts
Transformers	Check for loose mountings, defective solder connections, and signs of overheating

Table 2-1. Installation Inspection (Continued)

Inspection Item	Procedures
Transistors	Check for defective connections and signs of overheating
Wiring	Check for cut or abraded insulation, broken wires, faulty connections, and discoloration
	Check for damaged lacing and loose or missing cable clamps

2-4. Cables. (See table 2-2.)

Rf cables used in the Installation of the antenna group equipment are listed in table 2-2. When unpacking, identify groups of cables and transfer to appropriate location for installation as Indicated in table 2-2. Additional cable information may be found by referring to table 9-1. Goniometer cables (df group) are also listed for convenience.

Table 2-2. Rf Cables Identification, Antenna Group

Function	Cable No.	Wire List Dwg. No. AN/FLR-9 (V7)	AN/FLR-9 (V8)
Antenna elements to transmission line turners			
Band A	W0001 to W00048 incl.	3300 - 81000	3300 - 81000
Band B	Wooo49 to W00144 incl.	3300 - 81000	3300 - 81000
Band C	W00145 to W00192 incl.	3300 - 81000	3300 - 81000
Transmission line tuners to directional couplers			
Band A	W20201 to W20248 incl.	3300 - 82000	3300 - 82000
Band B	W20249 to W20344 incl.	3300 - 82000	3300 - 82000
Band C	W20345 to W20392 incl.	3300 - 82000	3300 - 82000

Table 2-2. Rf Cables Identification, Antenna Group (Continued)

Function	Cable No.	Wire List Dwg. No. AN/FLR-9 (V7)	Wire List Dwg. No. AN/FLR-9 (V8)
Directional couplers to rf preamplifiers			
Band A	W20401 to W20448 incl.	3300 - 82001	3300 - 82001
Band B	W20451 to W20546 incl.	3300 - 82002	3300 - 82002
Band C	W20551 to W20598 incl.	3300 - 82003	3300 - 82003
Rf amplifier outputs to (high level) power divider inputs			
Band A	W22535 to W22582 incl.	3300 - 82004	3300 - 82004
Band B	W22585 to W22680 incl.	3300 - 82005	3300 - 82005
Band C	W22685 to W22732 incl.	3300 - 82006	3300 - 82006
Rf amplifier output to power divider input			
Band A	W20601 to W20648 incl.	3300 - 82039	3300 - 82007
Band B	W20651 to W20746 incl.	3300 - 82040	3300 - 82008
Band C	W20751 to W20798 incl.	3300 - 82041	3300 - 82009
High level power divider to goniometer rf input			
Band A	W22735 to W22782 incl.	3300 - 82036	3300 - 82010
Band B	W22785 to W22880 incl.	3300 - 82037	3300 - 82011

Table 2-2. Rf Cables Identification, Antenna Group (Continued)

Function	Cable No.	Wire List Dwg. No. AN/FLR-9 (V7)	Wire List Dwg. No. AN/FLR-9 (V8)
Band C	W22885 to W22932 incl.	3300 - 82038	3300 - 82012
High level power divider to sector beam patch panel			
Band A	W23135 to W23182 incl.	3300 - 82013	3300 - 82013
Band B	W23185 to W23280 incl.	3300 - 82014	3300 - 82014
Band C	W23285 to W23332 incl.	3300 - 82015	3300 - 82015
High level power dividers to omnicombiners			
Band A	W22935 to W22982 incl.	3300 - 82016	3300 - 82016
Band B	W22985 to W23080 incl.	3300 - 82017	3300 - 82017
Band C	W23085 to W23132 incl.	3300 - 82018	3300 - 82018
Power dividers to monitor beamformers			
Band A	W20801 to W21568 incl.	3300 - 82033	3300 - 82019
Band B	W21571 to W22338 incl.	3300 - 82034	3300 - 82020
Band C	W22341 to W22532 incl.	3300 - 82035	3300 - 82021
Omnibeam forming bands A, B, and C (from omnicombiners 16:2 to omnicombiners 6:1, bands A and C; omnicombiners 16:1 to omnicombiners 6:1, band B)	W23335 to W23340 (A) W23341 to W23346 (B) W23347 to W23352 (C)	3300 - 82022	3300 - 82022

Table 2-2. Rf Cables Identification, Antenna Group (Continued)

Function	Cable No.	Wire List Dwg. No. AN/FLR-9 (V7)	Wire List Dwg. No. AN/FLR-9 (V8)
High level dividers spare port termination			
Band A	N/A	3300 - 82023	3300 - 82023
Band B	N/A	3300 - 82024	3300 - 82024
Band C	N/A	3300 - 82032	3300 - 82032
Monitor beamformers to directional couplers			
Band A	W23355 to W23402 incl.	3300 - 82044	3300 - 82025
Band B	W23405 to W23452 incl.	3300 - 82045	3300 - 82026
Band C	W23455 to W23478 incl.	3300 - 82046	3300 - 82027
Omni/sector beams to directional couplers			
Band A omnibeam	W23605	3300 - 82028	3300 - 82028
Band B omnibeam	W23606	3300 - 82028	3300 - 82028
Band C omnibeam	W23607	3300 - 82028	3300 - 82028
Band A sector beam No. 1 , 2, and 3	W23610 to W23612 incl.	3300 - 82028	3300 - 82028
Band A sector beam No. 4, 5, and 6	W23632 to W23634 incl.	3300 - 82028	3300 - 82028
Band B sector beam No. 1, 2, and 3	W23613 to W23615 incl.	3300 - 82028	3300 - 82028
Band B sector beam No. 4, 5, and 6	W23635 to W23637 incl.	3300 - 82028	3300 - 82028
Band C sector beam No. 1, 2, and 3	W23616 to W23618 incl.	3300 - 82028	3300 - 82028
Band C sector beam No. 4, 5, and 6	W23638 to W23640 incl.	3300 - 82028	3300 - 82028

Table 2-2. Rf Cables Identification, Antenna Group (Continued)

Function	Cable No.	Wire List Dwg. No. AN/FLR-9 (V7)	Wire List Dwg. No. AN/FLR-9 (V8)
Monitor beams, directional couplers to tunnel cables			
Band A	W23480 to W23527 incl.	3300 - 82029	3300 - 82029
Band B	W23530 to W23577	3300 - 82042	3300 - 82042
Band C	W23580 to W23603	3300 - 82043	3300 - 82043
Sector/omnibeams, directional couplers to tunnel cables			
Band A sector beam No. 1, 2, and 3	W23620 to W23622 incl.	3300 - 82047	3300 - 82047
Band A sector beam No. 4, 5, and 6	W23641 to W23643 incl.	3300 - 82047	3300 - 82047
Band A omnibeam	W23623	3300 - 82047	3300 - 82047
Band B sector beam No. 1, 2, and 3	W23624 to W23626 incl.	3300 - 82047	3300 - 82047
Band B sector beam No. 4, 5, and 6	W23644 to W23646 incl.	3300 - 82047	3300 - 82047
Band B omnibeam	W23627	3300 - 82047	3300 - 82047
Band C sector beam No. 1, 2, and 3	W23628 to W23630 incl.	3300 - 82047	3300 - 82047
Band C sector beam No. 4, 5, and 6	W23647 to W23649 incl.	3300 - 82047	3300 - 82047
Band C omnibeam	W23631	3300 - 82047	3300 - 82047
Tunnel cables			
Band A monitor beams No. 1 through 21 and 22 through 48	W24001 to W24021 incl.	3300 - 82030	3300 - 82030
	W24023 to W24049	3300 - 82030	3300 - 82030

Table 2-2. Rf Cables Identification, Antenna Group (Continued)

Function	Cable No.	Wire List Dwg. No. AN/FLR-9 (V7)	AN/FLR-9 (V8)
Tunnel cables			
Band A monitor beams No 1 through 21 and	W24001 to W24021 incl.	3300 - 82030	3300 - 82030
22 through 48	W24023 to W24049incl.	3300 - 82030	3300 - 82030
Spare cable No. 1	W24022	3300 - 82030	3300 - 82030
Band A sector beams Nos 1, 2, and 3 and	W24050 to W24052 incl.	3300 - 82030	3300 - 82030
Nos 4, 5, and 6	W24153 to W24155 incl.	3300 - 82030	3300 - 82030
Band A omnibeam	W24053	3300 - 82030	3300 - 82030
Band B monitor beams No. 1 through 12 and	W24054 to W24065 incl.	3300 - 82030	3300 - 82030
13 through 48	W24067 to W24102 incl.	3300 - 82030	3300 - 82030
Spare cable No. 2	W24066	3300 - 82030	3300 - 82030
Band B sector beams Nos 1, 2, and 3 and	W24103 to W24105 incl.	3300 - 82030	3300 - 82030
Nos 4, 5, and 6	W24156 to W24158 incl.	3300 - 82030	3300 - 82030
Band B omnibeam	W24106	3300 - 82030	3300 - 82030
Band C monitor beams 1 through 3	W24107 to W24109 incl.	3300 - 82030	3300 - 82030
4 through 24	W24111 to W24131 incl.	3300 - 82030	3300 - 82030
Spare cable No. 3	W24110	3300 - 82030	3300 - 82030
Band C sector beams Nos 1, 2, and 3 and	W24132 to W24134 incl.	3300 - 82030	3300 - 82030
Nos 4, 5, and 6	W24159 to W24161 incl.	3300 - 82030	3300 - 82030
Band C omnibeam	W24135	3300 - 82030	3300 - 82030

Table 2-2. Rf Cables Identification, Antenna Group (Continued)

Function	Cable No.	Wire List Dwg. No. AN/FLR-9 (V7)	Wire List Dwg. No. AN/FLR-9 (V8)
Goniometer signals			
Band A test output	W24136	3300-82030	3300-82030
Band A low angle sum output	W24137	3300-82030	3300-82030
Band A low angle null output	W24138	3300-82030	3300-82030
Band A high angle sum output	W24139	3300-82030	3300-82030
Band A high angle null output	W24140	3300-82030	3300-82030
Band B test output	W24141	3300-82030	3300-82030
Band B low angle sum output	W24142	3300-82030	3300-82030
Band B low angle null output	W24143	3300-82030	3300-82030
Band B high angle sum output	W24144	3300-82030	3300-82030
Band B high angle null output	W24145	3300-82030	3300-82030
Band C test output	W24146	3300-82030	3300-82030
Band C low angle sum output	W24147	3300-82030	3300-82030
Band C low angle null output	W24148	3300-82030	3300-82030
Band C high angle sum output	W24149	3300-82030	3300-82030
Band C high angle null output	W24150	3300-82030	3300-82030
On-line monitor and test	W24151	3300-82030	3300-82030
Spare cable No. 4	W24152	3300-82030	3300-82030
Air-flow alarms	W28000	3300-82048	3300-82048
Air-flow switch	N/A	3300-82049	3300-82049

2-5. Antenna Installation Guidelines. (See tables 2-3 and 2-4.)

a. General. The antenna installation must be performed by skilled personnel familiar with operating heavy construction equipment. Additionally, civil engineering techniques are required for planning, locating, and subsequent installation. Certain criteria exist for the antenna site location, but final determination rests with the user.

b. Site Location Criteria. Site location with respect to propagation, electromagnetic interference and climate is the responsibility of the using agency. Table 2-3 lists general requirements that should exist for installation and selection of a site. Whenever applicable, appropriate figures (with notes) are referenced. Engineering drawings associated with the antenna array are listed in table 2-4. This table is a compilation of the drawings necessary for the complete antenna installation. As indicated in a few entries, certain drawings are referenced to altered item drawings. The latter illustrate changed portions of the drawings they reference.

Table 2-3. AN/FLR-9(V7 and V8) Antenna Installation Criteria

Requirement	Remarks	See Figure No.
Area (excluding clear zones)	Circular, 1460 feet in diameter	2-1
Maximum height	Bands A and B reflecting screens, 120 feet above concrete piers	2-1
Bands A and B	Tilt not to exceed one degree from true horizontal. Grading antenna plane tolerance +6 inches for drainage ditches and access roads. The downward tilt, if existing, should be in the general direction which bisects the major sector of interest. Antenna elements are vertically plumb regardless of plane tilt.	
Band C antenna plane	The band C maximum elevation may exceed the bands A and B plane by as much as 20 feet. The surfaces of band C antenna pedestals lie within +1/4 inch in a common plane, This plane must be T foot, 10-3/4 inches above the C antenna plane.	
Antenna clear zone	Area within a 900-foot radius circle concentric with the antenna planes is the clear zone. See the following: In the sector of primary interest, the clear zone extends to 5,000 feet. Above areas are to be totally clear of all above ground structures that are not part of the antenna system.	

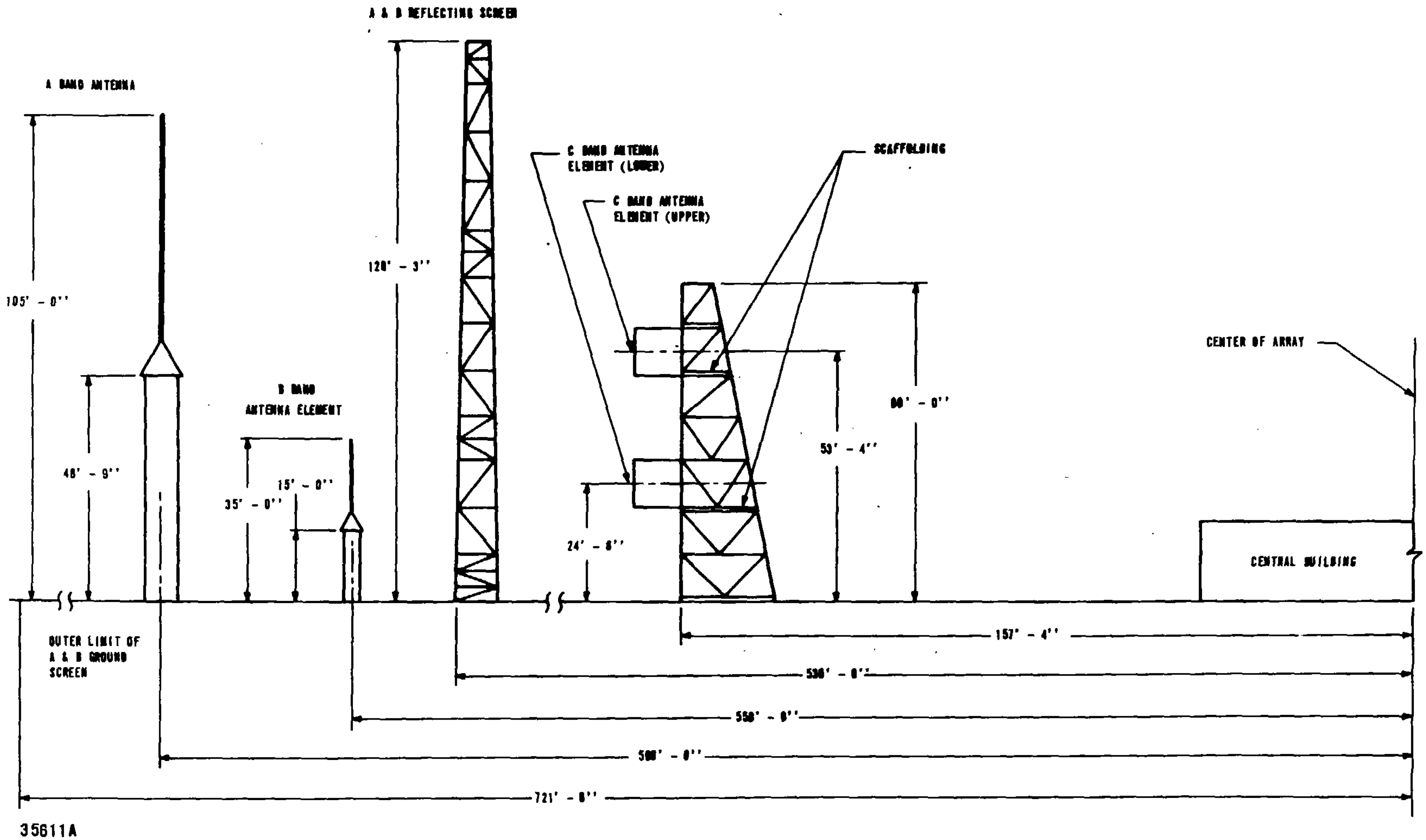


Figure 2-1. Antenna Array Cross-Section

Table 2-3. AN/FLR-9(V7 and V8) Antenna Installation Criteria (Continued)

Requirement	Remarks	See Figure No.
	Beyond the antenna clear zone, land masses or other obstructions of significant size that extend above the band C antenna plane should be avoided, particularly in the sector of major interest.	
Clearing and grubbing	Remove timber, snags, brush, fences, and poles down to ground level.	
Drainage	Where drainage ditches are necessary, it is preferable to use underground drainage.	
Fills	Fill construction should correspond to the shape and grades of the antenna clear zone. Fill is compacted to at least 90 percent of maximum density of optimum moisture content. Fills under slabs and footings to be compacted to 95 percent.	
Grounding of equipment	Neutral conductors, cable shields, metallic conduits, lightning arrestors, fence enclosures, and all non-carrying parts of non-electronic equipment are grounded. Ground resistance is less than 25 ohms.	2-2, Sheets 1 and 2
Orientation of external structures	The general antenna arrangement consists of bands A and B antennas and a band C antenna array. Forty-eight band A antenna elements are located 7.5 degrees apart about the circumference of a circle, the radius of which is 599 feet. Ninety-six band B antenna elements are erected inside the band A ring, located 3.75 degrees apart about the circumference of a circle, the radius of which is 558 feet. All antenna elements are numbered in a clockwise direction from the location of the underground tunnel connecting the central building (within the array) to the operations building outside the array. Band B element number 96 is located directly behind band A element number 48. A vertically polarized reflecting screen is required for the A and B antenna elements. This screen is located 20.5 feet inside the band B antenna ring, and is mounted on a support structure. A common ground screen is provided for the A and B antenna array. This screen projects approximately 96 feet out from the reflecting screen	2-2 2-3

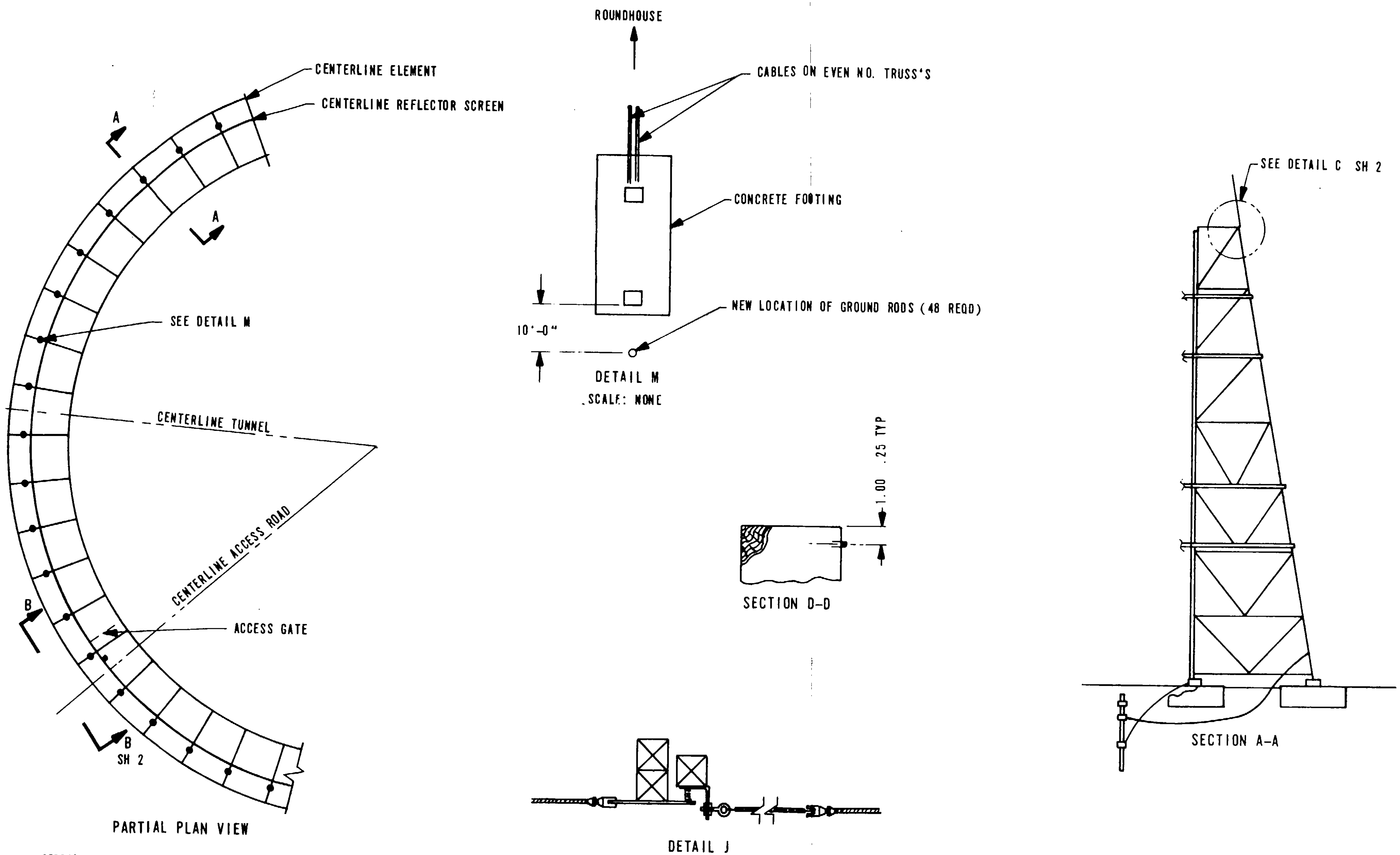


Figure 2-2. Typical Grounding Arrangement (Sheet 1 of 2)

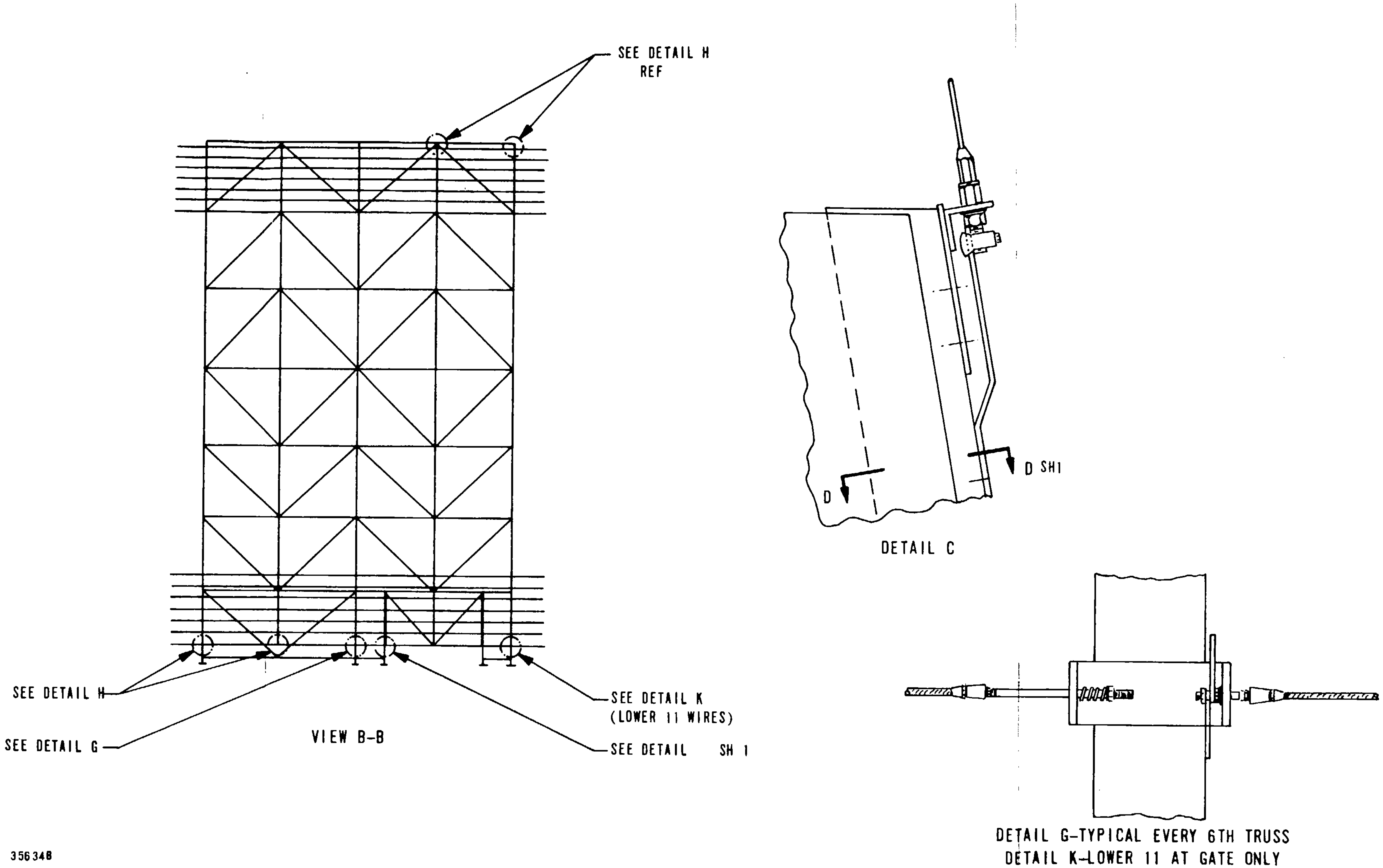


Figure 2-2. Typical Grounding Arrangement (Sheet 2 of 2)

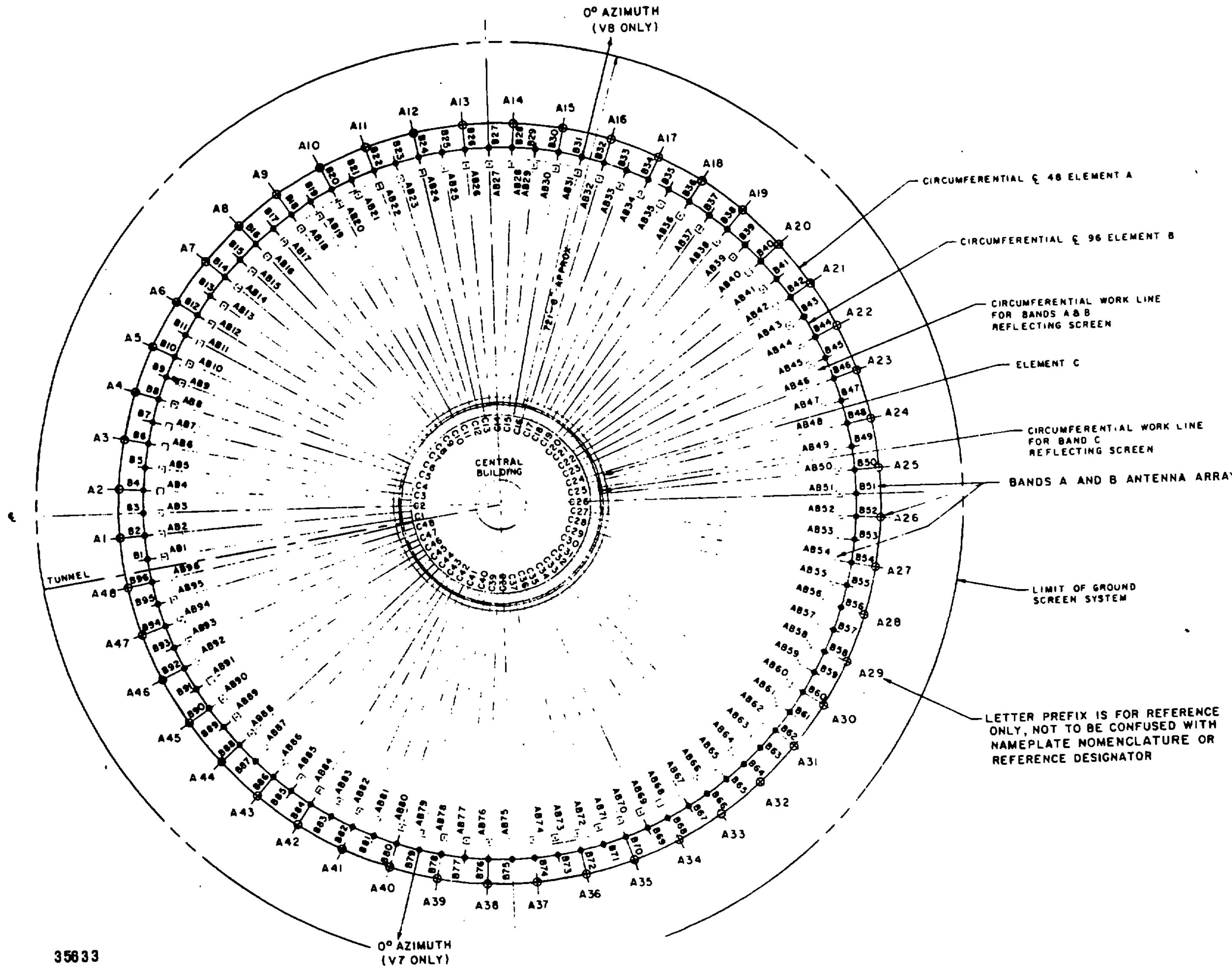


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Figure 2-3. Antenna Array General Arrangement

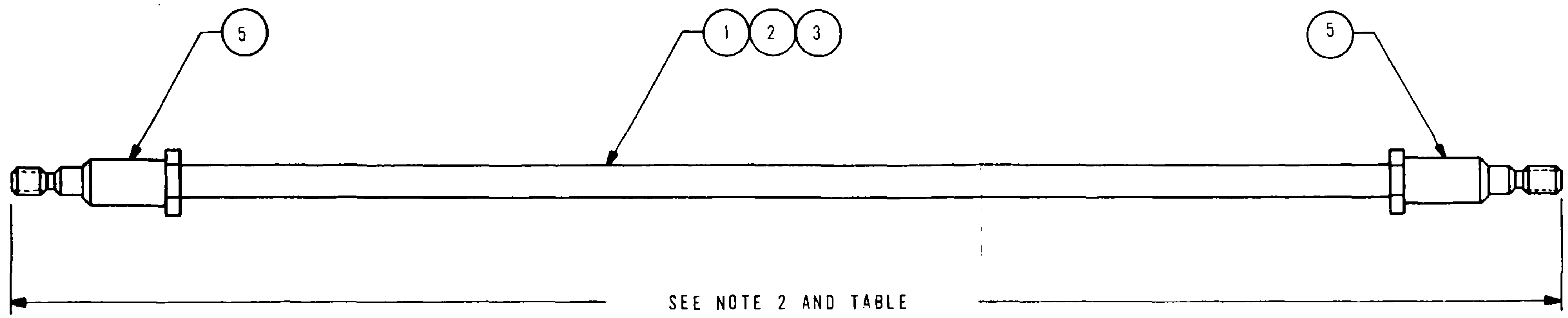
Table 2-3. AN/FLR-9(V7 and V8) Antenna Installation Criteria (Continued)

Requirement	Remarks	See Figure No.
Orientation of external structures (continued)	support structure. Radial wires extend outward an additional 88 feet from the end of the ground screen. Forty-eight band C antenna elements are located 7.5 degrees apart about the circumference of a circle whose radius is 167.25 feet. These elements are mounted on a support structure, and protrude away from the center of the array a distance of 10.25 feet from the support structure. A horizontally-polarized reflecting screen is mounted on the same band C support structure. This screen has a working radius of 157.33 feet.	
Antenna feed cables	Transmitted to center building via 7/8-inch coaxial cable.	2-4
Antenna feed cable installation	The cable trenches are dug to a depth of 4 feet +0.24 foot and are backfilled to the required depth.	

NOTE

Refer to plant in place records and table 2-5 for central building construction and installation details.

Central	Size Is user determined according to the quantity of equipment to be installed.	
Walls	Walls are of: 1. Reinforced concrete 2. Composite reinforced concrete 3. Masonry blocks with brick facing 4. Masonry block with joint reinforcing 5. Industrial metal insulated panels. All reinforcing rods, metal laths or industrial metal wall panels are electrically connected to the grounding system. Interior walls are exposed finish except where insulation is applied. Insulation is protected by a wainscot finish. Exterior walls and footings normally are carried below frost depth. A seal is provided at the external entrance to each of the cable wells through which the feed cables enter the building.	
Roof	The roof is of: 1. Reinforced concrete, insulated, and provided with a membrane waterproof surfacing, or	



DASH NO.	ROUGH CUT LENGTH (SEE NOTE 1)
-1	586 FEET
-2	555 FEET
-3	148.5 FEET

QTY ASSY			ITEM	PART NO.	DESCRIPTION	MATL	SPEC OR REF
2	2	2	5	AMS-5078JNF-55S	CONN, PLUG ELEC	07145	
149	555	586	4	M410039	LINE, RF, XMSN	07145	
X			3	3300-61001-3	CABLE ASSY	F&M	
	X		2	3300-61001-2	CABLE ASSY	F&M	
		X	1	3300-61001-1	CABLE ASSY	F&M	
			← QTY OF ASSY JOB		LIST OF MATERIAL OR PARTS LIST		

3. FOR CABLE RUN INFORMATION REFER TO 3300-81000, CABLE RUNNING LISTS, ANTENNA ARRAY.

2. INSTALLED LENGTHS, METHOD OF SEALING & CABLE MARKERS TO BE DETERMINED & SUPPLIED BY INSTALLATION CONTRACTOR.

1. LENGTHS SHOWN FOR PROCUREMENT ONLY.

NOTES:

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2-19/2-20

Figure 2-4. Cable Assembly, Rf Transmission Band A, B, & C

Table 2-3. AN/FLR-9(V7 and V8) Antenna Installation Criteria (Continued)

Requirement	Remarks	See Figure No.
Roof (continued)	2. Steel frame on reinforced concrete columns, steel or other deck and waterproof surfacing. Columns are located so as not to interfere with equipment or overload cable trays. All steel of any type of construction is bonded and grounded at the outside perimeter to the grounding grid. The roof preferably is flat, but a conical or domed shape is deemed acceptable.	
Ceiling and floor	The ceiling is a minimum height of 12 feet in the center of the building; however, in conical or dome-shaped configurations, the ceiling may slope to a minimum of 11 feet 4 inches at the perimeter where it joins the wall. The floor is of reinforced concrete on drainage fill, where practicable. Ceiling and floor is provided with a proven dustproof finish to minimize effect on electrical equipment. Wall and roof live loads are designed to resist wind and snow loads for the locale in which the facility is located. The floor is designed for a uniform live load of 150 pounds per square foot. Allowable soil bearing pressure is determined for each site by the design agency.	
Primary power	The primary power supply is underground in ducts. The transformer installation meets strict interference standards. The secondary voltage is three-phase, four-wire, 120/208 volts, 50 Hz or 60 Hz as required, with a capacity to be determined by equipment lighting, and air conditioning requirements. All lighting is of the incandescent type; however, fluorescent type may be used if the interference requirements specified in MIL-1-26600 are met. Suitable equipment is provided to maintain an environmental temperature of 70°F (+100F) inside the central building. Air conditioning units are uniformly spaced on the building perimeter.	
Cable trays	Overhead cable trays are provided in the central building for the rf and control cabling.	
Equipment racks	The antenna group equipment racks and configuration must be located for optimum use of phased (timed) cables.	

Table 2-3. AN/FLR-9(V7 and V8) Antenna Installation Criteria (Continued)

Requirement	Remarks	See Figure No.
Cable tunnel	A cable tunnel is provided to house cables carrying signals between the central building and the operations building outside the perimeter of the antenna array. The cable tunnel is located so that, starting in a clockwise direction from true north, the center line is located at such angles that describe arcs of 5 degrees, 37 minutes, 30 seconds, plus any integral multiple of 7 degrees, 30 minutes. The antenna cable trench pattern provides straight alignment through the antenna array without conflicting with the antenna feed cables.	

2-6. Central Building. (See figure 2-5 and table 2-5.)

a. Equipment Location. All of the antenna group equipment is located in the central building except the actual antenna array. Other equipment in the central building that is not a part of the antenna group consists of goniometers 105A2, A3, and A4 (df group), power control rack for goniometers 105A1 (df group), and equipment racks 411, 412, 413, and 414 (monitor and test group).

b. Equipment Identification. (See table 2-6.) Antenna group electronic equipment is identified in table 2-6 and illustrated in figure 2-5.

c. Equipment Floor Space. (See figure 2-5.) The antenna group electronic equipment is housed in 19 racks that occupy approximately 780 square feet of floor space. This does not Include the space occupied by the wall-mounted transmission line tuner assemblies.

d. Maintenance Floor Space. Individual rack-mounted assemblies cannot be serviced while mounted in the rack. The maintenance floor space required should be sufficient for cabinet door openings (minimum 2 feet). Additional space should be allowed if two people are working back-to-back. The maintenance floor space at sites V7 and V8 greatly exceeds the minimum requirements.

e. Minimum Ceiling Heights. A 4-foot area should exist between the top of equipment cabinets and the ceiling.

f. Floor Loading. Antenna group equipment presents no loading problems on tile covered concrete floors.

g. Heating and Ventilating. The antenna group equipment is designed to operate properly in temperature and humidity controlled areas suitable for people. This includes operating temperatures between +60°F to +80°F and up to 95-percent relative humidity for full performance requirements.

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
3300-00001	AN/FLR-9(V7) Set		15770	
3300-00002	AN/FLR-9(V8) Set		15770	
3300-00003	Antenna Group		15770	
3300-01000	Antenna Array, General		15770	
	Arrangement			
00-720074	Schematic Diagram Cable	02-720022	07397	
	Connector-A	02-720246	07397	
00-720075	Schematic Diagram Cable	02-720023	07397	
	Connector-B			
00-720166	Structural Design Element-A	97006	07397	
00-720167	Structural Design Element-B	00-720215	07397	
00-720172	Tower Hardware	02-720247	07397	
00-720175	Woodbeam Details	02-720240	07397	
00-720179	General Notes Structural Design	97006	07397	
00-720180	General Notes	00-720215	07397	
00-720201	Structural Wood Support Band-C	07397		
00-720202	Structural Wood Support Band-C	02-720268	07397	
	Design			
00-720203	Structural Wood Support Band-C	02-720268	07397	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
00-720204	Structural Wood Support Band C Details	02-720268	07397	-
00-720243	Weather Cap	00-720215	07397	
00-728519	Wire List Panel Power Distribution	02-727827	07397	
00-501079	Cover Antenna Element	85-720042	07397	
00-801474	Support Structural Wood Portion	02-720268	07397	
00-801475	Support Structure C Steel Portion		07397	
00-801479	Special Element-A	00-720213	07397	
00-801480	Element Structural Specification	00-720215	07397	
00-801506	Band-AB Woodbeams	00-720215	07397	
3300-01402	Cable Timing Procedure Antenna Impedance		15770	
02-720246	Antenna Element-A	97006	07397	
02-720247	Bands A and B Antenna Array	01000	07397	
02-720248	Antenna Element-B	02-720247	07397	
02-720266	Balun Assembly Band-C	02-720268	07397	
02-720268	Band-C Antenna Array	01000	07397	
02-720272	Reflecting Screen Lightning Rod	02-720268	07397	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
19-290290-295	Wire Electrical Copper		07397	
19-801090	Wire Electrical		07397	
19-801236	Cable Radio Frequency		07397	
19-801237	Cable Radio Frequency		07397	
19-801524	Cable Assembly Rf		07397	
27-801234	Antenna		07397	
29-801063	Arrestor Electrical Surge	02-720248	07397	
3300-31001	Band-A and B Antenna Array		15770	
3300-31002	Band-C Antenna Array		15770	
3300-31003	Antenna Element Assembly, Band-A		15770	
3300-31004	Antenna Element Assembly, Band-B		15770	
3300-41027	Structure Design Antenna Element-A		15770	
3300-41028	Structure Design Antenna Element-B		15770	
3300-41029	Hardware, Tower		15770	
3300-41030	Primary Supporting Structure		15770	
3300-41031	Wood Beam Details		15770	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
3300-41032	General Notes, Antenna Element-A Structure Design		15770	
3300-41033	Structure, Wood Support Band-C, General Notes		15770	
3300-41034	Structure, Wood Support, Band-C		15770	
3300-41035	Structure, Wood Support, Band-C, Main Truss Gussets		15770	
3300-41036	Cap, Weather Element-B		15770	
3300-41037	Core, Antenna Element		15770	
3300-41038	Support Structure, Band-C (wood portion)		15770	
3300-41039	Element Support-A		15770	
3300-41040	Balun Assembly, Band-C		15770	
3300-41001	Plate, Identification, Antenna	02-720246 02-720248	15770	
3300-41021	NC Insulator, Bushing	02-720268	15770	
3300-41022	NC Insulator Washer	02-720268	15770	
3300-41025	Marker Tags, Band A, B, and C	3300-61002	15770	
3300-41026	Marker Tags, Transmission Line A, B, and C	3300-01000	15770	
3300-41041	Reflecting Screen and Lightning Rod Assembly, Band-C		15770	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
3300-41042	Spring, Helical, Extension		15770	
3300-41044	Bracket, Weather Cap, Element-B		15770	
3300-41047	Plate, Shorting, Element-B		15770	
3300-41048	Cap, Weather, Element-A		15770	
3300-41049	Seal, Weather Cap, Element-A		15770	
3300-41050	Disc Conductor, Retaining, Element-A		15770	
3300-41051	Feed Point Assembly, Dipole		15770	
3300-61000	Schematic Diagram Cable Connection, Band-C	02-720268	15770	
3300-61001	Cable Assembly, Rf Transmission, Bands-A, B, and C	3300-01000	15770	
3300-61002	Cable Assembly, Bands A and B Matching Network	02-720246 02-720248	15770	
3300-61003	Cable Assembly, Band-C Antenna	02-720266 02-720268	15770	
65B16064	Plate Backing Ladder Tie Bracket	02-720268	13035	
65B16074	Block Spacer	02-720268	13035	
65B16075	Beam - Balun End Support	02-720268	13035	
65B16076	Plate Nut, U-Bolt	02-720268	13035	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
65B16077	U-Bolt, No. 1	02-720268	13035	
65B16078	U-Bolt, Flat	02-720268	13035	
65B16079	U-Bolt, No. 2	02-720268	13035	
65B16080	Bolt, Special	02-720268	13035	
65B16081	Bolt, Machine Square Head	02-720268	13035	
65C16056	Bracket Cable Support	02-720268	13035	
65C16058	Support End Panel, Lower Balun	02-720268	13035	
65C16059	Support Upright, Lower Balun	02-720268	13035	
65C16060	Block Plate, Upper Tie Balun	02-720268	13035	
65C16061	Block, Upper Balun Plate	02-720268	13035	
65C16062	Rung Ladder	02-720268	13035	
65C16063	Bracket Ladder Tie	02-720268	13035	
65C16065	Plate Clamping	02-720268	13035	
65C16066	Plate, Clamping, Back Up	02-720268	13035	
65C16067	Ladder, Removable	02-720268	13035	
65C16068	Plate, Removable Ladder	02-720268	13035	
65C16070	Platform Ladder Junction	02-720268	13035	
65C16071	Bracket Platform Ladder Junction	02-720268	13035	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
65C16073	Block Tie, Lower Balun	02-720268	13035	
65C16086	B-lock Platform Tie Perimeter	02-720268	13035	
65D16032	Site Plan, Scaffolding and Access, Band-C	02-720268	13035	
65D016033	Scaffolding and Access, Band-C Array	02-720268	13035	
65D016034	Lines Safety Elevation	02-720268	13035	
65016035	Platform Radial and Perimeter Installation	02-720268	13035	
65D16036	Line Safety Ladder, Upper Balun	02-720268	13035	
65D16037	Platform Installation Perimeter	02-720268	13035	
65D16038	Platform Installation, Upper Balun	02-720268	13035	
65D16039	Platform Installation, Lower Balun	02-720268	13035	
65D16040	Platform Radial Walkway	02-720268	13035	
65D16041	Platform Perimeter	02-720268	13035	
65D016042	Platform, Lower Balun	02-720268	13035	
65016043	Platform, Upper Balun	02-720268	13035	
65016049	Support, End Lower Balun	02-720268	13035	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
65D16050	Ladder, Upper and Lower	02-720268	13035	
65D16051	Ladder, Junction Access	02-720268	13035	
65D16052	Ladder, Upper Balun	02-720268	13035	
65D16055	Bracket Platform, Radial Perimeter	02-720268	13035	
65D16083	Platform, Lower, Balun, Heavy Duty	02-720268	13035	
70-201500-501	Clamp, Plastic		07397	
70-201520-521	Clamp Loop, Cushioned	02-720272	07397	
70-201680-699	Screw, Drive	02-720246	07397	
70-801074	Clamp, Electrical		07397	
70-801096	Bolt, Machine		07397	
70-801158	Strap, Retaining		07397	
70-801186	Clamp, Loop		07397	
70-801289	Staple, Cable		07397	
70-801298	Clamp, Ground Rod		07397	
70-801515	Ring, Retaining	89-720177	07397	
70-803374	Shackle, Anchor		07397	
70-803376	Bolt, Eye		07397	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
70A	Screw	02-720246	07397	
70A1	Screws, Machine	Varied	07397	
70A2	Screws, Assembled Seams	Varied	07397	
70A3	Screw Tapping and Threading, Forming and Cutting	Varied	07397	
70A4	Screw Tapping and Threading, Forming and Cutting	Varied	07397	
70A5	Screw, Wood	Varied	07397	
70A6	Screw Set	Varied	07397	
70A7	Screw Cap, Socket Head	Varied	07397	
70B	Bolt	02-720246	07397	
70C	Nuts	02-720246	07397	
70D	Washers	02-720246	07397	
73-32676	Terminal Lug	73-801083	07397	
73-801085				
73-801052	Adapter, Rf Cable	72-801087	07397	
73-801053	Adapter, Rf Cable	02-720248	:07397	
73-801069	Terminal Lug		07397	
73-801071	Splice Conductor		07397	
73-801073	Terminal Block	73-801087	07397	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
73-801081	Dummy Connector Plug		07397	
73-801083	Lead, Electrical		07397	
73-801O84	Lead, Electrical	02-720248	07397	
73-801085	Lead, Electrical	02-720248	07397	
73-801097	Cable Assembly, Rf	07397		
73-801088	Wire Jumper	02-720248	07397	
73-801092	Lug	Varied	07397	
73-801093	Lug	00-720213	07397	
73-801095	Holder Arrester		07397	
73-801185	Cover, Electrical Connector		07397	
73-801534	Connector, Plug Electrical		07397	
73-803216	Terminal Lug		07397	
73-803274	Connectors, Electrical		07397	
73D	Connector, Electrical Rf UG Type		07397	
74-720057	Plate Unit Identification, Element-A	02-720246	07397	
74-720058	Plate Unit Identification, Element-B	02-720248	07397	
74-720059	Plate Unit Identification, Element-C	02-720268	07397	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
81-720274	Extension Lightning Rod, Band-C	02-720272	07397	
81-801267	Wire Rope, Steel		07397	
82-720257	Angle Connector Mounting, Band-C	02-720266	07397	
			02-720270	
84-801290	Socket Wire Rope		07397	
84-801291	Socket Wire Rope		07397	
85-720042	Seal, Weather Cap	02-720246	07397	
86-720052	Seal, Weather Cap	02-720246	07397	
86-720064	Gasket, Head Seal	02-720246	07397	
86-720170	Retainer Conductor	89-720171	07397	
86-720178	Disc Retainer	89-720177	07397	
86-720249	Seal Compound	02-720248	07397	
86-720254	Cover Feed Point, Band-C	02-720268	07397	
86-720255	Shroud Dipole, Feed Point	02-720268	07397	
86-720256	Cover Dipole, Feed Point, Band-C	02-720267	07397	
86-720258	Shroud Assembly Feed Point,	02-720267	07397	
	Band-C	02-720268		
86-720259	Housing Feed Point	86-720258	07397	
86-720261	Cover Feed Point Housing, Band-C	02-720268	07397	
			02-720268	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
74-752242	Plate Identification, Reference Designation	02-72068	07397	
77-801288	Spring, Helical Compression		07397	
77-803375	Spring, Helical Extension		07397	
81-720001	Screen Grounding	02-720247	07397	
81-720036	Conductor Center, Element-B	89-720177	07397	
81-720043	Bracket, Weather Cap	00-720246	07397	
81-720044	Clip Bracket	02-720246	07397	
81-720045	Bracket, Weather Cap	02-720248	07397	
81-720046	Spacer	02-720248	07397	
81-720116	Guard Cable	02-720268	07397	
81-720117	Bracket, Guard Cable	02-720268	07397	
81-720169	Plate Shorting	98-720171	07397	
81-720176	Bolt, Special	89-720177	07397	
81-720181	Conductor Center, Element-A	89-720171	07397	
81-720187	Plate Shorting, A	89-720177	07397	
81-720217	Plate Base, Band-C	02-720268	07397	
81-720219	Frame, Dipole	02-720268	07397	
81-720263	Lug, Feed Point	89-720264	07397	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
81-720274	Extension Lightning Rod, Band-C	02-720272	07397	
81-801267	Wire Rope, Steel		07397	
82-720257	Angle Connector Mounting, Band-C	02-720266	07397	
		02-720270		
84-801290	Socket Wire Rope		07397	
84-801291	Socket Wire Rope		07397	
85-720042	Seal, Weather Cap	02-720246	07397	
86-720052	Seal, Weather Cap	02-720246	07397	
86-720064	Gasket, Head Seal	02-720246	07397	
86-720170	Retainer Conductor	89-720171	07397	
86-720178	Disc Retainer	89-720177	07397	
86-720249	Seal Compound	02-720248	07397	
86-720254	Cover Feed Point, Band-C	02-720268	07397	
86-720255	Shroud Dipole, Feed Point	02-720268	07397	
86-720256	Cover Dipole, Feed Point, Band-C	02-720267	07397	
86-720258	Shroud Assembly Feed Point,	02-720267	07397	
	Band-C	02-720268		
86-720259	Housing Feed Point	86-720258	07397	
			07397	

Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
86-720261	Cover Feed Point Housing, Band-C	02-720268	07397	
		02-720268		
86-720262	Band-C Mounting Feed Point	89-720264	07397	
86-720273	Clamp Cable, Band-C	02-720266	07397	
		02-720270		
89-720171	Shorting Plate Assembly	00-720166	07397	
89-720177	Shorting Assembly, Element-B	00-720167	07397	
89-720260	Wire Jumper Feed Point	02-720267	07397	
		02-720268		
89-720264	Feed Point Assembly, Dipole	02-720268	07397	
		02-720267		
89-803464	Comparison Standard Electrical		07397	
	Length Measurement			
90-801077	Rod Ground		07397	
95-204682	Adhesive	02-720248	07397	
95C	Ethyl Methyl Kit	02-720246	07397	
95C Supplement	Supplement to 95C	02-720246	07397	
96-201880-899	Solder, Soft		07397	
96-801248	Tape, Pressure Sensitive		07397	
96-801257	Insulating Compound, Electrical		07397	

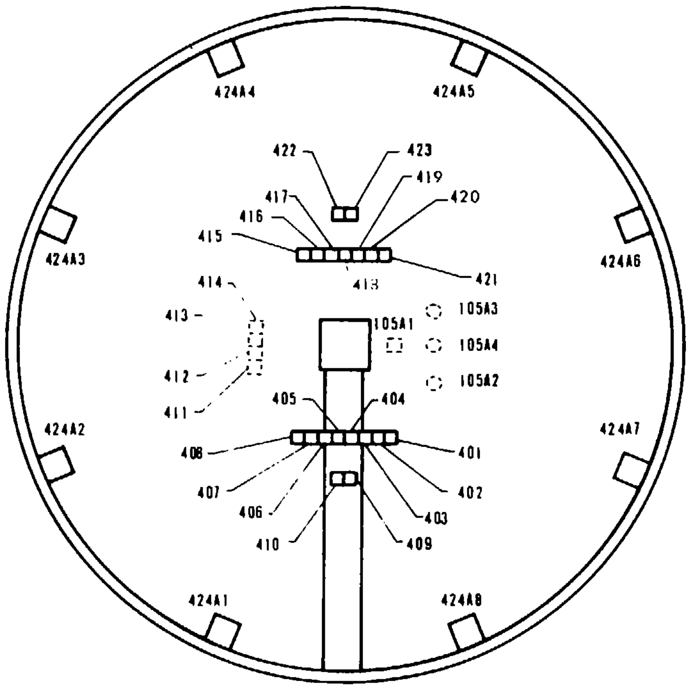
Table 2-4. Antenna Array Drawings

Drawing No.	Short Title	Next Assembly	Manufacturers Code	Remarks
97002	Antenna, Element-B, Specification Control		15770	
97003	Antenna, Element, Band C, Specification Control		15770	
97006	Antenna, Element, Band A, Specification Control		15770	

REF DES	DESCRIPTION	UNIT PART NO.
401	RF AMPLIFIER	3300-32002-1
402	MONITOR BEAMFORMER (BAND C)	3300-32005-1
403	RF AMPLIFIER	3300-32002-1
404	RF AMPLIFIER	3300-32002-1
405	MONITOR BEAMFORMER (BAND A)	3300-32004-2
406	MONITOR BEAMFORMER (BAND A)	3300-32004-2
407	MONITOR BEAMFORMER (BAND A)	3300-32004-2
408	RF AMPLIFIER	3300-32002-1
409	POWER DIVIDER & OMNI SECTOR (BAND C)	3300-32007-1
410	POWER DIVIDER & OMNI SECTOR (BAND A)	3300-32000-1
415	RF AMPLIFIER	3300-32002-1
416	RF AMPLIFIER	3300-32002-1
417	MONITOR BEAMFORMER (BAND B)	3300-32006-2
418	MONITOR BEAMFORMER (BAND B)	3300-32006-2
419	MONITOR BEAMFORMER (BAND B)	3300-32006-2
420	RF AMPLIFIER	3300-32002-1
421	RF AMPLIFIER	3300-32002-1
422	POWER DIVIDER & OMNI SECTOR (BAND B)	3300-32003-1
423	POWER DIVIDER & OMNI SECTOR (BAND B)	3300-32001-1
411-414	INTERCEPT GROUP - DWG - 3300-04000 (V7 & V8)	
105A1-105A4	DF GROUP - SEE DWG 3300-03000 (V7 & V8)	

REFERENCE DOCUMENTS

DWG NO	TITLE
3300-00400	TIMING PROCEDURES FOR INTERCONNECT COAX CABLES
3300-40019	MARKER. TAG-ROUNDHOUSE CABLES
3300-82000-3300-82041	CABLE TABLES



NOTES.

1. EQUIPMENT SHOWN WITH SOLID LINES APPLIES TO ANTENNA GROUP. EQUIPMENT SHOWN WITH DASHED LINES APPLIES TO OTHER GROUPS & IS SHOWN FOR INFORMATION ONLY.
2. 3300-32004-1 & 3300-32006-1 APPLIES TO V8
   3300-32004-2 & 3300-32006-2 APPLIES TO V7

Figure 2-5. Central Building - Antenna group, AN/FLR-9(V7 & V8)

h. Air Conditioning and Heat Dissipation. The antenna group dissipates 38000 btu per hour in normal operation. This heat is dissipated from the eight rf amplifier cabinets 401, 403, 404, 408, 415, 416, 420, and 421. Other cabinets contain passive equipment that is not powered.

Table 2-5. Central Building (Roundhouse) Engineering and Associated Drawings

Drawing No.	Short Title	Next Assembly	Manufac-turer's Code
50401	Cover Sheet Roundhouse Antenna	00002	15770
50402	Soil Test, Location	50401	15770
50403	Soil Borings	50401	15770
50404	Layout Plans	50401	15770
50405	Antenna Foundation Elevation	50401	15770
50407	Grading, Utilities Plan	50401	15770
50408	Grading, Utilities Plan	50401	15770
50409	Access Road Plan, Profile	50401	15770
50410	Utilidor Plan, Profile	50401	15770
50411	Cross Section 1	50401	15770
50412	Cross Section 2	50401	15770
50413	Miscellaneous Details, Diverse Details	50401	15770
50414	Plans and Schedules	50401	15770
50415	Elevations and 'Sections	50401	15770
50416	Door and Louver Details	50401	15770
50417 Details	Miscellaneous Details and Diverse	50401	15770
50418	Foundation and Ground Floor Plan	50401	15770
50419	Grace Beams, Footing Details	50401	15770
50420	Roof Plan and Details	50401	15770

Table 2-5. Central Building (Roundhouse) Engineering and Associated Drawings (Continued)

Drawing No.	Short Title	Next Assembly	Manufac-turer's Code
50421	Roof Beams, Building Section	50401	15770
50422	Roundhouse Antenna Array	50401	15770
50423	Foundations	50401	15770
50424	Foundations	50401	15770
50425	Foundations	50401	15770
j-0426	Air Condition and Equipment Schedule	50401	15770
50427	Plumbing and Air Condition Control System	50401	15770
50428	H T Feeder Plan	50401	15770
50429	One Line Diagonal and Panel Schedule	50401	15770
50430	Lighting Plan	50401	15770
50431	Power Plan	50401	15770
50432	Grounding Plan	50401	15770
50433	Legend and Lighting Fixture Details	50401	15770
50434	Electrical Installation	50401	15770
50435	N C Trays, Cable Roundhouse V8	50401	15770

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments

Description	Reference Designator
Racks 401, 403, 404, 408, 415, 416, 420 and 421	
Amplifier, Radio Frequency AM 6533/FLR-9(V)	A1
↕	A2
	A3
	A4
	A5
	A6
	A7
	A8
	A9
	A10
	A11
Amplifier, Radio Frequency AM 6533/FLR-9(V)	A12
Blower Assembly, 3300-40015-1	A13
Rack 402 (band C)	
Beamformer Assembly TD 1054/FLR-9(V)	A1
↕	A2
	A3
	A4
	A5
Beamformer Assembly TD 1054/FLR-9(V)	A6

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Rack 402 (band C) (Continued)	
Divider Assembly, Power Rf CU 2051/FLR-9(V)	A7
↑	A8
	A9
	A10
	A11
	A12
↓	A13
Divider Assembly, Power RF CU 2051/FLR-9(V)	A14
Racks 405, 406 and 407 (Site V7 only) (band A)	
Beamformer Assembly TD 1052/FLR-9(V)	A1
↑	A2
	A3
	A4
	A5
	A6
↓	A7
Beamformer Assembly TD 1052/FLR-9(V)	A8

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Racks 405, 406 and 407 (Site V7 only) (band A) (Continued)	
Divider Assembly, Power Rf CU 2050/FLR-9(V)	A9
↑	A10
	A11
	A12
	A13
	A14
↓	A15
Divider Assembly, Power Rf CU 2050/FLR-9(V)	A16
Racks 405, 406 and 407 (V8 only) (band A)	
Beamformer Assembly TD 1050/FLR-9(V)	A1
↑	A2
	A3
	A4
	A5
	A6
↓	A7
Beamformer Assembly TD 1050/FLR-9(V)	A8

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Racks 405, 406 and 407 (V8 only) (band A) (Continued)	
Divider Assembly, Power Rf CU 2050/FLR-9(V)	A9
	A10
	A11
	A12
	A13
	A14
	A15
Divider Assembly, Power Rf CU 2050/FLR-9(V)	A16
Rack 409 (band C)	
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A1
Divider Assembly, Power-Rf CU 2052/FLR-9(V)	A2
Coupler, Omni Assembly CU 2054/FLR-9(V)	A3
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A4
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A5
Coupler, Omni Assembly CU 2049/FLR-9(V)	A6
Panel, Patching, Antenna SB 3662/FLR-9(V)	A7
Beamformer Assembly TD 1057/FLR-9(V)	A8
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A9
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A10
Coupler, Omni Assembly CU 2054/FLR-9(V)	A11
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A12
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A13

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Rack 409. (band C) (Continued)	
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A14
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A15
Coupler, Omni Assembly CU 2054/FLR-9(V)	A16
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A17
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A18
Beamformer Assembly TD 1057/FLR-9(V)	A19
Rack 410 (band A)	
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A1
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A2
Coupler, Omni Assembly CU 2054/FLR-9(V)	A3
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A4
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A5
Coupler, Omni Assembly CU 2049/FLR-9(V)	A6
Panel, Patching, Antenna SB 3666/FLR-9(V)	A7
Beamformer Assembly TD 1055/FLR-9(V)	A8
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A9
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A10
Coupler, Omni Assembly CU 2054/FLR-9(V)	A11
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A12
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A13
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A14
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A15
Coupler, Omni Assembly CU 2054/FLR-9(V)	A16

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Rack 410 (band A) (Continued)	
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A17
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A18
Beamformer Assembly TD 1055/FLR-9(V)	A19
Racks 417, 418, 419 (site V7 only) (band B)	
Beamformer Assembly TD 1053/FLR-9(V)	A1
	A2
	A3
	A4
	A5
	A6
	A7
Beamformer Assembly TD 1053/FLR-9(V)	A8
Divider Assembly, Power Rf CU 2053/FLR-9(V)	A9
	A10
	A11
	A12
	A13
	A14
	A15
Divider Assembly, Power Rf CU 2053/FLR-9(V)	A16

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Racks 417, 418, 419 (site V8 only) (band B)	
Beamformer Assembly TD 1051/FLR-9(V)	A1
	A2
	A3
	A4
	A5
	A6
	A7
Beamformer Assembly TD 1051/FLR-9(V)	A8
Divider Assembly, Power Rf CU 2053/FLR-9(V)	A9
	A10
	A11
	A12
	A13
	A14
	A15
Divider Assembly, Power Rf CU 2053/FLR-9(V)	A16
Rack 422 (band B)	
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A1
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A2
Coupler, Omni Assembly, CU 2055/FLR-9(V)	A3
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A4
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A5

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Rack 422 (band B) (Continued)	
Panel, Patching, Antenna SB 3664/FLR-9(V)	A7
Beamformer Assembly TD 1056/FLR-9(V)	A8
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A9
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A10
Coupler, Omni Assembly, CU 2055/FLR-9(V)	A11
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A12
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A13
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A14
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A15
Coupler, Omni Assembly CU 2055/FLR-9(V)	A16
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A17
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A18
Rack 423 (band B)	
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A1
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A2
Coupler, Omni Assembly CU 2055/FLR-9(V)	A3
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A4
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A5
Beamformer Assembly TD 1056/FLR-9(V)	A6
Panel, Patching, Antenna SB 3663/FLR-9(V)	A7
Coupler, Omni Assembly CU 2049/FLR-9(V)	A8
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A9
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A10

Table 2-6. Antenna Group Electronic Equipment Reference Designator Assignments (Continued)

Description	Reference Designator
Rack 423 (band B) (Continued)	
Coupler, Omni Assembly CU 2055/FLR-9(V)	A11
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A12
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A13
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A14
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A15
Coupler, Omni Assembly CU 2055/FLR-9(V)	A16
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A17
Divider Assembly, Power Rf CU 2052/FLR-9(V)	A18

CHAPTER 3

PREPARATION FOR USE AND RESHIPMENT

SECTION I. PREPARATION FOR USE

3-1. General.

The antenna group requires no special tuneup, testing, or adjusting after installation except that which is necessary to confirm proper operation. Refer to Chapter 6 for antenna group tests and maintenance procedures. In the event that the equipment has been relocated and does not perform satisfactorily in a given area, check the rf cabling for possible connection errors.

3-2. Rf Amplifiers.

All components of the antenna group are passive devices except the eight racks of rf amplifiers. Therefore, preoperational procedures for the antenna rf amplifiers consist of assuring that the fuse is good, the power switch Is In the OFF position, and the ac power cable is connected. The HI-LOW switches on each motherboard (Al and A2) should be in the LOW position for bands A and B, and in the HI position for band C. Energize and determine that each rack blower assembly is functioning. Place each amplifier assembly ON-OFF switch in the ON position. Allow at least a 30-minute warm-up time before performing group level tests.

3-3. Test Description.

All of the tests to demonstrate that functional requirements have been met are described in Chapter 6. The antenna group has performance criteria in the following categories:

a. Single channel amplitude and phase tracking

b. Input vswr

c. Intermodulation distortion

d. Single channel noise figure.

Other tests to localize troubles are also described in Chapter 6.

3-4. Duration of Tests.

There are no tests in the antenna group that require monitoring for extended periods, e.g., tests wherein the data must be recorded or monitored for several hours.

NOTE

Test signals are provided and monitored by the monitor and test group on a continuous basis. These signals are compared In amplitude and phase, the latter where applicable, to a memory standard.

3-5. Test Sequence.

There is no particular sequence of testing; however, an unsatisfactory single channel amplitude and phase tracking test would likely result in one or more succeeding test failures. See paragraph 3-3.

3-6. Test Criteria.

Test criteria for the antenna group including test equipment, test configurations, and diagrams are contained in Chapter 6.

SECTION II. PREPARATION FOR RESHIPMENT

3-7. Conditions and Methods for Reshipment.

a. Conditions. With the possible exception of the antenna elements, antenna array materials become scrap. Disassembly of reflecting screens, removal of ground screens, feed cables, timbers, and steel structures does not appear to be economical. However, final determination of scrap materials is a user function.

b. Methods. Electronic Equipment from the central building is shipped in accordance with the best commercial practices.

c. Disassembly. There are no special disassembly techniques required for antenna group equipment. There are no special plug-in units to be removed before shipment. Racks may be shipped with internal cabling connected and in place.

d. Reusable Containers. There are no reusable containers in the antenna group equipment.

CHAPTER 4

OPERATION

SECTION I. CONTROLS AND INDICATORS

4-1. Operating Controls and Indicators. (See table 4-1 and figure 4-1.)

The only controls and indicators in the antenna group are those on the rf amplifiers. See figure 4-1. Table 4-1 lists control and indicator functions of the rf amplifiers.

Table 4-1. Amplifier, Radio Frequency AM-6533/FLR-9(V)

Controls and Indicators

Control or Indicator	Reference Designator	Function
ON-OFF Switch	S1	Applies power to unit in ON position
POWER lamp	DS1	Lights when power is applied to unit
1 AMP FUSE	F1	Fuses one side of ac line

SECTION II. OPERATING INSTRUCTIONS

4-2. Preoperational Radio Frequency Amplifier Checklist.

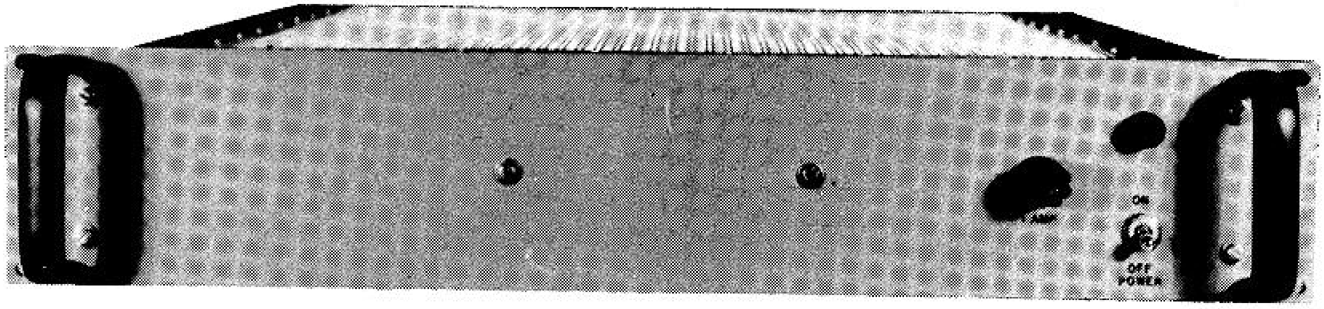
a. Power switch should be in OFF position.

b. Check for known good fuse.

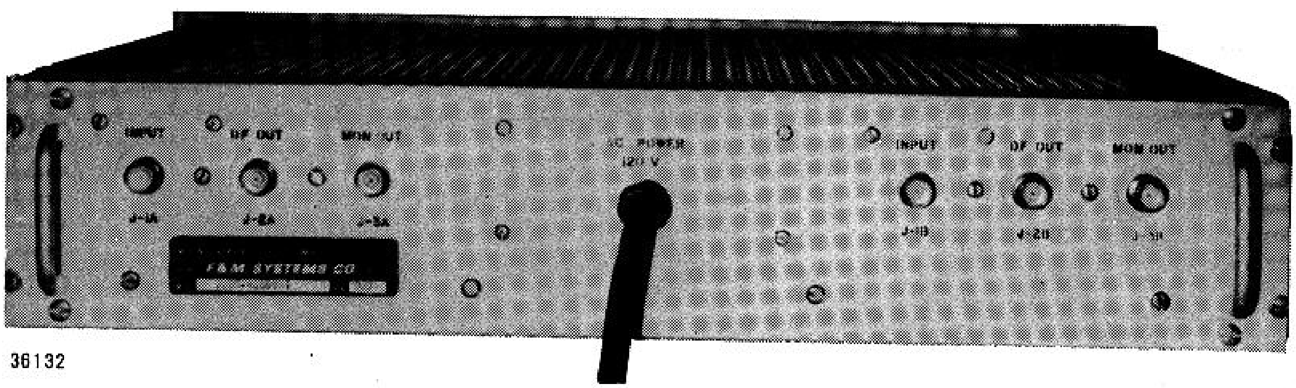
c. Check that power cable is connected at rear of unit.

4-3. Radio Frequency Amplifier Starting Procedures.

If not known, check the HI-LOW switches inside the unit (on motherboards A1 and A2) for proper position. The switch should be in LOW position for bands A and B; HI for band C. Remove assembly from the rack and remove the top cover by loosening the two rear quick-disconnect screws and sliding the cover toward the rear. Position HI-LOW switch and reassemble. Replace in rack and reconnect cables and power cord. Place ON-OFF switch to ON. Determine that the cabinet blowers are operating and allow a 30-minute warm-up time. For additional information refer to paragraph 1-6.



Front View



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Rear View

Figure 4-1. Amplifier, Radio Frequency AM-6533/FLR-9 (V)

4-4. Software Assignments.

When initially starting the system, the software must be notified of user determined sector beam assignments by the somc operator. Monitor and test group functions and sector beam selection functions provide misleading symptoms for maintenance personnel. if this is not accomplished. The software must also be notified when sector beams are changed from an existing assignment to a new assignment for these same reasons. See Chapter 5, tables 5-2, 5-4, 5-5, and 5-6 for azimuth/sector beam assignments. The following information is entered via the teletypewriter.

SECTOR X,Y,ZZ,WWW

Where:

X is band A, B, or C
Y is sector beam number 1, 2, or 3
Z is right boresight antenna number band A, 1-48; band B, 1-96; band C, 1-48
W is azimuth.

There are four antennas per sector beam in band A, three in band B, and two in band C. Boresight antenna is defined in paragraph 5-4.

EXAMPLE: SECTOR A,1,41,7

The above example can be found from table 5-2 and is a band A sector beam, patched to the No. 1 band A sector beamformer position with boresight azimuth of 7.5 degrees, site V7. When entering azimuth enter only the numbers to the left of the decimal point. EXAMPLE: for 7.5 degrees enter 7; for 322.5 degrees enter 322. Do not confuse the beam No. listing in table 5-2 with the 1 to 3 assignment to sector beams on the sector beamformer assembly. See figure 5-5 for patching scheme. Beamformer inputs suffixed A, B, and C correspond to sector beams numbered 1, 2, and 3. Since there are a total of three sector beams in each band, there will have to be a total of nine entries made in Initial system start-up. When a sector beam is changed, the new entry is entered on the teletypewriter. As soon as the carriage return is pressed, the new entry becomes effective. It is not necessary to re-enter the existing, unchanged, sector beams.

SECTION III. EMERGENCY OPERATION

4-5. Blower Failure, Rf Amplifier Cabinets.

In the event of blower failure, open the rear door of the affected cabinet. Do not turn off any of the rf amplifiers. Replace blower assembly with a spare. This can be accomplished in 20 minutes or less. If the cabinet is operated more than 20 minutes without the blower, an increasing risk of damage occurs. To remove the blower assembly, unplug line cord and disconnect sensing leads from TB1. Remove two filter retaining nuts and the filter. Remove screws holding blower assembly. Slide the blower assembly out from the front of the rack.

4-6. Equipment Failure.

The individual in charge of the site has the responsibility of determining the primary sectors of Interest and their priorities. Equipment failures in high priority areas may be replaced with identical units borrowed from other locations. This procedure would be followed in an emergency when no spares were available.

4-7. Jamming.

Refer to IM 32-5895-231-15 and IM 32-5895-231-15/1 manuals.

CHAPTER 5

THEORY OF OPERATION

SECTION I. FACILITY FUNCTIONAL OPERATION

5-1. Scope.

This section contains theory and facility functional information of the antenna group. A short discussion of intermodulation distortion, noise, and phase requirements is included. It is important that these factors are understood as they relate to system performance.

5-2. General. (See figure 5-1.)

The antenna group is a high frequency antenna system that provides processed (beamformed and omnidirectional) signals for ultimate use and detection in other system locations. The three antenna group bands are designated band A (2 to 6 MHz), band B (6 to 18 MHz), and band C (18 to 30 MHz). With the exception of frequency coverage, the functional operation of each band is essentially the same.

NOTE

The entire Countermeasures Receiving Set AN/FLR-9(V7)/(V8) system is a wideband receiving system. Ultimately, individual signals are detected at terminal locations by tuned receivers. Performance characteristics of an untuned, wideband system have parameters that must be understood for proper operation and maintenance. These parameters are intermodulation, distortion, noise, and phase shift requirements. The following subparagraphs explain the importance of these parameters as related to wideband systems and should be understood as related to the functional description.

a. Intermodulation distortion. (See figure 5-2.) Intermodulation distortion, in the general case, results when two or more signals are sent through a nonlinear device. In a Countermeasures Receiving Set AN/FLR-9(V7)/(V8) system the principal sources of intermodulation distortion occur in the active devices (transistors). In the antenna group, the antenna preamplifiers are the principal source of this distortion. An overloaded or incorrectly adjusted amplifier may produce excessive numbers and/or amplitudes of intermodulation distortion products. These appear at the amplifier output as signals. In relation to the input signals, the intermodulation products are spurious signals, and can be detected by system receivers. The spurious signals contain modulation components of the original signals and may likely be garbled. The obvious objection to these spurious signals is that they may exist on the same frequencies as legitimate signals of interest. How severe the interference between the two becomes depends on the relative magnitude of the two signals. Every signal handling component in the system has been designed to minimize intermodulation distortion. Refer to the tables of capabilities and limitations in Chapter 1 of this manual. An example of intermodulation distortion is shown in figure 5-2. This is a graphic representation from a spectrum analyzer of the output from a transistor amplifier whose input has equal 10-MHz and 12-MHz

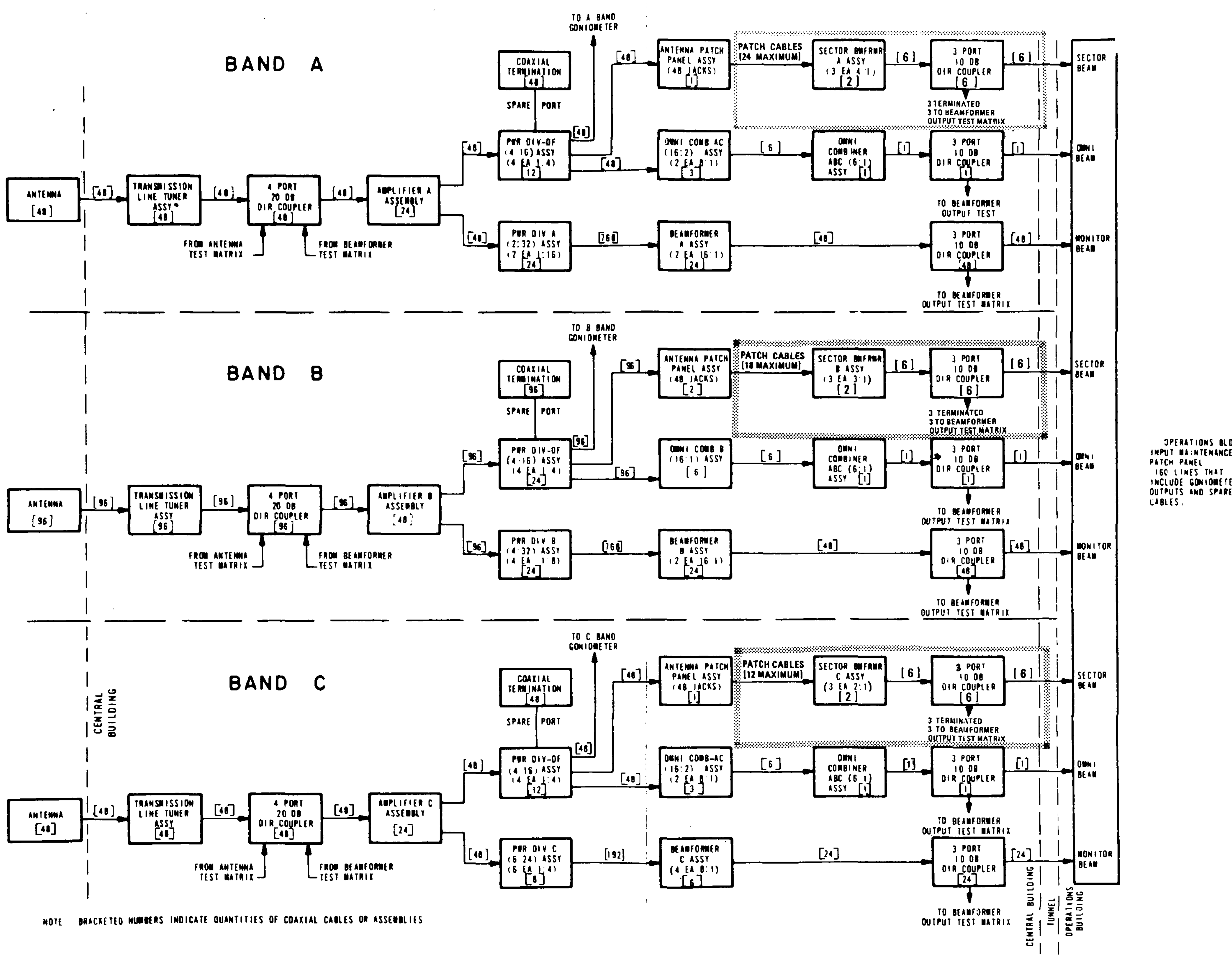


Figure 5-1. Block Diagram, Antenna Group

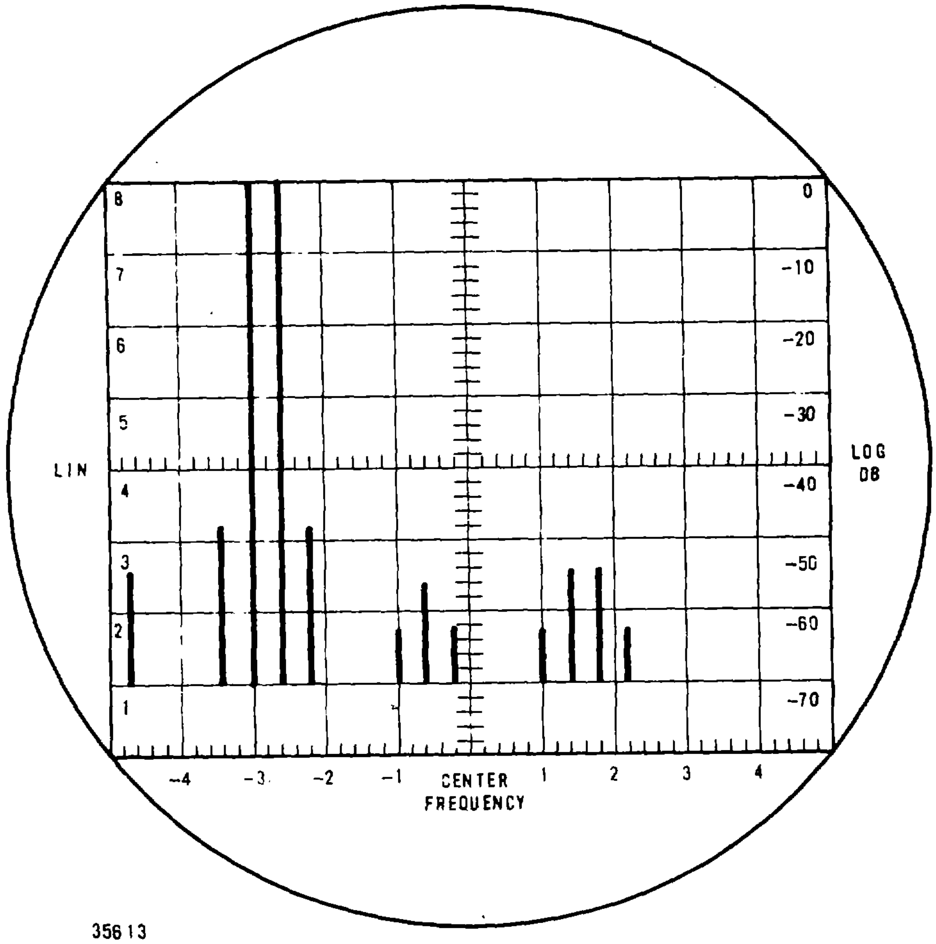


Figure 5-2. Typical Spectrum Analyzer Display Intermodulation Distortion Products

signals applied. The amplifier output contains the original 10-MHz and 12-MHz signals, as well as the following significant intermodulation and harmonic distortion products:

2-MHz	24-MHz
8-MHz	30-MHz
14-MHz	32-MHz
20-MHz	34-MHz
22-MHz	36-MHz

If more than two input signals were present at the input, as in the preceding case, the number of intermodulation distortion products increases by many times. An analysis of the number generated from more than two input signals involves complex mathematics beyond the scope of this manual. In figure 5-2, the input signals are of relatively large magnitude (300 millivolts) so that the distortion products are within the display capabilities of the spectrum analyzer. Note that a radio receiver could detect any of the ten spurious signals at the amplifier output of, the example shown.

b. Noise. Total system noise results from addition of noise powers generated principally from the active devices (transistors) in the system and that delivered to the system by the antennas. When a particular signal-to-noise ratio becomes small enough, then at some point the signal becomes undetectable by the operator at a radio receiver. The signal-to-noise ratio from the antenna is determined by atmospheric conditions and the received signal strength. It is important that the noise contributed by the active devices in the system does not further deteriorate the signal-to-noise ratio. The antenna preamplifiers provide the necessary gain ahead of the power dividers so that weak signals are not lost in system generated noise.

c. Phase. in order to form beams and furnish the goniometers with usable signals, the signal phase relationships are carefully controlled. Antenna cable lengths at the time of installation were cut to the same electrical length for a given band. Small differences in electrical lengths are adjusted by the line tuners to compensate for cable aging or seasonal temperature variations. Additionally, subsequent cables up to beamformers, omnicombiners, and patch panels are controlled in length for equal phase shifts within a band. These are sometimes referred to as timed or phased cables.

5-3. Functional Description. (See figure 5-1.) The rf energy received by an antenna element is fed into a high gain rf amplifier.

One rf amplifier is provided for each antenna element in each band. The preamplification overcomes signal losses due to subsequent power divisions for beamformers and omnicombiners. Power divisions without preamplification would result in the weaker signals being lost in the noise as described in paragraph 5.2.b. The preamplifiers are capable of handling relatively large input signals (100 millivolts) with low noise contribution and low intermodulation distortion. The preamplifiers for all three bands are identical; however, an internal switch is provided that selects either a 19-dB or 21-dB gain position. Bands A and B preamplifiers operate at a nominal 19-dB gain, whereas band C preamplifiers operate at 21-dB gain. Each preamplifier has two outputs. Signal distribution from the preamplifier outputs are discussed in the following paragraphs.

a. Band A. Forty-eight rf amplifiers (24 assemblies, 2 amplifiers per assembly) furnish two outputs each. One output feeds a 1: 4 power divider. The four outputs of the power divider are connected one each to the band A goniometer, sector beam patch panel, omnicombiner, and a spare output.

NOTE

All rf outputs in the system that are not being actively used, such as the preceding spare, are terminated with a coaxial termination (75 ohms). Failure to do this may result in an excessive vswr at the other power divider outputs and degrade beam formations.

The other rf amplifier output feeds a 1: 16 power divider that provides inputs for the monitor beams. Each monitor beam consists of inputs from 16 antennas. Refer to paragraph 5-4 for a description of the various beam formations.

b. Band B. Ninety-six rf amplifiers, one for each antenna element, furnish two outputs each. One output feeds a 1: 4 power divider, as mentioned previously. The four outputs are connected-one each to band-B goniometer, sector beam patch panel, omnicombiner, and a spare output. The other preamplifier output feeds two 1: 8 power dividers that provide Inputs for the monitor beamformers. Each monitor beam consists of inputs from 16 antenna elements.

c. Band C. Forty-eight rf amplifiers, one for each antenna element, furnish two outputs each. These amplifiers are used in the nominal 21-dB gain position. One output feeds a 1: 4 power divider. The four outputs are connected, one each to band C goniometer, sector beam patch panel, omnicombiner, and a spare output. The other amplifier output feeds a 1: 4 power divider that provides inputs for the monitor beamformers.

5-4. Beam Formation. (See figures 5-3 and 5-4.)

If signals from several antenna elements in a given band are combined in phase, the total signal strength is increased and a beam is formed. As an example, a wavefront arriving as shown at position I (figure 5-3) intersects the first two antenna elements. A short time later, the wavefront intersects the next two elements, shown at position 2 and finally at position 3. Signals from the first pair (position 1) enter the delay line and travel as indicated. By the time the signals reach the line connections for the next pair (position 2), the time delay is such that they add in phase. The resultant signals continue and add in phase to those from the last pair of elements. Outputs from both legs of the delay line are combined in phase in the power combiner to further Increase the signal power. Signals arriving from directions other than the one shown caused the phase relationships to be less than optimum in the beamformer. The overall beam formed by this configuration is similar to that of other high gain types such as yagi or log periodic antennas. Directional beams in bands A, B, and C consist of the sector and monitor beams. The principles Involved in beam formation are the same for all three bands regardless of the number of elements used in forming each beam.

a. Band A Monitor Beam Formation. (Refer to table 5-1.) Forty-eight monitor beams are formed in band A using a consecutive combination of 16 elements around the 360-degree circle. Table 5-1 lists the band A elements associated with each of the 48 beams. Antenna elements are numbered consecutively In a clockwise direction from the tunnel. The center line In each listing for each beam boresight is referenced from true North (zero degrees). The element numbers immediately adjacent to the boresight line are listed.

NOTE

As an example, table 5-1 shows element no. 1 positions in beams 3 through 18 of site V7. Sixteen separate rf inputs from each antenna element are required for the various beamformer inputs. Refer to the block diagram, figure 5-1, which shows how 16 separate signals are obtained from power dividers.

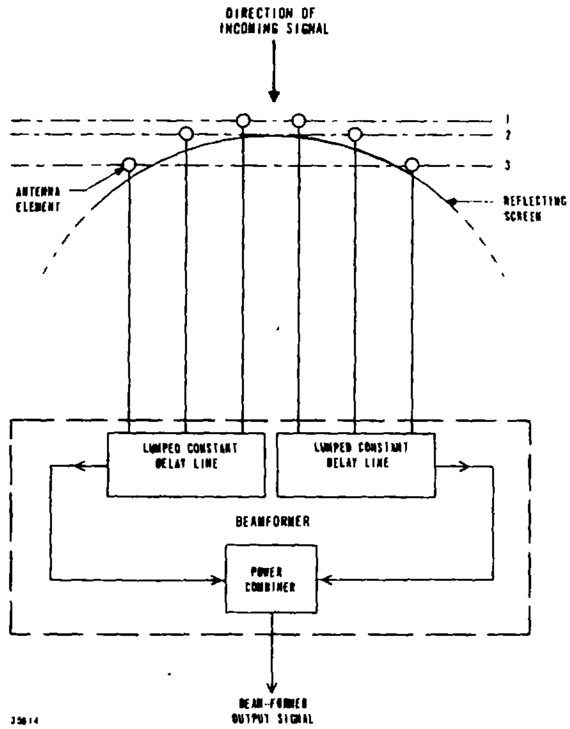


Figure 5-3. Simplified Block Diagram of Beamforming Process

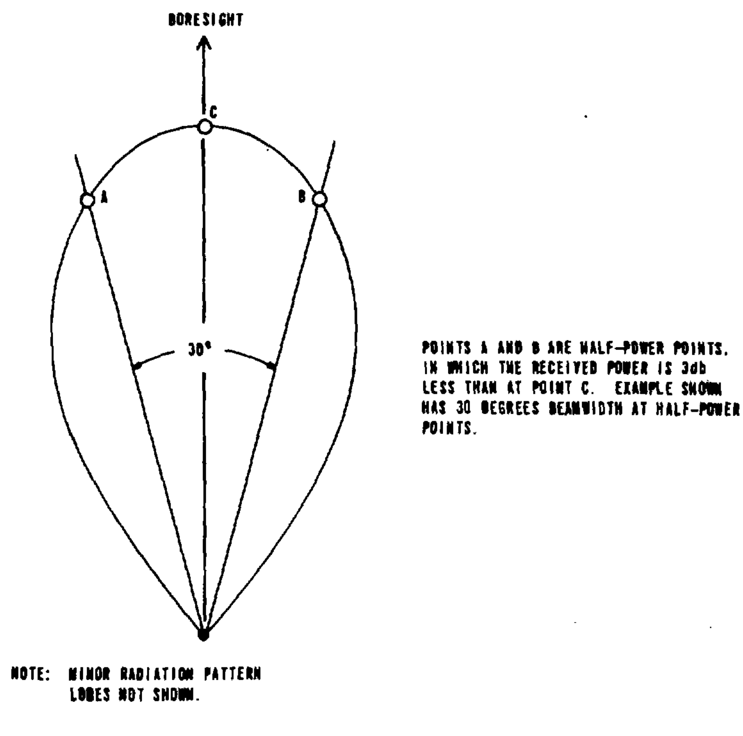


Figure 5-4. Beam Parameter Identification

Table 5-1. Monitor Beam Formation, Beam Boresight, Band A

Beam No.	V7 Elements								In Use								Azimuth Degrees	V8 Elements								In Use							
1	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	0	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2	33							40	41							48	7.5	9							16	17							24
3	34							41	42							1	15.0	10							17	18							25
4	35							42	43						1	2	22.5	11							18	19							26
5	36							43	44					1		3	30.0	12							19	20							27
6	37							44	45				1			4	37.5	13							20	21							28
7	3'							45	46			1				5	45.0	14							21	22							29
8	39							46	47		1					6	52.5	15							22	23							30
9	40							47	48	1						7	60.0	16							23	24							31
10	41							48	1							8	67.5	17							24	25							32
11	42							1	2							9	75.0	18							25	26							33
12	43						1	2	3							10	82.5	19							26	27							34
13	44					1		3	4							11	90.0	20							27	28							35
14	45				1			4	5							12	97.5	21							28	29							36
15	46			1				5	6							13	105.0	22							29	30							37
16	47		1					6	7							14	112.5	23							30	31							38
17	48	1						7	8							15,	120.0	24							31	32							39
18	1							8	9							16	127.5	25							32	33							40
19	2							9	10							17	135.0	26							33	34							41
20	3							10	11							18	142.5	27							34	35							42
21	4							11	12							19	150.0	28							35	36							43
22	5							12	13							20	157.5	29							36	37							44

Table 5-1. Monitor Beam Formation (Continued)
Beam Boresight, Band A

Beam No.	V7 Elements		In Use		Azimuth Degrees	V8 Elements		In Use	
23	6	13	14	21	165.0	30	37	38	45
24	7	14	15	12	172.5	31	38	39	46
25	8	15	16	23'	180.0	32	39	40	47
26	9	16	17	24	187.5	33	40	41	48
27	10	17	18	25	195.0	34	41	42	
28	11	18	19	26	202.5	35	42	43	2
29	12	19	20	27	210.0	36	43	44	3
30	13	20	21	28	217.5	37	44	45	4
31	14	21	22	29	225.0	38	45	46	5
32	15	22	23	30	232.5	39	46	47	6
33	16	23	24	31	240.0	40	47	48	7
34	17	24	25	32	247.5	41	48	1	8
35	18	25	26	33	255.0	42	I	2	9
36	19	26	27	34	262.5	43	2	3	
37	20	27	28	35	270.0	44	3	4	11
38	21	28	29	36	277.5	45	4	5	12
39	22	29	30	37	285.0	46	5	6	13
40	23	30	31	38	292.5	47	6	7	14
41	24	3 1	32	39	300.0	48	7	8	15
42	25	32	33	40	307.5	1	8	9	6
43	26	33	34	41	315.0	2	9	10	17
44	27	34	35	42	322.5	3	10	11	18
45	28	35	36	43	330.0	4	11	12	19

Table 5-1. Monitor Beam Formation (Continued)

Beam Boresight, Band A

Beam No.	V7 Elements		In Use		Azimuth Degrees	V8 Elements		In Use	
46	29	36	37	44	337.5	5	12	13	20
47	30	37	38	45	345.0	6	13	14	21
48	31	38	39	46	352.5	7	14	15	22

b. Band A Sector Beam Formation. (See figure 5-5 and table 5-2.) Sector beam formation involves the same principles as monitor beam formation, but only four consecutive antenna element signals are used at any one time. Sector signals are terminated on an antenna patch panel assembly. Patch cables are inserted in four consecutive antenna outputs for the desired beam direction. The beam boresight exists as shown in table 5-2 centered between the two inner elements. Attenuation in the beamformer of the two outer element signals reduces the magnitude of the side lobes. A total of six sector beams may be in use at any one time. The patching scheme for patching at the sector beamformers is shown in figure 5-5.

NOTE
See paragraph 4-4.a. for precautions in sector beam selection.

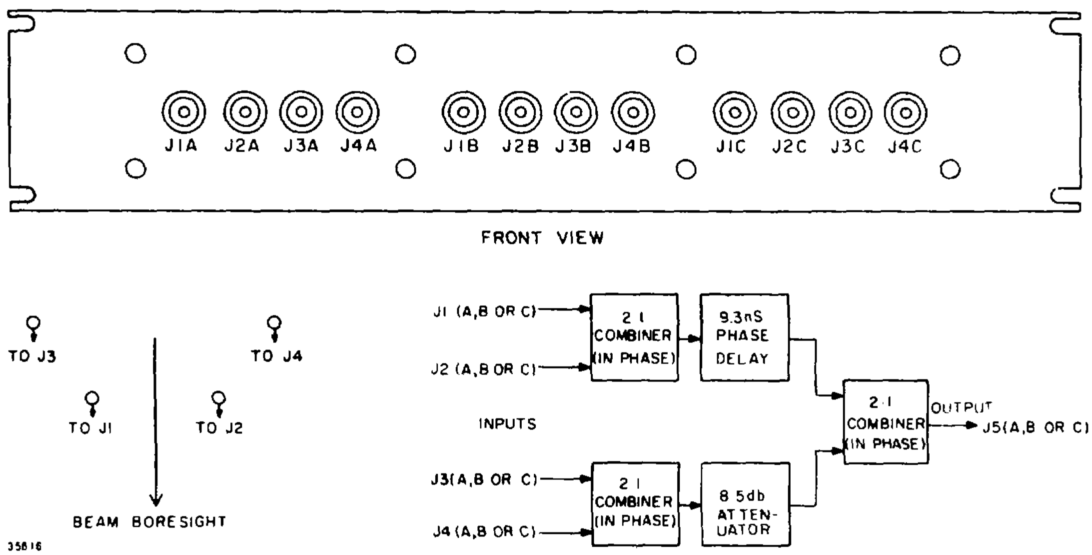


Figure 5-5. Block Diagram, Beamformer Assembly TD-1055/FLR-9(V) (Sector Beamformer A)

Table 5-2. Sector Beam Formation,

Beam Boresight, Band A

Item	V7 Elements		Azimuth Degrees	V8 Elements	
1	38 39	40 41	0	14 15	16 17
2	39 40	41 42	7.5	15 16	17 18
3	40 41	42 43	15	16 17	18 19
4	41 42	43 44	22.5	17 18	19 20

Table 5-2. Sector Beam Formation, (Continued)

Beam Boresight, Band A

Item	V7 Elements		Azimuth Degrees	V8 Elements	
5	42 43	44 45	30	18 19	20 21
6	43 44	45 46	37.5	19 20	21 22
7	44 45	46 47	45	20 21	22 23
8	45 46	47 48	52.5	21 22	23 24
9	46 47	48 1	60	22 23	24 25
10	47 48	1 2	67.5	23 24	25 26
11	48 1	2 3	75	24 25	26 27
12	1 2	3 4	82.5	25 26	27 28
13	2 3	4 5	90	26 27	28 29
14	3 4	5 6	97.5	27 28	29 30
15	4 5	6 7	105	28 29	30 31
16	5 6	7 8	112.5	29 30	30 31
17	6 7	8 9	120	30 31	32 33
18	7 8	9 10	127.5	31 32	33 34
19	8 9	10 11	135	32 33	34 35
20	9 10	11 12	142.5	33 34	35 36
21	10 11	12 13	150	34 35	36 37
22	11 12	13 14	157.5	35 36	37 38
23	12 13	14 15	165	36 37	38 39
24	13 14	15 16	172.5	37 38	39 40
25	14 15	16 17	180	38 39	40 41
26	15 16	17 18	187.5	39 40	41 42
27	16 17	18 19	195	40 41	42 43
28	17 18	19 20	202.5	41 42	43 44
29	18 19	20 21	210	42 43	44 45
30	19 20	21 22	217.5	43 44	45 46
31	20 21	22 23	225	44 45	46 47
32	21 22	23 24	232.5	45 46	47 48
33	22 23	24 25	240	46 47	48 1
34	23 24	25 26	247.5	47 48	1 2
35	24 25	26 27	255	48 1	2 3
36	25 26	27 28	262.5	1 2	3 4
37	26 27	28 29	270	2 3	4 5
38	27 28	29 30	277.5	3 5	4 6
39	28 29	30 31	285	4 5	6 7
40	29 30	31 32	292.5	5 6	7 8
41	30 31	32 33	300	6 7	8 9
42	31 32	33 34	307.5	7 8	9 10
43	32 33	34 35	315	8 9	10 11
44	33 34	35 36	322.5	9 1 0	11 12
45	34 35	36 37	330	10 11	12 13
46	35 36	37 38	337.5	11 12	13 14
47	36 37	38 39	345	12 13	14 15
48	37 38	39 40	352.5	13 14	15 16

c. Band A Omnidirectional Beam Formation. An omnidirectional beam is nondirectional; signals from all directions are received equally well. Refer to figure 5-1. Forty-eight outputs, one each from the 1: 4 power dividers, are connected to the omnicombiner assemblies. These assemblies are essentially power dividers connected in reverse. Each omnicombiner assembly consists of two 8: 1 (eight inputs, one output) units to give an effective 16: 2 combination. Three of the latter assemblies are required to combine 48 input signals into 6 output signals. These six signals are further combined in a 6: 1 omnicombiner that provides a single omnibeam output. This output is sent through a directional coupler via the tunnel cable to the input, maintenance patch panel associated with the rf matrix group.

d. Band B Monitor Beam Formation. (See table 5-3.) Band B monitor beam formation involves the same principles as band A. Band B has 96 antenna elements with any I beam formed from 16 consecutive antenna elements. Only 48 beams are formed in progressing around the complete circle of elements. Note that adjacent beams listed in table 5-3 are separated by 1 antenna element which results in only 48 beams being formed from 96 elements.

e. Band B Sector Beam Formation. (See figure 5-6 and tables 5-4 and 5-5.) Three consecutive antenna elements form a band B sector beam. The boresight bisects *the center antenna element in the combination chosen. A total of six sector beams may be in use at any one time.

NOTE
See paragraph 4-4.a. for precautions in sector beam selection.

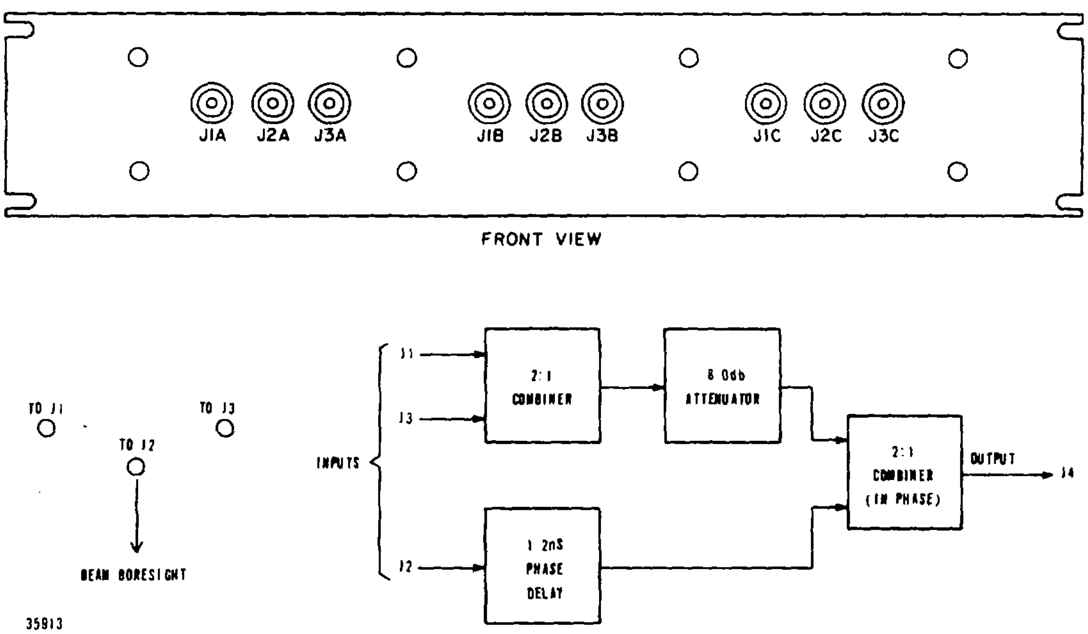


Figure 5-6. Block Diagram, Beamformer Assembly TD-1056/FLR-9(V) (Sector Beamformer B)

Table 5-3. Monitor Beam Formation,

Beam Boresight, Band B

Beam No.	V7 Elements	In Use	Azimuth Degrees	V8 Elements	In Use
1	72 73 74 75 76 77 78 79	80 81 82 83 84 85 86 87	1.875	24 25 26 27 28 29 30 31	32 33 34 35 36 37 38 39
2	74 81	82 89	9.357	26 33	34 41
3	76 83	84 91	16.875	28 35	36 43
4	78 85	86 93	24.375	30 37	38 45
5	80 87	88 95	31.875	32 39	40 47
6	82 89	90 1	39.375	34 41	42 49
7	84 91	92 3	46.875	36 43	44 51
8	86 93	94 5	54.375	38 45	46 53
9	88 95	96 7	61.875	40 47	48 55
10	90 1	2 9	69.375	42 49	50 57
11	92 3	4 11	76.875	44 51	52 59
12	94 5	6 13	84.375	46 53	54 61
13	96 7	8 15	91.875	48 55	56 63
14	2 9	10 17	99.375	50 57	5S 65
15	4 11	12 19	106.875	52 59	60 67
16	6 13	14 21	114.375	54 61	62 69
17	8 15	16 23	121.875	56 63	64 1
18	10 17	18 25	129.375	58 65	66 73
19	12 19	20 27	136.875	60 67	68 75
20	14 21	22 29	144.375	62 69	70 77
21	16 23	24 31	151.875	64 71	72 79
22	18 25	26 33	159.375	66 73	74 81

Table 5-3. Monitor Beam Formation, (Continued)
Beam Boresight, Band B

Beam No.	V7 Elements		In Use		Azimuth Degrees	V8 Elements		In Use	
23	20	27	28	35	166.875	68	75	76	83
24	22	29	30	37	174.375	70	77	78	85
25	24	31	32	39	181.875	72	79	80	87
26	26	33	34	41	189.375	74	81	82	89
27	28	35	36	43	196.875	76	83	84	91
28	30	37	38	45	204.375	78	85	86	93
29	32	39	40	47	211.875	80	87	88	95
30	34	41	42	49	219.375	82	89	90	1
31	36	43	44	51	226.875	84	91	92	3
32	38	45	46	53	234.375	86	93	94	5
33	40	47	48	55	241.875	88	95	96	7
34	42	49	50	57	249.375	90	1	2	9
35	44	51	52	59	256.875	92	3	4	11
36	46	53	54	61	264.375	94	5	6	13
37	48	55	56	63	271.875	96	7	8	15
38	50	57	58	65	279.375	2	9	10	17
39	52	59	60	67	286.875	4	11	12	19
40	54	61	62	69	294.375	6	13	14	21
41	56	63	64	71	301.875	8	15	16	23
42	58	65	66	73	309.375	10	17	18	25
43	60	67	68	75	316.875	12	19	20	27
44	62	69	70	77	324.375	14	21	22	29
45	64	71	72	79	331.875	16	23	24	31

Table 5-3. Monitor Beam Formation, (Continued)

Beam Boresight, Band B

Beam No.	V7 Elements		In Use		Azimuth Degrees	V8 Elements		In Use	
46	66	73	74	81	339.375	18	25	26	33
47	68	75	76	83	346.875	20	27	28	35
48	70	77	78	85	354.375	22	29	30	37

Table 5-4. Sector Beam Formation, Boresight, Band B (V7)

Item	Azimuth Degrees	Elements In Use			Item	Azimuth Degrees	Elements In Use		
1	0	78	79	80	49	180	30	31	32
2	3.75	79	80	81	50	183.75	31	32	33
3	7.5	80	81	82	51	187.5	32	33	34
4	11.25	81	82	83	52	191.25	33	34	35
5	15	82	83	84	53	195	34	35	36
6	18.75	83	84	85	54	198.75	35	36	37
7	22.5	84	85	86	55	202.5	36	37	38
8	26.25	85	86	87	56	206.25	37	38	39
9	30	86	87	88	57	210	38	39	40
10	33.75	87	88	89	58	213.75	39	40	41
11	37.5	88	89	90	59	217.5	40	41	42
12	41.25	89	90	91	60	221.25	41	42	43
13	45	90	91	92	61	225	42	43	44
14	48.75	91	92	93	62	228.75	43	44	45
15	52.5	92	93	94	63	232.5	44	45	46
16	56.25	93	94	95	64	236.25	45	46	47
17	60	94	95	96	65	240	46	47	48
18	63.75	95	96	1	66	243.75	47	48	49
19	67.5	96	1	2	67	247.5	48	49	50
20	71.25	1	2	3	68	251.25	49	50	51
21	75	2	3	4	69	255	50	51	52
22	78.75	3	4	5	70	258.75	51	52	53
23	82.5	4	5	6	71	262.5	52	53	54
24	86.25	5	6	7	72	266.25	53	54	55
25	90	6	7	8	73	270	54	55	56
26	93.75	7	8	9	74	273.75	55	56	57
27	97.5	8	9	10	75	277.5	56	57	58
28	101.25	9	10	11	76	281.25	57	58	59
29	105	10	11	12	77	285.75	58	59	60
30	108.75	11	12	13	78	288.75	59	60	61
31	112.5	12	13	14	79	292.5	60	61	62
32	116.25	13	14	15	80	296.25	61	62	63
33	120	14	15	16	81	300	62	63	64
34	123.75	15	16	17	82	303.75	63	64	65
35	127.5	16	17	18	83	307.5	64	65	66
36	131.25	17	18	19	84	311.25	65	66	67
37	135	18	19	20	85	315	66	67	68
38	138.75	19	20	21	86	318.75	67	68	69
39	142.5	20	21	22	87	322.5	68	69	70
40	146.25	21	22	23	88	326.25	69	70	71
41	150	22	23	24	89	330	70	71	72
42	153.75	23	24	25	90	333.75	71	72	73
43	157.5	24	25	26	91	337.5	72	73	74
44	161.25	25	26	27	92	341.25	73	74	75
45	165	26	27	28	93	345	74	75	76
46	168.75	27	28	29	94	348.75	75	76	77
47	172.5	28	29	30	95	352.5	76	77	78
48	176.25	29	30	31	96	356.25	77	78	79

Table 5-5. Sector Beam Formation, Boresight, Band B (V8)

Item	Azimuth Degrees	Elements In Use			Item	Azimuth Degrees	Elements In Use		
1	0	30	31	32	49	180	78	79	80
2	3.75	31	32	33	50	183.75	79	80	81
3	7.5	32	33	34	51	187.5	80	81	82
4	11.25	33	34	35	52	191.25	81	82	83
5	15	34	35	36	53	195	82	83	84
6	18.75	35	36	37	54	198.75	83	84	85
7	22.5	36	37	38	55	202.5	84	85	86
8	26.25	37	38	39	56	206.25	85	86	87
9	30	38	39	40	57	210	86	87	88
10	33.75	39	40	41	58	213.75	87	88	89
11	37.5	40	41	42	59	217.5	88	89	90
12	41.25	41	42	43	60	221.25	89	90	91
13	45	42	43	44	61	225	90	91	92
14	48.75	43	44	45	62	228.75	91	92	93
15	52.5	44	45	46	63	232.5	92	93	94
16	56.25	45	46	47	64	236.25	93	94	95
17	60	46	47	48	65	240	94	95	96
18	63.75	47	48	49	66	243.75	95	96	1
19	67.5	48	49	50	67	247.5	96	1	2
20	71.25	49	50	51	68	251.25	1	2	3
21	75	50	51	52	69	255	2	3	4
22	78.75	51	52	53	70	258.75	3	4	5
23	82.5	52	53	54	71	262.5	4	5	6
24	86.25	53	54	55	72	266.25	5	6	7
25	90	54	55	56	73	270	6	7	8
26	93.75	55	56	57	74	273.75	7	8	9
27	97.5	56	57	58	75	277.5	8	9	10
28	101.25	57	58	59	76	281.25	9	10	11
29	105	58	59	60	77	285	10	11	12
30	108.75	59	60	61	78	288.75	11	12	13
31	112.5	60	61	62	79	292.5	12	13	14
32	116.25	61	62	63	80	296.25	13	14	15
33	120	62	63	64	81	300	14	15	16
34	123.75	63	64	65	82	303.75	15	16	17
35	127.5	64	65	66	83	307.5	16	17	18
36	131.25	65	66	67	84	311.25	17	18	19
37	135	66	67	68	85	315	18	19	20
38	138.75	67	68	69	86	318.75	19	20	21
39	142.5	68	69	70	87	322.5	20	21	22
40	146.25	69	70	71	88	326.25	21	22	23
41	150	70	71	72	89	330	22	23	24
42	153.75	71	72	73	90	333.75	23	24	25
43	157.5	72	73	74	91	337.5	24	25	26
44	161.25	73	74	75	92	341.25	25	26	27
45	165	74	75	76	93	345	26	27	28
46	168.75	75	76	77	94	348.75	27	28	29
47	172.5	76	77	78	95	352.5	28	29	30
48	176.25	77	78	79	96	356.25	29	30	31

f. Band B Omnidirectional Beam Formation. (See figure 5-1.) The omnidirectional beam is formed from 96 band B antenna signals that are combined in six)6: 1 omnicombiner assemblies. These six outputs are further combined in a 6:1 omnicombiner for the single omnidirectional beam output.

g. Band C Monitor Beam Formation. (See figure 5-1 and table 5-6.) Twenty-four monitor beams are formed in band C using eight elements for each beam. Adjacent beams are separated by I antenna element so that a total of 24 beams are formed. Each antenna signal goes through a 1: 4 power division making 192 signals available for 8: 1 beamformers (24 total). The beam boresight exists between the two center elements.

Table 5-6. Monitor Beam Formation,

Boresight, Band C

Beam No.	V7 Elements in Use	Azimuth Degrees	V8 Elements in Use
1	37 38 39 40 41 42 43 44	7.5	13 14 15 16 17 18 19 20
2	39 42 43 46	22.5	15 18 19 22
3	41 44 45 48	37.5	17 20 21 24
4	43 46 47 2	52.5	19 22 23 26
5	45 48 1 4	67.5	21 24 25 28
6	47 2 3 6	82.5	23 26 27 30
7	1 4 5 8	997.5	25 28 29 32
8	3 6 7 10	112.5	27 30 31 34
9	5 8 9 12	127.5	29 32 33 36
10	7 10 11 14	142.5	31 34 35 38
11	9 12 13 16	157.5	33 36 37 40
12	11 14 15 18	172.5	35 38 39 42
13	13 16 17 20	187.5	37 40 41 44
14	15 18 19 22	202.5	39 42 43 46
15	17 20 21 24	217.5	41 44 45 48
16	19 22 23 26	232.5	43 46 47 2
17	21 24 25 28	247.5	45 48 1 4
18	23 26 27 30	262.5	47 2 3 6
19	25 28 29 32	277.5	1 4 5 8
20	27 30 31 34	292.5	3 6 7 10
21	29 32 33 36	307.5	5 8 9 12
22	31 34 35 38	322.5	7 10 11 14
23	33 36 37 40	337.5	9 12 13 16
24	35 38 39 42	352.5	11 14 15 18

h. Band C Sector Beam Formation. (See figure 5-7 and table 5-7.) Sector beams in band C are formed from only two antenna elements. Antenna signals from all 48 elements are terminated on the band C antenna patch panel. Three beamformers are *available so that a total of six sector beams may be in use at any one time. The beam boresight exists between the two beam elements.

NOTE
See paragraph 4-4 for precautions in sector beam selection.

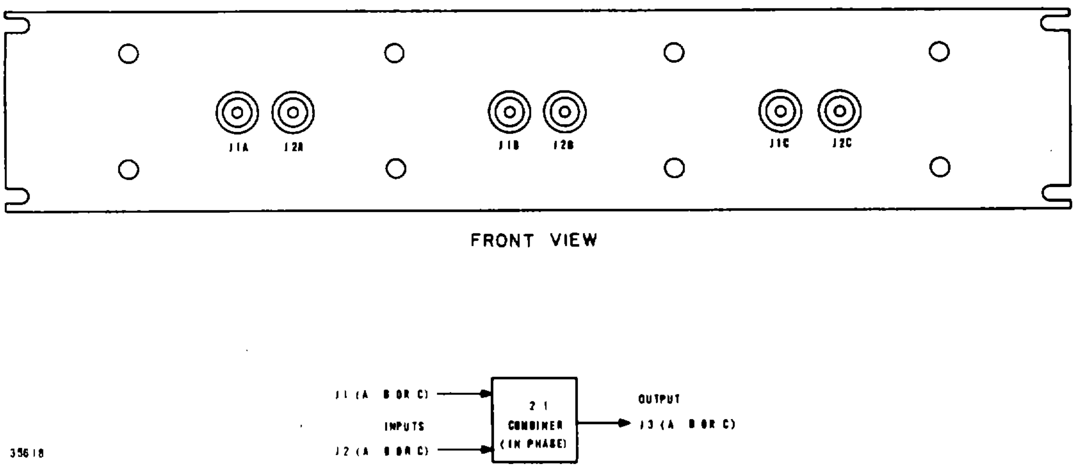


Figure 5-7. Block Diagram, Beamformer Assembly TD-1057/FLR-9(V) (Sector Beamformer C)

Table 5-7. Sector Beam Formation,

Boresight, Band C

Beam No.	V7 Elements in Use	Azimuth Degrees	V8 Elements in Use
1	40 41	7.5	16 17
2	41 42	15	17 18
3	42 43	22.5	18 19
4	43 44	30	19 20
5	44 45	37.5	20 21
6	45 46	45	21 22
7	46 47	52.5	22 23
8	47 48	60	23 24
9	48 49	67.5	24 25
10	1 2	75	25 26
11	2 3	82.5	26 27
12	3 4	90	27 28
13	4 5	97.5	28 29
14	5 6	105	29 30
15	6 7	112.5	30 31
16	7 8	120	31 32
17	8 9	127.5	32 33
18	9 10	135	33 34
19	10 11	142.5	34 35

Table 5-7. Sector Beam Formation, (Continued)

Boresight, Band C

Beam No.	V7 Elements in Use		Azimuth Degrees	V8 Elements in Use	
20	11	12	150	35	36
21	12	13	157.5	36	37
22	13	14	165	37	38
23	14	15	172.5	38	39
24	15	16	180	39	40
25	16	17	187.5	40	41
26	17	18	195	41	42
27	18	19	202.5	42	43
28	19	20	210	43	44
29	20	21	217.5	44	45
30	21	22	225	45	46
31	22	23	232.5	46	47
32	23	24	240	47	48
33	24	25	247.5	48	1
34	25	26	255	1	2
35	26	27	262.5	2	3
36	27	28	270	3	4
37	28	29	277.5	4	5
38	29	30	285	5	6
39	30	31	292.5	6	7
40	31	32	300	7	8
41	32	33	307.5	8	9
42	33	34	315	9	10
43	34	35	322.5	10	11
44	35	36	330	11	12
45	36	37	337.5	12	13
46	37	38	345	13	14
47	38	39	352.5	14	15
48	39	40	0	15	16

i. Band C Omnibeam Formation. The omnidirectional beam in band C is formed in the same manner as the band A omnidirectional beam.

Sector, omni-, and monitor beam signals for all bands are patched through the input maintenance patch panel in the rf matrix group to the used locations. At this point, signal lines may be opened for troubleshooting operations. Coverage of the input maintenance patch panel and signal flow beyond this point may be found in the rf matrix group instruction manual.

SECTION II. FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

5-5. Band A Antenna Elements (02-720246) and Band B Antenna Elements (02-720248). (See figure 5-8.)

The band A and band B antenna elements receive vertically polarized rf signals in the ranges of 2 to 6 MHz (band A) and 6 to 18 MHz (band B). Each antenna element

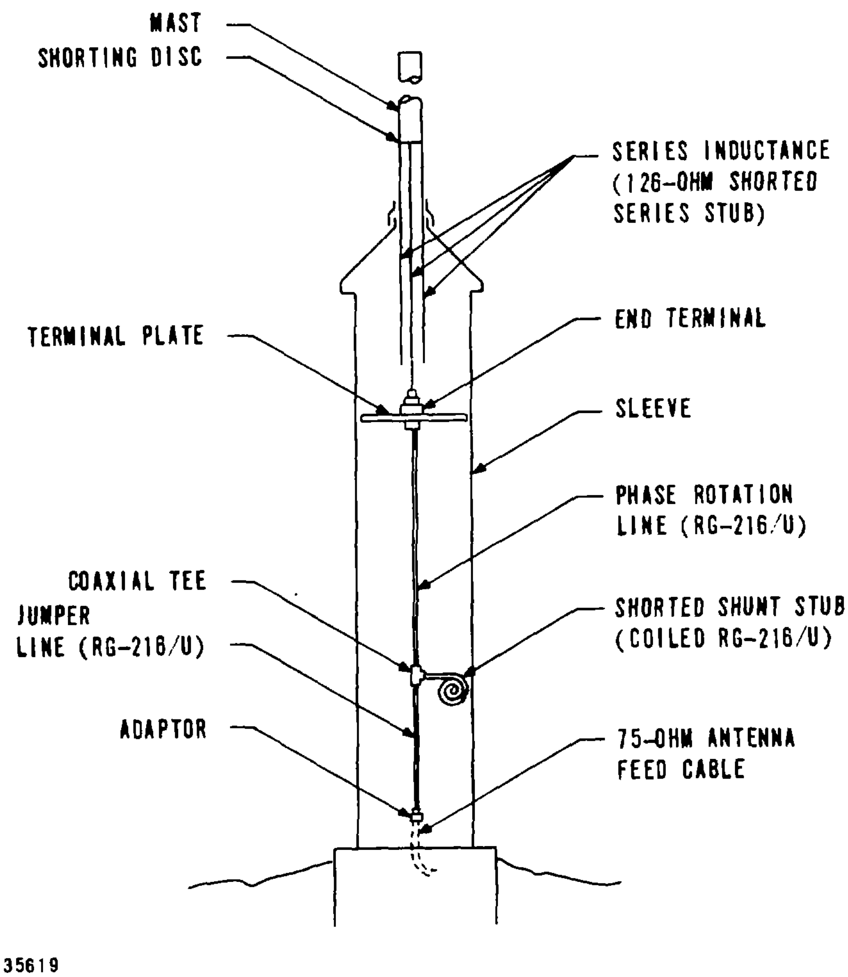


Figure 5-8. Band A or Band B Antenna Element, Electrical Configuration Diagram

is a sleeve monopole. This consists of a mast, a support sleeve, and an impedance matching network. The feed point of each element is on the mast near the top of the sleeve. The fixed impedance matching network matches the Impedance of the mast to the antenna feed cable. The impedance matching network consists of a shorted series stub, a phase rotation line, and a shorted shunt stub. The shorted series stub, formed by a shorting disc and a rod centered inside the mast, has an electrical length of less than 90 degrees throughout the operating frequency range. It acts as an inductance in series with the center conductor of the feed cable. A coaxial cable, located between the series inductance and one end of a coaxial tee connector, rotates the phase of the incoming signals to obtain the desired current and voltage relationship. The shorted shunt stub, attached to the center of the coaxial tee, 1is one-quarter wavelength long (90-degrees) at a given frequency within the band of operation, but acts as a shunt inductance when less than one-quarter wavelength long. A coaxial jumper line conducts the signals from the remaining end of the tee connector to the antenna feed cable.

5-6. Bands A and B Reflecting Screen (3300-31000) and Ground Screen (81-720001).

The bands A and B reflecting screen provides some directional sensitivity to the individual antenna elements which is independent of the other beamforming processes. The ground screen provides a uniform ground plane for the bands A and B antenna elements. This results in more uniform characteristics between antenna elements 4 within a band.

5-7. Band C Antenna Elements (02-720268). (See figure 5-9.)

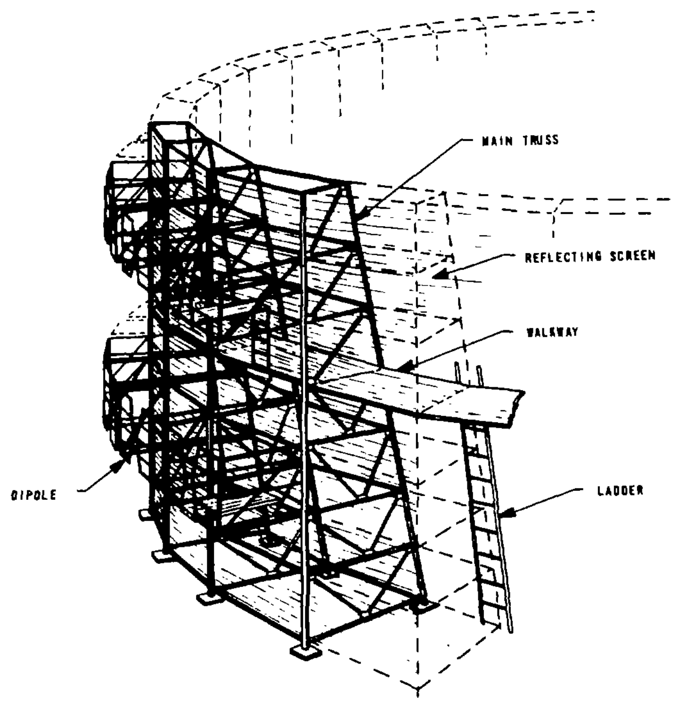
The band C antenna elements are horizontally polarized and receive signals in the 18to 30-MHz range. Each element consists of two dipoles, two dipole feed points, two sets of balun cables, two terminating points, two junction cables, a tee junction, and a length of cable which acts as a quarter-wave transformer. These components operate not only as a feed mechanism, but also as a matching network that matches the input of the dipole subelements (in parallel) to the 75-ohm feed cables. A balance-to-unbalanced match between the dipole subelements is provided by a balun at each dipole feed point. The balun consists of two parallel 75-ohm coaxial cables whose inner conductors form a twin-conductor transmission line, which is shorted one-quarter wavelength (at the center frequency) from the dipole feed points. One of these cables functions as the coaxial feed to the dipole feed point. A complete band C element consists of an upper and lower dipole subelement. The coaxial feed side from each dipole is connected with 75-ohm junction arms to the symmetrical arms of a coaxial tee junction. This tee is positioned half way between the upper and lower dipoles. The output of the tee passes through a quarter-wave transformer that matches the impedance to the 75-ohm feed cable. The matching section is a quarterwave length of 50-ohm cable (at the center frequency).

5-8. Band C Reflecting Screen (02-720272).

The band C reflecting screen provides each horizontally polarized antenna element with an appreciable forward gain. This gain is Independent of any that is obtained in subsequent beamforming processes.

5-9. Transmission Line Tuners. (See figure 5-10.)

The transmission line tuner is a sliding coaxial line stretcher that compensates for variations in the electrical length of the antenna feed cable. Two closely machined transmission lines, one inside of the other and adjustable in length, provide a capability to change the electrical length of the cable. This capability provides a means to compensate for the effective electrical length changes due to cable aging or seasonal temperature variations. This is necessary to maintain the same transmission line delay from each antenna element within a band. Any cable length that deviates from others has an undesired phase shift that Is ultimately introduced into the affected beamformers and degrades beam formation.



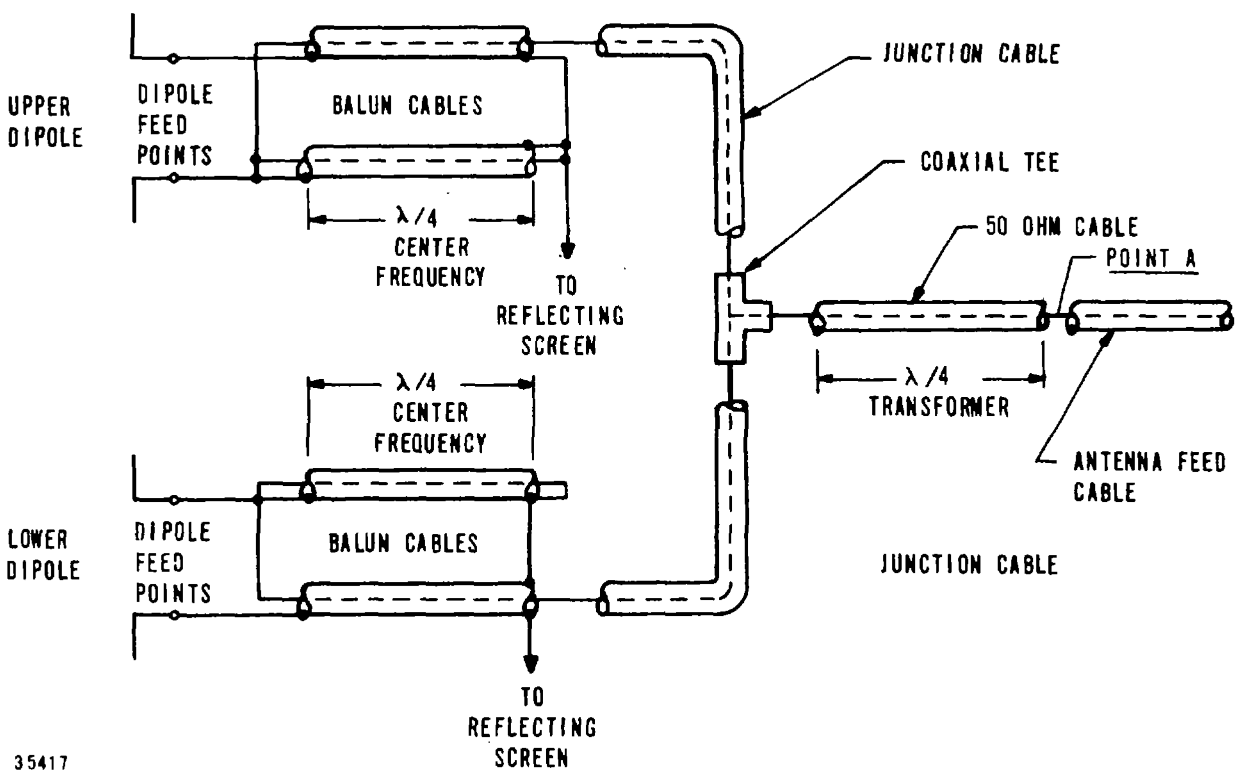


Figure 5-9. Band C Antenna and Feed Configuration

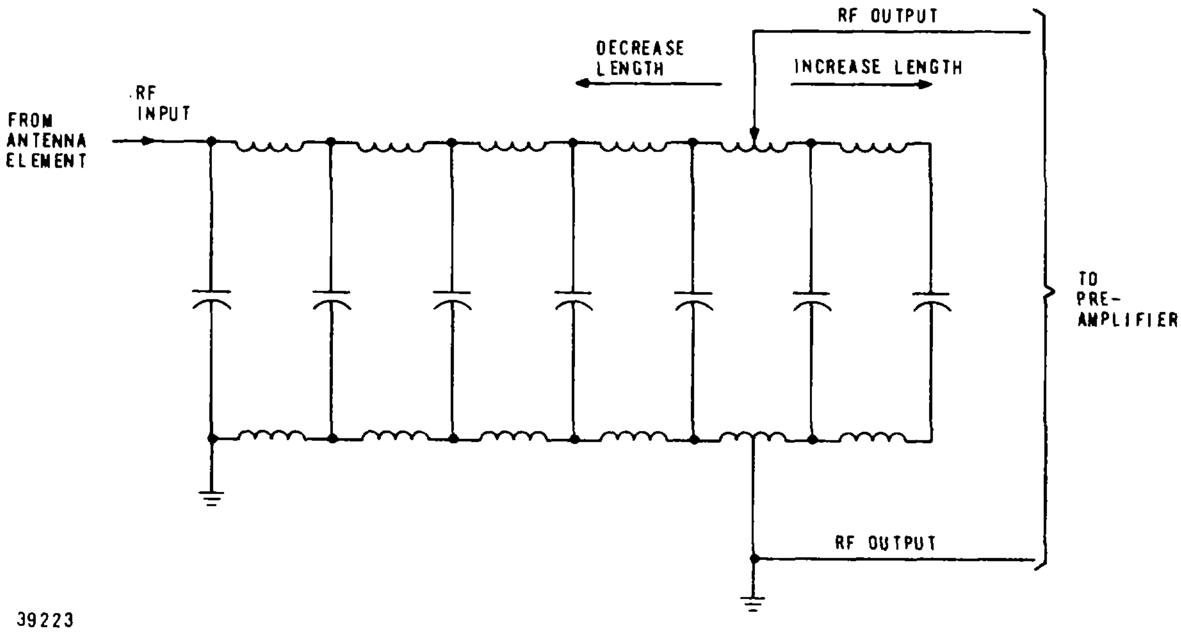


Figure 5-10. Transmission Line Tuner Functional Schematic

5-10. Rf Amplifiers. (See figure 5-11.)

Wideband antenna preamplifiers are provided in each antenna lead to amplify all signals before subsequent power divisions and beam formations. Each preamplifier has two outputs. Two preamplifiers, supplied from a common power supply, comprise an rf amplifier assembly. Each amplifier has a gas discharge tube lightning arrestor connected across the input for overload protection. An rf filter (A2) attenuates signals below 1.5-MHz. Strong broadcast station signals are undesirable in the system because they could possibly cause intermodulation (im) distortion products. Refer to paragraph 5-2.a. This signal is amplified by a nominal 16-dB by the basic amp module A3. Switch S1 and the associated resistor network provide a 2-dB attenuation for the preamplifier when used in bands A and B. In band C the full gain is utilized. A wideband transformer provides a center-tapped output so that two separate signals are available to drive separate emitter-follower isolator modules A4 and A6. These in turn drive basic amp modules A5 and A7. Outputs from A5 modules supply monitor beam channels. Outputs from A7 modules supply the df group and include the goniometers, and sector and omnibeam beamforming equipment. Each amplifier assembly (two separate rf amplifiers) is powered by one regulated power supply. The 60-Hz power input is filtered by filter FLI to exclude noise entering via the power lines. For additional information refer to CM 32-5895-236-14.

NOTE

Figure 5-11 contains the nominal signal levels at various places in the circuit. A reference level of 0 dB equals 100 millivolts (rms) at the input to the amplifier.

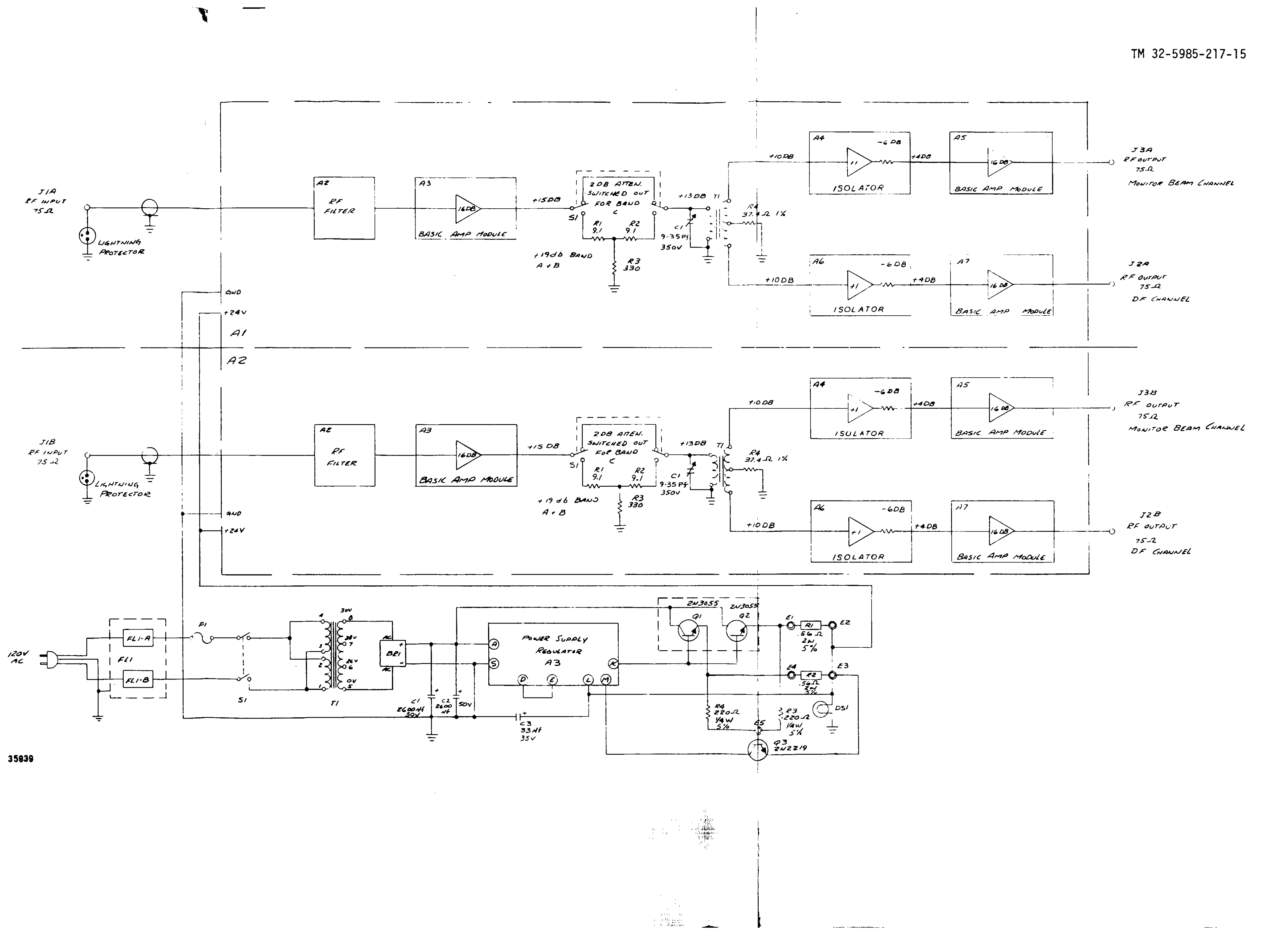


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Figure 5-11. Block Diagram, Amplifier, Radio Frequency AN-6533/FLR-9(V)

5-11. Power Dividers and Combiners. (See figures 5-12 through 5-20.)

Power dividers and combiners are used in the antenna group as shown in the block diagram, figure 5-1. A power divider and a transformer with multiple windings could perform the same function, except that the transformer does not provide significant isolation between output ports. Power dividers in the antenna group provide a minimum of 30-dB isolation between output ports. Note that these units are two-way devices; they may be used in reverse as power combiners. The basic circuit elements in these dividers/combiners are a splitter transformer and a step-down transformer. The splitter transformer divides an input signal into two equal parts which are approximately 3 dB lower than the input. Windings 1-1' and 2 - 2' are bifilar wound. The two windings are connected so that mutual inductance is aiding when a signal is applied as shown. The 75-ohm resistors shown represent terminations of ports A and B. The 150-ohm resistor assists in maintaining low vswr. Capacitor C helps maintain broadband operation as well as improving vswr. In order to match the impedance at the splitter transformer input, a step-down transformer is connected ahead of it as shown in figure 5-13. The step-down transformer connected to the splitter transformer forms an electrical subassembly which is in turn connected to two more subassemblies to form a 1:4 power divider. Various combinations of 1:4 power dividers are mounted on printed circuit boards to obtain the required power divisions for the various beams. Refer to figures 5-14 through 5-20.

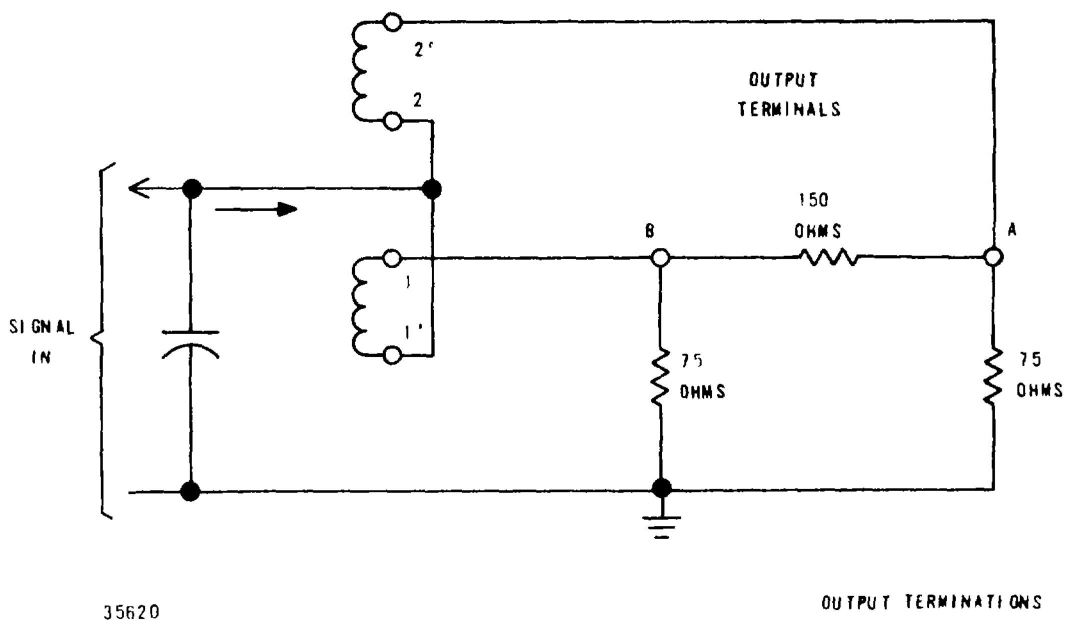


Figure 5-12. Basic Power Splitter

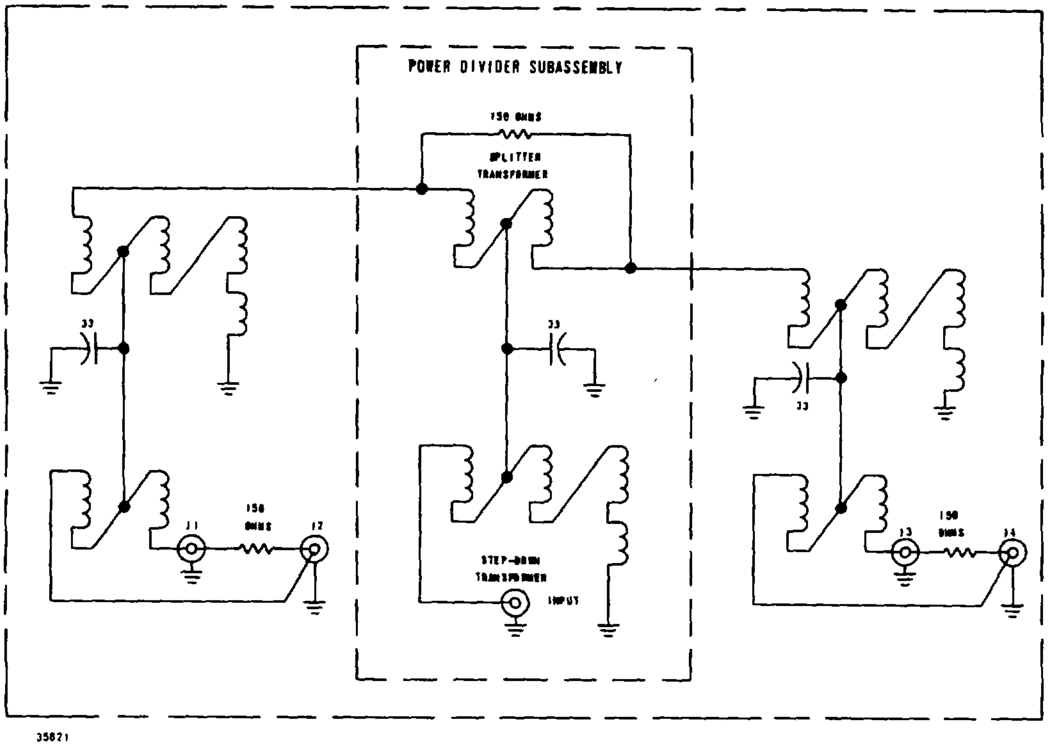


Figure 5-13. Typical Schematic, Divider Assemblies 1:4

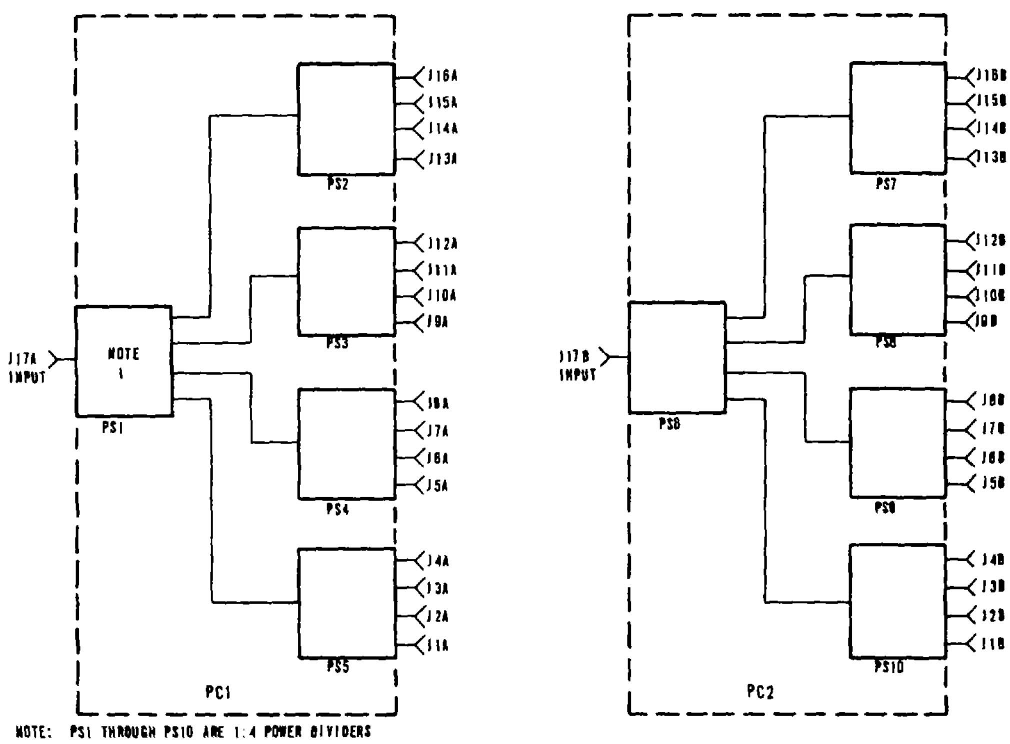


Figure 5-14. Schematic, Divider Assembly, Power Rf CU-2050/FLR-9(V)
(Power Divider, 2:32, Band A)

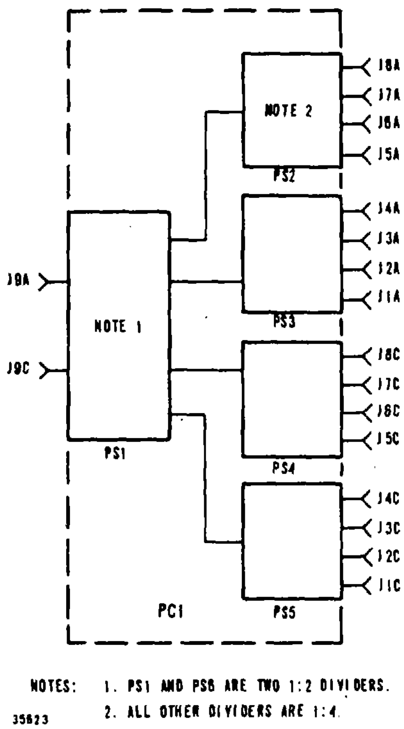


Figure 5-15. Schematic, Divider Assembly, Power Rf CU-2053/FLR-9(V) (Power Divider, 4:32, Band B)

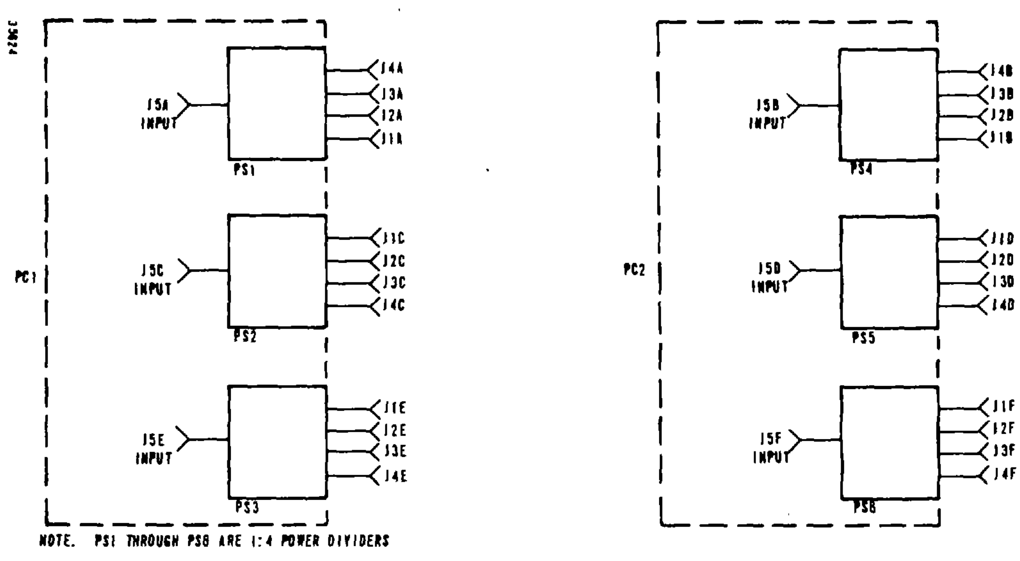
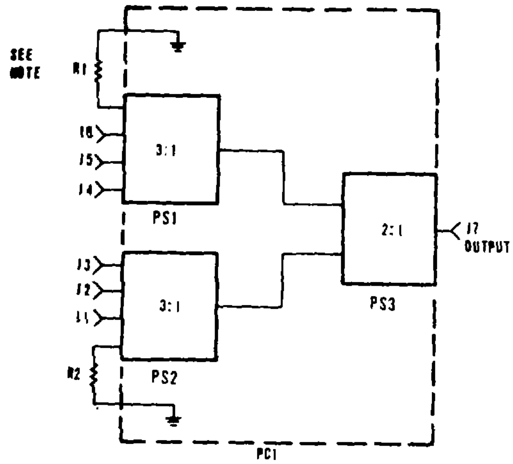
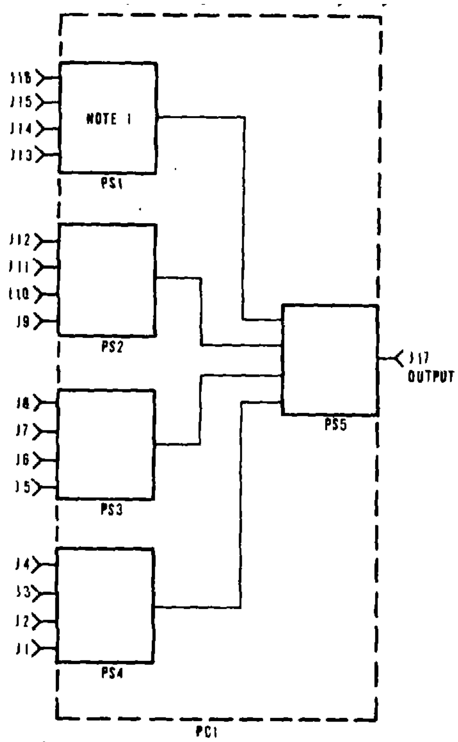


Figure 5-16. Schematic, Divider Assembly, Power Rf CU-2051/FLR-9(V) (Power Divider, 6:24, Band C)



NOTE: 3:1 UNIT FORMED BY TERMINATING ONE PORT EACH OF A 4:1 WITH A 75 OHM TERMINATION (R1 AND R2)

Figure 5-17. Schematic, Coupler, Omni Assembly CU-2049/FLR-9(V) (Omnicombiner, 6: 1, Bands A. B. and C)



NOTE. PS1 THROUGH PS5 ARE 4:1 POWER COMBINERS

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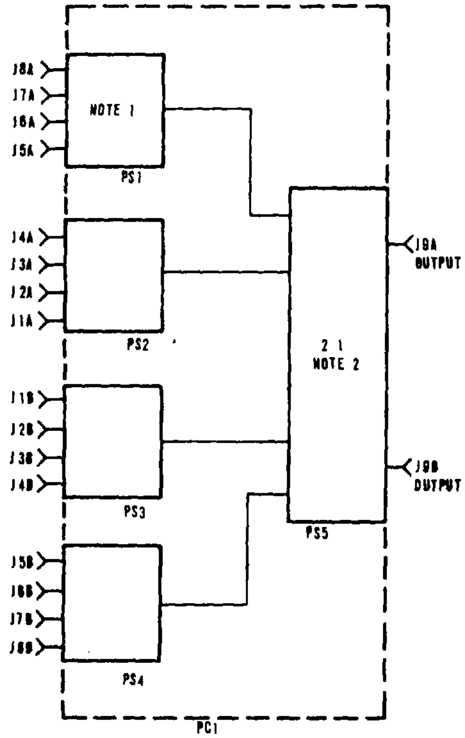
Figure 5-18. Schematic, Coupler, Omni Assembly CU-2055/FLR-9(V) (Omnicombiner 16: 1, Band B)



1. PS1 THROUGH PS4 ARE 4:1 POWER COMBINERS.
2. PS5 - TWO 2:1 POWER COMBINERS.

5-19. Schematic Coupler, Omni Assembly CU-2054/FLR-9(V) (Omnicombiner, Bands A and C)

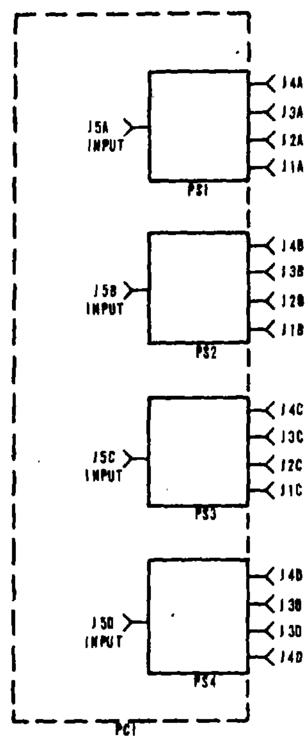


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Figure 5-20. Schematic, Divider Assembly, Power Rf CU-2052/FLR-9(V) (Power Divider, High Level 1: 4 Bands A, B, and C

5-12. Beamformers. (See figures 5-21 and 5-22.)

a. General. Simple beam formation has previously been described. The beamformers consist of balanced delay lines with varying rates of delay and attenuation. In figure 5-21 antenna element signals from the power dividers are connected to the beamformer as indicated. The center element signals that are connected to inputs 1 and 2 are delayed the most, with the delay decreasing for pairs 3-4, 5-6, and 7-8, respectively. The attenuation increases in the same manner so that the outside antenna signals (7-8) are attenuated the most. This results in lower side lobes. Element pairs, as illustrated, are connected to a balanced input impedance matching network. Small variable capacitors and inductors provide fine adjustment of phasing of the individual delay lines based on extremely accurate comparison standards during manufacture. These adjustments also optimize the isolation between signal pairs. Figure 5-22 illustrates a beamformer with 16 inputs that operates on the same principle, except that more signals form the desired beam. In each case the delayed signals are fed into impedance matching and combining networks so that a single 75-ohm beam output is obtained. Sector beamformers also operate on the same principle, except band C where only two antenna signals are used to form the beam. Because the electrical lengths of cable have been carefully controlled to this point, a 2: 1 power combiner is all that is necessary for band C sector beam formation.

b. Power Divider and Beamformer Interconnection. (See figure 5-23.) Interconnection between power dividers may be better understood by referring to figure 5-23 and the beam selection charts in Chapter 6. Figure 5-23 Illustrates antenna elements 72 through 89 connected through directional couplers to the rf amplifier assemblies and 1:8 power dividers. (Band B power divider assemblies consist of four each 1:8 power dividers.) The fan-out of power divider signals is shown without regard to specific part connections. It illustrates the overlapping of antenna element signals from one beam to the next, so that in the band B example shown, a total of 768 signals are required for formation of 48 monitor beams. Bands A and C are formed in a similar manner, except that only 24 beams are formed in band C.

5-13. Directional Coupler. (See figure 5-24.)

Directional couplers are used as points of test signal injection and retrieval In each rf signal path of the antenna group as shown in figure 5-1. Test signals are applied to the signal paths through the appropriate port of the 20-dB four-port directional couplers and retrieved through the output port of the 10-dB three-port directional couplers. The directional couplers enable conduct of the beamformer and antenna tests through use of short duration test signals under computer control as described in paragraph 6-6 and figure 6-1. The directional couplers consist of two identical wideband transformers T1 and T2 connected as shown In figure 5-24. Note the winding polarities indicated by the dots adjacent to the windings. The normal rf signal path with minimum attenuation is from J1 to J2. This is because the reflected impedance into L1 from L2 (T2) is very low as L2 is effectively shunted by Z_O at J3. When a test signal (antenna element test) is injected at J3, a voltage appears at the J1 input through the transformer action of T1. However, a voltage of opposite polarity is induced onto the line by transformer T2 so that very little signal appears at J2. The output at J1 is approximately 20 dB lower than the signal applied at J3. A beamformer test signal applied at J4 appears at J2 in the signal path in the same manner and with the same attenuation through the directional coupler. It is necessary for all directional coupler ports to be properly terminated

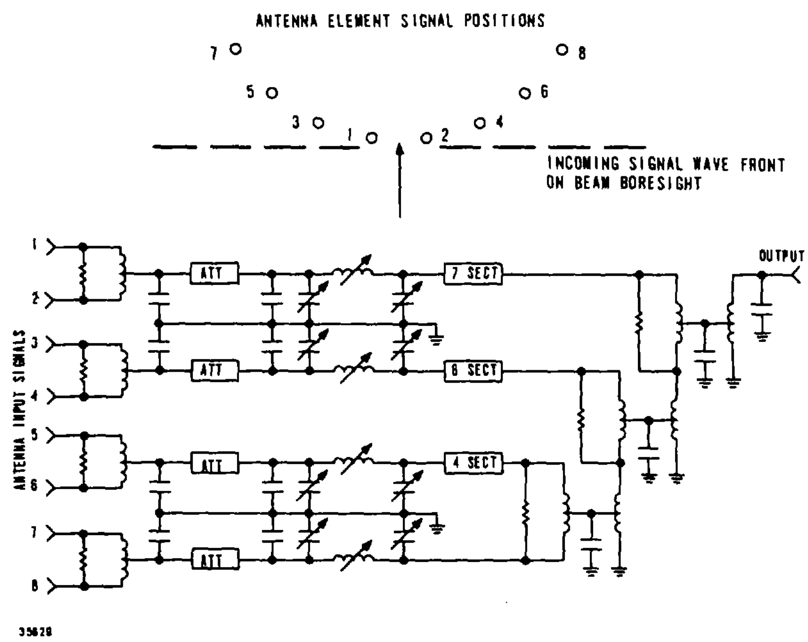

Figure 5-21. Simplified Schematic, Band C Monitor Beamformers

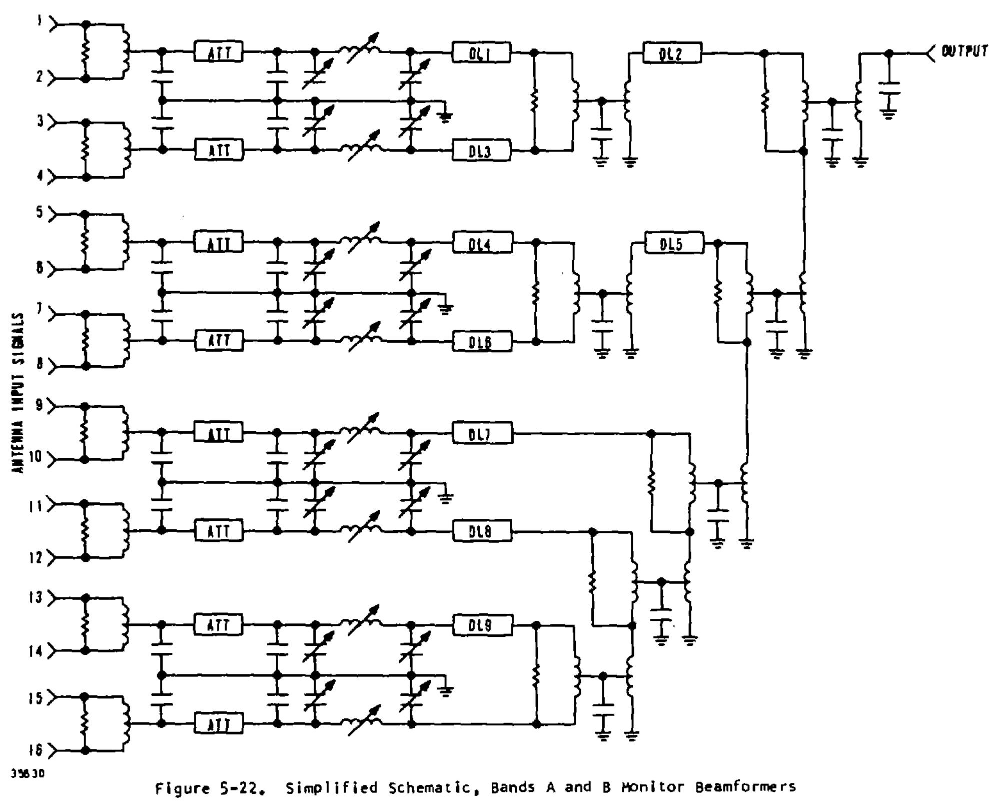

Figure 5-22. Simplified Schematic, Bands A and B Monitor Beamformers

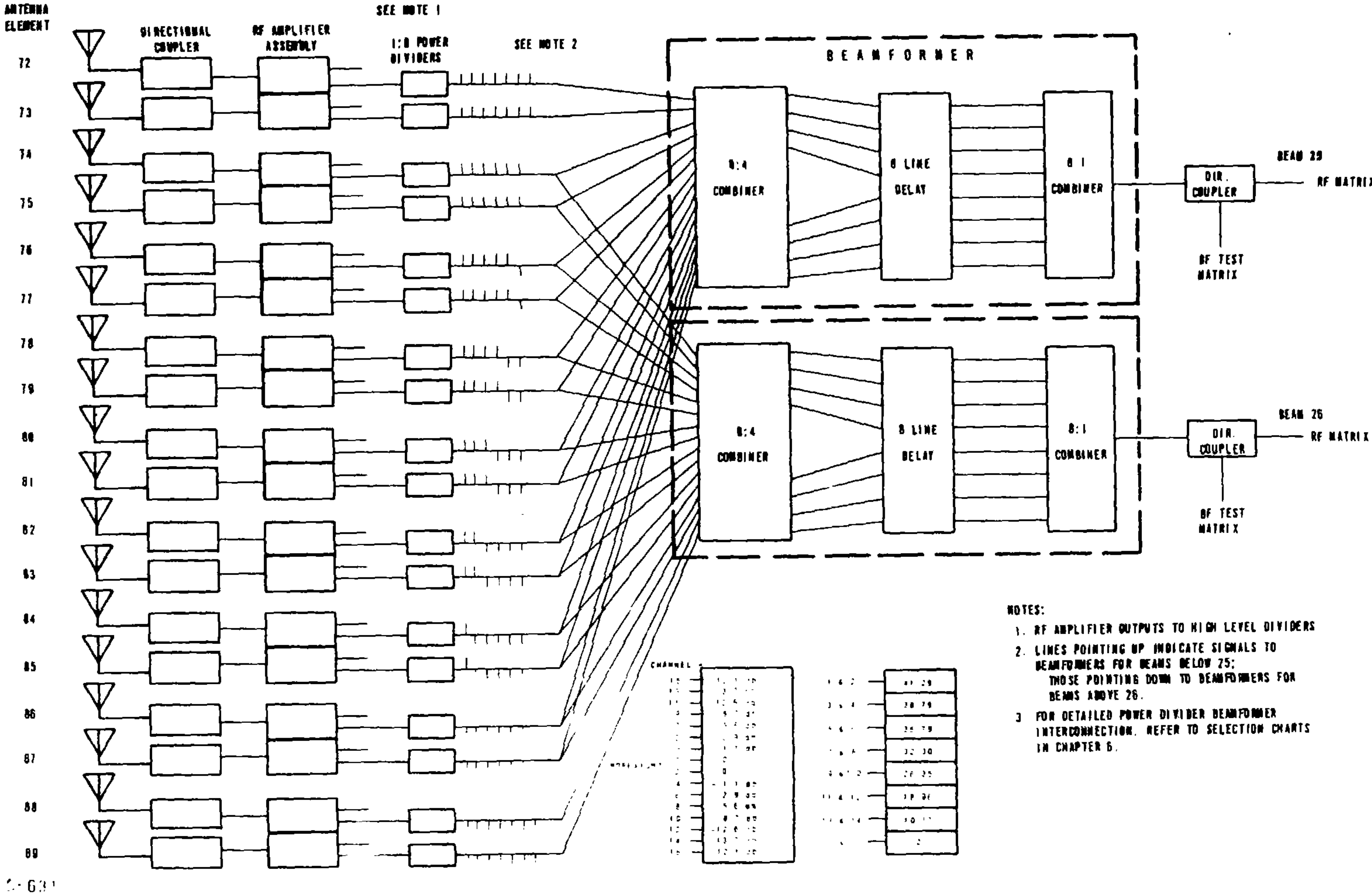

Figure 5-23. Simplified Pictorial Diagram, Monitor Beam Formation Band B

in 75 ohms to function correctly. The three-port directional couplers employed at the end of the antenna group are constructed in a similar manner, with the unused port terminated in 75 ohms. The loss through the cross path in this case is only 10 dB instead of 20 dB and results from different transformer characteristics.

5-14. Blower Assembly (3300-40015).

a. General. One blower assembly is used in each of the eight racks containing rf amplifiers. The blower assemblies are located in the bottom of each rack. Each assembly has a 200-cfm capacity and operates on 120 volts (±10 percent), 2 amperes, 48 to 63 Hz at a nominal 3200 rpm. Each is equipped with a permanent, washable metal mesh filter. These assemblies have permanently sealed bearings for extended life. Lubrication is not required. The only maintenance required is filter cleaning on a periodic basis.

b. Blower Assembly Fault Indication. Each blower assembly is equipped with an air flow switch which closes in the event of blower failure. This is indicated on the somc in the operations building. Grouped under the PREAMPLIFIER AIR FLOW panel nomenclature are the individual rf amplifier rack numbers and associated indicators (RH 401, RH 403, etc). A flashing indicator indicates a blower failure or severe air flow restriction sufficient to allow the switch to close. Wiring between the rf amplifier cabinets and the monitor and test group is shown in figure 5-25. Ac wiring to blower assemblies is shown in figure 5-26.

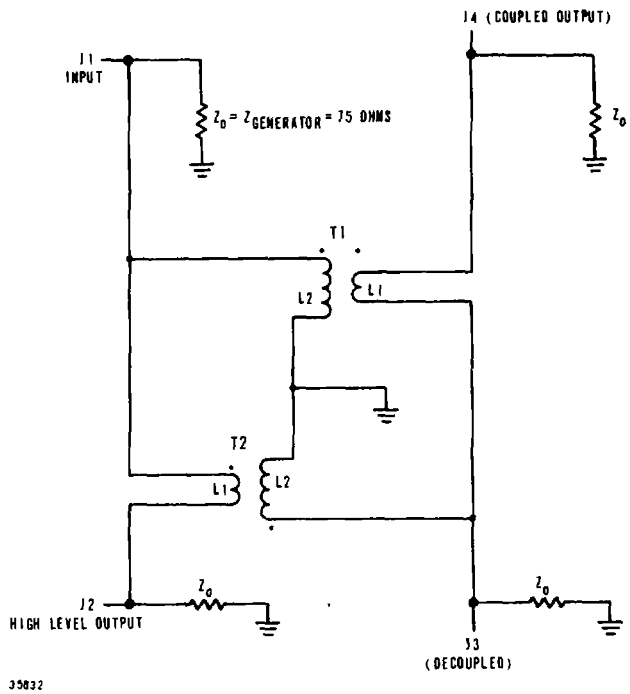

Figure 5-24. Schematic, Directional Couplers (All)

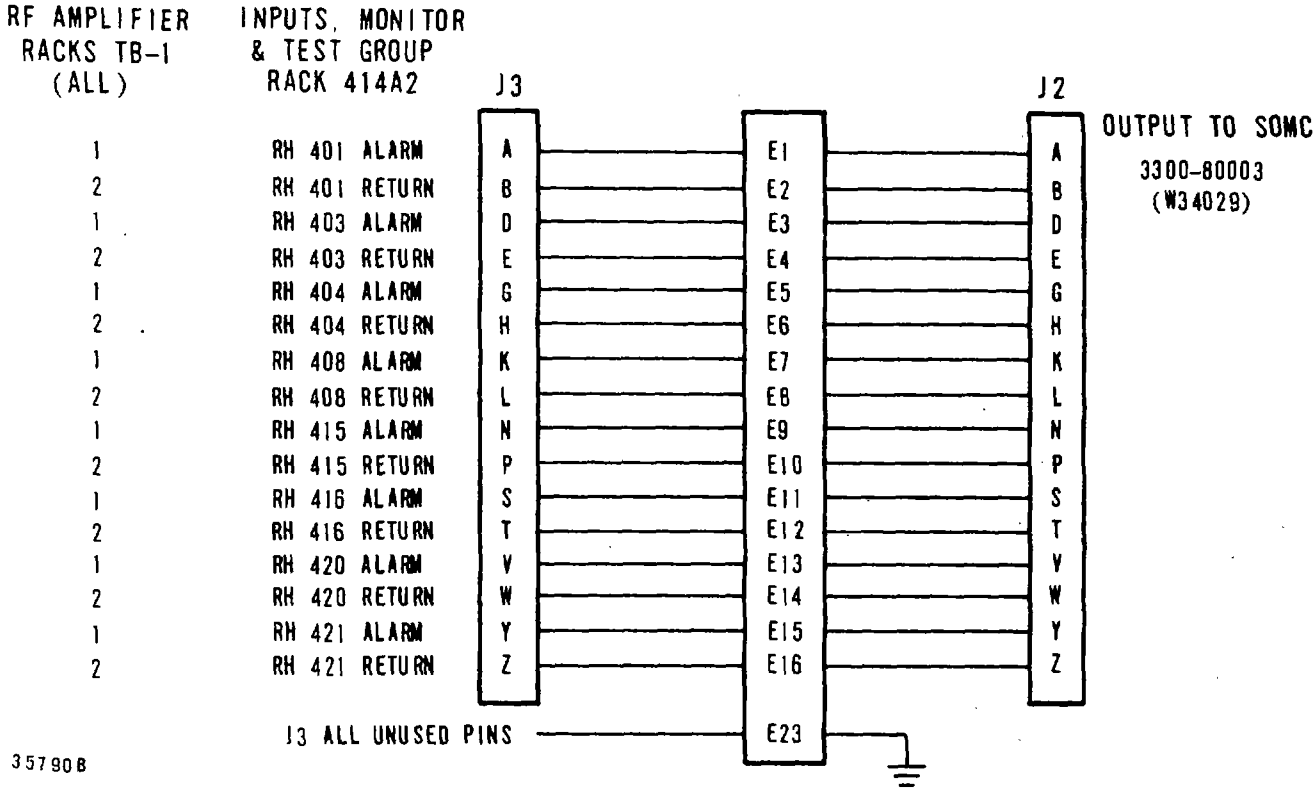

Figure 5-25. Air Flow Alarm Wiring Interface to Monitor and Test Group

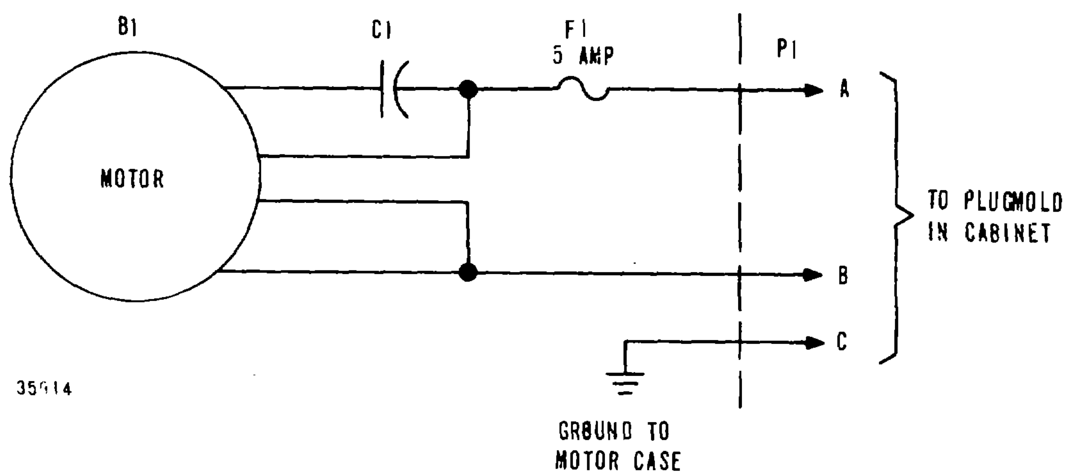

Figure 5-26. Cabinet Blower Assembly Ac Wiring Schematic

CHAPTER 6

MAINTENANCE

SECTION I

ORGANIZATIONAL AND INTERMEDIATE MAINTENANCE

6-1. Scope.

This chapter presents detailed maintenance procedures necessary to maintain the AN/ FLR-9(V7)/(V8) Antenna Group equipment. The antenna group consists of the antenna array and 19 racks of electronic equipment in the central building. Additionally, approximately 2700 cables are used which cannot be arbitrarily replaced or exchanged with other random length cables.

a. Maintenance Concept. The primary functions of the antenna group are to receive and amplify the rf signal, and form monitor, sector, and omni beams for the user. The only manual operation involved is patching the antenna signal inputs to the sector beamformers as directed by mission requirements. Refer to paragraph 4-4 for precautions regarding sector beams. Verification of proper operation is normally accomplished by the monitor and test group on an as-requested basis. The direction finding group can also verify performance, up to the power dividers, by use of the goniometer test. Alarm indicators on the monitor and test group supervisory operation and maintenance console (somc) will alert maintenance personnel In the event of an rf amplifier rack cooling blower failure. In the event of monitor and test group failure, the first Indication of possible antenna group malfunction would probably be an operator report. If it is determined that there is an antenna or beamformer problem, the performance test check procedures in this chapter may be used to isolate the failure.

b. Interface Requirements. The antenna group interfaces with the df group (goniometers), rf matrix group (Input maintenance patch panel), and the monitor and test group (directional couplers). These are the signal boundaries for the antenna group. The input maintenance patch panel, in the operations building, makes possible opening of all monitor, sector, and omni beam signal paths for maintenance purposes. The following paragraphs explain the scope of performance test checks necessary to verify antenna group performance.

1. Antenna Array. Two series of tests are necessary for the antenna array, single antenna Impedance and swept frequency vswr. The impedance test involves four groups of antenna elements: band A, band B, (behind band A), band B (between band A), and band C. Band B Is broken Into two groups because the physical arrangement places half of the elements between band A elements and the other half behind band A elements. As a result, each group will have different impedance characteristics. The impedance tests will verify uniform impedance of all elements in a group. The measurements are performed on each element individually, with the impedance measured at the feedpoint. Swept frequency vswr measurements are performed from inside the central building.

2. Antenna Electronics. The equipment involved consists of transmission line tuners (including the transmission lines), directional couplers, rf amplifiers, power dividers and beamformers. The following are required tests:

(a) Single channel amplitude and phase tracking
(b) Input vswr
(c) Single element swept frequency vswr
(d) Single antenna impedance measurement
(e) Transmission line phase tracking

3. Cable Tests. The antenna group has approximately 2700 phase-matched cable assemblies for each site, V7 and V8. The cables are grouped into 12 different lengths from 18 inches to 52 feet. Phased cables are fabricated by alternately trimming and comparing to a standard electrical length cable. The new cable is checked for electrical characteristics that should duplicate the standard reference cable.

6-2. Servicing.

a. Non-Repairable Items. Power dividers/combiners are built from a basic 1:4 unit. The latter is in a metal case completely soldered around the seams. Repair of these units is not feasible. This also applies to directional couplers. Transmission line tuners are also non-repairable items, except that coaxial connectors can be replaced by standard procedures in the event of physical damage.

b. Items Most Subject to Failure. The antenna group electronic equipment is passive except for rf amplifiers. It is probable that these units will require the most servicing.

6-3. Maintenance Support Equipment. (See table 6-1.)

Test equipment required for maintenance and performance test checks of the antenna group Is listed in table 6-1. This equipment is in addition to that included in the Analog Test Station for individual card/unit repair and checkout.

6-4. Performance Test Standards and Tables.

Performance test standards and tables are not included in this manual because of system configuration and the on-line monitor and test (olm&t) procedures described in paragraph 6-6. Performance test checks are included in paragraphs 6-10 through 6-14. The performance test checks are to ensure that the system is operating above the olm&t system performance standards. The transmission line phase tracking check (see paragraph 6-12) must always be performed if a line tuner is replaced or adjusted.

Table 6-1. Maintenance Support Equipment

Equipment Identification	Characteristics
HP 8610A Generator/Sweeper	Frequency Coverage: 1.5 to 110 MHz110 MHz Frequency Accuracy: ±1 percent of frequency ±100 kHz Frequency Linearity: ± 0.5 percent of full sweep

Table 6-1. Maintenance Support Equipment

Equipment Identification	Characteristics
	Frequency Stability: (0.005 percent ±500 Hz)/5 minutes Harmonic Suppression: (cw output level below +10 dBm).at least 35 dB below carrier; spurious signals at least 40 dB below carrier Rf output level: +20 to -100 dBm Flatness: ±0.1 dB over any 10-MHz portion of coverage Sweep: Manual sweep, continuous tuning over preset limits; sweep from low to high preset frequency Sweep Output: to 7 volts VTO Output: 200.1 to 310 MHz at -25 dBm minimum Blanking: -4-volt pulse concurrent with rf blanking Auxiliary Output: For frequency counter monitoring
HP8407A Network Analyzer and HP8412A Phase-Magnitude Display with Accessory Kit 11652A	8407A Test Input: Direct: -10 to -90 dBm Attenuated: +20 to -50 dBm Impedance: 50 ohms Reference Input: Direct: level required is -10 to -60 dBm. Attenuated: level required is +20 to -30 dBm Impedance: 50 ohms Amplitude accuracy: Frequency response: ±0.3 dB, 0.1 to 116 MHz; ±0.1 dB over any 10-MHz portion Display reference: 0.05 dB/1-dB step, total error does not exceed 0.1 dB; 0.1-dB/10-dB step, total error does not exceed 0.25 dB

Table 6-1. Maintenance Support Equipment (Continued)

Equipment Identification	Characteristics
	Reference channel level variation: 0.5 dB/10 dB over 30-dB operating range
	Phase accuracy (amplitude reading must be on-scale at the 10-dB/division setting):
	Frequency response: ± degrees 0.1 to 116 MHz; ±2 degrees over any 10-MHz portion
	Display reference: 0.1 degree/1-dB step, total error does not exceed 0.2 degree; 0.5 degree/ 10-dB step, total error does not exceed 1 percent
	Reference channel level variation: 0.4 degree/10dB, I degree total error over 40-dB operating range
	8412A
	Amplitude accuracy:
	Display: 0.08 dB/dB
	Rear output: 0.03 dB/dB
	Phase accuracy:
	Display: 0.065 degree/degree
	Rear output: 0.015 degree/degree
	Phase offset: 0.3-degree/20-degree step, not to exceed total error of 3 degree for 360 degrees of change, positive or negative direction
	Phase versus displayed amplitude: 1 degree/10 dB, 4 degrees total error for 80 dB
	11652A
	General: Reflection-Transmission Kit, contains power splitter, directional bridge, two precision 50 ohm terminations, calibrating short, bnc adapters and matched, low-leakage cables
	Directional bridge: 6-dB coupling in main and auxiliary arm; frequency response ±0.5 dB, 0.1 to 110 MHz; directivity 40 dB, 1 to 110 MHz

Table 6-1. Maintenance Support Equipment (Continued)

Equipment Identification	Characteristics
	Power splitter: 6-dB loss through each arm
	50-ohm termination: return loss 43 dB
HP8600A Digital Marker	Frequency measurements:
	Range: 0.1 kHz to 15 MHz
	Gate time: 10 millisecond (100-Hz resolution)
	Accuracy: ±1 count ± time base accuracy
	Readout: 6 digit with automatic blanking of leading zeros; least significant digit may be suppressed.
	Input Sensitivity: 100 millivolts rms to 10 volts rms. (Do not exceed 10 volts rms.)
	Sample rate: 5/sec
	Reset: Automatic
HP5245M Electronic Counter	Frequency measurements:
	Range: dc coupled, 0 to 50 MHz; ac coupled, 25 Hz to 50 MHz
	Gate time: 1 microsecond to 10 seconds in decade steps
	Accuracy: ± 1 count ± time base accuracy
	Readout: kHz or MHz with positioned decimal point; units annunciator in line with digital display
	Display: 8 digits in-line with rectangular Nixie tubes; 99,999,999 maximum display; including units annunciator and auto-positioned decimal point indication
	Display storage: holds reading between samples; rear panel switch overrides storage
	Attenuation: step attenuator (SENSITIVITY switch) provides nominal sensitivities of 0.1, 1, and 10 volts rms

Table 6-1. Maintenance Support Equipment (Continued)

Equipment Identification	Characteristics
	Trigger level adjustment (minimum): front panel control has ±0.3-volt trigger level range on 0.1volt position, ±3-volt range on]-volt position, ±30-volt range on 10-volt position. A PRESET position automatically centers trigger level at 0 volt
	Overload protection: diodes protect input circuit for up to 120 volts rms (500 Hz) on 0.1-volt range, 240 volts rms on 1-volt range, 500 volts rms on 10-volt range
	Pulse measurement: front panel TRIGGER LEVEL adjustment allows counting positive or negative pulses
HP7035B X-Y Recorder	Input ranges: English: 1, 10, 100 millivolts/inch; I and 10 volts/inch; Metric: 0.4, 4, 40, 400 millivolts/cm and 4 volts/cm; continuous vernier between ranges
	Type of inputs: floated and guarded signal pair; ,i rear input connector
	Accuracy: ±0.2 percent of full scale
	Linearity: ±0.1 percent of full scale
	Resettability: ±0.1 percent of full scale
	Zero set: zero may be set up to one full scale in any direction from zero index; lockable zero controls
	Paper holddown: Autogrip electric: will grip any chart up to size of platen
	Pen lift: Electric
HP4815A Rf Vector Impedance Meter	Frequency range: 500 kHz to 108 MHz
	Accuracy: ±2 percent of reading, ±1 percent of reading at 1.59 and 15.92 MHz
	Impedance magnitude measurement range: 1 ohm to 10K ohms in 9 ranges
	Accuracy: ±4 percent of full scale ±[(f/30 MHz) + (Z/25 Kohms)] percent of reading

Table 6-1. Maintenance Support Equipment (Continued)

Equipment Identification	Characteristics
	Calibration: Linear meter scale with increments 2 percent of full scale
HP606B Hf Signal Generator	Frequency range: 50 kHz to 65 MHz in 6 bands
	Accuracy: ±1 percent
	Output level: Adjustable from 0.1 microvolt to 3 volts. Direct reading rf output meter calibrated 0 to 3 volts and -10 dBm to +30 dBm
	Harmonic output: Minimum 30 dB below carrier frequency
SKTU Noise Generator BN4151/2/75	Frequency range: 1 to 1000 MHz
	Vswr: Less than 1.1
	Noise power: Continuously adjustable from 0 to 16 dB
USVH Selective Microvoltmeter BN1521/2	Frequency range: 10 kHz to 30 MHz
	Frequency accurage: 10 kHz to 1 MHz, ± 2 percent ±2.5 kHz; 1 MHz to 30 MHz ±2 percent ±50 kHz
	Voltage and level ranges: 0.2 microvolt to 1 volt or -134 dB to +2 dB
	Image frequency rejection: Greater than 60 dB
Boonton 91H Sensitive Rf Voltmeter	Voltage range: 100 microvolts to 3 volts in 8 ranges
	Frequency range: 20 kHz to 1200 MHz
	Accuracy (full scale): 3 percent from 150 kHz to 100 MHz; 5 percent from 50 kHz to 400 MHz; 10 percent from 20 kHz to 1200 MHz
	Noise: Indicator un-rest less than 2 percent full scale on most sensitive range (0.001 volt); essentially zero on all other ranges
	dB range: 80 dB (70 dB in 10-dB steps plus 10 dB on meter scale)

Table 6-1. Maintenance Support Equipment (Continued)

Equipment Identification	Characteristics
Tektronics 453A 60-MHz Dual Trace Oscilloscope	Bandwidth: 60 MHz at 20 millivolts/division Deflection: 20 millivolts/Division to 10 volts/ division at full bandwidth X-Y Display: 5 millivolts/Division to 10 volts/ division in 11 steps Trigger modes: Automatic or Normal on time base A; Normal triggering only on time base B
Simpson 260-5 Multimeter	
Kings KA-99-69	Rf feed through.

6-5. Voltage Requirements and Sources. (See table 6-2.)

The majority of equipment in the antenna group is passive and requires no power. The rf amplifiers and cooling blowers in racks 401, 403, 404, 408, 415, 416, 420 and 421 are supplied 120 volts ac via an individual convenience bus in each rack. Circuit breaker assignments are shown in table 6-2. Power cord entry is through the top of the rack.

Table 6-2. Antenna Group Circuit Breakers

Circuit Breaker Number	Power To	Circuit Type
CB1	Rack 401	3-wire, single phase, 15 amperes
CB2	Racks 403 and 404	3-wire, single phase, 15 amperes
CB3	Rack 408	3-wire, single phase, 15 amperes
CB6	Racks 415 and 416	3-wire, single phase, 15 amperes
CB7	Racks 420 and 421	3-wire, single phase, 15 amperes

6-6. Checkout (See figure 6-1.)

Under normal operating conditions, the system is operating under the control of the system control group on-line computer. A major function of the computer is to control the on-line monitor and test subgroup (olm&t) in its routine monitoring of system performance and operator requested testing and troubleshooting of various portions of the system. In either case, teletype printouts identify the failure parameters.

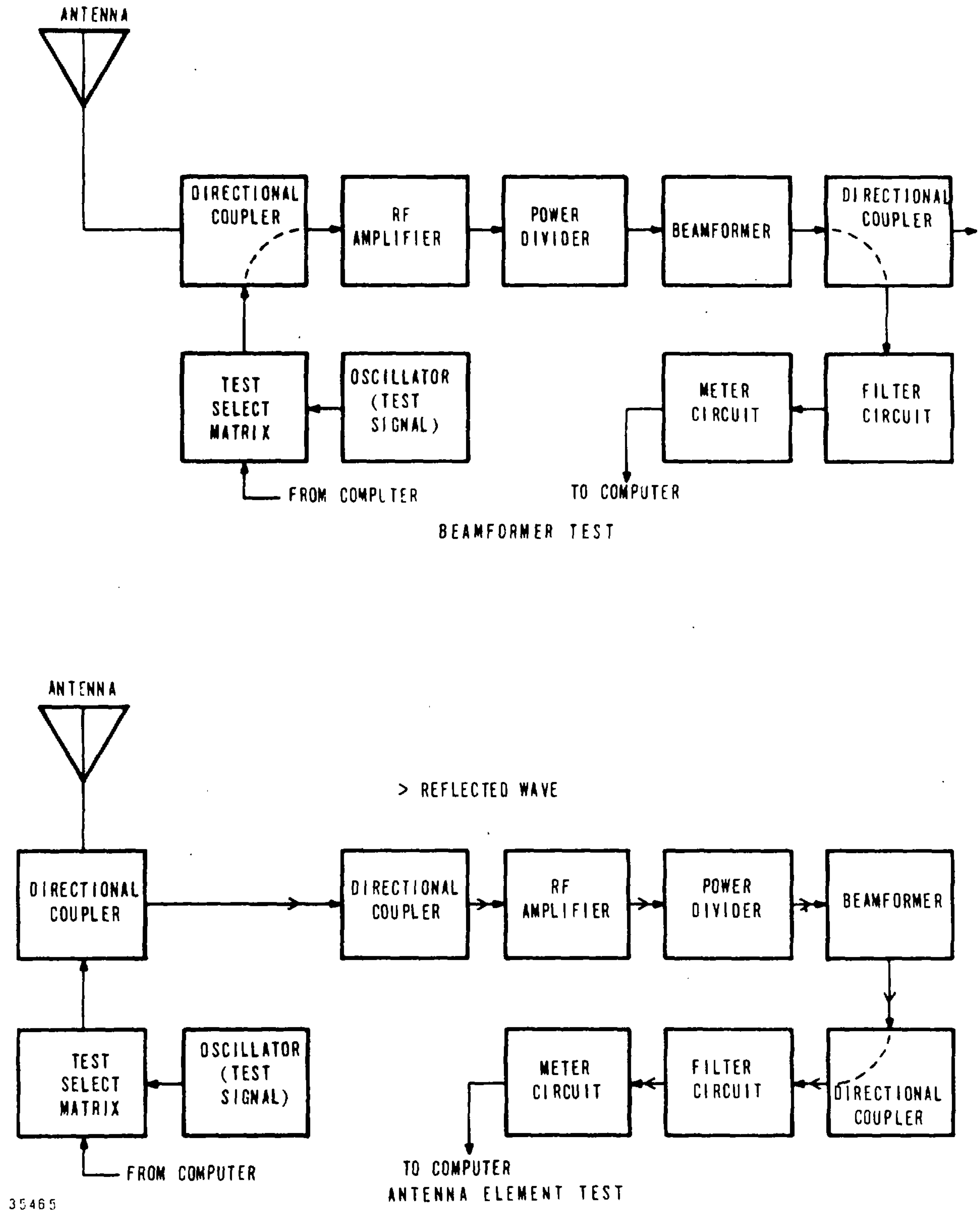

Figure 6-1. Simplified Block Diagram Olm&t Test Signals Through Antenna Group

In most cases, the printout will also Identify the faulty equipment group and unit or assembly within the equipment group. The maintenance routines are performed by the monitor and test group equipment under the control of the system control group computer. As a general rule, the routines are conducted by routing a selected test oscillator signal through a selected path and comparing the resultant output signal to the original test oscillator signal for phase shift or amplitude difference or both where applicable. The tests are selected by the maintenance operator by initiating the required test message to the computer from the teletype (tty) keyboard or by the test switch indicators on the supervisory operation and maintenance console (somc). The selected path and oscillator Is then automatically selected by the program and the two signals are compared in a vector voltmeter. The amplitude and phase comparison is made only in circuits with timed cables where this parameter affects system performance. The results of these comparisons are coupled to the computer. The computer then compares these figures to a tolerance level which has been previously established. Out-of-tolerance signals are output to the tty machine in a message format that defines the reference signal parameters as stored in memory the allowable tolerance as stored in memory, and the measured signal amplitude, phase, or frequency. The antenna group is checked on a go/no-go basis by the online monitor and test equipment (olm&t) in the monitor and test group. There are two tests performed: a check of all beamformer circuits (except nine sector beamformers), and an antenna continuity test. These tests are initiated by pressing the BEAM FORM or ANT TEST switch indicators on the somc in the operations building. The computer controlled tests check the rf paths on a time shared basis with the other portions of the operational program. The beamformer test inserts a test signal via the directional coupler as shown In figure 6-1. The outputs of the beamformers are sequentially measured and compared with programmed amplitude and phase reference and tolerance values. In the antenna continuity test, the oscillator test signal is transmitted through the input directional coupler to the antenna element under test. The reflected wave developed by this element is coupled back through the directional coupler to the monitor beamformer network and then to the vector voltmeter as indicated by the arrows. If the reflected wave amplitude as relayed to the computer is out of tolerance, the antenna or transmission line is defective. The antenna continuity test does not provide a close tolerance analysis of the antenna elements as changes in ground conductivity due to rain and other changing environmental factors precludes close limits. These tests, when initiated will use one of six test oscillator frequencies available in each band. The test frequencies available are shown in table 6-3. Each band (A,R,C) has six reference oscillators, one of which must be assigned for these tests In each band. Band A has 1 through 6; band B has 7 through 12; and band C, 13 through 18. In order to select an oscillator, the operator enters the following message via the tty keyboard:

OSCILLATOR XX

followed by pressing carriage return bar.

Where:

XX is number of oscillator.

Until another oscillator is selected for this band either manually or as a result of the Interference test, all olm&t operations use this oscillator.

Table 6-3. Test Frequencies

Band A		Band B		Band C	
Test Frequency	MHz	Test Frequency	MHz	Test Frequency	MHz
1	1.5	7	6.0	13	18.0
2	2.0	8	7.5	14	19.0
3	3.0	9	9.0	15	22.0
4	3.5	10	12.0	16	24.0
5	4.5	11	14.0	17	27.0
6	6.0	12	18.0	18	30.0

a. Olm&t Test Select Operation. Three antenna group test routines can be selected from the four tests on the somc panel. These are: BEAM FORM (beamformer delay verification), ANT TEST (antenna amplitude verification), and OSC TEST (oscillator frequency verification). The following is general information applicable to sites V7 and V8. Detailed information is provided in paragraphs 6-6.b. through 6-6.g.

1. If all test results are to be printed on the tty, press OLM&T PRINT switch on the somc, otherwise only out-of-tolerance test results will be printed.

2. Select the desired test by selecting the OLM&T TEST SELECT BEAM FORM, ANT TEST, or OSC TEST switch on the somc. The test is repeated until the switch is reset. Two or more tests may be selected simultaneously, but this is not recommended.

3. The tty prints the following message followed by the time and date to show acceptance of the test.

OLMT XXXX TEST START
DAY HH MM SS Z

Where:

X is name of test selected. (BMFR: ANT: OSC)

4. After the test is complete, the tty prints the following message.

OLMT XXXX TEST FINISHED

Where:

X is the name of the test. (BMFR: ANT: OSC)

5. If a fault is located in the beamformer or antenna amplitude verification tests one of the following amplitude or phase messages is printed on the tty to identify the reference, tolerance, and actual levels involved in the test.

REF XXX.X TOL Y.Y AMPZZZ.Z
or
REF ±XXX.X TOL Y.Y PHS ±ZZZ.Z

An oscillator fault is identified by the following frequency message: REF YYYYYYYY TOL ZZ FREQ WWWWWWW

6. To terminate these tests, again press the previously selected test switch. To momentarily suspend the beamformer or antenna amplitude verification test, press

the OLM&T FAULT switch (switch-indicator lights). To resume these tests where halted, press the OLM&T FAULT switch again (switch extinguishes).

b. General Olm&t Test Select Output Messages. The previous paragraph described in general terms three types of tests initiated at the somc. The following information further correlates output messages and activities associated with these tests.

1. General. Each time an olm&t test is requested from the somc or the tty operator enters data or commands via the tty, the computer outputs the time in order to indicate that the input was valid and that the command was honored. The format is as follows:

DAY HH MM SS Z

For example:

365 12 59 59 Z

means day of year 365, 12 hour, 59 minutes, and 59 seconds Greenwich mean time.

2. Commence Olm&t Tests. Each time the somc operator initiates an olm&t test from the somc console, the program identifies the test using the following format.

OLMT XXX TEST START

Where XXXX is:

BMFR Beamformer delay verification test
ANT Antenna amplitude verification test
OSC Oscillator frequency test This message is followed by the time message.

3. Completion of Olm&t Tests. When the olm&t test has completely cycled through its assignments, the computer outputs the teletype message.

OLMT XXXX TEST FINISHED

The value of X being the same as in paragraph c. above.

4. Teletype Input Error Message. When the tty operator attempts to enter a command which does not agree with the format or data limits specified, an error output message results. Its format is as follows:

ILLEGAL FORMAT

In this case, input the command again being sure to use the proper format.

c. Test Operation. Tests previously described, initiated from the somc, perform programmed operational procedures described in the following paragraphs.

1. Beamformer Test. To initiate the beamformer test, press the BEAM FORM switch on the somc. The following messages are printed on the tty.

OLMT BMFR TEST START
DAY HH MM SS Z

(a) Cable Test. At the beginning of the beamformer test, the program performs an olm&t system test (cable test). The cable test involves three reference paths (one per band) through the olm&t network only. The paths are checked with the selected test oscillator in each band. As a result of these tests the following message are printed:

(1) TEST CABLES OK. This message is printed if the reference paths are satisfactory. It is an indication that olm&t is functioning properly.

(2) TEST CABLE FAULT BAND W.

Where:

W is band A, B, or C.

This message is printed when one of the reference cables is found to be out of tolerance. It will be followed immediately by one of the following two messages indicating the fault of the oscillator used in the test or the involved circuits in the monitor and test group. In this case the olm&t circuit is assumed to be faulty and the monitor and test group oscillator and measuring circuits are to be investigated for fault isolation and repair.

(3) Amplitude Message.

REF XXX.X TOL YY.Y AMP ZZZ.Z

Where:

X is reference amplitude in millivolts
Y is tolerance allowed in millivolts
Z is measured amplitude in millivolts.

(4) Phase Message.

REF ±XXX.X TOL Y.Y PHS ±ZZZ.Z

Where:

X is reference phase stored in memory
Y is tolerance allowed in degrees
Z is measured phase in degrees.

These messages give the parameters of a failure. Low amplitude readings may be assumed to be O because the voltmeter measures noise.

(5) Print Test Results. If test results are desired for each cable test, press the PRINT switch. The following message will appear if the PRINT switch is activated during cable test.

CABLE X AMP YYY.Y PHS ±ZZZ.Z

Where:

X is band
Y is amplitude millivolts
Z is phase degrees.

(b) Interference Test. The interference test is performed after the cable test and before testing the beamformers or antenna elements. The oscillators which pass the interference test will be used for all subsequent olm&t tests. The interference test connects the vector voltmeter through a frequency filter to an omni beamformer at the frequency of the selected test oscillator. If the measured signal exceeds the amplitude limit (interference limit) then the test oscillator number for that band will be incremented by one and the test repeated. If interference is excessive at all oscillator frequencies in a band, the originally selected oscillator is used. The following message will be output to the tty.

INT OSC XX

If interference is not excessive, the following message appears once for each band indicating oscillator in use.

OSC XX

Where:

X is oscillator number 1-18.

(c) Beamformer Test Routines. After performing routines in paragraphs (a). and (b). described previously, the actual beamformer testing occurs. The test was initiated by pressing the BEAM FORM switch, which lights white when activated. The test runs until the switch is again pressed which extinguishes the indicator. If allowed, these tests continue and repeat unless terminated. With only the BEAM FORM switch pressed, only faulty conditions are printed by the tty. If all test results are desired, the PRINT switch must also be pressed. In this condition, all measurements taken are printed by the tty. In conducting the beamformer test, the program conducts the previously described cable test and interference test; additionally, monitor beamformer tests, omni beamformer tests and 9 sector beamformer tests are performed. In the cable test, the three in-use oscillator frequencies are coupled directly to the olm&t measuring equipment through the A and B test select matrix (see figure 6-1). The measured amplitude and phase of this signal is compared to values contained in the reference table of the program. If within tolerance, the cable test is considered good; a message indicating this is printed by the tty, and the test next sequences to the interference test. In the interference test, the vector voltmeter is connected to the omni beamformer in each band through a frequency filter at the-frequency of the test oscillator. The measured signal amplitude is compared to reference tables in the program. If the amplitude is excessive, it is assumed that an interfering signal at the same frequency of the test oscillator is being received by the antenna group. In this case the oscillator is incremented by one and the test repeated. When a test oscillator for each band has been selected, the test sequences to the monitor beamformer test. In this test the selected oscillator frequency is input to the antenna group amplifier/power divider and monitor beamformer circuit through the directional coupler on each antenna element. The injected test signal is monitored for amplitude and phase at the output of the monitor beamformer. If this test is out-of-tolerance, the program selects a different monitor beamformer attached to the same amplifier/power divider. The injected test signal through this path is monitored for amplitude and phase. If this test fails, the amplifier/power divider is considered faulty. If this test is good, the original beamformer is considered faulty. As a result, two fault message types may be printed by the tty. Each input port of every beamformer is tested. Therefore, a faulty amplifier/power divider or faulty monitor beamformer will cause a number of out-of-tolerance conditions. These numerous conditions are printed by the tty using shorthand messages. At the conclusion of this test, the program sequences to the omni beamformer test. In this test, the single output port of the three omni beamformers are monitored while the oscillator signal is injected into the directional coupler associated with each amplifier/power divider. The output is measured for both amplitude and phase. At the conclusion of this test. the program sequences to the sector beamformer test. In this test, the output of each of three sector beamformers In each band is monitored while the oscillator signal is injected Into the directional coupler associated with each amplifier/power divider connected to the sector beamformer under test. The output Is measured for both amplitude and phase. The beamformers are tested as described In the following paragraphs.

(1) Amplifier/Power Divider Monitor Beamformer Test. Amplifiers, power dividers and monitor beamformers combine to provide the various monitor beams used In the set. A block diagram showing a simplified amplifier/power divider and monitor beamformer network is shown in figure 6-2. In this simplified block diagram, an eight antenna element array is shown with 1: 4 power dividers. The antenna elements drive the associated amplifier which provide the received signal to the power dividers. The power dividers route signals to beamformers as indicated. Note that if the diagram was completed for the full circle, all power divide ports would be connected to beamformers in the same scheme as illustrated. The beamformer provides the attenuation and delay necessary to form a typical beam. The monitor beam signal is then routed to the rf matrix group and to the olm&t monitoring equipment through the directional coupler. In testing the amplifier/power divider and beamformers, the test oscillator signal is injected into the circuit path at the directional coupler associated with the amplifier/power divider. This signal is routed to the amplifier and then to the power divider. The power divider in turn routes the test signal to the input ports of the associated beamformers. The directional coupler at the

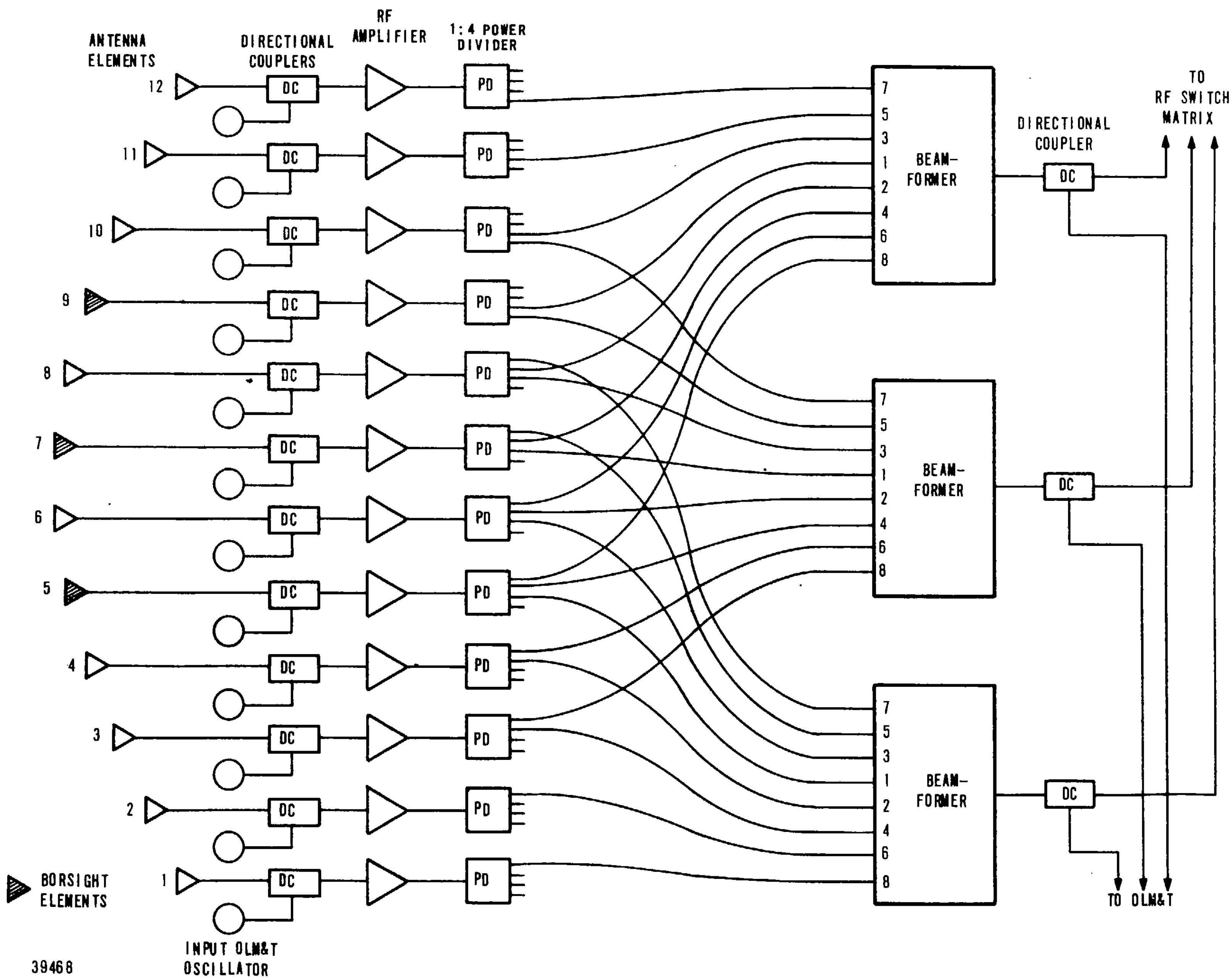

Figure 6-2. Beamforming Network Simplified Block Diagram

output of the beamformer routes this test signal to the olm&t monitoring equipment. The beamformer output is measured and compared against the reference standard in the computer memory. The test begins by selecting the rf path through the amplifier/ power divider and outer channel of the beamformer under test. If this test measurement is within tolerance, the test sequences to the next input to the beamformer under test. In this test, the test signal is injected to the directional coupler associated with the amplifier which is the next input to the beamformer under test. This sequence continues until all inputs to the beamformer under test have been checked. The program then steps to the next beamformer and repeats the cycle. This cycle is repeated until all inputs to all monitor beamformers have been checked. When any measurement is out of tolerance, a fault isolation test is conducted to determine the faulty component. Note that the fault could be the beamformer under test, the power divider, or the amplifier. To localize the fault, a different beamformer associated with the same power divider is selected for a comparison test. This new beamformer uses the same antenna element as the original beamformer where the antenna element has approximately the same electrical displacement from boresight. This comparison test reveals one of two things, the two tested signals are both out of tolerance or the comparison test signal is within tolerance. If both test signals are out of tolerance, the amplifier/power divider circuit is assumed to be faulty. If the comparison test signal is within tolerance, the beamformer is assumed to be faulty. Note that an amplifier failure will cause a fault each time it is used as an input to a beamformer; a beamformer fault or a power divider fault may cause any number of faults to appear. This is due to the construction of these circuits. Therefore, in any one of these three circumstances a number of faults may be noted which are produced by a single faulty circuit amplifier, power divider, or beamformer. Note that the rf amplifier is the only active device in the circuit, and will likely be subject to the most failures.

(2) <u>Test Messages</u>. The amplifier/power divider, beamformer tests develop several messages in defining a faulty circuit. As previously described, the test isolates a fault to either a beamformer or a combination of amplifier/power divider. In testing the amplifier/power divider beamformer path, the output of a beamformer is monitored while the input is sequenced from one antenna element directional coupler to the next. In this manner each input and associated path in the beamformer is monitored. In this testing procedure a number of fault messages may be generated due to a single malfunctioning circuit.

(3) <u>Beamformer Fault Sequence</u>. When the fault isolation test identifies a beamformer fault, the program will print a tty message. The first fault message during a test cycle associated with a particular beamformer is printed using the longhand message of paragraph 6-6.c.1.(d). Amplitude and phase are considered separately and may result in a longhand message for each type of fault. Subsequent faults during one test cycle associated with this beamformer may result in either longhand or shorthand messages. When the program determines that a subsequent fault is identified for this beamformer, the antenna element number associated with the input directional coupler used in the measurement is examined. If this element number is one greater than the element number found in the previous fault condition for this beamformer, the shorthand beamformer fault messages is printed. This identifies a fault sequence for one beamformer in which two or more sequential inputs to the beamformer result in faults. The beamformer identified in a longhand or shorthand fault message should be investigated for problems using the special monitor beamformer test (see paragraph 6-6.f.1.). If the element number for the current fault condition is more than one greater than the element number associated with the previous fault condition, another longhand message is output.

Thus, if a beamformer is marginal, shorthand or longhand output messages may result depending on whether the faults are associated with sequential inputs or not. Since all input ports to a beamformer are checked sequentially, a beamformer with a total failure results in one longhand amplitude fault message, one longhand phase fault message and a series of shorthand amplitude and phase beamformer fault messages.

(4) Amplifier/Power Divider Fault Sequence. When the fault isolation test identifies power divider fault, an amplifier/power divider fault message is printed by the tty. The first fault message during a test cycle associated with a particular amplifier/power divider is output using the longhand format of paragraph 6-6.c.1.(g) as follows. As with beamformer faults, amplitude and phase are considered separately and may each result in a longhand message. When the program determines that a subsequent fault is identified for this particular amplifier/power divider, the beamformer number used in the measurement is examined. If this beamformer number is one greater than the beamformer number found in the previous fault condition for this amplifier/power divider, the shorthand amplifier/power divider fault message is printed. This identifies a fault sequence for one amplifier/power divider in which the test fails each time the amplifier/power divider is used as input to a series of beamformers. Note that the beamformer test sequence tests all inputs to a single beamformer before proceding to the next beamformer. Thus, several paths will be tested between any two test measurements involving a particular amplifier/power divider. These path tests do not have any effect on the longhand/shorthand determination for a particular amplifier/power divider fault. The amplifier/power divider associated with the antenna element identified in a longhand or shorthand amplifier/ power divider fault message may be investigated by using the special monitor beamformer test on any beam in which the amplifier/power divider is used as an input. If the beamformer number associated with a fault condition for a particular amplifier/ power divider is more than one greater than the beamformer number associated with the previous fault condition for this amplifier/power divider, another longhand message is printed. The sequence of longhand and/or shorthand messages for either a beamformer or amplifier/power divider fault is not critical. Any fault message is sufficient to identify a component to be investigated further using the special beamformer test tty command.

(d) Beamformer Longhand Messages. Beamformer failure message is defined as follows.
(1) BMFR FAILURE BAND X BEAM YY
(2) BAND X BEAM YY PORT ZZ FAULT
(3) REF XXX.X TOL Y.Y AMP ZZZ.Z
(4) REF ±XXX.X TOL Y.Y PHS ±ZZZ.Z

The first message defines the band as A, B, or C and the monitor beam found to be out of tolerance; the second message again defines the band and monitor beam plus the input port of the monitor beamformer under test; the last two messages define the amplitude or phase measurement which was out of tolerance, the reference value, and the tolerance. Only one message, (3) or (4), will appear on the tty at any one time.

(e) Beamformer Shorthand Amplitude Message. The beamformer amplitude shorthand message is the shorthand form of the data in the preceding paragraph (d) (1), (2), and (3). This message is as follows.

BM XX AM

Where:

XX is the beamformer under test.

(f) Beamformer Shorthand Phase Message. The beamformer phase shorthand message is the shorthand form of the data in the preceding paragraph (d)(4). This message is as follows.

BM XX PH

Where:

XX is the beamformer under test.

(g) Amplifier/Power Divider Longhand Messages. Amplifier/power divider failure message is defined as follows.

(1) AMP/PWR DIV FAILURE BAND X ANT Z
(2) BAND X BEAM YY PORT ZZ FAULT
(3) REF XXX.X TOL Y.Y AMP ZZZ.Z
(4) REF ±XXX.X TOL Y.Y AMP ±ZZZ.Z

The first message defines the band as A, B, or C and the antenna element connected to the faulty amplifier; the second message again defines the band plus the monitor beam where the test signal is measured and the input port of the beamformer where the signal is injected; the last two messages, only one appearing at any one time, defines the amplitude or phase measurement which was out of tolerance, the reference value, and the tolerance.

(h) Amplifier/Power Divider Shorthand Amplitude Message. The amplifier/power divider amplitude message is the shorthand form of the data in the preceding paragraph (g) (1), (2), and (3). This message is as follows.

ANT XX AM

Where:

XX is the antenna element number connected to the amplifier under test.

(i) Amplifier/Power Divider Shorthand Phase Message. The amplifier/power divider phase message is the shorthand form of the data in the preceding paragraph (g)(1), (2), and (4). This message is as follows.

ANT XX PH

Where:

XX is the antenna element number connected to the amplifier under test.

(j) Print Test Results. If test results are desired for each beamformer test press the PRINT switch. The following message results if the PRINT switch is activated during beamformer test.

MONI BEAM XX BAND Y

Where:

X is beam under test Y is band under test

It appears as each new beam is tested. It is followed by the following message.

ANT XX AMP YYY.Y PHS ±ZZZ.Z

Where:

X is antenna number
Y is measured amplitude in millivolts
Z is measured phase in degrees.

This message appears 16 times for each beam in bands A and B and 8 times for band C.

(k) Omni Beamformer Test.

(1) Omni Test. Immediately following the monitor beamformer test, the program tests the omni beamformers. In this test the output port of the omni beamformer is monitored while the test signal is injected in each applicable input port from the antenna element directional coupler. The following message is printed to denote a fault.

BAND X OMNI PORT YY FAULT

Where:

X is band A, B, or C Y is antenna number for omni input.

This message appears when an omni beamformer measurement is out of tolerance. No fault isolation is done. This message is followed by the amplitude or phase message previously described. The omni beamformer portion of the antenna group should be investigated for fault isolation and repair when this message appears.

(2) Print Test Results. If test results are desired for each omni input port press the PRINT switch. The following message appears at the beginning of each omni beam tested if the PRINT switch is on.

OMNI BEAM BAND X

Where:

X is band A, B, or C.

This message is followed by the following message a total of 48 times for band A or C and 96 times for band B to define the measured values of each input port.

ANT XX AMP YYY.Y PHS ± ZZZ. Z

Where:

X is antenna element input number Y is measured amplitude in millivolts Z is measured phase in degrees.

(I) Sector Beamformer Tests.

(1) Sector Tests. Immediately following the omni beamformer tests, the program tests sector beamformers Nos. 1 through 6 In each band. In this test the outputs of the sector beamformers are monitored while the test signal is injected in each applicable input port from the antenna element directional coupler. Four antenna elements are used per beam in band A, three in band B, and two in band C. The following message is printed to denote a fault.

BAND X SECT Y ANT ZZ FAULT

Where:

X is band A, B, or C

Y is sector beamformer 1, 2, 3, 4, 5, or 6

Z is antenna number for sector input.

This message appears when a sector beamformer is out of tolerance. No fault isolation is done. This message is followed by the amplitude or phase message previously described. The sector beamformer portion of the antenna group should be investigated for fault isolation and repair when this message appears.

(2) Print Test Results. If test results are desired for each sector input port, press the PRINT switch. The following message appears at the beginning of a sector beamformer test when the PRINT switch is on.

SECT BEAM X BAND Y

Where:

X is sector beam 1, 2, 3, 4, 5, or 6

Y is band A, B, or C.

This message is followed by the following message a total of four times for each beam in band A, three times for each beam in band B, and two times for each beam in band C to define the measured values of each input port.

ANT XX AMP YYY.Y PHS ± ZZZ.Z

Where:

X, Y, and Z is the same as in preceding paragraph (k)(2).

The following message appears at the end of each monitor, omni, or sector beam test result when the PRINT switch is on to specify the tolerance limits on which the tests are made.

AMP TOL X.X PHS TOL Y.Y

Where:

X is amplitude tolerance in millivolts Y is phase tolerance in millivolts.

(m) Beamformer Test Complete. At the conclusion of the beamformer test, the following message is printed by the tty.

OLMT BMFR TEST FINISHED

The program will cycle through another beamformer test if the BEAM FORM switch remains set (lamp lit). Reset the BEAM FORM switch (lamp extinguished) to terminate the test.

NOTE

After terminating somc beamformer tests, tests of individual monitor, sector, or omni beamformers may be accomplished using tty commands defined in paragraph 6-6.f.

d. Antenna Element Tests.

1. General. The antenna element test is controlled from the somc. The test is initiated by pressing the ANT TEST switch, which lights when activated. The test runs until the switch is again pressed, repeating the antenna element test if allowed. If only the ANT TEST switch is pressed only faulty conditions are printed by the tty. If all test results are desired the PRINT switch must also be pressed. In conducting the antenna element test, the test oscillator signal is coupled through the input directional coupler to the antenna element under test (see figure 6-1). The reflected wave developed by the element under test is coupled back through the same directional coupler to the antenna group monitor beamformer network. The signal is monitored at the beamformer which has the antenna element as a boresight element. The amplitude of this signal is compared to the reference amplitude as stored in memory. This procedure is repeated once for all elements in each band.

2. Antenna Element Test Start. To initiate the antenna element test, press the ANT TEST switch on the somc. The following messages are printed on the tty.

OLMT ANT TEST START

DAY HH MM SS Z

3. Interference Tests. The same interference test used in the beamformer test is conducted prior to conducting the antenna element test. Note that the cable test is not conducted prior to this test.

4. Element Tests. The antenna element test uses the same networks as the beamformer test except that the test signal is injected through the directional coupler to the antenna element rather than to the beamformer network. The reflected wave is then coupled back through the same directional coupler through the boresight input port of the beamformer for measurement. If a faulty antenna element is located, the following message is printed on the tty.

ANT X YY FAULT

Where:

X is band A, B, or C YY is antenna element number.

This message is followed by the amplitude message previously described to further define the fault. In such cases the antenna group antenna elements and transmission lines are to be investigated for fault isolation and repair.

5. Print Test Results. If test results are desired for each antenna element test, press the PRINT switch. The following message results when PRINT switch is on during antenna test.

ANT TST X YY AMP ZZZ.Z

Where:

X is band A, B, or C
Y is antenna number
Z is measured amplitude in millivolts.

6. Antenna Element Test Complete. At the conclusion of the antenna element test, the following message is printed on the tty.

OLMT ANT TEST FINISHED

To terminate test, reset the ANT TEST switch (lamp extinguished).

NOTE

After terminating somc antenna tests, tests of individual antenna elements may be accomplished using tty commands defined in paragraph 6-6.f.2.

e. Oscillator Test Procedures. The oscillator test is designed to test the frequency of each of the 18 olm&t oscillators. To initiate this test, momentarily press OSC TEST. The following messages are printed each time the oscillator test starts.

OLMT OSC TEST START DAY
HH MM SS Z

The following message is printed for each oscillator with a frequency which is out of tolerance.

OSC XX FREQ FAULT
REF YYYYYYYY TOL ZZ FREQ WWWWWWWW

Where:

X is oscillator number 1-18
Y is reference frequency in Hz
Z is tolerance for oscillator XX
W is measured frequency in Hz.

1. Print Test Results. The following message is printed for each oscillator if the PRINT switch is activated at the somc during the oscillator test.

OSC XX FREQ YYYYYYYY

Where:

X is oscillator 1-18
Y is measured frequency in Hz.

2. Oscillator Test Complete. This message is printed each time the oscillator test cycle is completed.

OLMT OSC TEST FINISHED

To terminate the test, reset the OSC TEST switch (lamp extinguished).

NOTE

After terminating the somc oscillator test, tests of individual oscillators may be accomplished using the commands defined in paragraphs 6-6.f.3. and 6-6.g.3.

f. Teletype Test Select Operation. The previously described tests initiated from the somc panel are relatively time consuming particularly if full printouts are desired when the somc PRINT switch is activated. After a repair is completed, the affected circuit may be individually checked from the tty console by using the following described commands. The only circuit checked is the one specifically entered via the tty machine. If the operator makes an error, pressing the rubout key removes the last character input. Inputting a slash (/) deletes an entire input line. The tty inputs have the same basic format. It consists of a command followed by a carriage return which indicates the end of the input message. Each message is checked for format errors and indicated to the operator that the command is accepted by printing day of year and time of day or rejected by an ILLEGAL FORMAT message. Commas and spaces are used as field separators. The following paragraphs define applicable antenna group input messages. In each case, after the command is entered, the carriage return bar must be pressed to initiate the test.

1. Special Beamformer Tests. To initiate a special beamformer test using the olm&t network, the operator enters the parameters specifying the network to be tested. The operator enters one of the following messages:

(a) TEST OMNI X to test the omni beam for band X, where X is A, B, or C
(b) TEST SECT X,Y to test a sector beam where X is band A, B, or C and Y is sector 1, 2, or 3
(c) TEST MONI X,YY to test a monitor beam where X is band A, B, or C and Y is the beam number

2. Special Antenna Element Test. To initiate a special antenna element test, the operator enters the following message: TEST ANT X,YY Where: X is band A, B, or C YY is the antenna number.

3. Special Oscillator Test. To initiate a special oscillator test using the olm&t network, the operator enters the following message:

TEST OSC FREQ XX

Where:
X is oscillator 1-18. (See table 6-3.)

g. Teletype Selected Test Output Messages. Special beamformer, antenna element, and oscillator tests use the same test routines used in the somc olm&t tests; however, the cable and interference tests are not used in these tests. The tests are initiated by inputting one of the single element test messages defined in the previous subparagraphs. If the test measurements are within tolerance and if the PRINT switch is off, the single word message DONE is output. If the test measurements are not within tolerance, a fault message is output regardless of the PRINT switch setting to define the fault. These fault messages are identical to the fault messages output during the somc olm&t tests. If the PRINT switch is ON, test results are output as defined in paragraph 6-6.c.1.(j), (k)(2), (1)(2), 6-6.d.5, and 6-6.e.1. The test is terminated in all cases with the message DONE.

1. Beamformer Test Output Messages. The beamformer test printout is the format as described in paragraph 6-6.c.1(d) through (m). Shorthand messages are obtained sequential when consecutive ports in a beamformer are proven to be defective. Only the beamformer circuit requested is checked. The somc PRINT switch will initiate phase and amplitude printouts as previously described.

2. Special Antenna Element Test Output Messages. The antenna element test will contain the format contained in paragraphs 6-6.d.4 and 5. Only the antenna element entered is tested. The somc PRINT switch will activate amplitude printouts.

3. Oscillator Test Output Messages. Refer to paragraph 6-6.e. for messages printed for each oscillator with a frequency which is out of tolerance.

6-7. Troubleshooting.

Antenna group troubleshooting requires rapid identification of circuits, their location, and the associated group components. Tables 6-4 through 6-20 provide quick identification of all rf paths. The tables present wiring information in a form that enables rapid identification and location of all rf paths. The tables for the monitor, sector, and omni beam formation (tables 6-4 through 6-13) do not reference the associated line tuners with antenna elements. These tables can be read from the top (antenna element) down, and then to the left on the horizontal line for the beam of concern. The tables can also be read from the left (beam number) right to the vertical column for the antenna element of concern. In either method, each component and port will be identified. Separate tables (tables 6-14 through 6-20) list-line tuners to antenna elements and goniometer inputs because these references are used the least. Due to the large number of signal paths, it is not considered feasible as a routine procedure to manually open a path, inject a signal, and look for it in another location for test purposes. Additionally, this procedure will degrade performance of receiving locations in the system as a result of disabling a signal path. These tables are useful in locating and identifying the to-from connections of cables without resorting to wire lists.

a. Troubleshooting Cables. Visually inspect suspected defective cables, particularly for bent pins in connectors. The timed cables that have been subjected to mechanical abuse may have to be rechecked for the correct electrical length (paragraph 6-11). It is essential when disconnecting or connecting these cables that they are not forced, bent or subjected to any more strain than is absolutely necessary. The preferred continuity check for cables consists of the following:

1. Insert a 200to 300-millivolt rf signal at one end of the cable. Use a low frequency that will not disturb receiving activities and is low enough to be accepted by the vertical amplifier of the oscilloscope (see next step).

2. Terminate the cable in 75 ohms (noninductive resistor) at the other end. Connect the terminated end to a general-purpose oscilloscope and view amplitude. Use enough vertical gain so that small changes in display are visible. While viewing the oscilloscope, flex the cables at the connectors and at any other locations where damage is suspected. Any intermittent connections are easily observed on the oscilloscope waveform. This procedure is preferable to simple ohmmeter checks.

ANTENNA ELEMENT NUMBER					32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
DIRECTIONAL COUPLER RACK NUMBER					404																	408																					
DIRECTIONAL COUPLER ASSEMBLY NUMBER					8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
RF AMPLIFIER ASSEMBLY NUMBER					A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B
POWER DIVIDER RACK NUMBER					407													406								405																406	
POWER DIVIDER ASSEMBLY NUMBER					A9A	A9B	A10B	A11B	A12B	A13B	A14B	A15B	A16B	A16A	A15A	A14A	A13A	A13B	A14B	A15B	A16B	A9A	A10A	A11A	A12A	A12B	A11B	A10B	A9B	A9A	A10A	A11A	A12A	A13A	A14A	A15A	A16A	A16B	A15B	A14B	A13B	A13A	A14A
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO																																							
1	412	21	407	A1B	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																							
2	412	22	407	A2B		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																						
3	412	23	407	A3B			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																					
4	412	24	407	A4B				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
5	412	25	407	A5B					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																			
6	412	26	407	A6B						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
7	412	27	407	A7B							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																	
8	412	28	407	A8B								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
9	412	29	407	A8A									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16															
10	412	30	407	A7A										15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
11	412	31	407	A6A											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16													
12	412	32	407	A5A												15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
13	412	33	406	A5B													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16											
14	412	54	406	A6B														15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
15	412	55	406	A7B															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16									
16	412	56	406	A8B																15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
17	412	57	406	A8A																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16							
18	412	58	406	A7A																		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
19	412	59	406	A6A																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16					
20	412	60	406	A5A																				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
21	412	61	405	A5B																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16			
22	412	62	405	A6B																						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
23	412	63	405	A7B																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16	
24	412	64	405	A8B																								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

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Table 6-4. Monitor Beam Formation Chart, Band, A, (V7)

ANTENNA ELEMENT NUMBER					8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
DIRECTIONAL COUPLER RACK NUMBER					← 408 →																	← 404 →																					
DIRECTIONAL COUPLER ASSEMBLY NUMBER					8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22	23
RF AMPLIFIER ASSEMBLY NUMBER					A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B
POWER DIVIDER RACK NUMBER					← 405 →													← 406 →								← 407 →																← 406 →	
POWER DIVIDER ASSEMBLY NUMBER					A9B	A9A	A10A	A11A	A12A	A13A	A14A	A15A	A16A	A16B	A15B	A14B	A13B	A13A	A14A	A15A	A16A	A9B	A10B	A11B	A12B	A12A	A11A	A10A	A9A	A9B	A10B	A11B	A12B	A13B	A14B	A15B	A16B	A16A	A15A	A14A	A13A	A13B	A14B
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO																																							
25	412	65	405	A8A	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																							
26	412	66	405	A7A		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																						
27	412	87	405	A6A			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																					
28	412	88	405	A5A				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
29	412	89	405	A4A					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																			
30	412	90	405	A3A						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
31	412	91	405	A2A							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																	
32	412	92	405	A1A								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
33	412	93	405	A1B									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16															
34	412	94	405	A2B										15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
35	412	95	405	A3B											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16													
36	412	96	405	A4B												15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
37	412	97	406	A4A													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16											
38	412	98	406	A3A														15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
39	412	99	406	A2A															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16									
40	412	120	406	A1A																15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
41	412	121	406	A1B																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16							
42	412	122	406	A2B																		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
43	412	123	406	A3B																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16					
44	412	124	406	A4B																				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
45	412	125	407	A4A																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16			
46	412	126	407	A3A																						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
47	412	127	407	A2A																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16	
48	412	128	407	A1A																								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

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Table 6-4. Monitor Beam Formation Chart, Band A, (V7) (Continued)

ANTENNA ELEMENT NUMBER					8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
DIRECTIONAL COUPLER RACK NUMBER					408																	404																					
DIRECTIONAL COUPLER ASSEMBLY NUMBER					8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
RF AMPLIFIER ASSEMBLY NUMBER					A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B
POWER DIVIDER RACK NUMBER					407													406								405																406	
POWER DIVIDER ASSEMBLY NUMBER					A9A	A9B	A10B	A11B	A12B	A13B	A14B	A15B	A16B	A16A	A15A	A14A	A13A	A13B	A14B	A15B	A16B	A9A	A10A	A11A	A12A	A12B	A11B	A10B	A9B	A9A	A10A	A11A	A12A	A13A	A14A	A15A	A16A	A16B	A15B	A14B	A13B	A13A	A14A
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAMFORMER RACK	BEAMFORMER NO.								SEE	NOTE 1																														
1	412	21	407	A1B	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16	SEE	NOTE 2																					
2	412	22	407	A2B		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																						
3	412	23	407	A3B			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																					
4	412	24	407	A4B				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
5	412	25	407	A5B					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																			
6	412	26	407	A6B						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
7	412	27	407	A7B							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																	
8	412	28	407	A8B								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
9	412	29	407	A8A									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16															
10	412	30	407	A7A										15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
11	412	31	407	A6A											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16													
12	412	32	407	A5A												15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
13	412	33	406	A5B													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16											
14	412	54	406	A6B														15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
15	412	55	406	A7B															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16									
16	412	56	406	A8B																15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
17	412	57	406	A8A																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16							
18	412	58	406	A7A																		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
19	412	59	406	A6A																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16					
20	412	60	406	A5A																				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
21	412	61	405	A5B																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16			
22	412	62	405	A6B																						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
23	412	63	405	A7B																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16	
24	412	64	405	A8B																								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

NOTES:

1. THIS ENTRY IS THE FIRST ONE LISTED IN CABLE ASSEMBLY WIRE LIST 3300-82019
2. POWER DIVIDER OUTPUT PORTS CONNECT TO BEAMFORMER INPUT PORTS OF THE SAME NUMBER (A OUTPUTS MAY CONNECT TO B INPUTS, BUT NUMBER IS SAME)
   EXAMPLE: ANTENNA ELEMENT 15 TO POWER DIVIDER 407A15B, OUTPUT PORT J1(J1B) (FROM HORIZONTAL COLUMN) CONNECTS TO BEAMFORMER 407A1B. INPUT PORT IS J1(J1B)

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Table 6-5. Monitor Beam Formation Chart, Band A, (V8)

ANTENNA ELEMENT NUMBER					32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
DIRECTIONAL COUPLER RACK NUMBER					404																	408																					
DIRECTIONAL COUPLER ASSEMBLY NUMBER					8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
RF AMPLIFIER ASSEMBLY NUMBER					A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B
POWER DIVIDER RACK NUMBER					405													406								407																406	
POWER DIVIDER ASSEMBLY NUMBER					A9B	A9A	A10A	A11A	A12A	A13A	A14A	A15A	A16A	A16B	A15B	A14B	A13B	A13A	A14A	A15A	A16A	A9B	A10B	A11B	A12B	A12A	A11A	A10A	A9A	A9B	A10B	A11B	A12B	A13B	A14B	A15B	A16B	A16A	A15A	A14A	A13A	A13B	A14B
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.																																							
25	412	85	405	A8A	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																							
26	412	86	405	A7A		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																						
27	412	87	405	A6A			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																					
28	412	88	405	A5A				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
29	412	89	405	A4A					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																			
30	412	90	405	A3A						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
31	412	91	405	A2A							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																	
32	412	92	405	A1A								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
33	412	93	405	A1B									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16															
34	412	94	405	A2B										15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
35	412	95	405	A3B											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16													
36	412	96	405	A4B												15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
37	412	97	406	A4A													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16											
38	412	98	406	A3A														15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
39	412	99	406	A2A															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16									
40	412	120	406	A1A																15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
41	412	121	406	A1B																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16							
42	412	122	406	A2B																		15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
43	412	123	406	A3B																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16					
44	412	124	406	A4B																				15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
45	412	125	407	A4A																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16			
46	412	126	407	A3A																						15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
47	412	127	407	A2A																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16	
48	412	128	407	A1A																								15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

35739B

Table 6-5. Monitor Beam Formation Chart, Band A, (V8) (Continued)

ANTENNA ELEMENT NUMBER					72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	1	2	3	4	5	6	7	8	9	10	11	12	13
DIRECTIONAL COUPLER RACK NUMBER					420	421																								415												
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					418	417																																418				
POWER DIVIDER ASSEMBLY NUMBER					A12B	A12C	A12D	A11C	A11D	A10C	A10D	A9C	A9D	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A13A	A13B	A14A	A14B	A15A	A15B	A16A	A16B	A16C	A16D	A15C	A15D	A14C	A14D	A13C	A13D	A13A	A13B	A14A	A14B	A15A
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.							SEE NOTE 1																															
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																						
1	412	8	417	A1A	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																						
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
2	412	9	417	A2A			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
3	412	10	417	A3A					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
4	412	11	417	A4A							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
5	412	12	417	A5A									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
6	412	13	417	A6A											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
7	412	14	417	A7A													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
8	412	15	417	A8A															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
9	412	16	417	A8B																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
10	412	17	417	A7B																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
11	412	18	417	A6B																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
12	412	19	417	A5B																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

POWER DIVIDER OUTPUT PORTS
BEAMFORMER INPUT PORTS

NOTES: 1. THIS ENTRY IS THE FIRST LISTING IN CABLE ASSEMBLY WIRE LIST 3300-82034

35743A

Table 6-6. Monitor Beam Formation Chart, Band B, (V7)

ANTENNA ELEMENT NUMBER					98	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
DIRECTIONAL COUPLER RACK NUMBER					421	← 415 →																								← 416 →												
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					← 418 →																									← 419 →												
POWER DIVIDER ASSEMBLY NUMBER					A16B	A16C	A16D	A15C	A15D	A14C	A14D	A13C	A13D	A13A	A13B	A14A	A14B	A15A	A15B	A16A	A16B	A9C	A9D	A10C	A10D	A11C	A11D	A12C	A12D	A12A	A12B	A11A	A11B	A10A	A10B	A9A	A9B	A9C	A9D	A10C	A10D	A11C
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.																																						
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
13	412	20	418	A5A	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		BEAMFORMER INPUT PORTS																				
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
14	412	41	418	A6A			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
15	412	42	418	A7A					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
16	412	43	418	A8A							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
17	412	44	418	A8B									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
18	412	45	418	A7B											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
19	412	46	418	A6B													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
20	412	47	418	A5B															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
21	412	48	419	A5A																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
22	412	49	419	A6A																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	15				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
23	412	50	419	A7A																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
24	412	51	419	A8A																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

35743B

Table 6-6. Monitor Beam Formation Chart, Band B, (V7) (Continued)

ANTENNA ELEMENT NUMBER					24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
DIRECTIONAL COUPLER RACK NUMBER					415	416																								420												
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					418	419																																418				
POWER DIVIDER ASSEMBLY NUMBER					A12D	A12A	A12B	A11A	A11B	A10A	A10B	A9A	A9B	A9C	A9D	A10C	A10D	A11C	A11D	A12C	A12D	A13C	A13D	A14C	A14D	A15C	A15D	A16C	A16D	A16A	A16B	A15A	A15B	A14A	A14B	A13A	A13B	A13C	A13D	A14C	A14D	A15C
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.																																						
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
25	412	52	419	A8B	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		BEAMFORMER INPUT PORTS																				
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
26	412	53	419	A7B			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
27	412	74	419	A6B					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
28	412	75	419	A5B							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
29	412	76	419	A4B									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
30	412	77	419	A3B											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
31	412	78	419	A2B													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
32	412	79	419	A1B															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
33	412	80	419	A1A																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
34	412	81	419	A2A																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
35	412	82	419	A3A																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
36	412	83	419	A4A																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

35743C

Table 6-6. Monitor Beam Formation Chart, Band B, (V7) (Continued)

ANTENNA ELEMENT NUMBER					48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
DIRECTIONAL COUPLER RACK NUMBER					416	420																								421												
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					419									418																417												
POWER DIVIDER ASSEMBLY NUMBER					A16D	A16A	A16B	A15A	A15B	A14A	A14B	A13A	A13B	A13C	A13D	A14C	A14D	A15C	A15D	A16C	A16D	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A12C	A12D	A11C	A11D	A10C	A10D	A9C	A9D	A9A	A9B	A10A	A10B	A11A
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.																																						
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
37	412	84	418	A4B	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		BEAMFORMER INPUT PORTS																				
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
38	412	85	418	A3B			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
39	412	86	418	A2B					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
40	412	107	418	A1B							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
41	412	108	418	A1A									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
42	412	109	418	A2A											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
43	412	110	418	A3A													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
44	412	111	418	A4A															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
45	412	112	417	A4B																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
46	412	113	417	A3A																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
47	412	114	417	A2B																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
48	412	115	417	A1B																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

357430

Table 6-6. Monitor Beam Formation Chart, Band B, (V7) (Continued)

ANTENNA ELEMENT NUMBER					24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
DIRECTIONAL COUPLER RACK NUMBER					415	416																								420												
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					417																	418																419				
POWER DIVIDER ASSEMBLY NUMBER					A12B	A13A	A13B	A14B	A14A	A15A	A15B	A16A	A16B	A16C	A16D	A15C	A15D	A14C	A14D	A13C	A13D	A13A	A13B	A14A	A14B	A15A	A15B	A16A	A16B	A9C	A9D	A10C	A10D	A11C	A11D	A12C	A12D	A12A	A12B	A11A	A11B	A10A
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.																																						
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
1	412	8	417	A1A	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		BEAMFORMER INPUT PORTS																				
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
2	412	9	417	A2A			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
3	412	10	417	A3A					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
4	412	11	417	A4A							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
5	412	12	417	A5A									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
6	412	13	417	A6A											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
7	412	14	417	A7A													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
8	412	15	417	A8A															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
9	412	16	417	A8B																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
10	412	17	417	A7B																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
11	412	18	417	A6B																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
12	412	19	417	A5B																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

35740A

Table 6-7. Monitor Beam Formation Chart, Band B, (V8)

ANTENNA ELEMENT NUMBER					48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
DIRECTIONAL COUPLER RACK NUMBER					420																									421												
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					418									419																												
POWER DIVIDER ASSEMBLY NUMBER					A16B	A9C	A9D	A10C	A10D	A11C	A11D	A12C	A12D	A12A	A12B	A11A	A11B	A10A	A10B	A9A	A9B	A9C	A9D	A10C	A10D	A11C	A11D	A12C	A12D	A13C	A13D	A14C	A14D	A15C	A15D	A16C	A16D	A16A	A16B	A15A	A15B	A14A
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.																																						
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
13	412	20	418	A5A	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		BEAMFORMER INPUT PORTS																				
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
14	412	41	418	A6A			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
15	412	42	418	A7A					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
16	412	43	418	A8A							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
17	412	44	418	A8B									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
18	412	45	418	A7B											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
19	412	46	418	A6B													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
20	412	47	418	A5B															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
21	412	48	419	A5A																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
22	412	49	419	A6A																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
23	412	50	419	A7A																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
24	412	51	419	A8A																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

357408

Table 6-7. Monitor Beam Formation Chart, Band B, (V8) (Continued)

ANTENNA ELEMENT NUMBER					72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	1	2	3	4	5	6	7	8	9	10	11	12	13
DIRECTIONAL COUPLER RACK NUMBER					421																									415												
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					419																	418																417				
POWER DIVIDER ASSEMBLY NUMBER					A12D	A13C	A13D	A14C	A14D	A15C	A15D	A16C	A16D	A16A	A16B	A15A	A15B	A14A	A14B	A13A	A13B	A13C	A13D	A14C	A14D	A15C	A15D	A16C	A16D	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A12C	A12D	A11C	A11D	A10C
BEAM NO	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO.																																						
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1	POWER DIVIDER OUTPUT PORTS																					
25	412	52	419	A8B	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16	BEAMFORMER INPUT PORTS																					
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
26	412	53	419	A7B			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
27	412	74	419	A6B					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
28	412	75	419	A5B							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
29	412	76	419	A4B									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
30	412	77	419	A3B											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
31	412	78	419	A2B													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
32	412	79	419	A1B															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
33	412	80	419	A1A																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
34	412	81	419	A2A																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
35	412	82	419	A3A																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
36	412	83	419	A4A																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

35740C

Table 6-7. Monitor Beam Formation Chart, Band B, (V8) (Continued)

POWER DIVIDER OUTPUT PORTS
BEAMFORMER INPUT PORTS

ANTENNA ELEMENT NUMBER					96	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
DIRECTIONAL COUPLER RACK NUMBER					421	← 415																							→	← 416												→
DIRECTIONAL COUPLER ASSEMBLY NUMBER					24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
RF AMPLIFIER ASSEMBLY NUMBER					A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A
POWER DIVIDER RACK NUMBER					← 418								→	← 417																												→
POWER DIVIDER ASSEMBLY NUMBER					A16D	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A12C	A12D	A11C	A11D	A10C	A10D	A9C	A9D	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A13A	A13B	A14A	A14B	A15A	A15B	A16A	A16B	A16C	A16D	A15C	A15D	A14C
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAMFORMER RACK	BEAMFORMER NO.																																						
					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																						
37	412	84	418	A4B	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																						
							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																				
38	412	85	418	A3B			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																				
									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																		
39	412	86	418	A2B					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																		
											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1																
40	412	107	418	A1B							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16																
													8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1														
41	412	108	418	A1A									15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16														
															8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1												
42	412	109	418	A2A											15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16												
																	8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1										
43	412	110	418	A3A													15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16										
																			8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1								
44	412	111	418	A4A															15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16								
																					8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1						
45	412	112	417	A4B																	15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16						
																							8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1				
46	412	113	417	A3B																			15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16				
																									8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1		
47	412	114	417	A2B																					15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16		
																											8	8	7	7	6	6	5	5	4	4	3	3	2	2	1	1
48	412	115	417	A1B																							15	13	11	9	7	5	3	1	2	4	6	8	10	12	14	16

357400

Table 6-7. Monitor Beam Formation Chart, Band B, (V8) (Continued)

ANTENNA ELEMENT NUMBER					37	38	39	40	41	42	43	44	45	46	47	48	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DIRECTIONAL COUPLER RACK NUMBER					401												403																	
DIRECTIONAL COUPLER ASSEMBLY NUMBER					13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RF AMPLIFIER ASSEMBLY NUMBER					A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B
POWER DIVIDER RACK NUMBER					402																													
POWER DIVIDER ASSEMBLY NUMBER					A7F	A7E	A7D	A8F	A8E	A8D	A9F	A9E	A9D	A10F	A10E	A10D	A11F	A11E	A11D	A12F	A12E	A12D	A13F	A13E	A13D	A14F	A14E	A14D	A14C	A14B	A14A	A13C	A13B	A13A
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO.	BEAM-FORMER RACK	BEAM-FORMER NO																														
					4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
1	412	1	402	A1D	7	5	3	1	2	4	6	8		BEAMFORMER INPUT PORTS																				
							4	4	3	3	2	2	1	1																				
2	412	2	402	A1C			7	5	3	1	2	4	6	8																				
									4	4	3	3	2	2	1	1																		
3	412	3	402	A2D					7	5	3	1	2	4	6	8																		
											4	4	3	3	2	2	1	1																
4	412	4	402	A2C							7	5	3	1	2	4	6	8																
													4	4	3	3	2	2	1	1														
5	412	5	402	A3D									7	5	3	1	2	4	6	8														
															4	4	3	3	2	2	1	1												
6	412	6	402	A3C											7	5	3	1	2	4	6	8												
																	4	4	3	3	2	2	1	1										
7	412	7	402	A4D													7	5	3	1	2	4	6	8										
																			4	4	3	3	2	2	1	1								
8	412	34	402	A4C															7	5	3	1	2	4	6	8								
																					4	4	3	3	2	2	1	1						
9	412	35	402	A5D																	7	5	3	1	2	4	6	8						
																							4	4	3	3	2	2	1	1				
10	412	36	402	A5C																			7	5	3	1	2	4	6	8				
																									4	4	3	3	2	2	1	1		
11	412	37	402	A6D																					7	5	3	1	2	4	6	8		
																											4	4	3	3	2	2	1	1
12	412	38	402	A6C																							7	5	3	1	2	4	6	8

35744A

Table 6-8. Monitor Beam Formation Chart, Band C, (V7)

ANTENNA ELEMENT NUMBER:					13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
DIRECTIONAL COUPLER RACK NUMBER					403												401																	
DIRECTIONAL COUPLER ASSEMBLY NUMBER					13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RF AMPLIFIER ASSEMBLY NUMBER					A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B
POWER DIVIDER RACK NUMBER					402																													
POWER DIVIDER ASSEMBLY NUMBER					A14C	A14B	A14A	A13C	A13B	A13A	A12C	A12B	A12A	A11C	A11B	A11A	A10C	A10B	A10A	A9C	A9B	A9A	A8C	A8B	A8A	A7C	A7B	A7A	A7F	A7E	A7D	A8F	A8E	A8C
BEAM NO	DIR COUPLER		BEAM-FORMER																															
	RACK	NO	RACK	NO																														
					4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
13	412	39	402	A6B	7	5	3	1	2	4	6	8		BEAMFORMER INPUT PORTS																				
							4	4	3	3	2	2	1	1																				
14	412	40	402	A6A			7	5	3	1	2	4	6	8																				
									4	4	3	3	2	2	1	1																		
15	412	67	402	A5B					7	5	3	1	2	4	6	8																		
											4	4	3	3	2	2	1	1																
16	412	68	402	A5A							7	5	3	1	2	4	6	8																
													4	4	3	3	2	2	1	1														
17	412	69	402	A4B									7	5	3	1	2	4	6	8														
															4	4	3	3	2	2	1	1												
18	412	70	402	A4A											7	5	3	1	2	4	6	8												
																	4	4	3	3	2	2	1	1										
19	412	71	402	A3B													7	5	3	1	2	4	6	8										
																			4	4	3	3	2	2	1	1								
20	412	72	402	A3A															7	5	3	1	2	4	6	8								
																					4	4	3	3	2	2	1	1						
21	412	73	402	A2B																	7	5	3	1	2	4	6	8						
																							4	4	3	3	2	2	1	1				
22	412	100	402	A2A																			7	5	3	1	2	4	6	8				
																									4	4	3	3	2	2	1	1		
23	412	101	402	A1B																					7	5	3	1	2	4	6	8		
																											4	4	3	3	2	2	1	1
24	412	102	402	A1A																							7	5	3	1	2	4	6	8

357446

Table 6-8. Monitor Beam Formation Chart, Band C, (V7) (Continued)

ANTENNA ELEMENT NUMBER					13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
DIRECTIONAL COUPLER RACK NUMBER					← 403 →												← 401 →																	
DIRECTIONAL COUPLER ASSEMBLY NUMBER					13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RF AMPLIFIER ASSEMBLY NUMBER					A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B
POWER DIVIDER RACK NUMBER					← 402 →																													
POWER DIVIDER ASSEMBLY NUMBER					A7F	A7E	A7D	A8F	A8E	A8D	A9F	A9E	A9D	A10F	A10E	A10D	A11F	A11E	A11D	A12F	A12E	A12D	A13F	A13E	A13D	A14F	A14E	A14D	A14C	A14B	A14A	A13C	A13B	A13A
BEAM NO	DIR COUPLER RACK	DIR COUPLER NO	BEAMFORMER RACK	BEAMFORMER NO																														
					4	4	3	3	2	2	1	1																						
1	412	1	402	A1D	7	5	3	1	2	4	6	8																						
							4	4	3	3	2	2	1	1																				
2	412	2	402	A1C			7	5	3	1	2	4	6	8																				
									4	4	3	3	2	2	1	1																		
3	412	3	402	A2D					7	5	3	1	2	4	6	8																		
											4	4	3	3	2	2	1	1																
4	412	4	402	A2C							7	5	3	1	2	4	6	8																
													4	4	3	3	2	2	1	1														
5	412	5	402	A3D									7	5	3	1	2	4	6	8														
															4	4	3	3	2	2	1	1												
6	412	6	402	A3C											7	5	3	1	2	4	6	8												
																	4	4	3	3	2	2	1	1										
7	412	7	402	A4D													7	5	3	1	2	4	6	8										
																			4	4	3	3	2	2	1	1								
8	412	34	402	A4C															7	5	3	1	2	4	6	8								
																					4	4	3	3	2	2	1	1						
9	412	35	402	A5D																	7	5	3	1	2	4	6	8						
																							4	4	3	3	2	2	1	1				
10	412	36	402	A5C																			7	5	3	1	2	4	6	8				
																									4	4	3	3	2	2	1	1		
11	412	37	402	A6D																					7	5	3	1	2	4	6	8		
																											4	4	3	3	2	2	1	1
12	412	38	402	A6C																							7	5	3	1	2	4	6	8

POWER DIVIDER OUTPUT PORTS
BEAMFORMER INPUT PORTS

35741A

Table 6-9. Monitor Beam Formation Chart, Band C, (V8)

ANTENNA ELEMENT NUMBER					37	38	39	40	41	42	43	44	45	46	47	48	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DIRECTIONAL COUPLER RACK NUMBER					401												403																	
DIRECTIONAL COUPLER ASSEMBLY NUMBER					13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RF AMPLIFIER ASSEMBLY NUMBER					A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B
POWER DIVIDER RACK NUMBER					402																													
POWER DIVIDER ASSEMBLY NUMBER					A14C	A14B	A14A	A13C	A13B	A13A	A12C	A12B	A12A	A11C	A11B	A11A	A10C	A10B	A10A	A9C	A9B	A9A	A8C	A8B	A8A	A7C	A7B	A7A	A7F	A7E	A7D	A8F	A8E	A8D
BEAM NO.	DIR COUPLER RACK	DIR COUPLER NO	BEAM-FORMER RACK	BEAM-FORMER NO.																														
					4	4	3	3	2	2	1	1		POWER DIVIDER OUTPUT PORTS																				
13	412	39	402	A6B	7	5	3	1	2	4	6	8		BEAMFORMER INPUT PORTS																				
							4	4	3	3	2	2	1	1																				
14	412	40	402	A6A			7	5	3	1	2	4	6	8																				
									4	4	3	3	2	2	1	1																		
15	412	67	402	A5B					7	5	3	1	2	4	6	8																		
											4	4	3	3	2	2	1	1																
16	412	68	402	A5A							7	5	3	1	2	4	6	8																
													4	4	3	3	2	2	1	1														
17	412	69	402	A4B									7	5	3	1	2	4	6	8														
															4	4	3	3	2	2	1	1												
18	412	70	402	A4A											7	5	3	1	2	4	6	8												
																	4	4	3	3	2	2	1	1										
19	412	71	402	A3B													7	5	3	1	2	4	6	8										
																			4	4	3	3	2	2	1	1								
20	412	72	402	A3A															7	5	3	1	2	4	6	8								
																					4	4	3	3	2	2	1	1						
21	412	73	402	A2B																	7	5	3	1	2	4	6	8						
																							4	4	3	3	2	2	1	1				
22	412	100	402	A2A																			7	5	3	1	2	4	6	8				
																									4	4	3	3	2	2	1	1		
23	412	101	402	A1B																					7	5	3	1	2	4	6	8		
																											4	4	3	3	2	2	1	1
24	412	102	402	A1A																							7	5	3	1	2	4	6	8

35741B

Table 6-9. Monitor Beam Formation Chart, Band C, (V8) (Continued)

BAND A

ANTENNA ELEMENT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DIRECTIONAL COUPLER RACK NUMBER	← 408 →																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER	A1 A	A1 B	A2 A	A2 B	A3 A	A3 B	A4 A	A4 B	A5 A	A5 B	A6 A	A6 B	A7 A	A7 B	A8 A	A8 B	A9 A	A9 B	A10 A	A10 B	A11 A	A11 B	A12 A	A12 B
HIGH LEVEL DIVIDER INPUT RACK 410	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	A1 J2 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
SECTOR BEAMFORMER PATCH PANEL RACK 410	A7 J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24

ANTENNA ELEMENT NUMBER	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	ANTENNA ELEMENT NUMBER
DIRECTIONAL COUPLER RACK NUMBER	← 404 →																								DIRECTIONAL COUPLER RACK NUMBER
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER
RF AMPLIFIER ASSEMBLY NUMBER	A1 A	A1 B	A2 A	A2 B	A3 A	A3 B	A4 A	A4 B	A5 A	A5 B	A6 A	A6 B	A7 A	A7 B	A8 A	A8 B	A9 A	A9 B	A10 A	A10 B	A11 A	A11 B	A12 A	A12 B	RF AMPLIFIER ASSEMBLY NUMBER
HIGH LEVEL DIVIDER INPUT RACK 410	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D	HIGH LEVEL DIVIDER INPUT RACK 410
HIGH LEVEL DIVIDER OUTPUT	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J2 D	HIGH LEVEL DIVIDER OUTPUT
SECTOR BEAMFORMER PATCH PANEL RACK 410	J25	J26	J27	J28	J29	J30	J31	J32	J33	J34	J35	J36	J37	J38	J39	J40	J41	J42	J43	J44	J45	J46	J47	A7 J48	SECTOR BEAMFORMER PATCH PANEL RACK 410

THREE SECTOR BEAMS, EACH USING 4 SIGNALS, MAY BY PATCHED TO THE SECTOR BEAMFORMER (410A8). BEAMS CHOSEN ARE USER-DETERMINED REFER TO FIGURE 5-5 AND TABLE 5-2.

OUTPUTS FROM EACH BEAMFORMER ARE J5A, J5B AND J5C.
THESE OUTPUTS ARE CONNECTED TO DIRECTIONAL COUPLERS
412DC129J1, 412DC130J1 AND 412DC131J1 RESP
(BAND A SECTOR BEAMS 1, 2 AND 3 RESPECTIVELY)

BAND C

ANTENNA ELEMENT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DIRECTIONAL COUPLER RACK NUMBER	← 403 →																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	J1 1 J2	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER INPUT RACK 409	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	J2 A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
SECTOR BEAMFORMER PATCH PANEL RACK 409	A7 C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24

ANTENNA ELEMENT NUMBER	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	ANTENNA ELEMENT NUMBER
DIRECTIONAL COUPLER RACK NUMBER	← 401 →																								DIRECTIONAL COUPLER RACK NUMBER
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	J1 24 J2	DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER
RF AMPLIFIER ASSEMBLY NUMBER	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B	RF AMPLIFIER ASSEMBLY NUMBER
HIGH LEVEL DIVIDER INPUT RACK 409	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D	HIGH LEVEL DIVIDER INPUT RACK 409
HIGH LEVEL DIVIDER OUTPUT	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	J2 D	HIGH LEVEL DIVIDER OUTPUT
SECTOR BEAMFORMER PATCH PANEL RACK 409	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35	C36	C37	C38	C39	C40	C41	C42	C43	C44	C45	C46	C47	A7 C48	SECTOR BEAMFORMER PATCH PANEL RACK 409

THREE SECTOR BEAMS, EACH USING 2 SIGNALS, MAY BE PATCHED TO THE SECTOR BEAMFORMER (409A8). BEAMS CHOSEN ARE USER-DETERMINED. REFER TO FIGURE 5-7 AND TABLE 5-7.

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OUTPUTS FROM EACH BEAMFORMER ARE J3A, J3B, AND J3C.
THESE OUTPUTS ARE CONNECTED TO DIRECTIONAL COUPLERS
412DC103J1, 412DC104J1, AND 412DC105J1 RESPECTIVELY.
(BAND C SECTOR BEAMS 1, 2, AND 3 RESPECTIVELY).

Table 6-10. Sector Beam Formation Charts, Bands A and C, (V7 and V8)

ANTENNA ELEMENT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DIRECTIONAL COUPLER RACK NUMBER	415																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	422																							
HIGH LEVEL DIVIDER INPUT	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	J2 A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
SECTOR BEAMFORMER PATCH PANEL RACK 422	A7 J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24
SECTOR BEAMFORMER PATCH PANEL FRONT PANEL NOMENCLATURE	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24

ANTENNA ELEMENT NUMBER	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
DIRECTIONAL COUPLER RACK NUMBER	416																							
DIRECTIONAL COUPLER ASSEMBLY (DV) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	422																							
HIGH LEVEL DIVIDER INPUT	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A'7 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D
HIGH LEVEL DIVIDER OUTPUT	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	J2 D
SECTOR BEAMFORMER PATCH PANEL RACK 422	J25	J26	J27	J28	J29	J30	J31	J32	J33	J34	J35	J36	J37	J38	J39	J40	J41	J42	J43	J44	J45	J46	J47	A7 J48
SECTOR BEAMFORMER PATCH PANEL FRONT PANEL NOMENCLATURE	B25	B26	B27	B28	B29	B30	B31	B32	B33	B34	B35	B36	B37	B38	B39	B40	B41	B42	B43	B44	B45	B46	B47	B48

THREE SECTOR BEAMS, EACH USING 3 SIGNALS, MAY BE PATCHED TO THE SECTOR BEAMFORMER (422AR). BEAMS CHOSEN ARE USER-DETERMINED. REFER TO FIGURE 5-6 AND TABLES 5-4 AND 5-5.

OUTPUTS FROM EACH BEAMFORMER ARE J4A, J4B, AND J4C
THESE OUTPUTS ARE CONNECTED TO DIRECTIONAL COUPLERS
412DC116J1, 412DC117J1 AND 412DC118J1 RESPECTIVELY
(BAND B SECTOR BEAMS 1, 2 AND 3 RESPECTIVELY)

ANTENNA ELEMENT NUMBER	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
DIRECTIONAL COUPLER RACK NUMBER	420																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	423																							
HIGH LEVEL DIVIDER INPUT	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	J2 A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
SECTOR BEAMFORMER PATCH PANEL (REAR) RACK 423	A7 J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	J16	J17	J18	J19	J20	J21	J22	J23	J24
SECTOR BEAMFORMER PATCH PANEL FRONT PANEL NOMEN	B49	B50	B51	B52	B53	B54	B55	B56	B57	B58	B59	B60	B61	B62	B63	B64	B65	B66	B67	D68	D69	B70	B71	B72

ANTENNA ELEMENT NUMBER	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
DIRECTIONAL COUPLER RACK NUMBER	421																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	ACA	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	423																							
HIGH LEVEL DIVIDER INPUT	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	415 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D
HIGH LEVEL DIVIDER OUTPUT	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	J2 D
SECTOR BEAMFORMER PATCH PANEL (REAR) RACK 423	J25	J26	J27	J28	J29	J30	J31	J32	J33	J34	J35	J36	J37	J38	J39	J40	J41	J42	J43	J44	J45	J46	J47	A7 J48
SECTOR BEAMFORMER PATCH PANEL FRONT PANEL NOMEN	B73	B74	B75	B76	B77	B78	B79	B80	B81	B82	B83	B84	B85	B86	B87	B88	B89	B90	B91	B92	B93	B94	B95	B96

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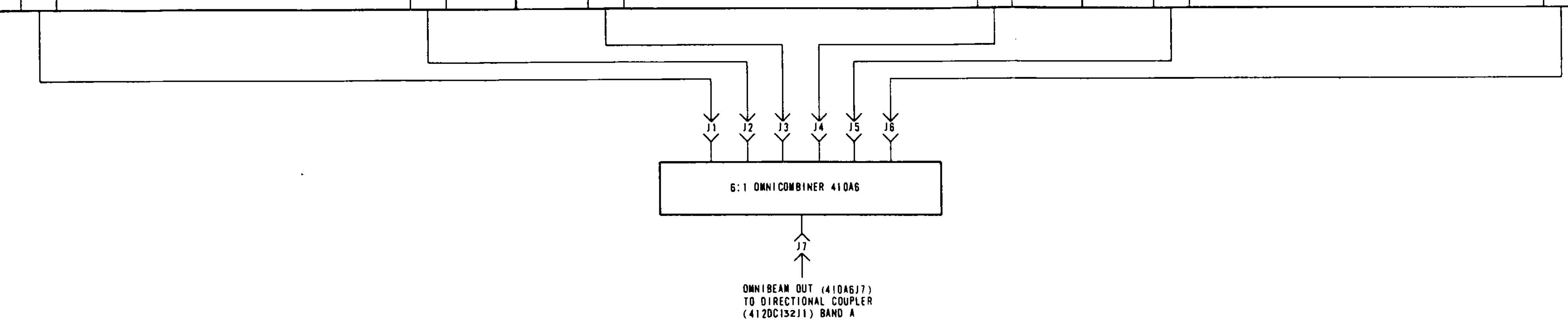
Table 6-11. Sector Beam Formation Chart, Band B, (V7 and V8)

BAND A

ANTENNA ELEMENT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DIRECTIONAL COUPLER RACK NUMBER	408																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER *	A1 A	A1 B	A2 A	A2 B	A3 A	A3 B	A4 A	A4 B	A5 A	A5 B	A6 A	A6 B	A7 A	A7 B	A8 A	A8 B	A9 A	A9 B	A10 A	A10 B	A11 A	A11 B	A12 A	A12 B
HIGH LEVEL DIVIDER INPUT RACK 410	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	J1 A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
OMNICOMBINERS (8:1) INPUT RACK 410	A3 J1A	J2A	J3A	J4A	J5A	J6A	J7A	J8A	J1B	J2B	J3B	J4B	J5B	J6B	J7B	A3 J8B	A11 J1A	J2A	J3A	J4A	J5A	J6A	J7A	J8A
OMNICOMBINER OUTPUTS			J9A											J9B					J9A					

ANTENNA ELEMENT NUMBER	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
DIRECTIONAL COUPLER RACK NUMBER	404																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER *	A1 A	A1 B	A2 A	A2 B	A3 A	A3 B	A4 A	A4 B	A5 A	A5 B	A6 A	A6 B	A7 A	A7 B	A8 A	A8 B	A9 A	A9 B	A10 A	A10 B	A11 A	A11 B	A12 A	A12 B
HIGH LEVEL DIVIDER INPUT RACK 410	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D
HIGH LEVEL DIVIDER OUTPUT	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	J1 D
OMNICOMBINERS (8:1) INPUT RACK 410	J1B	J2B	J3B	J4B	J5B	J6B	J7B	A11 J8B	A16 J1A	J2A	J3A	J4A	J5A	J6A	J7A	J8A	J1B	J2B	J3B	J4B	J5B	J6B	J7B	A16 J8B
OMNICOMBINER OUTPUTS						J9B					J9A											J9B		



BAND C

ANTENNA ELEMENT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DIRECTIONAL COUPLER RACK NUMBER	403																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	J1 1 J2	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER *	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER INPUT RACK 409	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	J1 A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
OMNICOMBINER (16:2) RACK 409	A3 J1A	J2A	J3A	J4A	J5A	J6A	J7A	J8A	J1B	J2B	J3B	J4B	J5B	J6B	J7B	A3 J8B	A11 J1A	J2A	J3A	J4A	J5A	J6A	J7A	J8A
OMNICOMBINER (16:2) OUTPUTS								J9A								J9B								J9A

ANTENNA ELEMENT NUMBER	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
DIRECTIONAL COUPLER RACK NUMBER	401																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	J1 24 J2
RF AMPLIFIER ASSEMBLY NUMBER *	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER INPUT RACK 409	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D
HIGH LEVEL DIVIDER OUTPUT	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	J1 D
OMNICOMBINER (16:2) RACK 409	J1B	J2B	J3B	J4B	J5B	J6B	J7B	A11 J8B	A16 J1A	J2A	J3A	J4A	J5A	J6A	J7A	J8A	J1B	J2B	J3B	J4B	J5B	J6B	J7B	A16 J8B
OMNICOMBINER (16:2) OUTPUTS								J9B								J9A								J9B

* J2 OUTPUTS FROM ALL RF AMPLIFIERS GO TO HIGH LEVEL DIVIDERS. (OMNIBEAM AND ASSOCIATED SIGNALS)

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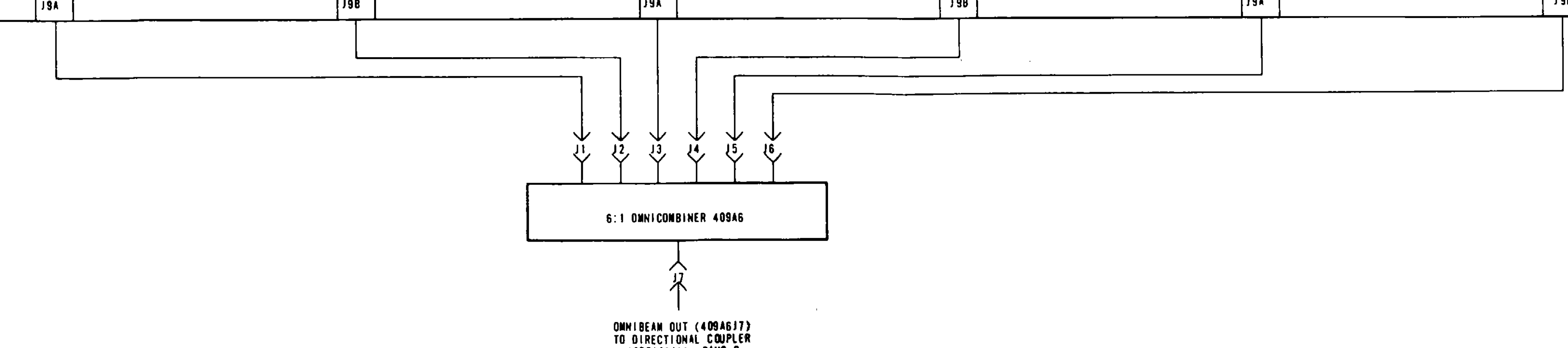
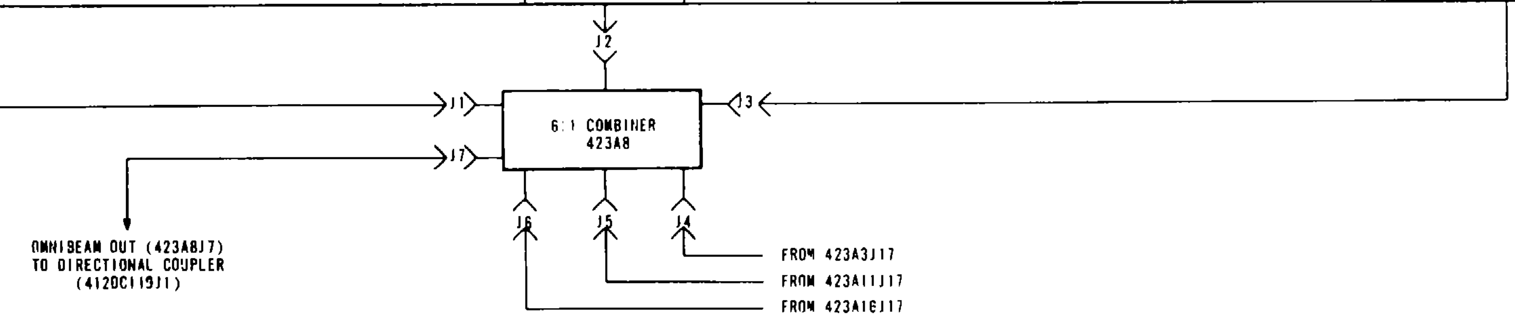


Table 6-12. Omni Beam Formation Charts, Bands A and C, (V7 and V8)

ANTENNA ELEMENT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DIRECTIONAL COUPLER RACK NUMBER	415																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER *	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	422																							
HIGH LEVEL DIVIDER INPUT	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	J1 A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
OMNICOMBINERS (16:1), RACK 422	A3 J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	A3 J16	A11 J1	J2	J3	J4	J5	J6	J7	J8
OMNICOMBINERS (16:1) OUTPUTS							A3J17																	

ANTENNA ELEMENT NUMBER	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
DIRECTIONAL COUPLER RACK NUMBER	416																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER *	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	422																							
HIGH LEVEL DIVIDER INPUT	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D
HIGH LEVEL DIVIDER OUTPUT	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	J1 D
OMNICOMBINERS (16:1), RACK 422	J9	J10	J11	J12	J13	J14	J15	A11 J16	A16 J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	A16 J16
OMNICOMBINERS (16:1) OUTPUTS	A11J17																	A16J17						



ANTENNA ELEMENT NUMBER	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
DIRECTIONAL COUPLER RACK NUMBER	420																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER *	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	423																							
HIGH LEVEL DIVIDER INPUT	A1 J5 A	A1 B	A1 C	A1 D	A2 A	A2 B	A2 C	A2 D	A4 A	A4 B	A4 C	A4 D	A5 A	A5 B	A5 C	A5 D	A9 A	A9 B	A9 C	A9 D	A10 A	A10 B	A10 C	A10 D
HIGH LEVEL DIVIDER OUTPUT	J1 A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
OMNICOMBINERS (16:1) RACK 423	A3 J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	A3 J16	A11 J1	J2	J3	J4	J5	J6	J7	J8
OMNICOMBINERS (16:1) OUTPUTS									A3J17															

ANTENNA ELEMENT NUMBER	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
DIRECTIONAL COUPLER RACK NUMBER	421																							
DIRECTIONAL COUPLER ASSEMBLY (DC) NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
RF AMPLIFIER ASSEMBLY NUMBER *	A1A	A1B	A2A	A2B	A3A	A3B	A4A	A4B	A5A	A5B	A6A	A6B	A7A	A7B	A8A	A8B	A9A	A9B	A10A	A10B	A11A	A11B	A12A	A12B
HIGH LEVEL DIVIDER RACK NUMBER	423																							
HIGH LEVEL DIVIDER INPUT	A12 A	A12 B	A12 C	A12 D	A13 A	A13 B	A13 C	A13 D	A14 A	A14 B	A14 C	A14 D	A15 A	A15 B	A15 C	A15 D	A17 A	A17 B	A17 C	A17 D	A18 A	A18 B	A18 C	A18 J5 D
HIGH LEVEL DIVIDER OUTPUT	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	J1 D
OMNICOMBINERS (16:1) RACK 423	J9	J10	J11	J12	J13	J14	J15	A11 J16	A16 J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15	A16 J16
OMNICOMBINERS (16:1) OUTPUTS	A11J17															A16J17								

TO 423A8J4 TO 423A8J5 TO 423A8J6

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* J2 OUTPUTS FROM ALL RF AMPLIFIERS GO TO HIGH LEVEL DIVIDERS (OMNIBEAM AND ASSOCIATED SIGNALS)

Table 6-13. Omni Beam Formation Chart, Band B, (V7 and V8)

b. Routine Troubleshooting. Routine troubleshooting consists of a daily checkout of the monitor, sector and omnibeam circuits via the tty. Individual tests can be requested when trouble is suspected. Complete antenna group checkout may be scheduled when least likely to interfere with other activities involving the tty.

c. Emergency Troubleshooting. There are no specific emergency procedures. Logical interpretation of olm&t printouts will isolate most failures to the component level. Performance test checks (paragraphs 6-10 through 6-14) may be used as required.

Table 6-14. Antenna Elements To Transmission Line Tuners Band A, V7 and V8

Antenna Element No.	Transmission Line Tuner	Antenna Element No.	Transmission Line Tuner
501A1	424A1A4	501A18	424A3A21
501A2	424A1A8	501A19	424A4A4
501A3	424A1A10	501A20	424A4A8
501A4	424A1A15	501A21	424A4A10
501A5	424A1A19	501A22	424A4A15
501A6	424A1A21	501A23	424A4A19
501A7	424A2A4	501A24	424A4A21
501A8	424A2A8	501A25	424A5A4
501A9	424A2A10	501A26	424A5A8
501A10	424A2A15	501A27	424A5A10
501A11	424A2A19	501A28	424A5A15
501A12	424A2A21	501A29	424A5A19
501A13	424A3A4	501A30	424A5A21
501A14	424A3A8	501A31	424A6A4
501A15	424A3A10	501A32	525A6A8
501A16	424A3A15	501A33	424A6A10
501A17	424A3A19	501A34	424A6A15

Table 6-14. Antenna Elements To Transmission Line Tuners Band A, V7 and V8 (Continued)

Antenna Element No.	Transmission Line Tuner	Antenna Element No.	Transmission Line Tuner
501A35	424A6A19	501A42	424A7A21
501A36	424A6A21	501A43	424A8A4
501A37	424A7A	501A44	424A8A8
501A38	424A7A8	501A45	424A8A10
501A39	424A7A10	501A46	424A8A15
501A40	424A7A15	501A47	424A8A19
501A41	424A7A19	501A48	424A8A21

Table 6-15. Antenna Elements To Transmission Line Tuners Band B, V7 and V8

Antenna Element No.	Transmission Line Tuner	Antenna Element No.	Transmission Line Tuner
502A1	424A1A3	502A20	424A2A16
502A2	424A1A5	502A21	424A2A17
502A3	424A1A6	502A22	424A2A18
502A4	424A1A7	502A23	424A2A20
502A5	424A1A9	502A24	424A2A22
502A6	424A1A1l	502A25	424A3A3
502A7	424A1A14	502A26	424A3A5
502A8	424A1A16	502A27	424A3A6
502A9	424A1A17	502A28	424A3A7
502A10	424AA1I8	502A29	424A3A9
502A11	424A1A20	502A30	424A3A11
502A12	424A1A22	502A31	424A3A14
502A13	424A2A3	502A32	424A3A16
502A14	424A2A5	502A33	424A3A17
502A15	424A2A6	502A34	424A3A18
502A16	424A2A7	502A35	424A3A20
502A17	424A2A9	502A36	424A3A22
502A18	424A2A11	502A37	424A4A3
502A19	424A2A14	502A38	424A4A5

Table 6-15. Antenna Elements To Transmission Line Tuners Band B, V7 and V8 (Continued)

Antenna Element No.	Transmission Line Tuner	Antenna Element No.	Transmission Line Tuner
502A39	424A4A6	502A69	424A6A17
502A40	424A4A7	502A70	424A6A18
502A41	424A4A9	502A71	424A6A20
502A42	424A4A11	502A72	424A6A22
502A43	424A4A14	502A73	424A7A3
502A44	424A4A16	502A74	424A7A5
502A45	424A4A17	502A75	424A7A6
502A46	424A4A18	502A76	424A7A7
502A47	424A4A20	502A77	424A7A9
502A48	424A4A22	502A78	424A7A11
502A49	424A5A3	502A79	424A7A14
502A50	424A5A5	502A80	424A7A16
502A51	424A5A6	502A81	424A7A17
502A52	424A5A7	502A82	424A7A18
502A53	424A5A9	502A83	424A7A20
502A54	424A5A11	502A84	424A7A22
502A55	424A5A14	502A85	424A8A3
502A56	424A5A16	502A86	424A8A5
502A57	424A5A17	502A87	424A8A6
502A58	424A5A18	502A88	424A8A7
502A59	424A5A20	502A89	424A8A9
502A60	424A5A22	502A90	424A8A11
502A61	424A6A3	502A91	424A8A14
502A62	424A6A5	502A92	424A8A16
502A63	424A6A6	502A93	424A8A17
502A64	424A6A7	502A94	424A8A18
502A65	424A6A9	502A95	424A8A20
502A66	424A6A11	502A96	424A8A22
502A67	424A6A14		
502A68	424A6A16		

Table 6-16. Antenna Elements To Transmission Line Tuners Band C, V7 and V8

Antenna Element No.	Transmission Line Tuner	Antenna Element No.	Transmission Line Tuner
503A1	424A1A1	503A25	424A5A1
503A2	424A1A2	503A26	424A5A2
503A3	424A1A12	503A27	424A5A12
503A4	424A1A13	503A28	424A5A13
503A5	424A1A23	503A29	424A5A23
503A6	424A1A24	503A30	424A5A24
503A7	424A2A1	503A31	424A6A1
503A8	424A2A2	503A32	424A6A2
503A9	424A2A12	503A33	424A6A12
503A10	424A2A13	503A34	424A6A13
503A11	424A2A23	503A35	424A6A23
503A12	424A2A24	503A36	424A6A24
503A13	424A3A1	503A37	424A7A1
503A14	424A3A2	503A38	424A7A2
503A15	424A3A12	503A39	424A7A12
503A16	424A3A13	503A40	424A7A13
503A17	424A3A23	503A41	424A7A23
503A18	424A3A24	503A42	424A7A24
503A19	424A4A1	503A43	424A8A1
503A20	424A4A2	503A44	424A8A2
503A21	424A4Al2	503A45	424A8A12
503A22	424A4A13	503A46	424A8A13
503A23	424A4A23	503A47	424A8A23
503A24	424A4A24	503A48	424A8A24

Table 6-17. Goniometer Signals, Band A

High Level Power Divider Rack 410	Signal From Antenna No.	Site V7	Site V8
		Goniometer Input 105A2	Goniometer Input 105A2
A1J3A	1	J10	J34
A1J3B	2	J11	J35
A1J3C	3	J12	J36
A1J3D	4	J13	J37
A2J3A	5	J14	J38
A2J3B	6	J15	J39
A2J3C	7	J16	J40
A2J3D	8	J17	J41
A4J3A	9	J18	J42
A4J3B	10	J19	J43
A4J3C	11	J20	J44
J4J3D	12	J21	J45
A5J3A	13	J22	J46
A5J3B	14	J23	J47
A5J3C	15	J24	J48
A5J3D	16	J25	J1
A9J3A	17	J26	J2
A9J3B	18	J27	J3
A9J3C	19	J28	J4
A9J3D	20	J29	J5
A10J3A	21	J30	J6
A10J3B	22	J31	J7
A10J3C	23	J32	J8
A10J3D	24	J33	J9
A12J3A	25	J34	J10
A12J3B	26	J35	J11
A12J3C	27	J36	J12
A12J3D	28	J37	J13

Table 6-17. Goniometer Signals, Band A (Continued)

High Level Power Divider Rack 410	Signal From Antenna No.	Site V7	Site V8
		Goniometer Input 105A2	Goniometer Input 105A2
A13J3A	29	J38	J14
A13J3B	30	J39	J15
A13J3C	31	J40	J16
A13J3D	32	J41	J17
A14J3A	33	J42	J18
A14J3B	34	J43	J19
A14J3C	35	J44	J20
A14J3D	36	J45	J21
A15J3A	37	J46	J22
A15J3B	38	J47	J23
A15J3C	39	J48	J24
A15J3D	40	J1	J25
A17J3A	41	J2	J26
A17J3B	42	J3	J27
A17J3C	43	J4	J28
A17J3D	44	J5	J29
A18J3A	45	J6	J30
A18J3B	46	J7	J31
A18J3C	47	J8	J32
A18J3D	48	J9	J32

Table 6-18. Goniometer Signals, Band B (Rack 422)

High Level Power Divider Rack 422	Signal From Antenna to.	Site V7	Site V8
		Goniometer Input 105A3	Goniometer Input 105A3
A1J3A	1	J19	J67
A1J3B	2	J20	J68
A1J3C	3	J21	J69
A1J3D	4	J22	J70
A2J3A	5	J23	J71
A2J3B	6	J24	J72

Table 6-18. Goniometer Signals, Band B (Rack 422) (Continued)

High Level Power Divider Rack 422	Signal From Antenna No.	Site V7	Site V8
		Goniometer Input 105A3	Goniometer Input 105A3
A2J3C	7	J25	J73
A2J3D	8	J26	J74
A4J3A	9	J27	J75
A4J3B	10	J28	J76
A4J3C	11	J29	J77
A4J3D	12	J30	J78
A5J3A	13	J31	J79
A5J3B	14	J32	J80
A5J3C	15	J33	J81
A5J3D	16	J34	J82
A9J3A	17	J35	J83
A9J3B	18	J36	J84
A9J3C	19	J37	J85
A9J3D	20	J38	J86
A10J3A	21	J39	J87
A10J3B	22	J40	J88
A10J3C	23	J41	J89
A1OJ3D	24	J42	J90
A12J3A	25	J43	J91
A12J3B	26	J44	J92
A12J3C	27	J45	J93
A12J3D	28	J46	J94
A13J3A	29	J47	J95
A13J3B	30	J48	J96
A13J3C	31	J49	J1
A13J3D	32	J50	J2
A14J3A	33	J51	J3
J14J3B	34	J52	J4
A14J3C	35	J53	J5
A14J3D	36	J54	J6
A15J3A	37	J55	J7
A15J3B	38	J56	J8

Table 6-18. Goniometer Signals, Band B (Rack 422) (Continued)

High Level Power Divider Rack 422	Signal From Antenna No.	Site V7	Site V8
		Goniometer Input 105A3	Goniometer Input 105A3
A15J3C	39	J57	J9
A15J3D	40	J58	J10
A17J3A	41	J59	J11
A17J3B	42	J60	J12
A17J3C	43	J61	J13
A17J3D	44	J62	J14
A18J3A	45	J63	J15
A18J3B	46	J64	J16
A18J3C	47	J65	J17
A18J3D	48	J66	J18

Table 6-19. Goniometer Signals, Band B (Rack 423)

High Level Power Divider Rack 423	Signal From Antenna No.	Site V7	Site V8
		Goniometer Input 105A3	Goniometer Input 105A3
A1J3A	49	J67	J19
A1J3B	50	J68	J20
A1J3C	51	J69	J21
A1J3D	52	J70	J22
A2J3A	53	J71	J23
A2J3B	54	J72	J24
A2J3C	55	J73	J25
A2J3D	56	J74	J26
A4J3A	57	J75	J27
A4J3B	58	J76	J28
A4J3C	59	J77	J29
A4J3D	60	J78	J30
A5J3A	61	J79	J31
A5J3B	62	J80	J32
A5J3C	63	J81	J33
A5J3D	64	J82	J34
A9J3A	65	J83	J35

Table 6-19. Goniometer Signals, Band B (Rack 423) (Continued)

High Level Power Divider Rack 423	Signal From Antenna No.	Site V7	Site V8
		Goniometer Input 105A3	Goniometer Input 105A3
A9J3B	66	J84	J36
A9J3C	67	J85	J37
A9J3D	68	J86	J38
A10J3A	69	J87	J39
A10J3B	70	J88	J40
A10J3C	71	J89	J41
A10J3D	72	J90	J42
A12J3A	73	J91	J43
A12J3B	74	J92	J44
A12J3C	75	J93	J45
A12J3D	76	J94	J46
A13J3A	77	J95	J47
A13J3B	78	J96	J48
A13J3C	79	J1	J49
A13J3D	80	J2	J50
A14J3A	81	J3	J51
A14J3B	82	J4	J52
A14J3C	83	J5	J53
A14J3D	84	J6	J54
A15J3A	85	J7	J55
A15J3B	86	J8	J56
A15J3C	87	J9	J57
A15J3D	88	J10	J58
A17J3A	89	J11	J59
A17J3B	90	J12	J60
A17J3C	91	J13	J61
A17J3D	92	J14	J62
A18J3A	93	J15	J63
A18J3B	94	J16	J64
A18J3C	95	J17	J65
A18J3D	96	J18	J66

Table 6-20. Goniometer Signals, Band C

High Level Power Divider Rack 409	Signal From Antenna No.	Site V7 Goniometer Input 105A4	Site V8 Goniometer Input 105A4
A1J3A	1	J10	J34
A1J3B	2	J11	J35
A1J3C	3	J12	J36
A1J3D	4	J13	J37
A2J3A	5	J14	J38
A2J3B	6	J15	J39
A2J3C	7	J16	J40
A2J3D	8	J17	J41
A4J3A	9	J18	J42
A4J3B	10	J19	J43
A4J3C	11	J20	J44
A4J3D	12	J21	J45
A5J3A	13	J22	J46
A5J3B	14	J23	J47
A5J3C	15	J24	J48
A5J3D	16	J25	J1
A9J3A	17	J26	J2
A9J3B	18	J27	J3
A9J3C	19	J28	J4
A9J3D	20	J29	J5
A10J3A	21	J30	J6
A10J3B	22	J31	J7
A10J3C	23	J32	J8
A10J3D	24	J33	J9
A12J3A	25	J34	J10
A12J3B	26	J35	J11
A12J3C	27	J36	J12
A12J3D	28	J37	J13

Table 6-20. Goniometer Signals, Band C (Continued)

High Level Power Divider Rack 409	Signal From Antenna No.	Site V7	Site V8
		Goniometer Input 105A4	Goniometer Input 105A4
A13J3A	29	J38	J14
A13J3B	30	J39	J15
A13J3C	31	J40	J16
A13J3D	32	J41	J17
A14J3A	33	J42	J18
A14J3B	34	J43	J19
A14J3C	35	J44	J20
A14J3D	36	J45	J21
A15J3A	37	J46	J22
A15J38	38	J47	J23
A15J3C	39	J48	J24
A15J3D	40	J1	J25
A17J3A	41	J2	J26
A17J3B	42	J3	J27
A17J3C	43	J4	J28
A17J3D	44	J5	J29
A18J3A	45	J6	J30
A18J3B	46	J7	J31
A18J3C	47	J8	J32
A18J3D	48	J9	J33

6-8. Alignment and Adjustment.

There are no in-system alignments or adjustments required, except for the line tuners. Procedures for this adjustment are contained in paragraph 6-14. Out-of-tolerance components are removed and bench repaired or discarded (1: 4 power dividers/combiners and directional couplers).

6-9. Preventive Maintenance. (See table 6-21.)

Preventive maintenance is the systematic care, servicing, and inspecting of equipment to prevent occurrence of trouble, reduce downtime, and ensure that the equipment is serviceable. Table 6-21 lists the preventive maintenance routines and recommended periods when this maintenance should be performed.

Table 6-21. Preventive Maintenance Schedule

Period	Procedure
Daily	1. Visually inspect ac power cords and sense leads in racks 401, 403, 404, 408, 415, 416, 420 and 421 for: a. Firm physical connection. b. Signs of overheating, blistering, discoloration, fraying, etc. 2. Cycle Beamformer and Antenna tests from somc (do not press PRINT button). 3. Visually check sector beam patch panels to ensure all ports are terminated with 75-ohm terminators and sector beam patch cables are secure. 4. Visually check that all aircraft warning lights are illuminated (if installed).
Weekly	1. Clean air filters in racks 401, 403, 404, 408, 415, 416, 420 and 421. 2. Visually inspect antenna ground connections, ground screen, and reflecting screens for loose connections or wires.
Quarterly	Visually inspect the rubber strip between the weather cap and the head seal gasket on the intermediate mast (A and B band antennas) for sealing in both places. Check that upper portions of the weather cap are concentric about the mast, providing uniform space between the mast and weather cap.
Annually (or as required)	1. Perform Input Vswr Performance Test Check (paragraph 6-10). 2. Perform Single Channel Amplitude and Phase tracking Performance Test Check (paragraph 6-11).

Table 6-21. Preventive Maintenance Schedule (Continued)

Period	Procedure
Annually (Cont)	3. Perform Transmission Line Phase Tracking Performance Test Check (paragraph 6-12).
	4. Perform Swept Frequency Vswr Performance Test Check (Singly driven elements) (paragraph 6-13).
	5. Perform Single Antenna Impedance Performance Test Check (paragraph 6-14).
	6. Perform operational check of Aiken Rf Amplifier (See CM 32-5895-236-14).

NOTE

The following paragraphs, 6-10 to 6-14 inclusive, contain antenna group test procedures used to isolate a particular problem not identified by any other method. In general, performance of these procedures will either degrade system performance or suspend operations within an affected band. The nature of antenna elements, transmission lines, and associated components, along with available testing techniques, makes these tests time consuming. The accuracy of measurements at rf frequencies generally is less than those made at lower frequencies or dc with comparable equipment. Data evaluation from several measurements over a long period of time may be necessary to observe long term performance characteristics.

6-10. Antenna Electronics Input Vswr Check

a. Purpose. The purpose of this check is to verify that the input vswr of the antenna electronics does not exceed 2:1 for in-band frequencies as measured at the input directional couplers. The in-band frequencies are:

Band A 2-6 MHz

Band B 6-18 MHz

Band C 18-30 MHz

NOTE

The input being checked will degrade the associated beams which this input normally supplies. Coordination is required in accordance with local procedures.

This test may prove useful in determining if a path fault exists since an unsatisfactory vswr will affect phase relationships and amplitudes at various frequencies in the pass band. The tests will provide an indication of problems that may exist from the directional coupler input up to and including the rf amplifier input.

1. Procedure

(a) Connect the equipment as shown in figure 6-3. Apply power and allow at least 30 minutes for warmup.

(b) Set 8601A generator/sweeper as follows:

(1) Set OUTPUT LEVEL range switch to -10 dB.

(2) Set level to zero as shown on the meter using OUTPUT LEVEL VERNIER.

(3) Set SWEEP to VIDEO.

(4) Set SWEEP MODE to MANUAL.

(5) Turn manual sweep control fully clockwise.

(c) While observing the 5245M frequency counter, set the upper frequency of the 8601A generator/sweeper. The frequency is 6 MHz band A, 18 MHz band B, and 30 MHz band C.

(d) Place a TNC female short circuit at POINT A.

(e) Set MODE switch on the 8407A to AMPL. Use DISPLAY REFERENCE switch and AMPL VERNIER to set the beam on the center horizontal line. Using the HORIZONTAL CENTERING and GA1N controls, move the beam on the extreme right vertical line of the graticule. (When testing band C, the 30-MHz point is to the left of this point due to the horizontal gain of the 8407A.)

(f) Set the lower frequency of the 8601 sweep by turning the MANUAL SWEEP control counterclockwise until the lower frequency is displayed on the frequency counter as follows:

Band A 1.5 MHz

Band B 6.0 MHz

Band C 18.0 MHz

(g) Use the HORIZONTAL centering control on the 8412A and place the beam on the extreme left vertical line of the scope graticule.

(h) Repeat steps c. through 9. until the beam tracks with the MANUAL SWEEP control. The sweep is properly adjusted when the beam travels from the left vertical line to the right vertical line on the scope graticule as the MANUAL SWEEP control varies the frequency from the low to upper end of the frequency band of interest.

(i) On the 8407A, set MODE to PHASE and PHASE DEG/DIV to 90. Adjust PHASE VERNIER to move trace to center line.

(j) Set PHASE DEG/DIV to 1.0 and adjust PHASE VERNIER to center trace.

(k) Set MODE to AMP and AMP db/DIV to 0.25 adjust AMPL VERNIER and DISPLAY REFERENCE as necessary to center sweep.

(l) Remove short circuit from point A and connect cable at point A to the input directional coupler for the channel being tested.

(m) Observe the amplitude display on the 8412A. The display should never indicate less than 9.5 db (2:1 vswr) for the in-band frequencies. An indication between 15 dB and 30 dB can be expected.

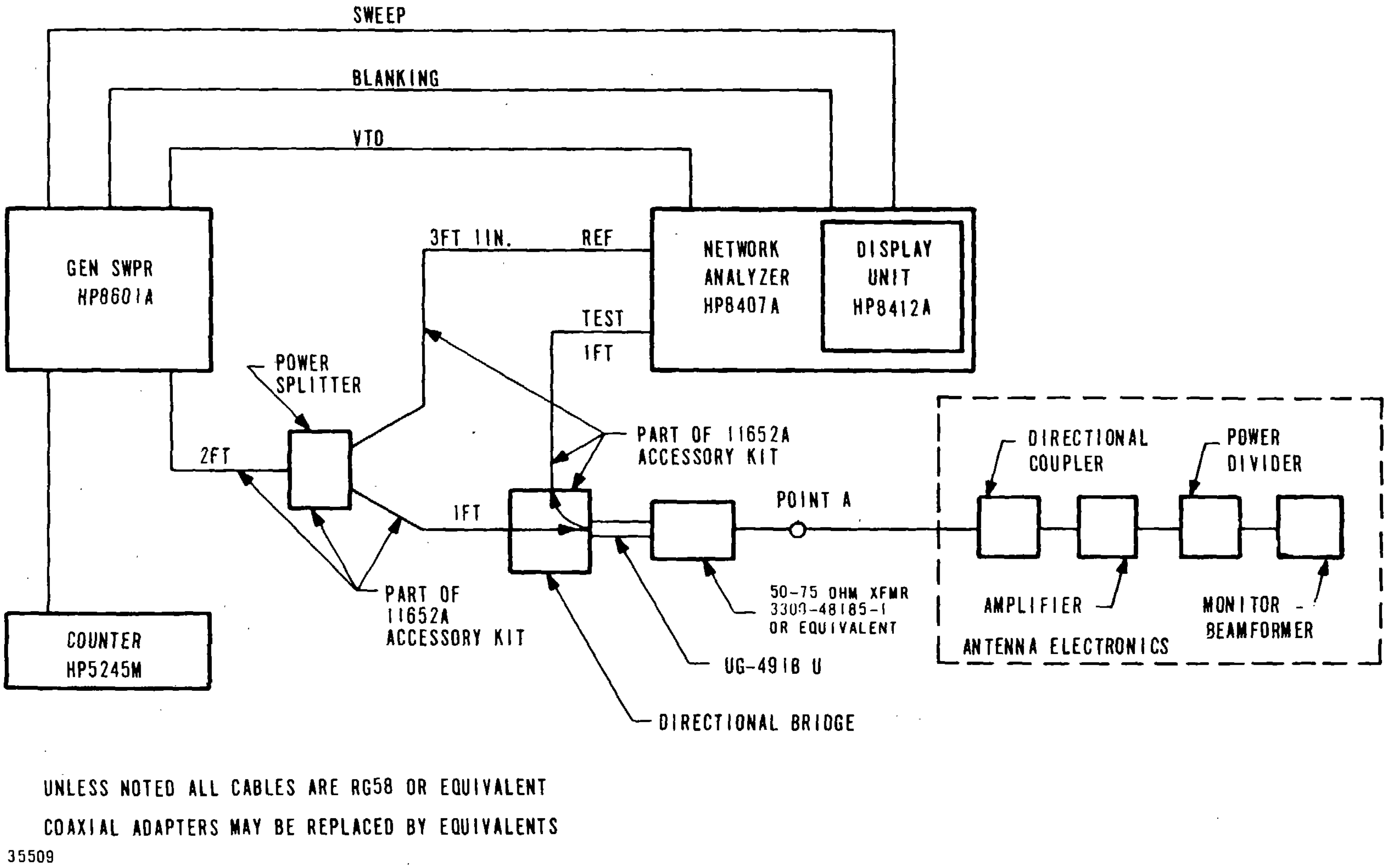


Figure 6-3. Input Vswr Test Setup

2. Repair Procedures. If the vswr exceeds 2:1, replace the associated rf amplifier and repeat steps 1. and m. above. If the vswr remains excessive, change the test input to the individual units in the antenna electronic circuits. Isolation to an individual unit may be accomplished in this manner.

6-11. Antenna Electronics Phase and Amplitude Tracking Test Check.

a. Purpose. The purpose of the phase and amplitude tracking checks is to verify that rf signals reach the beamformers and goniometers through paths having the same phase delay and attenuation (within tolerance), thus allowing the beamformers to form an undistorted beam.

NOTE

The band being checked will be degraded while the check is in progress. Coordination is required in accordance with local procedures.

Phase and amplitude tracking measurements are made from input directional couplers to the monitor beamformer outputs. Paths will also be checked from input directional couplers to the inputs of the goniometers. Relative measurements are made between identical paths, i.e., a reference path is chosen for each type of path and other paths of the same type compared to it.

NOTE

The reference channel should always be in a path like the one being checked. For example, assume that an outer channel is being checked, then the reference path must be in an outer channel. If a center channel is being checked then the reference path must be a center channel. In addition, the test path and the reference path must not feed the same beamformer. The phase and amplitude tracking test equipment should be left ON at all times. Changing the signal insertion and measuring points for both the reference and test paths will allow rapid isolation of faults in any component from the input directional coupler through the antenna electronics. Use of the X-Y recorder is optional under these conditions.

1. Procedures.

(a) Connect equipment as shown in figure 6-4. Apply power and allow at least 30 minutes for warmup.

(b) Set the 8601A Generator/Sweeper as follows:

(1) Set OUTPUT LEVEL range switch to 0 dB.
(2) Use OUTPUT RANGE vernier to set output level to 0 dB as shown on the meter.
(3) Set SWEEP selector to VIDEO.
(4) Set SWEEP MODE to MANUAL.
(5) Turn MANUAL SWEEP control fully clockwise.

(c) While observing the 5245M Frequency Counter, set the upper frequency of the 8601A Generator/Sweeper. The frequency is as follows:

Band A 6 MHz
Band B 18 MHz
Band C 30 MHz

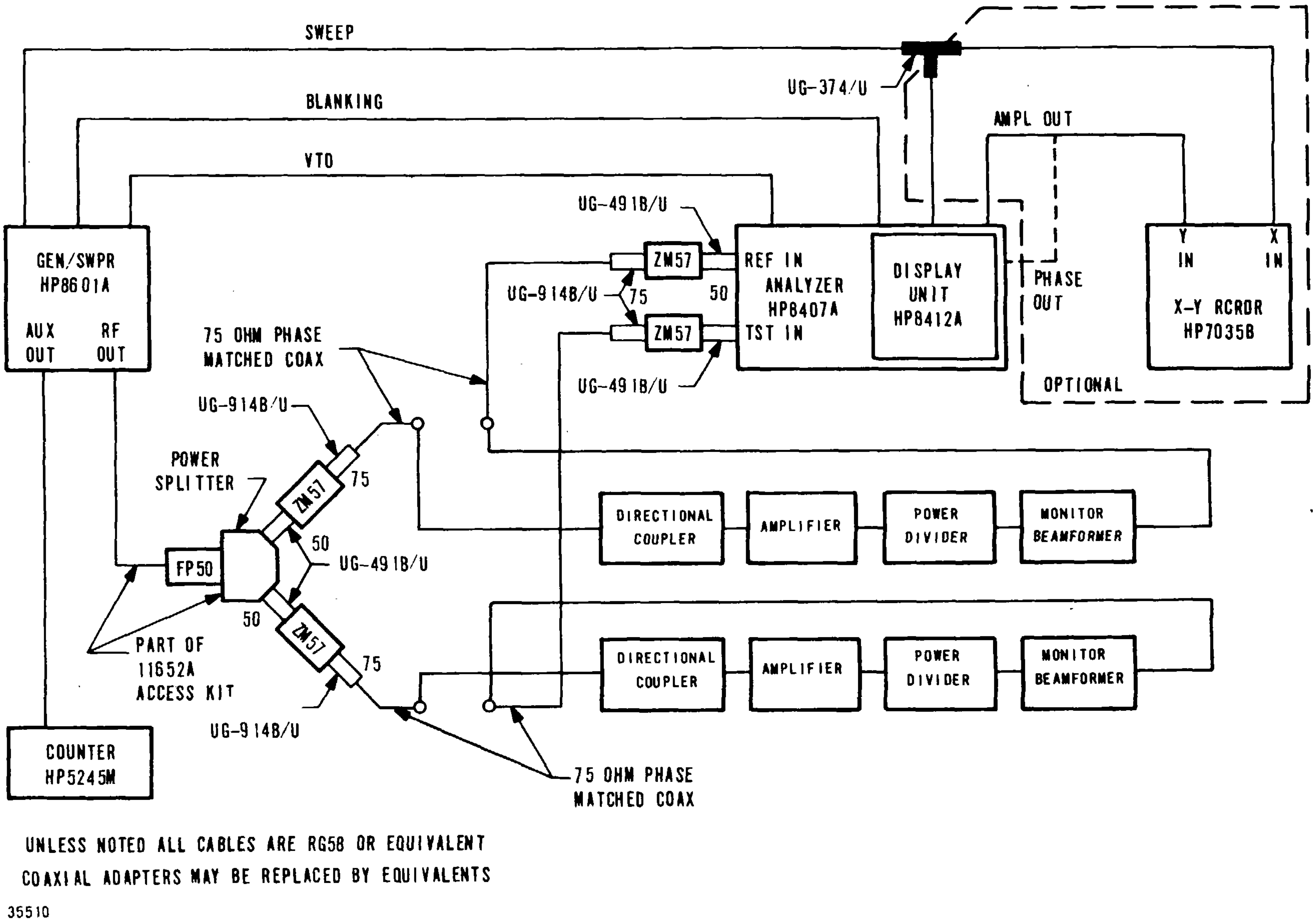


Figure 6-4. Phase/Amplitude Test Setup.

(d) Use two Kings KA-99-69 feedthroughs to connect POINT A to POINT B and POINT C to POINT D.

(e) Set the MODE switch on the 8412A Display to AMPL. Use the DISPLAY REFERENCE switches and AMPL VERNIER to set the beam on the 8412A Display on the center horizontal line. With the display unit's HORIZONTAL CENTERING and HORIZONTAL GA1N controls, move the beam to the extreme right vertical line of the scope graticule. (When testing Band C, the 30-MHz point is to the left of this point due to the horizontal gain of the 8412A.)

(f) While observing the 5245M, slowly turn the 8601A MANUAL SWEEP control counterclockwise until the frequency is displayed on the frequency counter as follows:

Band A	1.5 MHz
Band B	6.0 MHz
Band C	18.0 MHz

(g) Use the 8412A HORIZONTAL CENTERING control to place the beam on the extreme left vertical line of the scope graticule.

(h) Repeat steps (c) through (g) until the beam tracks with the MANUAL SWEEP control. The sweep is properly adjusted when the beam travels from the left vertical line to the right vertical line on the scope graticule as the MANUAL SWEEP control is rotated from the low frequency to the upper frequency of the band of interest.

(i) On the 8407A set MODE to PHASE and PHAZE DEG/DIV to 90. Adjust PHASE VERNIER to move trace to center line.

(j) Set PHASE DEG/DIV to 1.0 and adjust PHASE VERNIER to center trace.

(k) Set MODE to AMPL and AMPL dB/DIV to 0.25. Adjust AMPL VERNIER and DISPLAY REFERENCE as necessary to center sweep.

NOTE

If recorder is not used, proceed to step t.

(l) Place a data sheet on the 7035B X-Y Recorder. Move the chart HOLD/ RELEASE switch to the HOLD position. Set the MANUAL SWEEP control of the 8601A so that the frequency counter indicates near the center frequency between those frequencies set in steps (c) and (f). Set the OFF/ON/SERVO switch to SERVO. Change the X and Y RANGE switches until the pen is near the center of the data sheet.

(m) Slowly turn the MANUAL SWEEP control of the 8601A fully clockwise. Adjust the X RANGE and VERNIER gain controls until the pen stops at the upper frequency end of the data sheet.

(n) Turn the 8601A MANUAL SWEEP control counterclockwise until the frequency counter indicates the low frequency of the band of interest. Turn the X ZERO control of the X-Y recorder until the pen stops on the low frequency end of the data sheet.

(o) Repeat steps (j) and (k) until the pen of the X-Y recorder tracks precisely with 8412A Scope.

(p) With the beam of the 8412A resting on the zero line of the graticule, adjust the Y RANGE and GA1N controls until the pen rests over the zero line of the data sheet. With the AMPL dB/DIV switch of the 8412A in the .25 dB/DIV position, move the 8407A DISPLAY REFERENCE 1 dB/step switch down on step, introducing 1 dB of attenuation into the circuit. The beam should move down exactly 4 cm on the scope graticule; if not, adjust the 8407A AMPL VERNIER to place the beam on the bottom line of the scope graticule. With the beam of the 8412A at this position, the pen of the S-Y recorder should be resting over the -I-dB line of the data sheet. If not, adjust the Y RANGE and GAIN VERNIER controls to position the pen.

(q) Move the 8407A DISPLAY REFERENCE 1 dB/step switch up two steps, removing 2-dB attenuation from the circuit. The recorder pen should move past the O-dB line of the data sheet and stop on the +]-dB line.

(r) Repeat steps (m) and (n) until the pen of the X-Y recorder tracks with the beam of the 8412A Scope.

(s) Set COAXIAL switch SI to the PHASE position. Move the 8412A MODE switch to the PHASE position. Adjust the 8407A PHASE VERNIER control to place the beam of the 8412A Scope on the center horizontal line of the scope. The pen of the X-Y recorder should rest on the zero line of the data sheet. Turn the 8407A PHASE VERNIER control clockwise to introduce 4 degrees positive phase shift on the face of the 8412A Scope. The pen of the X-Y recorder should shift to the +4-degree line of the data sheet. Move the PHASE VERNIER control counterclockwise past zero to the -4degree line on the 8412A. The X-Y recorder pen should stop on the -4-degree line of the data sheet. If necessary, adjust the Y VERNIER gain and ZERO controls until the recorder tracks the scope. Place OFF/ON/SERVO switch in the OFF position.

(t) Select a reference path from table 6-22. This must be a path identical to the path to be tested. See tables 6-4 through 6-13 to determine the input/output jacks.

Table 6-22. Reference Beam Numbers

Band A	Band B	Band C
20	10	9
36	23	18
2	44	1

NOTE

When testing paths routed through the beamformer, the two beamformers containing the test path and reference path must not be fed by a common power divider.

(u) Connect POINT A of the test setup to the input of the device or devices in the reference path.

(v) Connect POINT C to the input of the device or devices under test. Connect POINT D to the output of the device or devices under test. See tables 6-4 through 6-13 to determine input/output jacks.

(w) The 8407A display (with MODE switch set to AMPL or PHASE) is the difference between the two chambers. The difference should never exceed values shown in table 6-23.

NOTE

If X-Y recorder is used, perform the following steps.

(x) Rotate the MANUAL SWEEP control of the 8601A fully clockwise. Place a fresh data sheet on the X-Y recorder and place CHART HOLD/RELEASE switch in the HOLD position. Switch OFF/ON/SERVO switch on recorder to SERVO. Rotate MANUAL SWEEP control counterclockwise until pen rests over the low frequency end line of the chart. Move PEN UP/DOWN switch to DOWN. Slowly rotate MANUAL SWEEP control fully clockwise. Move PEN UP/DOWN switch to UP. Mark the trace just recorded with a for phase. Phase tracking is listed in table 6-23.

(y) Set SI to the AMPLITUDE position and the 8412A MODE to AMP. Rotate MANUAL SWEEP control on 8601A counterclockwise until pen rests over the low frequency

Table 6-23. Amplitude and Phase Tracking Limits

Unit	Amplitude (±dB)	Phase (±Degrees)
Total Path	0.5	3.0
Directional Coupler	See tables of Capabilities and Limitations in Chapter 1 for Specifications.	
Rf Amplifier		
Monitor Beamformer		
Sector Beamformer		

end line of the chart. Place pen in the DOWN position. Slowly rotate the MANUAL SWEEP control fully clockwise to record swept frequency amplitude. Mark this trace with an A, denoting amplitude. Amplitude tracking limits are listed in table 6-23.

(z) Repeat steps (v) through (y) for remaining tests of the same type, changing only POINTS C and D of the test setup as required.

NOTE

Ensure that all rf paths not being tested are terminated in the system configuration.

2. Isolation Procedure. If the total path is out of tolerance, change both reference and test paths to a partial path and repeat the test. This can be repeated, following the rf path, until the faulty unit is isolated.

6-12. Transmission Line Phase Tracking Measurement Test Check.

a. Purpose. The purpose of these measurements is to verify that all transmission lines (from antenna element to input directional coupler, including the transmission line tuner) phase track within the required tolerance. The relative electrical length of all transmission lines within each band will be determined at one frequency and adjustments made as required to meet tolerance specifications. These measurements must be performed if a line tuner is replaced for any reason.

NOTE

One antenna line is selected as a reference to adjust the line under consideration. The band being checked will be degraded while the check is in progress. Coordination is required in accordance with local procedures.

1. Procedures.

(a) Disconnect all transmission lines to be measured from the antennas at the point of connection of the foamflex cable to antenna.

(b) Select one transmission line as a reference and terminate it with a short circuit at the antenna. Set up the test equipment (allow at least one hour for warmup) at the input directional couplers, for the band being measured, as shown in figure 6-5 (use cable lengths as shown) connect cable at POINT A to the reference transmission line to be measured using KA-99-69 Kings connector.

(c) While observing the HP5245, set the HP8601 FREQUENCY control to the highest in-band frequency (6 MHz for band A, 18 MHz for band B, 30 MHz for band C).

(d) Set CW/SWEEP switch to CW.

(e) Set OUTPUT LEVEL control to -10 dBm.

(f) On the 8412A, set MODE to PHASE, PHASE DEG/DIV to 1.0.

(g) Using the PHASE VERNIER control on the HP8407A and the PHASE OFFSET control on the HP8412A, adjust the phase reading for a O-degree reference.

(h) Disconnect POINT A from the reference transmission line and connect to the transmission line to be tested. Connect a short circuit termination (at the antenna) on the transmission line to be tested.

(i) Read and record the transmission line phase tracking error.

NOTE

The transmission line phase tracking error is one-half of the phase reading.

(j) Repeat steps (h) and (i) for the remaining transmission lines in the band being measured.

NOTE

The O-degree reference should be rechecked occasionally to determine whether or not measuring equipment has drifted. If drift has occurred, those measurements affected should be rechecked.

2. Repair Procedure. The maximum allowable phase tracking deviation from the mean is +0.5 degree. After all cables are measured on a given band, determine the mean phase error and check to see that no cable deviates from the mean by more than +0.5 degree. If any transmission line is out of tolerance, adjust the transmission line tuner to correct it.

6-13. Swept-Frequency Vswr (Singly Driven Elements) Test Check.

a. Purpose. The purpose of this test is to determine the input vswr of each antenna element as measured at the point of connection between the transmission line and the input directional coupler. All antenna elements are measured. Swept frequency plots will be recorded over the following frequency ranges for each band:

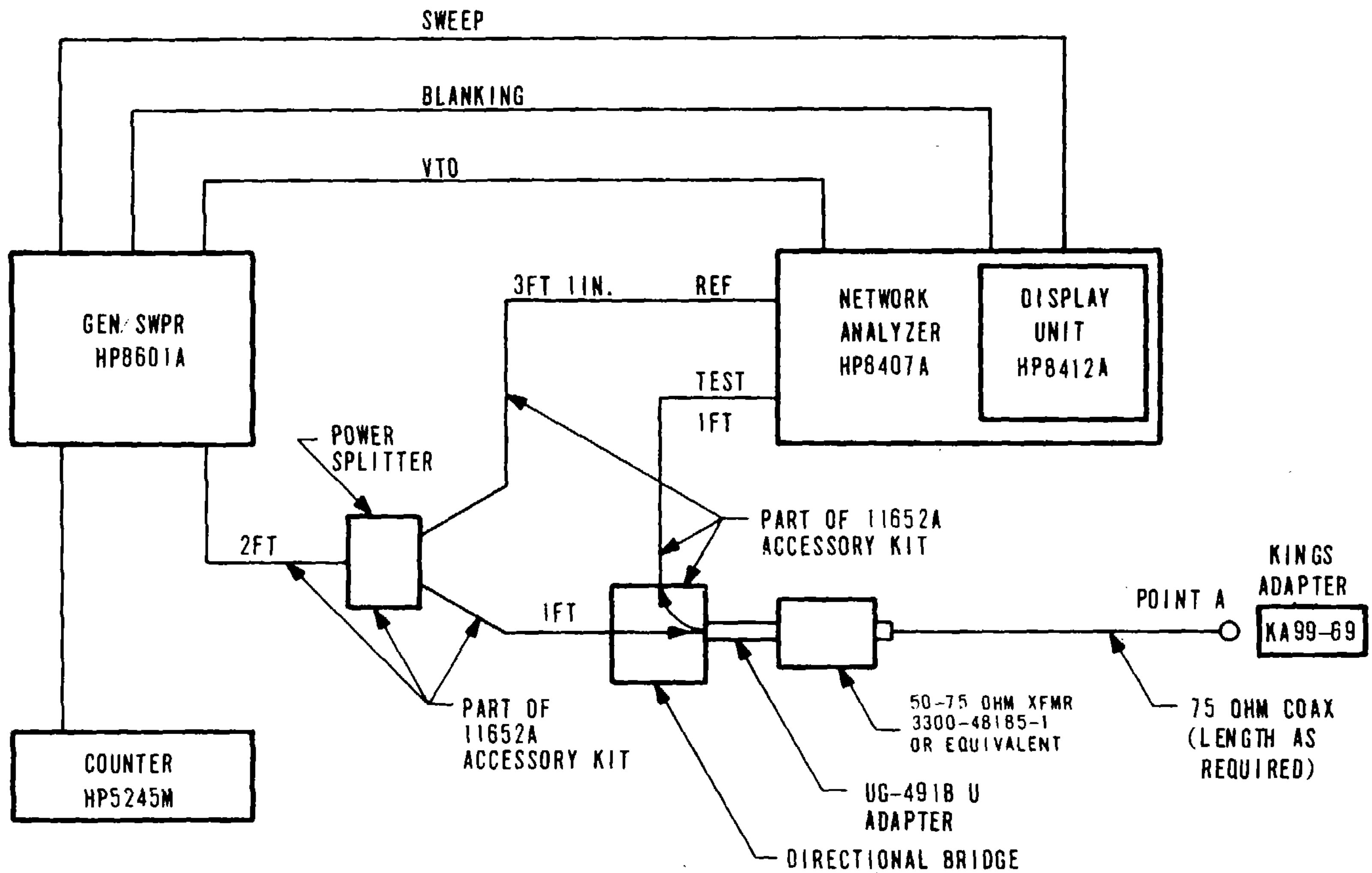
Band A 1.5 - 12 MHz

Band B 4 - 24 MHz

Band C 12 - 30 MHz

NOTE

The band being checked will be degraded while the check is in progress. Coordination is required in accordance with local procedures.



UNLESS NOTED ALL CABLES ARE RG58 OR EQUIVALENT

COAXIAL ADAPTERS MAY BE REPLACED BY EQUIVALENTS

35509A

Figure 6-5. Phase Tracking and Swept Frequency

1. Procedures.

NOTE

For this test, all transmission lines and antenna elements, except for the one under test, will be connected in the system configuration. Do not conduct these measurements during rain.

(a) Connect the equipment as shown in figure 6-5. (Use cable lengths as shown.)

(b) Set 8601A Generator/Sweeper as follows:

(1) Set OUTPUT LEVEL range switch to -10 dB.

(2) Set level to zero as shown on the meter using OUTPUT LEVEL vernier.

(3) Set SWEEP to VIDEO (4) Set SWEEP MODE to MANUAL.

(5) Turn MANUAL SWEEP control fully clockwise.

(c) While observing the 5245M Frequency Counter, set the frequency of the 8601A Generator/Sweeper to the highest frequency on the band of interest.

(d) Place a tnc female short circuit at POINT A of figure 6-5. Next, set MODE switch on the 8407A to AMPL. Use AMPLITUDE RANGE switch and AMPLITUDE VERNIER to set the beam on the center horizontal line. Using the HORIZONTAL POSITION and GA1N controls, set the beam on the extreme right vertical line of the graticule.

(e) Set the lower frequency of the band of interest by observing the frequency counter while slowly turning the MANUAL SWEEP control of the 8601A counterclockwise.

(f) Use the HORIZONTAL POSITION control on the 8412A and place the beam on the extreme left vertical line of the scope graticule.

(g) Repeat steps (c) through (f) until beam will track with the MANUAL SWEEP control. The sweep is properly adjusted when the beam travels from the left vertical line to the right vertical line on the scope graticule as the MANUAL SWEEP control is rotated from the low frequency to the high frequency of the band of interest.

(h) Remove short circuit and connect cable at POINT A to the antenna element being tested using KA 99-69 Kings adapter. (The transmission line is considered a part of the element.)

(i) Check to see that the recorder vswr is no greater than 5: 1 in bands A and B; 3: 1 in band C.

(j) Repeat steps (o) through (q) for each antenna element.

NOTE

Variations in ground conductivity and other environmental conditions may result in moderate vswr differences between antenna elements within a band. Any one or two elements deviating considerably from the average should be inspected carefully for defects. Specific limits are impossible to define, due to the above mentioned undefinable variables.

2. Repair Procedures. If an antenna element is found to exceed the vswr limits specified, check all connections and grounding. Ensure that other elements are terminated in the system configuration. Repeat the measurement after the defect is corrected.

6-14. Single Antenna Impedance Measurement Test Check.

a. Purpose. The purpose of this measurement is to verify the impedance of each antenna element, as measured at its feedpoint (POINT A on figures 6-6 and 6-7).

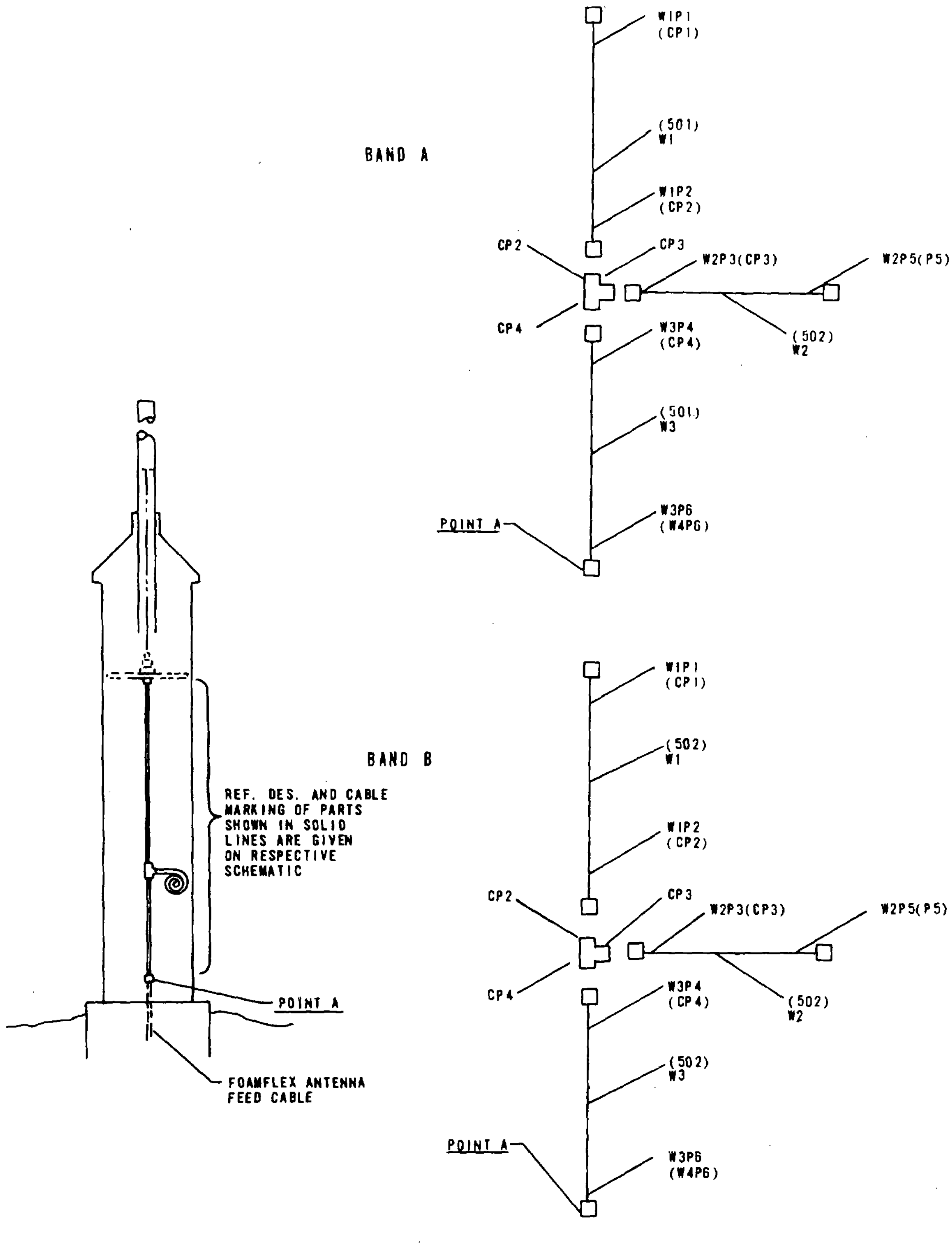


Figure 6-6. Band A & B Antenna & Feed Configuration

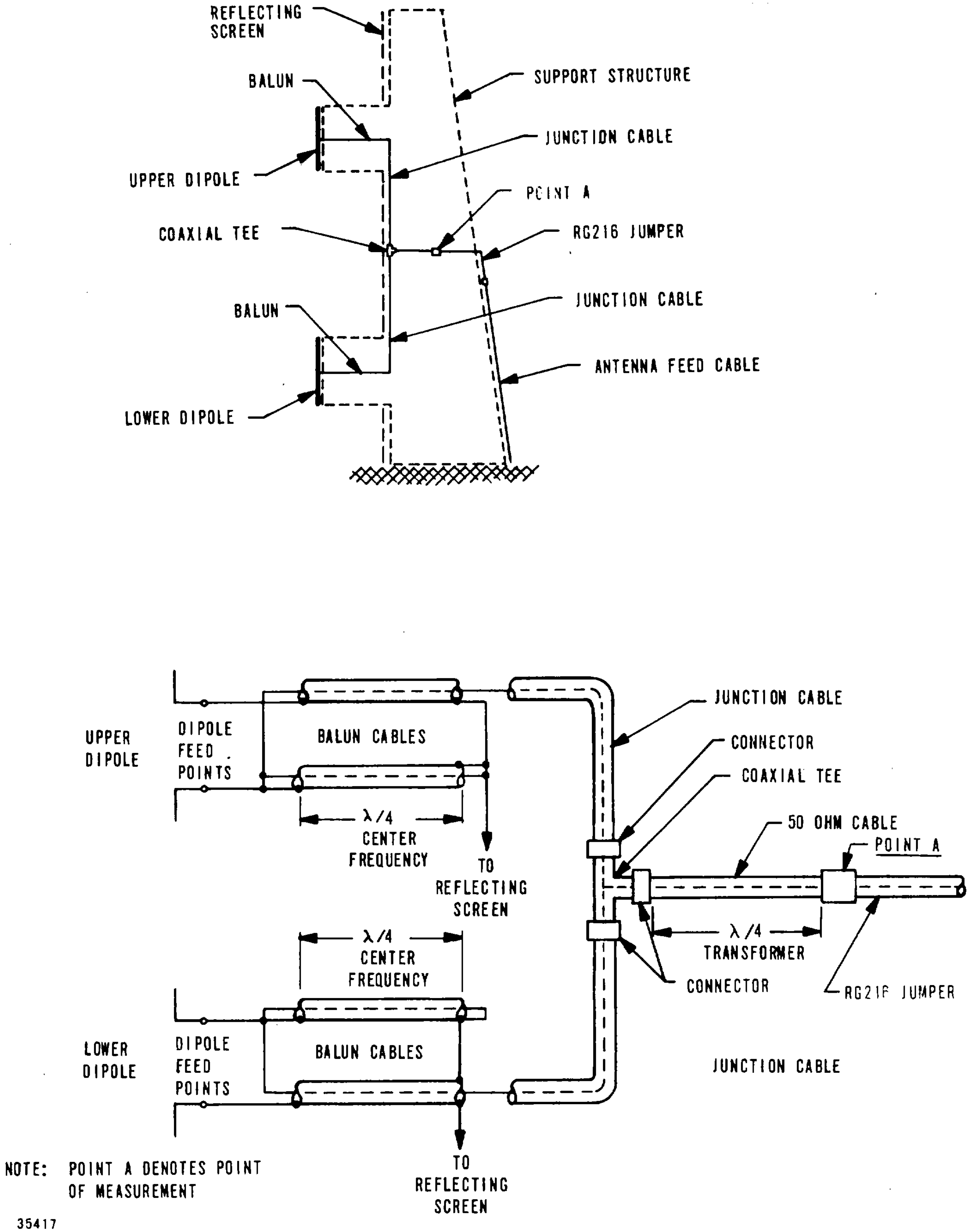


Figure 6-7. Band C Antenna & Feed Configuration

NOTE

The band being checked will be degraded while the check is in progress. Coordination is required in accordance with local procedures.

Antenna impedance measurements can be affected by the terrain in the near field of the antenna, large objects (such as buildings, machinery and utility lines), the presence of strong radio frequency signals in the band of interest, and variations in the moisture content of the ground. Do not perform these measurements during rain. Due to these factors, it will be necessary to establish mean values of impedance for the antennas in each group. This is done by measuring all antennas in each group. By analysis of this data, the mean values and allowable deviations from this mean are determined. Antennas whose impedances deviate grossly from the majority are considered faulty. If a defective antenna is found, its impedance and that of the two adjacent antennas must be remeasured after repair since mutual coupling may cause it to affect the others. Impedance measurements will involve four distinct groups of elements:

Band A

Band B (behind Band A)

Band B (between Band A)

Band C

Band B must be broken into two groups because the physical layout places half of the elements between band A elements and the other half behind band A elements. Thus, each group will have somewhat different impedance characteristics. This measurement will verify impedance uniformity of all elements in each group. It is performed on each element individually, and the impedance is measured at the feedpoint. Band C is measured at the input to the 50-ohm cable (X/4 transformer).

NOTE

It is important that all band A and band B antennas be terminated in the system configuration when either band is under test. Band C antennas must all be terminated when band C is under test.

Antennas in any one of the bands under test may appear to be questionable or unsatisfactory if there is any strong incoming interference at the frequency of the checkout. Any antennas which seem to be questionable or unsatisfactory should be retested later in the day or at another time before being given an unsatisfactory rating. Excessive irregularities in the element near fields (due to buildings and the immediate terrain) can cause minor variations in element impedances. Such variations will be gradual and systematic among adjacent elements (adjacent alternate elements in band B). There should be no sudden change in impedance between adjacent elements.

NOTE

All antennas in a given band must be checked at the same frequencies to establish a mean impedance value for the band. The following frequencies are typical for each band. These may be changed to avoid interference from external signals.

Band A 2.0 MHz and 6.0 MHz

Band B 6.0 MHz and 18.0 MHz

Band C 18.0 MHz and 30.0 MHz

1. Procedures.

(a) Connect HP4815A Vector Impedance Meter to ac power source and allow 30 minutes of warmup before operating.

(b) Set test RANGE and FREQUENCY to the lower frequency specified for the band under test.

(c) Connect probe to POINT A of the antenna. (Refer to figures 6-6 and 6-7.) (d) Adjust MAGNITUDE RANGE for an on-scale reading on the OHMS meter and record reading.

(e) Set test RANGE and FREQUENCY to the upper frequency specified for the band under test.

(f) Repeat step (d).

(g) Repeat steps (b) through (f) for each antenna to be tested.

(h) Record impedance and phase angle for all antennas in the band.

2. Repair Procedure. If an element is found which is defective, check all electrical connections, including the grounding. Also, ensure that proper test procedures were followed for that antenna group. When the defect is corrected, repeat the measurements on the adjacent elements as well as the one repaired.

SECTION II

SPECIAL MA1NTENANCE

6-15. Removal and Replacement Procedures.

a. Procedures for removal of rf amplifiers, power dividers, or beamformers are as follows:

NOTE

For an rf amplifier, turn unit OFF and unplug ac line cord before proceeding with step 1.

1. Disconnect the required coaxial cables. Be sure all are properly tagged for proper replacement.
2. Remove the retaining screws on the front of the rack, and remove the unit from the front.

b. A directional coupler is replaced as follows:

1. Attach the coaxial connectors to the new coupler.
2. Disconnect the old coupler from the mounting rack and attach the new one.

c. Transmission line tuners can be replaced without observing any special precautions. The new line tuner must be adjusted to the proper electrical length using the procedures in paragraph 6-12.

d. Antenna array components can also be replaced without observing any special precautions. Care must be taken to verify performance with the performance test procedures.

6-16. Bench Test Procedures

a. General. In the antenna group, beamformers, power dividers/combiners, directional couplers and rf amplifiers cannot be checked or serviced while mounted in their normal operating locations. Power dividers and combiners are repairable only by replacing the 1: 4 sealed units of which the various units are constructed. Directional couplers are sealed units which are non-repairable. Beamformers, directional couplers, and power dividers/combiners are passive devices. As such, they are subjected to relatively small rf signal voltages (as opposed to power devices) and normally are the most reliable elements in the signal chain. The tests that follow will provide data on individual components to indicate whether they are suitable for use. In any event, a suspect beamformer, directional coupler, power divider/combiner or rf amplifier should be replaced with a spare. The olm&t test that originally detected the out-of-tolerance condition should be repeated. This test should confirm whether the removed item was, in fact, defective.

b. Power Dividers/Omni Combiners. The following equipment is tested for phase and amplitude performance using the same test equipment setup: (See figure 6-8.)

Divider Assembly Power Rf CU-2052/FLR-9(V) (1:4 power divider, 3300-42840-1) all bands
Divider Assembly Power Rf CU-2051/FLR-9(V) (6:24 power divider, 3300-42841-1) C band
Divider Assembly Power Rf CU-2053/FLR-9(V) (4:32 power divider, 3300-42842-1) B band
Divider Assembly Power Rf CU-2050/FLR-9(V) (2:32 power divider, 3300-42843-1) A band
Coupler, Omni Assembly CU-2054/FLR-9(V) (16:2 omnicombiner, 3300-42844-1) Bands A and C
Coupler, Omni Assembly CU-2049/FLR-9(V) (6:1 omnicombiner, 3300-42845-1) all bands
Coupler, Omni Assembly CU-2055/FLR-9(V) (16:1 omnicombiner, 3300-42846-1) Band B

1. Test Equipment Required. The following equipment is required for power divider and omni combiner testing:

Type	Nomenclature
HP8601A	Generator Sweeper
HP8600A	Digital Marker
Microlab/FXR SR-05B	Line Stretcher
HP8407A with 1165A kit containing HP11851-80001 power splitter	Network Analyzer
F & M Systems 3300-48185-1	50/75-ohm transformers (2)
KA-99-51	Adapter, TNC to TNC, 75 ohm (2)
KA-89-19	75-ohm terminations

2. Connect test equipment as shown in figure 6-8 using the 75-ohm TNC to TNC adapter between the two transformers.

3. Initial Setup of 8601A

(a) Set SWEEP switch to VIDEO
(b) Set RANGE switch to 110.
(c) Set OUTPUT LEVEL to dBm as read on meter.
(d) Set I kHz MOD switch and CRYSTAL CAL switch to OFF.
(e) Set SWEEP MODE to MANUAL
(f) Set RIG-LINE-FREE to LINE

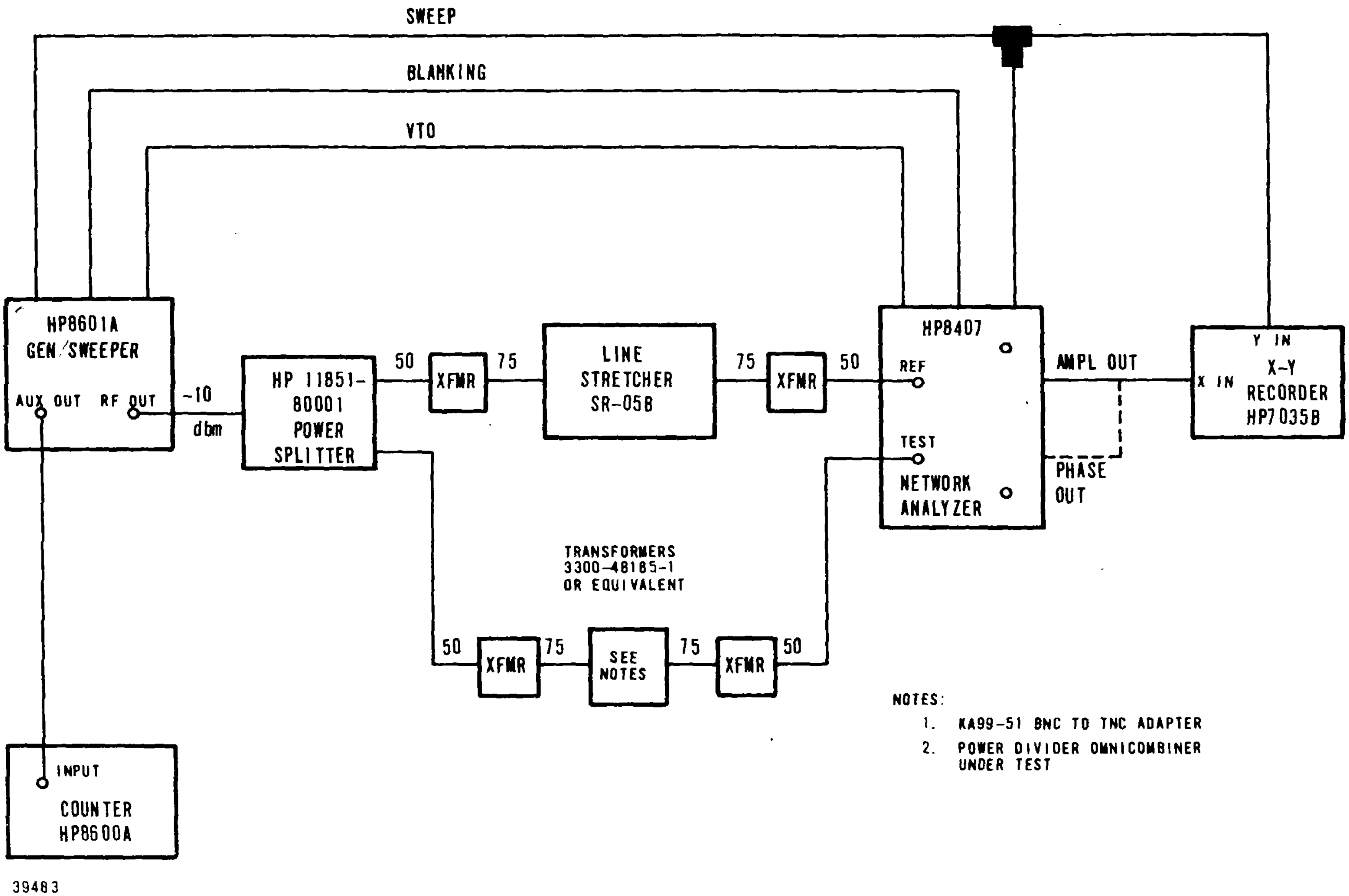


Figure 6-8. Power Divider/Combiners Test Setup

(g) Set FREQUENCY to 30 MHz.

(h) OUTPUT LEVEL to -20 dB.

4. Initial Setup of 8600A. Press CW COUNTER.

5. Initial Setup of 8407A/8412A

(a) Set PHASE OFFSET switch to +.

(b) Set PHASE OFFSET DEGREES switch to 0 (zero) degrees.

(c) Set MODE switch to DUAL.

(d) Adjust REF CHAN LEVEL ADJ until meter indicates at upper end of OPERATE range.

(e) Adjust DISPLAY REFERENCE switches until spot can be centered (0.0 volts) using AMPL VERNIER with AMPL dB/DIV switch set at 0.25 position. AMPL VERNIER should fall in mid-range to allow for later adjustments.

(f) Using DISPLAY REFERENCE CAL thumb-wheels, adjust DISPLAY REFERENCE readout to 0 dB on 10 dB steps and 0 dB on 1 dB steps.

(g) Set PHASE DEG/DIV switch to 1.0.

(h) Adjust PHASE VERNIER until display spot is centered.

(i) On the HP8601A adjust SWEEP MODE control through 1.5 to 30 MHz to check that amplitude and phase are reasonable flat.

(j) Adjust line stretcher and/or check test setup if phase and amplitude are not flat

6. Phase Measurement Procedures.

(a) Place the data sheet as illustrated in figure 6-9 on the 7035B X-Y Recorder, move the chart HOLD/RELEASE switch to the HOLD position.

(b) Set the SWEEP control of the 8601A so that the frequency counter indicates near 15 MHz. Set 8412A MODE switch to PHASE, VERNIER, and ZERO controls for full deflection of stylus (zero through ten) while trace on HP8407A travels through ten degrees. Slowly turn the MANUAL SWEEP control of the 8601A fully clockwise. Adjust the RANGE and VERNIER gain controls until the pen stops at the upper frequency end of the data sheet.

(c) Turn the 8601A MANUAL SWEEP control counterclockwise until the frequency counter indicates the low frequency of the band of interest. Turn the Y ZERO control of the X-Y recorder until the pen stops on the low frequency end of the data sheet.

(d) Repeat steps (b) and (c) until the pen of the X-Y recorder tracks precisely with 8412A Scope.

(e) With the beam of the 8412A resting on the zero line of the graticule, adjust the X ZERO control until the pen rests over the zero line of the data sheet.

(f) Set the PHASE OFFSET DEGREES switch of the 8412A to 80. Adjust the RANGE and GA1N VERNIER controls to position the pen over the 80 dB line of the data sheet.

(g) Repeat steps (e) and (f) until the pen tracks precisely.

(h) Replace TNC to TNC adapter with device to be tested.

(i) Rotate the MANUAL SWEEP control of the 8601A fully clockwise. Switch OFF/ON/SERVO switch on recorder to SERVO. Rotate MANUAL SWEEP control counterclockwise until pen rests over the low frequency end line of the chart. Move PEN UP/DOWN switch to DOWN. Slowly rotate MANUAL SWEEP control fully clockwise. Move PEN UP/ DOWN switch to UP. Compare tracking curve with phase levels listed in figure 6-9. If tracking accuracy exceeds ±1.75 degrees, replace faulty component.

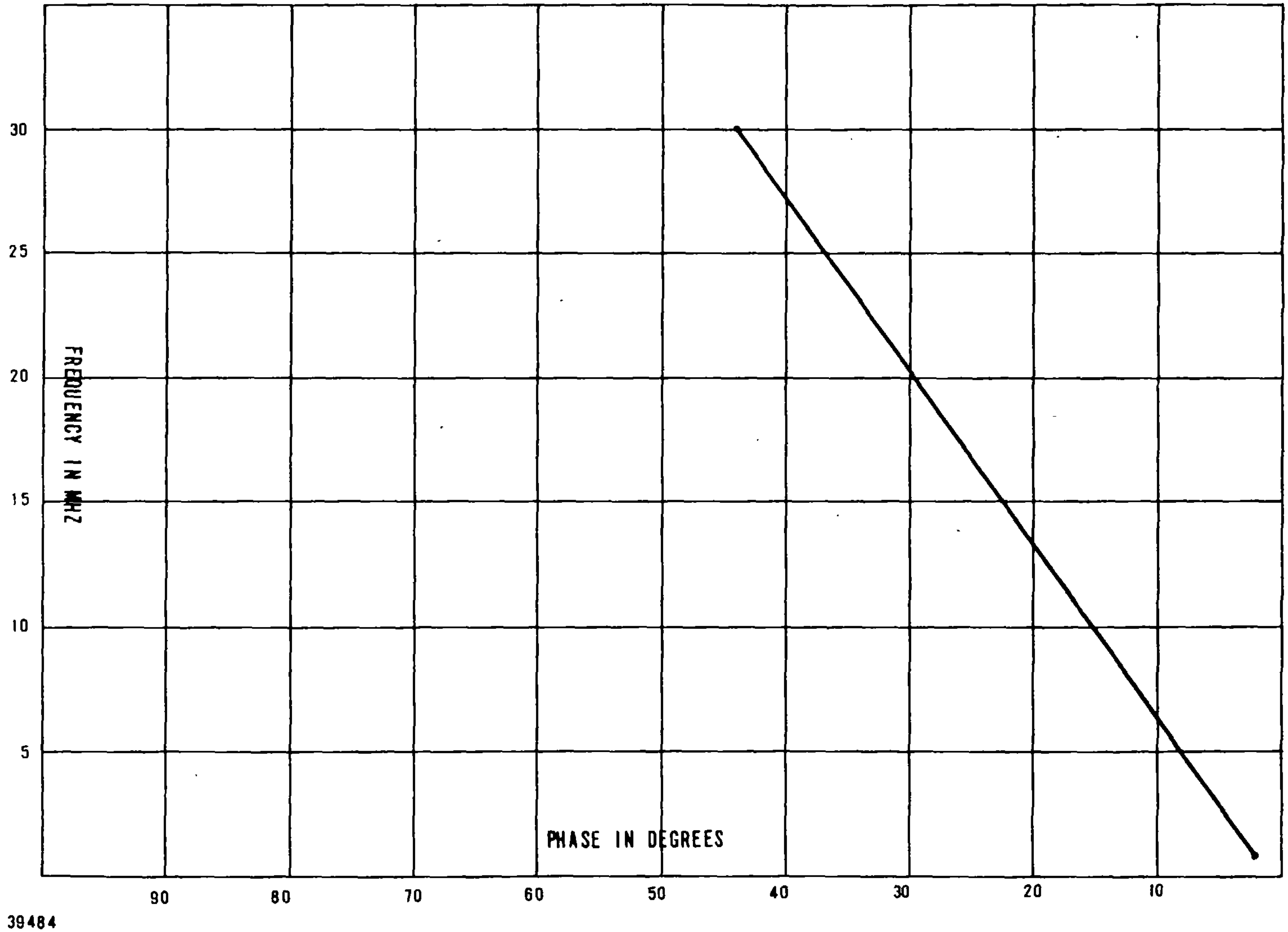


Figure 6-9. Phase Level Tracking Curve Typical Data Sheet

7. Amplitude Measurement Procedures

(a) Use bnc to bnc adapter to connect test leads.

(b) Set 8412A AMPL dB/DIV switch to 0.25

(c) Use 8407A AMPL VERNIER to adjust the zero display sweep to the center gratical.

(d) Adjust DISPLAY REFERENCE 1O-dB steps to +10 and 1-dB steps to -4 for 6 dB amplitude; 10-dB step to +10 and l-dB steps to 0 for 9-dB and 12-dB amplitudes, See table 6-23 for amplitudes.

(e) Remove bnc to bnc adapter and connect test leads to unit under test.

(f) Observe the maximum dB deflection on the 8412A between the minimum and maximum frequencies as listed in table 6-24. If deflection exceeds +0.5 dB, replace the faulty component.

Table 6-24. Power Divider/Combiner Amplitude and Phase Requirements

Divider, Power Rf, CU-2052/FLR-9(V)
3300-42840-1 (1:4 Power Divider)

Frequency	Amplitude dB
1.5 MHz	-6.16 dB
2.0	-6.16
2.5	-6.16
3.0	-6.17
3.5	-6.17
4.0	-6.18
4.5	-6.19
5.0	-6.19
5.5	-6.20
6.0	-6.21
7.5	-6.22
9.0	-6.24
10.5	-6.26
12.0	-6.28
13.5	-6.29
15.0	-6.30
16.5	-6.31
18.0	-6.33
19.5	-6.34
21.0	-6.35
22.5	-6.36
24.0	-6.37
25.5	-6.38
27.0	-6.39
28.5	-6.40
30.0	-6.41

Table 6-24. Power Divider/Combiner Amplitude and Phase Requirements (Continued)

Divider, Power Rf, CU-2052/FLR-9(V) 3300-42840-1 (1:4 Power Divider)

Frequency	Phase
1.5 MHz	-2.5
2.0	-3.3
2.5	-4.2
3.0	-5.0
3.5	-5.8
4.0	-6.6
4.5	-7.4
5.0	-8.2
5.5	-9.0
6.0	-9.8
7.5	-12.1
9.0	-14.4
10.5	-16.7
12.0	-19.0
13.5	-21.3
15.0	-23.5
16.5	-25.8
18.0	-28.1
19.5	-30.3
21.0	-32.6
22.5	-34.9
24.0	-37.1
25.5	-39.3
27.0	-41.6
28.5	-43.9
30.0	-46.2

Divider Assembly, Power Rf CU-2051/FLR-9(V) 3300-42841-1 (6:24 Power Divider)

Frequency	Phase
18.0	-28.4 degrees
19.5	-30.7
21.0	-33.0
22.5	-35.3
24.0	-37.6
25.5	-39.2
27.0	-42.2
28.5	-44.6
30.0	-46.9

Table 6-24. Power Divider/Combiner Amplitude and Phase Requirements (Continued)

Divider Assembly, Power Rf CU-2051/FLR-9(V) 3300-42841-1 (6:24 Power Divider)

Frequency	Amplitude dB
18.0	-6.28
19.5	-6.29
21.0	-6.30
22.5	-6.31
24.0	-6.32
25.5	-6.33
27.0	-6.35
28.5	-6.35
30.0	-6.37

Divider Assembly, Power Rf CU-2053/FLR-9(V) 3300-42842-1 (4:32 Power Divider)

Frequency	Phase
6.0 MHz	-17.3 degrees
7.5	-21.5
9.0	-25.7
10.5	-29.8
12.0	-33.9
13.5	-38.0
15.0	-42.1
16.5	-46.2
18.0	-50.4

Frequency	Amplitude dB
6.0 MHz	-9.25
7.5	-9.29
9.0	-9.31
10.5	-9.34
12.0	-9.36
13.5	-9.39
15.0	-9.41
16.5	-9.43
18.0	-9.45

Divider Assembly, Power Rf CU-2050/FLR-9(V) 3300-42843-1 (2:32) Power Divider)

Frequency	Phase
2.0 MHz	-8.0 degrees
2.5	-10.0
3.0	-12.0

Table 6-24. Power Divider/Combiner Amplitude and Phase Requirements (Continued)

Divider Assembly, Power Rf CU-2050/FLR-9(V) 3300-42843-1 (2:32) Power Divider) (Continued)

Frequency	Phase
3.5	-14.0 degrees
4.0	-16.0
4.5	-17.8
5.0	-20.3
5.5	-21.5
6.0	-23.5

Frequency	Amplitude dB
2.0	-12.19
2.5	-12.21
3.0	-12.23
3.5	-12.24
4.0	-12.26
4.5	-12.28
5.0	-12.30
5.5	-12.31
6.0	-12.33

Coupler, Omni Assembly CU-2054/FLR-9(V) 3300-42844-1 (16:2 Omnicombiner)

Frequency	Phase
2.0 MHz	- 5.8 degrees
2.5	- 7.2
3.0	- 8.7
3.5	-10.1
4.0	-11.6
4.5	-13.0
5.0	-14.4
5.5	-15.8
6.0	-17.3
7.5	-21.4
9.0	-25.6
10.5	-29.7
12.0	-33.8
13.5	-37.9
15.0	-42.0
16.5	-46.1
18.0	-50.2
19.5	-54.3
21.0	-58.4
22.5	-62.4
24.0	-66.4
25.5	-70.6

Table 6-24. Power Divider/Combiner Amplitude and Phase Requirements (Continued)

Coupler, Omni Assembly CU-2054/FLR-9(V) 3300-42844-1 (16:2 Omnicombiner)

Frequency	Phase
27.0	-74.7
28.5	-78.8
30.0	-82.9

Frequency	Amplitude dB
2.0 MHz	-9.18
2.0 MHz	-9.18
2.5	-9.19
3.0	-9.19
3.5	-9.20
4.0	-9.21
4.5	-9.22
5.0	-9.23
5.5	-9.24
6.0	-9.25
7.5	-9.28
9.0	-9.31
10.5	-9.33
12.0	-9.36
13.5	-9.38
15.0	-9.40
16.5	-9.42
18.0	-9.44
19.5	-9.46
21.0	-9.48
22.5	-9.51
24.0	-9.53
25.5	-9.53
27.0	-9.55
28.5	-9.57
30.0	-9.59

Coupler, Omni Assembly CU-2049/FLR-9(V) 3300-42845-1 (6:1 Omnicombiner)

Frequency	Phase
2.0 MHz	-5.8 degrees
2.5	-7.3
3.0	-8.7
3.5	-10.2
4.0	-11.6
4.5	-13.1
5.0	-14.5
5.5	-15.9

Table 6-24. Power Divider/Combiner Amplitude and Phase Requirements (Continued)

Coupler, Omni Assembly CU-2049/FLR-9(V) 3300-42845-1 (6:1 Omnicombiner) (Continued)

Frequency	Phase
6.0	-17.3
7.5	-21.5
9.o	-25.6
10.5	-29.8
12.0	-33.9
13.5	-38.0
15.0	-42.1
16.5	-46.2
18.0	-50.3
19.5	-54.4
21.0	-58.5
22.5	-62.6
24.0	-66.4
25.5	-70.7
27.0	-74.8
28.5	-78.9
30.0	-83.0

Coupler, Omni Assembly CU-2049/FLR-9(V) 3300-42845-1 (6:1 Omnicombiner) (Continued)

Frequency	Amplitude dB
2.0 MHz	-9.18
2.5	-9.19
3.0	-9.20
3.5	-9.21
4.0	-9.22
4.5	-9.23
5.0	-9.24
5.5	-9.25
6.0	-9.26
7.5	-9.29
9.0	-9.32
10.5	-9.35
12.0	-9.37
13.5	-9.39
15.0	-9.42
16.5	-9.44
18.o	-9.46
19.5	-9.48
21.0	-9.5
22.5	-9.53
24.0	-9.53
25.5	-9.55
27.0	-9.57

Table 6-24. Power Divider/Combiner Amplitude and Phase Requirements (Continued)

Coupler, Omni Assembly CU-2049/FLR-9(V) 3300-42845-1 (6:1 Omnicombiner) (Continued)

Frequency	Amplitude dB
28.5	-9.59
30.0	-9.61

Coupler, Omni Assembly CU-2055/FLR-9(V) 3300-42846-1 (16:1 Omnicombiner)

Frequency	Phase
6.0 MHz	-21.7 degrees
7.5	-27.0
9.0	-32.1
10.5	-37.3
12.0	-42.5
13.5	-47.6
15.0	-52.8
16.5	-57.9
18.0	-63.0

Frequency	Amplitude dB
6.0 MHz	-12.45
7.5	-12.49
9.0	-12.52
10.5	-12.56
12.0	-12.59
13.5	-12.62
15.0	-12.65
16.5	-12.68
18.0	-12.71

c. Directional Couplers. Directional couplers, in all cases, consist of two transformers enclosed in a sealed box. Repair of these units is not feasible. Extensive testing for all published characteristics is unnecessary since one set of measurements, as described below, will identify defective units. The units can develop only an open circuit, a short circuit, a cracked toroid transformer core, or one or more shorted turns in a transformer. There are no other components inside other than the two transformers. Any of the above defects will cause an unsatisfactory impedance to be reflected at one or more ports.

1. Test Equipment Required.

HP4815 Rf Vector Impedance
Meter KA-89-19 75-ohm termination (3)

2. Directional Coupler Operating Frequencies. The following directional couplers operate as listed in the frequency bands A, B, and C.

<u>Olektron Type</u>	<u>Frequency</u>	
T-D4-101-1; T-D4-102-1	A.	1.5 to 6 MHz
T-D4-IOI-1; T-D4-102-11	B.	6 to 18 MHz
T-D4-101-111; T-D4-102-111	C.	18 to 30 MHz

3. Directional Coupler Tests.

(a) Terminate all ports except the one being checked with KA-89-19 terminations.

(b) Connect impedance meter probe to port under test. Use impedance meter frequencies as determined from type of coupler and band of operation as determined from preceding step 2.

NOTE

An adapter containing a TNC connector is furnished as an accessory with the impedance meter. This facilitates probe connection to the directional coupler.

(c) The impedance of any port, when checked at any frequency within the appropriate band, should read 75 ±5 ohms. The upper and lower and two or three in-band frequency checks should confirm proper impedance.

NOTE

In all cases, all ports except the one being checked must be terminated in 75 ohms. Check all ports so that each side is tested.

d. <u>Beamformers.</u> Beamformers consist of artificial delay lines, attenuators, and power combiners. It is necessary to determine the phase delay and attenuation of the various input ports, relative to the output port, to confirm proper operation. Internal trimming adjustments are provided that make small changes of inductance and capacitance in the individual delay lines. Normally, these adjustments will retain their electrical parameters over the life of the beamformer. Only infrequently should it become necessary to make readjustments. When a port or ports contain an apparent out of-tolerance condition, recheck the test setup to positively identify that the beamformer is, in fact, at fault. Rf adjustments on artificial delay lines are critical, and experience with these devices and their measurement must be accomplished only by qualified personnel.

1. <u>Test Equipment Required</u>

<u>Type</u>	<u>Description</u>
HP8601A Generator/Sweeper	Signal Generator
HP11652A Transmission Kit	Power Splitter
Variable Time Delay Type 2081	Continuously Variable Delay Line
Time Delay Standard Model 20A2C	Decade Line Delay
SR-05B	Line Stretcher

Type	Description
F & M 3300-48185-1	50- to 75-ohm transformers (2)
HP8407A	Network analyzer
Weinschel Precision Attenuator Set Model AS-9146	Selected attenuators in three bands
KA-99-19	75-ohm termination (quantity as required)
Electronic Counter HP5245	Determines accuracy of test frequency
KC-99-70	TNC to TNC adapter (Female)
Rotary Step Assembly Attenuator	0-to 1-dB attenuator in 0.1-dB steps.

2. Test Setup. Figure 6-10 illustrates the test setup for beamformer phase tracking tests.

3. Test Procedure.

(a) Initially, connect bnc to bnc adapter between points 1 and 2. Do not use cables; the adapter should be the only connection between points 1 and 2.

(b) Set line stretcher SR-05B and adjustable delay lines 201B and 20A2C to minimum delay.

(c) Use HP5245 to set signal generator to within 100 cycles of frequency for beamformer to be tested. (See table 6-25), the generator output level is not critical; use approximately 100 mv output level.

(d) Adjust line stretcher SR-05B for 0 degrees phase shift on network analyzer.

NOTE

It may be necessary to add a short length of cable between the power divider and one side or the other in order to adjust phasing to 0 degrees. A positive phase shift indicates additional line is required.

(e) Adjust HP8407A DISPLAY REFERENCE and AMPL VERNIER for 0-dB indication.

(f) Repeat steps d. and e. for 0 phase and amplitude.

(g) Set DISPLAY REFERENCE CAL for 00 indication on DISPLAY REFERENCE.

(h) Remove adapter connected in step (a) and replace with desired beamformer.

NOTE

All unused ports must be terminated in 75 ohms.

(i) Adjust the decade line delay and, using the continuously variable line as a vernier, insert a total nanosecond delay as determined from table 6-25 for the port and beamformer under test.

(j) Set DISPLAY REFERENCE to relative attenuation for port and beamformer under test as listed in table 6-25.

(k) Phase shift should be no more than 2 degrees as indicated on the HP8407A

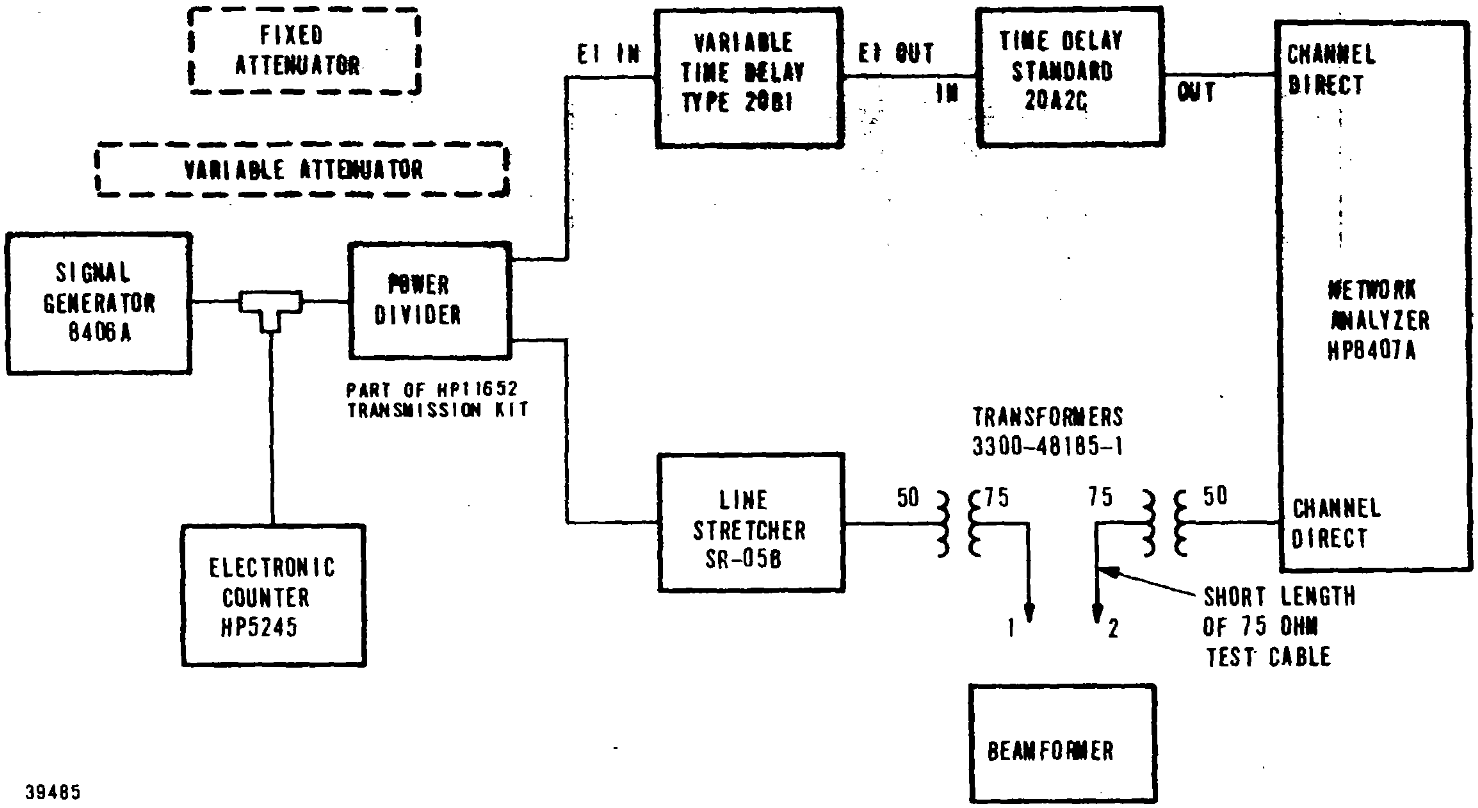


Figure 6-10. Beamformer Phase and Amplitude Test Setup

(l) Repeat steps (g), (h), and (i) to check other ports in the same manner, being certain that all others not under test are terminated in 75 ohms.

(m) Connect the rotary step assembly attenuator (variable attenuator) between the variable time delay and power divider.

(n) Use bnc to bnc adapter to connect points 1 and 2.

(o) Set HP8407A DISPLAY REFERENCE TO 00.

(p) Repeat steps b, d and e for 0 phase and amplitude.

(q) Remove adapter connected in step (m) and replace with beamformer port under test.

(r) Determine amount of attenuation required for beamformer port under test from attenuation listed in table 6-25.

(s) Select the attenuator from the Weinschel Precision Attenuator Set approximating the required attenuation and connect between the input (E1IN) of the variable time delay unit and the variable attenuator.

(t) Adjust the variable attenuator to provide total attenuation determined in step (r).

(u) Adjust decode line delay and variable time delay for total nanosecond delay from table 6-25 for beamformer port under test.

4. Beamformer Adjustments. If all readings taken are consistently high or low, carefully check test setup before making adjustments inside beamformers. Refer to section 7 for beamformer schematics. Remove top and bottom cover plates. With the test equipment operating observe the out-of-tolerance channel.

(a) Phase Adjustments. The variable L and C adjustments shown on schematics are clearly indicated in the beamformer. Place a finger lightly on the various variable capacitors or inductors associated with the out-of-tolerance port. If additional capacitance indicates the reading may fall in, adjust the associated capacitor. Do likewise with the variable inductors. If the beamformer channel comes within tolerance, recheck adjacent channels to see what effect, if any, the adjustment made.

(b) Amplitude Adjustments. These are critical adjustments, since they can only be accomplished by removing existing resistors and trimming with replacement resistors. Selected resistors used to adjust amplitude during manufacture are indicated on the schematics as -;. Replacement of any resistors will necessitate complete recheck of phase and amplitude of the beamformer. A representative set of trimming resistors are available as spares at both sites. Artificial transmission lines, as used in beamformers, are critical in adjustment and have interlocking effects in phase and amplitude. Only personnel with a background in transmission line theory should attempt adjustments.

NOTE

In the following table, ns = nanoseconds.

Table 6-25. Phase and Amplitude Data For Beamformers

Beamformer Assembly TD-1050/FLR-9(V) (V8 only.)

Input Jack Number	At 4 MHz, Phase Deviation ±2° Max (±1.4 ns)	Attenuation, Input to Output ±0.5 dB
1	189.8 ns	-10.0 dB
2	189.8	-10.0
3	183.8	-11.1
4	183.8	-11.1
5	171.9	-12.9
6	171.9	-12.9
7	154.3	-15.6
8	154.3	-15.6
9	131.3	-18.7
10	131.3	-18.7
11	103.3	-22.6
12	103.3	-22.6
13	70.9	-23.7
14	70.9	-23.7
15	34.4	-22.1
16	34.4	-22.1

Beamformer Assembly TD-1052/FLR-9(V) (V7 only)

Input Jack Number	At 4 MHz, Phase Deviation ±2° Max (±1.4 ns)	Attenuation, Input to Output ±0.5 dB
1	229.2 ns	-10.0 dB
2	229.2	-10.0
3	221.7	-11.1
4	221.7	-1.1

Table 6-25. Phase and Amplitude Data For Beamformers (Continued)

Beamformer Assembly TD-1052/FLR-9(V) (V7 only.) (Continued)

Input Jack Number	At 4 MHz, Phase Deviation ± 2° Max (±1.4 ns)	Attenuation, Input to Output ±0.5 dB
5	206.9 ns	-12.9 dB
6	206.9	-12,9
7	184.9	-15.6
8	184.9	-15.6
9	156.2	-18.7
10	156.2	-18.7
11	121.3	-22.6
12	121.3	-22.6
13	80.7	-23.7
14	80.7	-23.7
15	35.2	-22.1
16	35.2	-22.1

Beamformer Assembly TD-1051/FLR-9(V) (V8 only)

Input Jack Number	At 12 MHz6 Phase Deviation ±2° Max (+0.46 ns)	Attenuation, Input to Output ±0.5 dB
1	63.69 ns	-10.0 dB
2	63.69	-10.0
3	62.19	-11.1
4	62.19	-11.1
5	59.19	-12.9
6	59.19	-12.9
7	54.70	-15.6
8	54.70	-15.6

Table 6-25. Phase and Amplitude Data For Beamformers (Continued)

Beamformer Assembly TD-1051/FLR-9(V) (V8 only) (Continued)

Input Jack Number	At 12 MHz6 Phase Deviation ±2° Max (+0.46 ns)	Attenuation, Input to Output ±0.5 dB
9	48.75 ns	-18.7 dB
10	48.75	-18.7
11	41.36	-22.6
12	41.36	-22.6
13	32.57	-23.7
14	32.57	-23.7
15	22.40	-22.1
16	22.40	-22.1

Beamformer Assembly TD-1053/FLR-9(V) (V7 only.)

Input Jack Number	At 12 MHz, Phase Deviation ±2° Max (+0.46 ns)	Attenuation, Input to Output ± 0.5 dB
1	81.77 ns	-10.0 dB
2	81.77	-10.0
3	79.64	-1.1
4	79.64	-11.1
5	75.38	-12.9
6	75.38	-12.9
7	69.02	-15.6
8	69.02	-15.6
9	60.57	-18.7
10	60.57	-18.7
11	50.09	-22.6
12	50.09	-22.6

Table 6-25. Phase and Amplitude Data For Beamformers (Continued)

Beamformer Assembly TD-1053/FLR-9(V) (V7 only.) (Continued)

Input Jack Number	At 12 MHz, Phase Deviation ±2° Max (+0.46 ns)	Attenuation, Input to Output ±0.5 dB
13	37.61	-23.7
14	37.61	-23.7
15	23.18	-22.1
16	23.18	-22.1

Beamformer Assembly TD-1054/FLR-9(V)

Input Jack Number	At 24 MHz, Phase Deviation ± 2° Max (+0.23 ns)	Attenuation, Input to Output ± 0.5 dB
1	31.48 ns	-7.8 dB
2	31.48	-7.8
3	28.75	-9.8
4	28.75	-9.8
5	23.35	-14.4
6	23.35	-14.4
7	15.36	-15.7
8	15.36	-15.7

Beamformer Assembly TD-1055/FLR-9(V)
Test Frequence: 4 MHz at 100 mv

Procedure (See figure 6-10)

NOTE

All ports not under test must be terminated in 75 ohms. See figure 5-5.

Step a. Check phase delay between J1 and J5.
Step b. Check phase delay between J2 and J5. Step a. and b. should agree within ± 1 degree as read on network analyzer.
Step c. Check phase delay between J3 and J5.
Step d. Check phase delay between J4 and J5. C and d. should agree within ±1 degree as read on vector voltmeter. The delay path through a. b. should be 9.3 nanoseconds greather than paths c. or d. above

Table 6-25. Phase and Amplitude Data For Beamformers (Continued)

within ±2 degrees as read on network analyzer. At 4 MHz. 9.3 nanoseconds equals 13.5 degrees

Step e. Insert 100-mV signal at each input port separately and note output reading (at J5)

Step f. Level at J5 should be 8.5 ±0.2 dB greater than J1 and J2 than from J3 or J4.

Beamformer Assembly TD-1056/FLR-9(V)
Test Frequency: 12 MHz at 100 mV

Procedure (See figure 6-10)

NOTE

All ports not under test must be terminated in 75 ohms. See figure 5-6.

Step a. Check phase delay between J1 and J4.

Step b. Check phase delay between J2 and J4. Steps a. and b. should agree within ±1 degree as read on network analyzer

Step c. Check phase delay between J3 and J4. The delay through c., above, should b 1.2 nanoseconds greater than that of steps a. or b. within ±2 degrees as read on vector voltmeter. At 12 MHz, 1.2 nanoseconds equals 5.2 degrees.

Step d. Insert 100-mV signal at each input port and note output reading (at J4)

Step e. Level at J4 should be 8.0 ±0.2 dB greater from J2 than from J1 or J3.

Beamformer Assembly TD-1057/FLR-9(V)
Test Frequency: 24 MHz at 100 mV

Procedure (See figure 6-10)

NOTE

Port not under test must be terminated in 75 ohms. See figure 5-7.

Step a. Insert test frequency in J1 and measure phase delay to J3.

Step b. Repeat using the J2 port. The phase delay between ports should agree within ±1 degree as read on the network analyzer.

Step c. Insert 100-mV signal at each input port separately and note output reading. The maximum insertion loss should not exceed 3.5 dB and both channels should agree within ±0.2 dB.

e. Radio Frequency Amplifier. Refer to CM 32-5895-236-14 and associated supplement for servicing and checkout.

CHAPTER 7

CIRCUIT DIAGRAMS

7-1. General.

Circuit diagrams contained in this chapter are presented to aid in maintenance operations and consist of all beamformers used in the antenna group. Components that are non-repairable are sealed 1:4 power dividers and directional couplers. Refer to Chapter 1, paragraph 1-6. for a listing of related manuals that contain maintenance information and schematics. A schematic of the blower assembly used in all antenna amplifier racks may be found in Chapter 5, figure 5-26. Figures 7-1 through 7-9 consist of the following

Figure 7-1. Schematic, 8eamformer Assembly TD-1050/FLR-9(V)
Figure 7-2. Schematic, Beamformer Assembly TD-1051/FLR-9(V)
Figure 7-3. Schematic, Beamformer Assembly TD-1054/FLR-9(V)
Figure 7-4. Schematic, Beamformer Assembly TD-1052/FLR-9(V)
Figure 7-5. Schematic, Beamformer Assembly TD-1053/FLR-9(V)
Figure 7-6. Schematic, Beamformer Assembly TD-1055/FLR-9(V)
Figure 7-7. Schematic, Beamformer Assembly TD-1056/FLR-9(V)
Figure 7-8. Schematic, Beamformer Assembly TD-1057/FLR-9(V)
Figure 7-9. Antenna Group Cabling Diagram

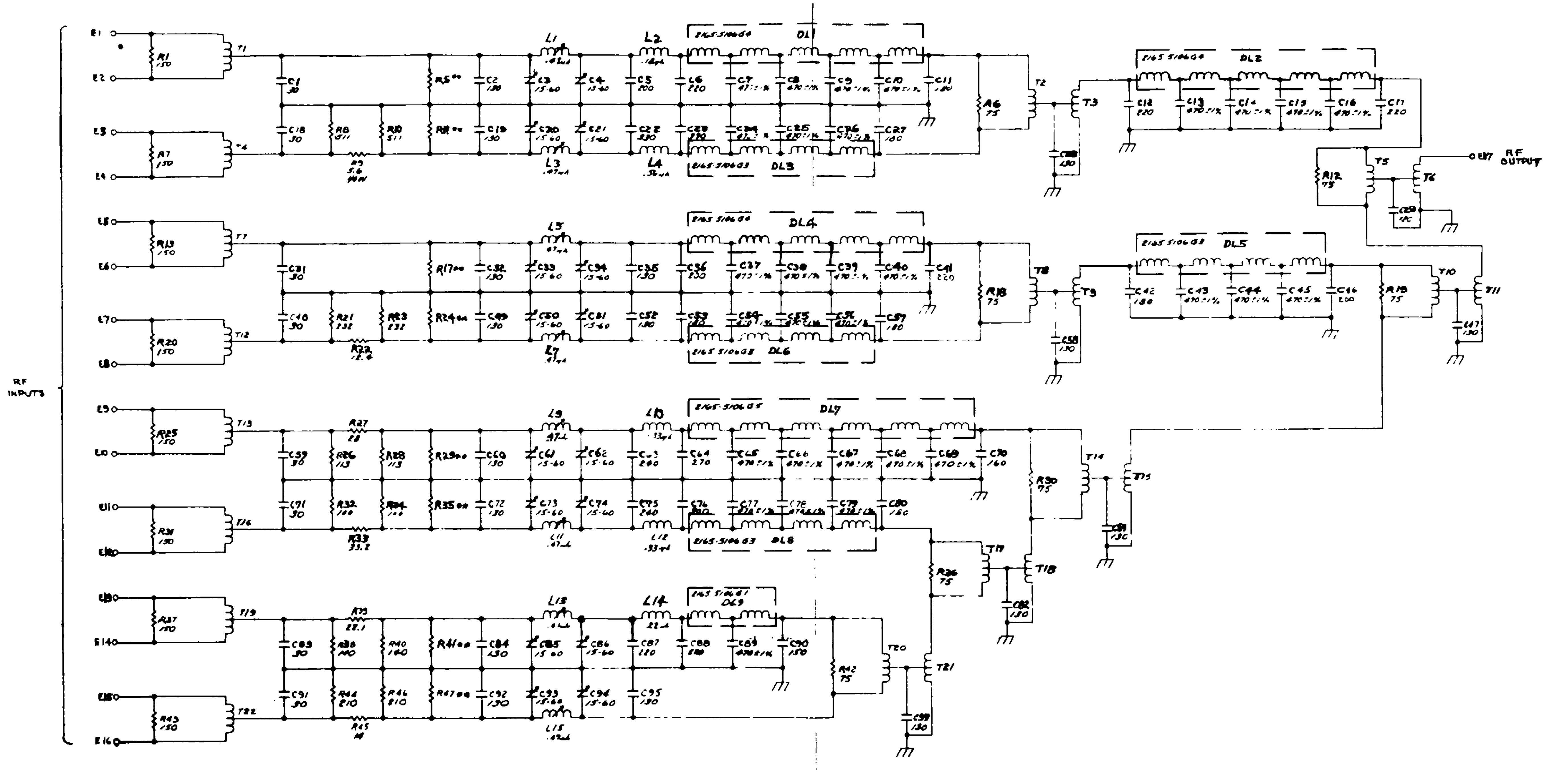


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Figure 7-1. Schematic, Beamformer Assembly TD-1050/FLR-9(V)

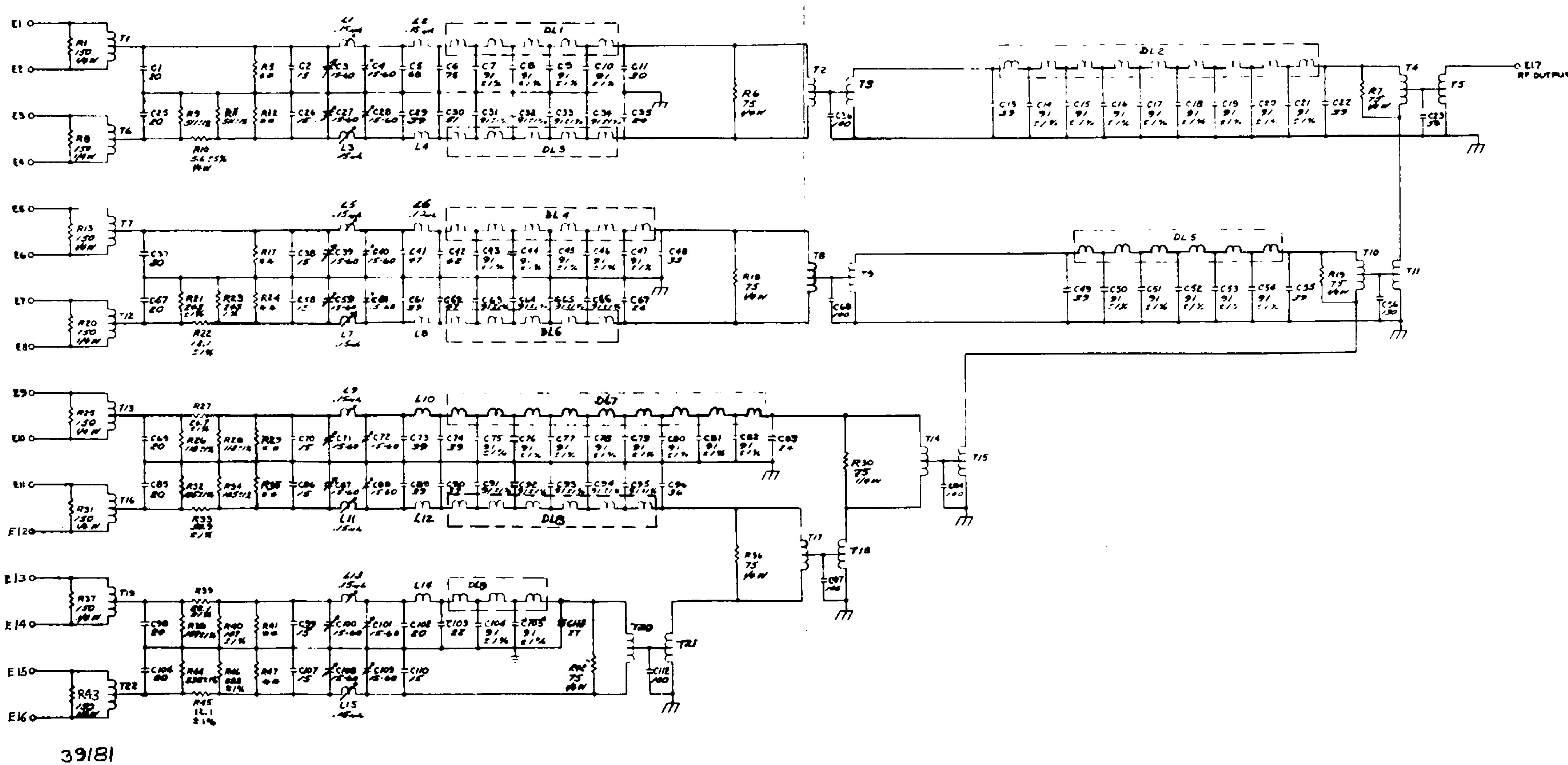

Figure 7-2. Schematic, Beamformer Assembly TD-1051/FLR-9(V)

NOTES:
1. PARTIAL REF DESIGNATIONS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH UNIT NO. OR SUBASSEMBLY DESIGNATION.
2. ALL RESISTORS ARE IN OHMS, 1/8 W ± 2 % UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITORS ARE IN PF, ± 5 % UNLESS OTHERWISE SPECIFIED.
4. ** INDICATORS VALUE TO BE DETERMINED AT ASSY TO TRIM ATTENUATION, IF REQUIRED.

HIGHEST REF DESIG		
R46	C79	T20
L18	DL6	

REF DESIG NOT USED		
R8	R9	R10
R31	R32	R33
C14		C40
C54		C80
L8	L16	

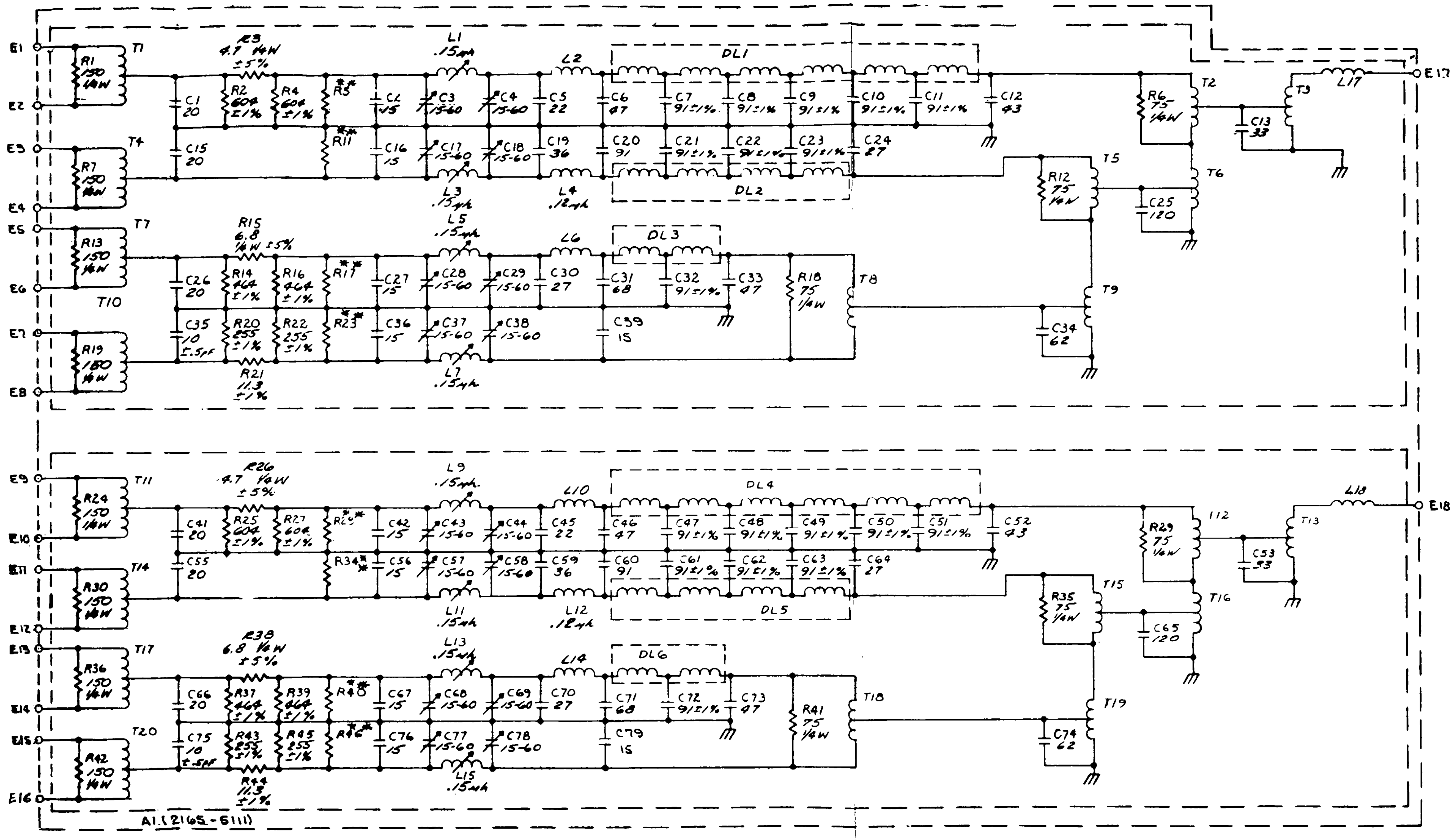

Figure 7-3. Schematic, Beamformer Assembly TD-1054/FLR-9(V)

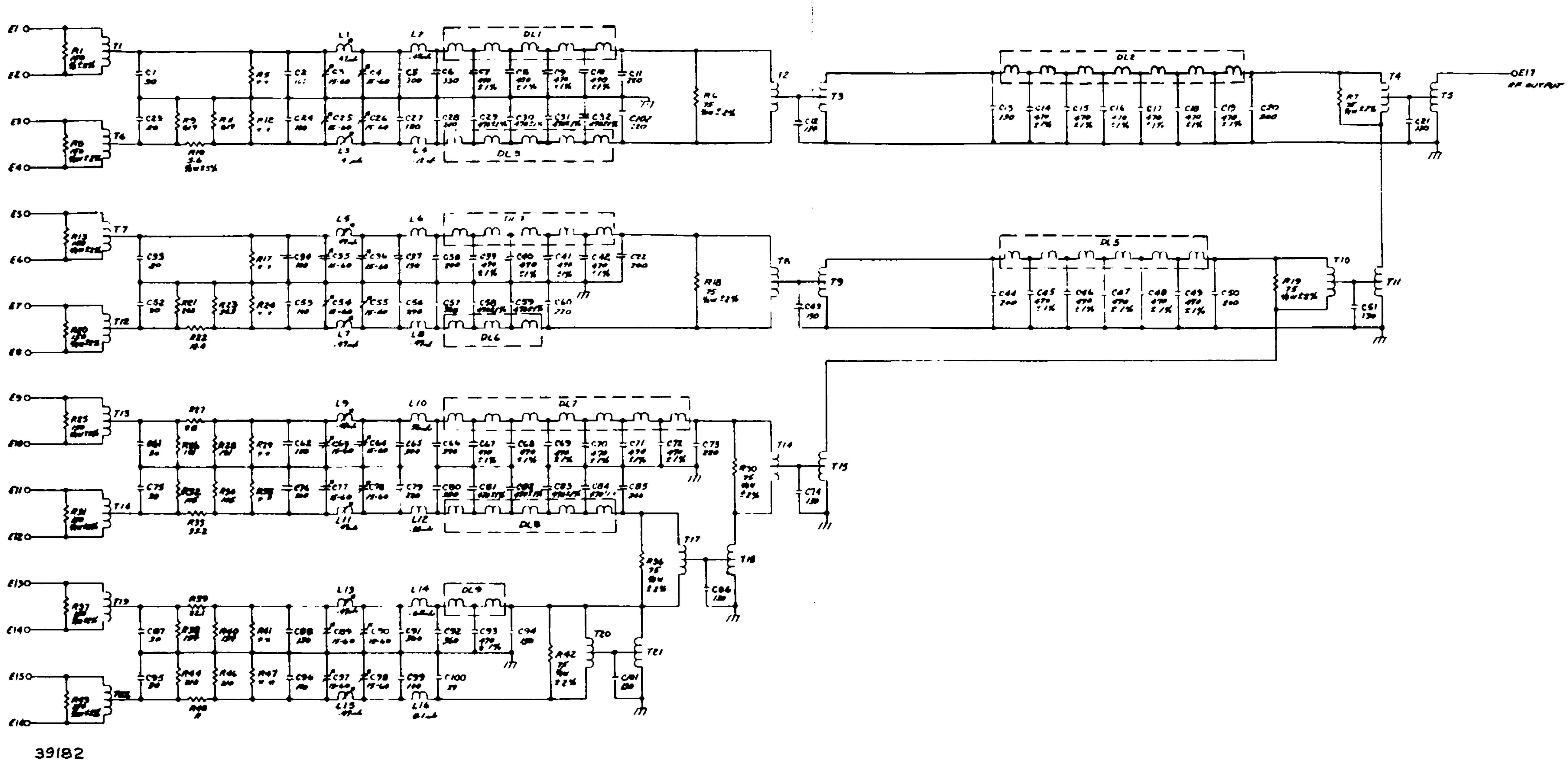

Figure 7-4. Schematic, Beamformer Assembly TD-1052/FLR-9(V)

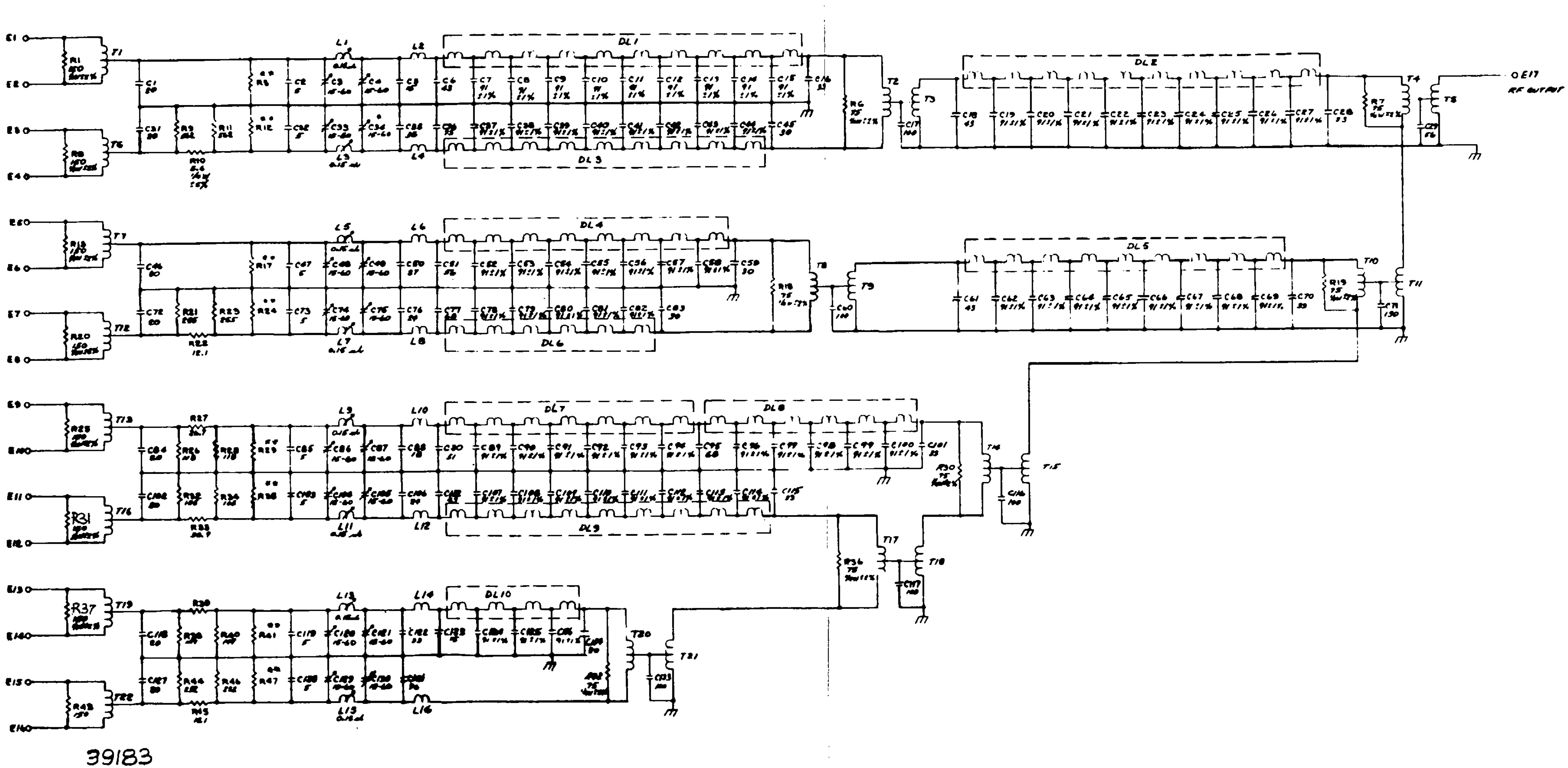

Figure 7-5. Schematic, Beamformer Assembly TD-1053/FLR-9(V)

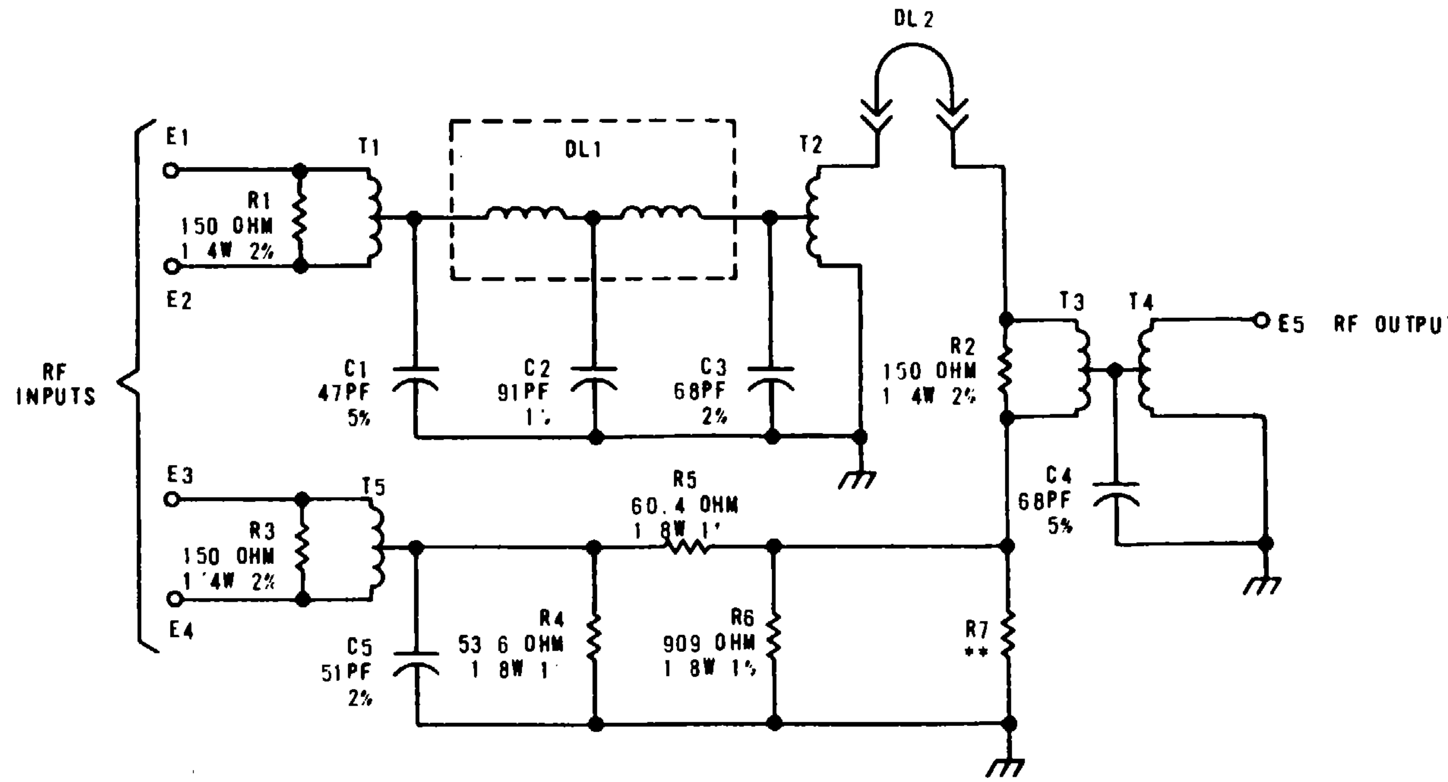

Figure 7-6. Schematic, Beamformer Assembly TD-1055/FLR-9(V)

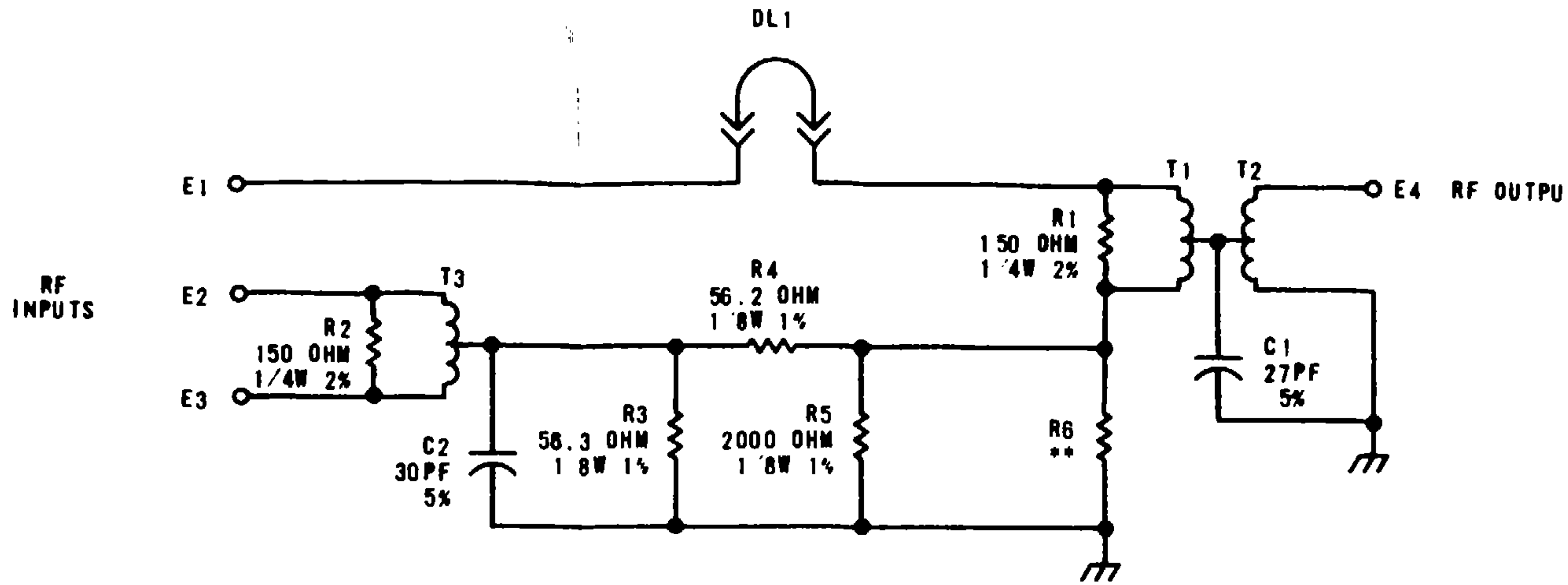

Figure 7-7. Schematic, Beamformer Assembly TD-1056/FLR-9(V)

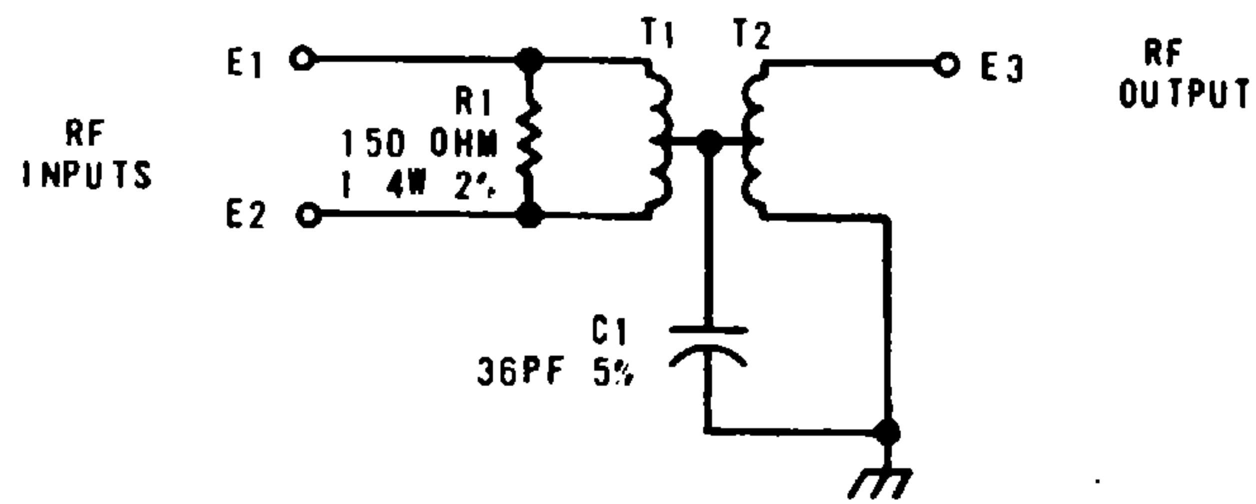

Figure 7-8. Schematic, Beamformer Assembly TD-1057/FLR-9(V)

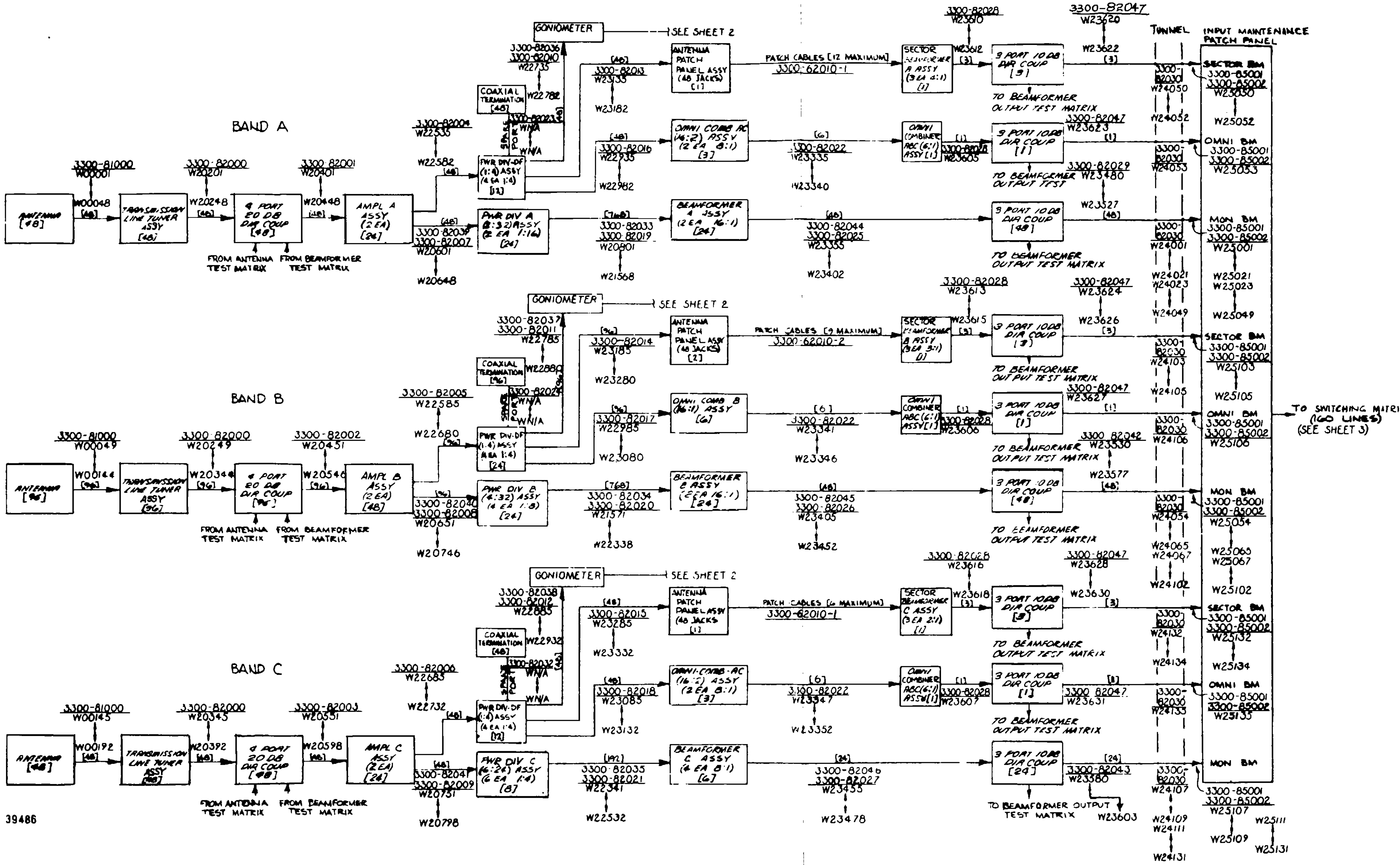

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Figure 7-9. Antenna Group Cabling Diagram

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INDEX (Continued)

INDEX (Continued)

GLOSSARY

A

A/D - Analog-to-digital,

ANTENNA ARRAY - Circular disposed antenna elements tuned to a particular band of frequencies.

ANTENNA ELEMENT - A single element used in an antenna array.

ASCII - American Standard code for information interchange (See LEC Leap Assembler Manual).

ASR - Automatic send/receive.

AZIMUTH - Angular direction clockwise from true north.

B

BCD - Binary coded decimal In which lines are weighted 8, 4, 2, and 1.

BEAM ASSIGNMENT TABLE - A table contained in the computer program which defines rf beams available to a radio receiver as selected by a bsu/biu.

BEAMFORMER - A device which forms a directional broadband rf signal.

BLOCKING - Inhibiting use of paths between A1 and A2 or A2 and A3 switch matrix submatrices.

BOOTSTRAP - Simple initial computer routine which enables the computer to initiate loading of larger program from an external device.

BORESIGHT ELEMENT - Antenna element to the right of (even elements) or on (odd elements) the received radio beam center line.

BSU/BIU - Beam select unit/Beam Identification unit.

BUFFER - Circuit which stores data or provides load isolation for signal lines.

C

CABLE SCANNER - Multiplexer which routes input signals to the computer.

CARD FILE - Assembly containing circuit cards, card jacks and interconnecting wiring.

CCD - Cyclic coded decimal in which the bits change In segments of one each per word.

CENTRAL BUILDING - Building located In center of antenna array.

CPU - Central processing unit; the computer minus input/output accessories.

COUPLING - Connection of the same rf input beam to two or more receivers that are connected to the output ports in a common A3 submatrix.

D

DECOUPLING - Use of STAGE REMOVED command to clear switch map table of paths of receivers who are coupled to the same faulty rf beam in the A3 submatrlx to allow the operator to obtain an alternate path to the receiver.

DECODER - Circuit for conversion between numerical systems (such as bcd to decimal).

DFG - Direction finding group

DIAGNOSTIC ROUTINE - Special computer program which senses and defines faults.

DIRECTIONAL COUPLER - Passive device which provides low Impedance In the desired direction and high Impedance in all other directions to rf signal Inputs.

DIU - Digital interface unit.

DOT-OR - Logical OR function not present in any one circuit; occurs because of the nature of connected outputs from other circuits.

DAUGHTER BOARD - Pcb which mounts on a motherboard.

DUMP - Output computer memory contents to some output device such as a tty.

E

EAI - External address in; computer output signal which enables transfer of address between two computers.

ECI - External command input; computer output signal which enables routing of a command to the computer.

ECO - External command output computer output signal which defines the nature of i/o bus signal.

EDI - External data input; computer output signal which enables routing of data to the computer.

EDO - External data output; computer output signal which defines the nature of i/o bus signal.

EMI - Electromagnetic interference.

ESI - External status input; computer output signal which enables routing of status signal to the computer.

EXCLUSIVE-OR - Logic circuit which produces a high output when one (not more than one) input is high.

G

Goniometer - Rotating device which forms a directional rf beam from received signals.

H

HANDOVER - Occurs when the primary computer relinquishes control of the system to the on-line standby computer.

HEXADECIMAL - The numbering system in the computer program which uses 16 as a radix. The 16 combination of bits in a 4-bit group provides decimal digits of 0 through 9 and A through F.

I

INTERFACE - Circuits between the computer and other equipment necessary for routing, storage, format/level conversion, or special processing.

INTERRUPT - Causes computer to stop doing a relatively unimportant routine and perform one of higher priority; after interrupt, computer returns to previous task.

I/0 - Input and output.

I/O BUS - Computer's connection to external equipment.

I/O BUS SWITCH - Routes signals from/to active computer to/from external devices.

I/O DRIVER RECEIVER - Line driver and signal converter.

IPDC - Internal programmed data channel.

J

J-K FLIP-FLOP - Flip-flop which can be operated asynchronously, like an R-S flip-flop, and/or synchronously with a clock, J, and K inputs. The J and K Inputs are sometimes provided with AND gates.

L

LATCH - Storage register.

LEC - Lockheed Electronics Company

LINE DRIVER - Circuit which produces balanced signals in response to single-ended logic signal.

LINE RECEIVER - Circuit which produces a single-ended logic signal in response to a balanced input signal.

LOAD - To enter the program into the computer.

LOGIC - Electronic circuits or groups of circuits designed to make a discrete response to a particular combination of input signal levels.

LOGIC ERROR - Program detects that set is executing at an Illegal location or detects that a cpu controlled parameter is out of limits.

M

MAGNETIC TAPE CONTROLLER - Electrical interface between computer and tape unit; it provides buffering, motion control, and error control.

MATRIX - An array of crosspoints in which any point may be addressed by a system of coordinates.

MATRIX MULTIPLEXER - Multiplexer which routes computer outputs to external equipment.

MCC - Memory control chassis associated with MAC 16 computer.

MDC - Multiplex data channel; a high-speed portion of the computer pdc i/o structure.

MEMORY EXPANSION CHASSIS - Holds all computer memory in excess of 8192 words, and also interface logic circuits.

MONITOR BEAM - A directional beam, selected with automatic selected directivity.

MOTHERBOARD - A circuit card where other circuit cards are physically mounted.

MULTIPLEXER - Signal selector or router which acts as a multiple-pole rotary switch, under external (computer) control.

MUX - Multiplexer.

N

NAND - Circuit which produces a low output only when all inputs are high.

NOR - Circuit which produces a low output when any (one or more) inputs (including all inputs) are high.

O

OLM&T - On-line monitor and test function of the monitor and test group.

OMNIBEAM - A non-directional beam.

OPTICAL ENCODER - Produces a ccd output to define the direction of the goniometer beam.

P

PDC - Programmed data channel; part of computer i/o structure.

PERIPHERAL EQUIPMENT - Equipments interfacing with a single unit of equipment for control or signal application purposes.

PROGRAM - Set of instructions, constraints, and information stored in computer memory which enables a computer to perform a particular task (or series of tasks).

PROGRAM AZIMUTH SHEET - List of beams assigned to a given bsu/biu.

R

REDUNDANT (MUX, CPU, etc) - Energized standby equipment identical to that equipment presently in control.

REED SWITCH MATRIX - Any of three test matrices in the monitor and test group designated matrix A, matrix B, and matrix C and the special project switch matrix.

RFI - Radio frequency interference.

RFSM - Radio frequency switch matrix; a part of the rf matrix group.

ROUTINE - A particular part of an overall program which performs a certain function within the program.

S

SAMPLING MATRIX, OLM&T - A reed switch mounting assembly contained as a part of, or all of, an olm&t test matrix designated matrix A, matrix B, or matrix C.

SECTOR BEAM - A directional beam with manually selected directivity.

SINGLE-SHOT - Circuit which produces a single fixed duration pulse in response to an input signal.

SOMC - Supervisory operation maintenance console.

SPECIAL PROJECT BSU/BIU - A beam select unit which selects any bands and beams without requiring a beam assignment table.

STANDBY - The non-controlling computer of the two provided. When on-line, it is continuously accepting data from the primary computer; can assume control immediately upon request.

SUBMATRIX - Consists of a number of circuit cards, each with multiple inputs and a single output, arranged in such a manner as to provide a two-dimensional (X, Y) array of switchable rf crosspoints.

T

TABLE - An array of data, constraints, or references in the computer program.

TELETYPE CONTROLLER - LEC provided circuit card which provides signal buffering for a teletype under computer control.

TRANSMISSION LINE TUNERS - Coaxial line stretcher.

TSA - Computer program instruction.

TTY - Teletypewriter.

TUNNEL - Underground access between operating building and central building housing connecting cables.

V

VVM - Vector voltmeter.

W

WATCHDOG TIMER - A periodically reset counter which provides an interrupt to the opposite computer if not reset within 150 milliseconds.

X

X-PT - A crosspoint in the switch matrix.

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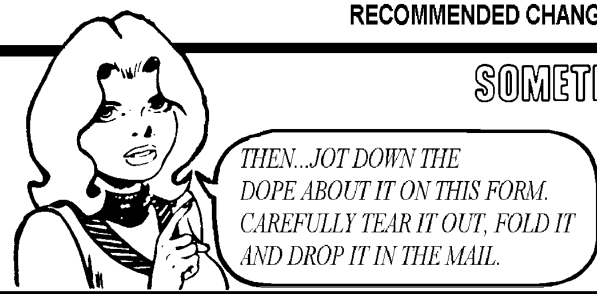

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