UNION SWITCH & SIGNAL

645 Russell Street
Batesburg, SC 29006

Service Manual 6121

DR-50

Solid State Radar Unit

Installation, Operation and Maintenance

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UNION SWITCH & SIGNAL

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1.1 General Description

The DR-50 Solid State Radar Unit is designed to detect and measure car velocity by means of the Doppler effect. When the transmitted signal from the DR-50 strikes and is reflected back from the target, a change in frequency occurs. The return signal is detected and compared to the original radiated frequency. The degree of shift in frequency (31.4 Hz/mile per hour) is detected, amplified and limited. The output signal frequency, directly proportional to the target's speed, can then be put into and translated by a velocity meter.

The DR-50 utilizes complete solid state electronics. The conventional klystron RF source is replaced by a solid state Gunn Diode. Power supply, amplifiers and check circuitry for the DR-50 are contained on a PCB mounted to a chassis. The chassis, in turn, is contained in an all-weather housing designed to be mounted and aimed at an appropriate yard location for scanning of cars. The unit is internally shock-mounted for vibration protection in the typical classification yard environment.

1.2 Physical Design

The DR-50 Radar consists of two main assemblies, a weatherproof enclosure and a subplate assembly. These are shown in Figures 1-1, 1-2 and 1-3. Cabling is terminated at an AAR terminal strip inside the DR-50's enclosure. A plug connector cable connects the AAR terminal strip to the DR-50 subplate assembly.

The DR-50 Radar enclosure is constructed of steel sheeting to resist damage by dragging equipment. A non-metallic plate forms the RF window, which allows the microwave to pass through while shielding the electronics from dirt and the elements. The DR-50 Radar is available complete with any of three mounting bases: N451127-0301 for mounting on a cast iron foundation and N451127-0302 for mounting on a concrete foundation and N451127-0303 for mounting on two cast iron foundations (see Section 4.0 for details).

The subplate assembly forms the composite electronics package. The subplate is composed of three primary sub-assemblies: Antenna-Doppler module assembly, radar P.C. board, and mounting plate. Details of these items are shown in Section 8.0 - Parts List.

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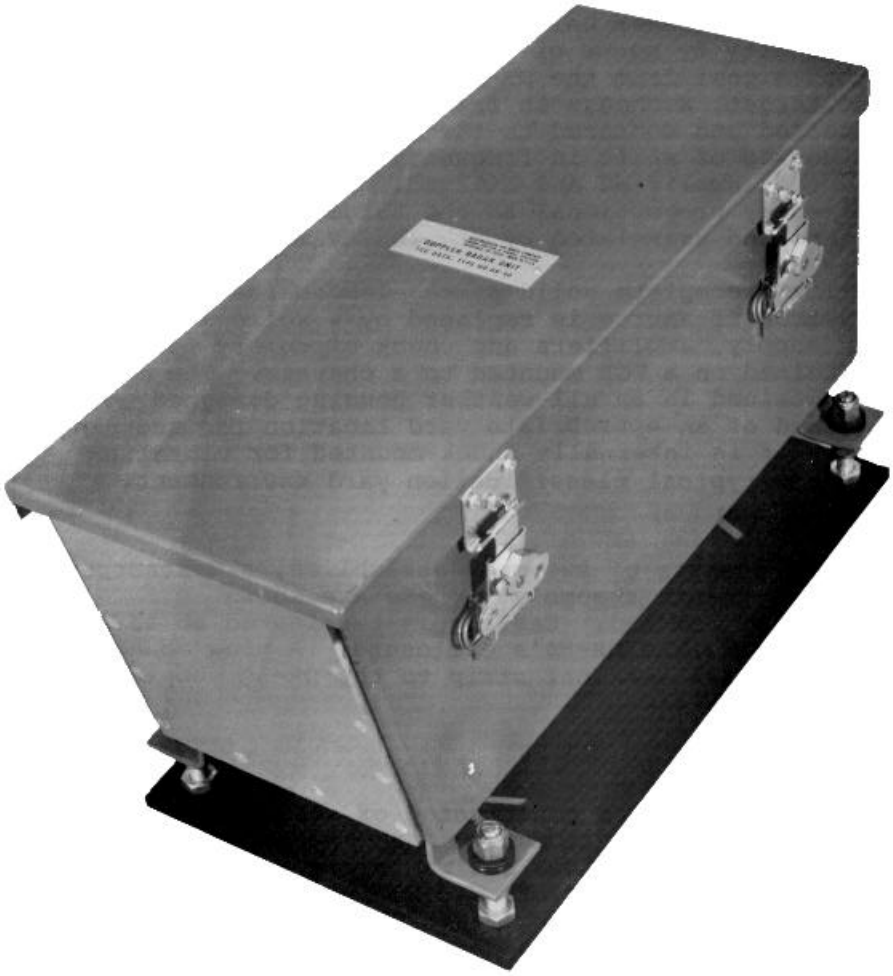

Figure 1-1. DR-50 Weatherproof Enclosure

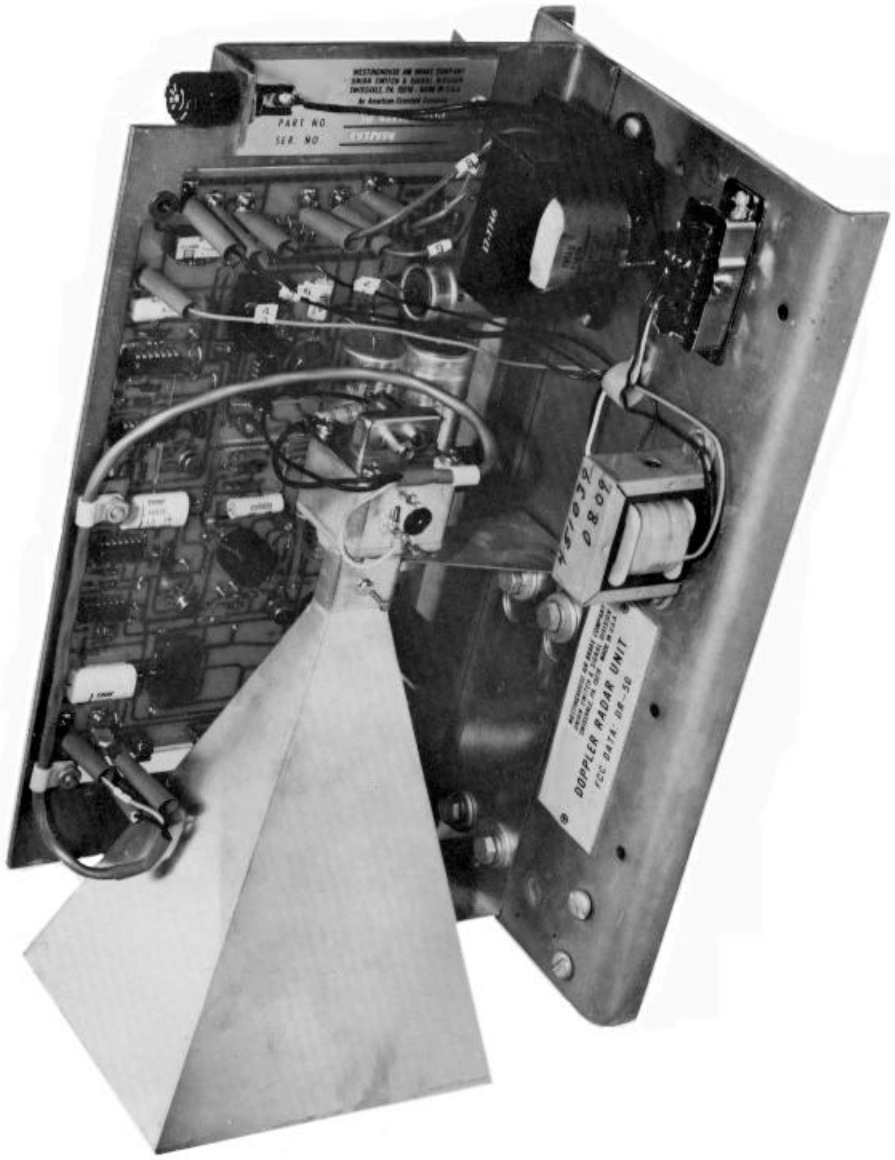

Figure 1-2. DR-50 Radar Subplate Assembly N451128-2101

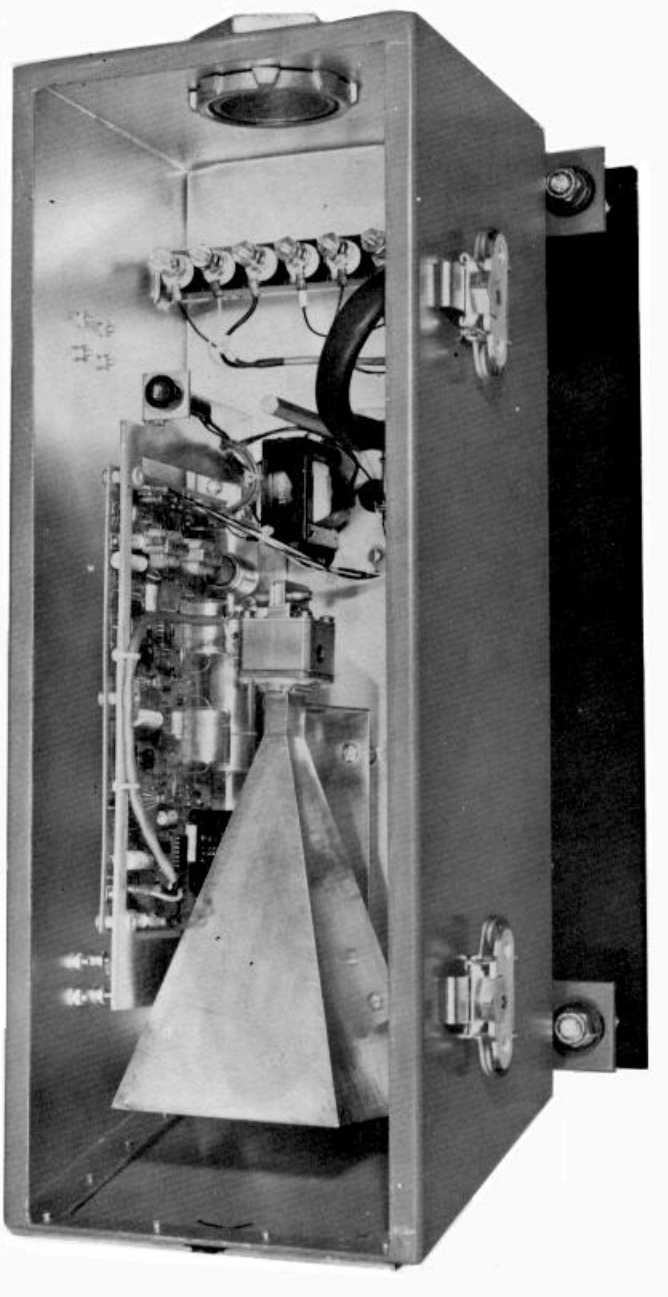

Figure 1-3. DR-50 Subplate Assembly Mounted in DR-50 Enclosure

1.3 General Description of Circuits

The DR-50 unit is a complete self-contained solid state Doppler radar transceiver. It operates on a frequency of 10.525 GIGAHERTZ (10,525,000,000 Hz) with a nominal power output of 25 milliwatts. Power requirements for all active circuitry in the unit, are provided by regulated power supplies which operate from 117 VAC 60 Hz power lines. Following is a block diagram of the DR-50 unit:

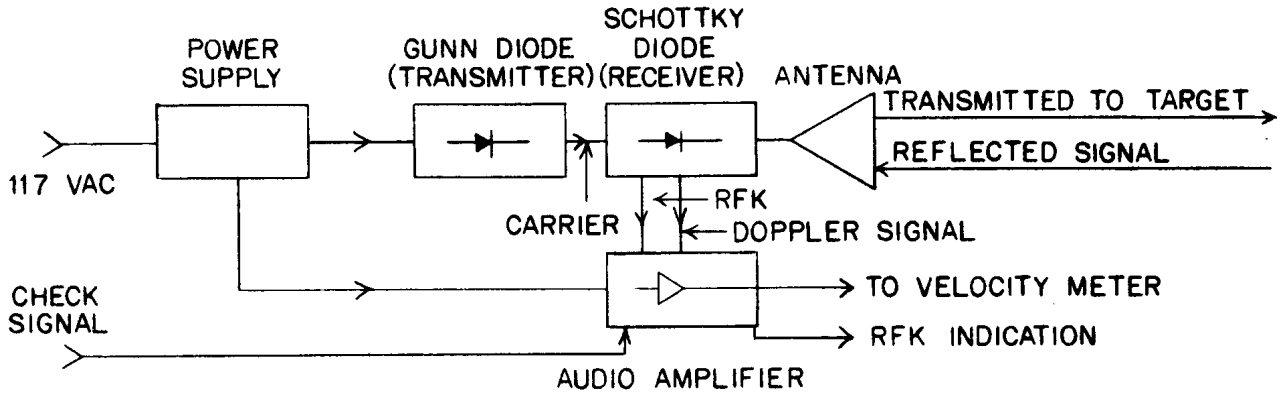

Figure 1-4. DR-50 Basic Block Diagram

The DR-50 radar consists of four sections: transmitter, receiver, audio amplifier, and regulated power supply.

1.3.1 Transmitter Section

The transmitter section contains a Gunn diode microwave oscillator that oscillates with sufficient RF power output to provide a one step conversion from DC to microwave energy, thereby eliminating complex circuitry. The diode operates through a negative resistance caused by transfer of electrons from a high mobility band to a low mobility conduction band. The signal is fed to the antenna through a waveguide. A ferrite circulator, located in the waveguide deflects a small amount of transmitted energy that is used to bias the mixer diode of the receiver. The deflected signal serves as a reference frequency in the receiver.

1.3.2 Receiver Section

The receiver section is located in the portion of the waveguide that joins the Gunn Diode Microwave source to the antenna. The detector is a Schottky Barrier Mixer semi-conductor junction, which is hermetically sealed in a ceramic case.

In operation, microwave energy transmitted from the antenna is reflected from the target and enters the receiver waveguide by way of a common antenna. This return signal is mixed with the reference signal, providing a Doppler frequency equal to 31.4 Hz per M.P.H. The resulting Doppler/audio frequency is applied to the audio amplifier section.

1.3.3 Audio Amplifier

The audio amplifier receives either the Doppler signal or a precise 784.7 Hz check frequency from a frequency standard. Either of these signals is amplified, limited and are outputted to the velocity meter.

The amplifier passes the Doppler signal when a check signal is not present. When a check signal is present, the Doppler signal is shunted and the check signal passes. This check signal is used to assure that the audio amplifier is operating properly.

In addition to the audio amplifier, the printed circuit board also contains an RFK voltage controlled oscillator (VCO) check amplifier. This circuit provides a 784.7 Hz test signal. To activate this test signal, the Gunnplexer must be operating and an external 24 VDC must be applied.

1.3.4 Regulated Power Supply

The regulated power supply provides all the necessary operating voltages to the various electronic components, and is normally operated from the commercial 117 volt AC, 60 Hz power lines.

It should be noted that all input and output signals to the DR-50 Radar Unit are isolated via transformers, providing complete electrical isolation.

1.4 Theory of Operation

Velocity measurements, which are made using the Doppler principle, rely on a shift in frequency that occurs when a radio signal bounces off a moving target. The frequency difference between the incident and reflected signal is proportional to the speed of the moving object. If the frequency of the reflected wave is higher than that of the incident wave, the object is approaching. If the frequency of the reflected wave is lower, the object is receding. However, either condition produces the same difference frequency at any given speed.

The DR-50 Doppler Radar Unit employs a continuous wave transmitter. The return energy is detected by a Schottky detector diode.

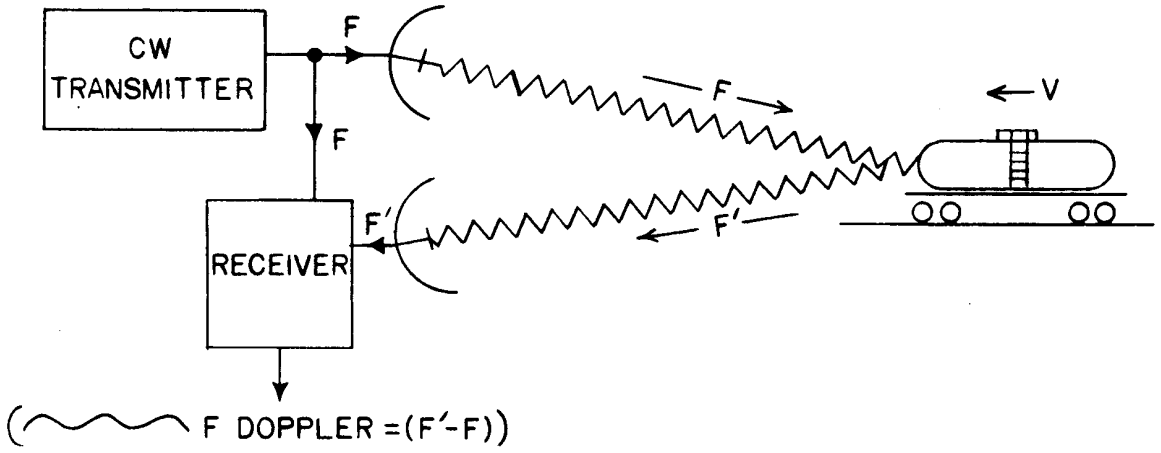

Figure 1-5. Doppler Effect-Incident and Reflected Signal

Reflected signals from a stationary object produce no difference frequency in the mixer diode, whereas a moving target produces the Doppler frequency difference between transmitted and reflected signals. The following is the mathematical formula for this phenomenon:

$$Fd = Ft\frac{C+V}{C-V} - Ft \approx \frac{2V}{C}Ft$$

Where:

FD = Doppler frequency in Hz/second
FT = Transmitted frequency in Hz/second
V = Target radial velocity in M.P.H.
C = Speed of propagation in M.P.H. (6.714×10^8)

In the case of the DR-50 Radar units operating at 10.525 GHz, the following calculation can be made:

Frequency of Doppler per mile per hour = $$Fd = \left(\frac{2}{(1.86x10^{5})(3.6x10^{3})} \right) \bullet \left(\frac{(10.525x10^{9}}{1} \right) = 31.4Hz / MPH$$

1.5 General Specifications

Physical

Dimensions Complete Unit..... 28" L x 11" W x 12-7/8' H

Dimensions Sub-Plate Unit..... 15-3/8" L x 7-3/8" W x 7-5/8" H

Weight Complete Unit..... 44 lbs. (housing included)

Weight Sub-Plate Unit..... 10.4 lbs.

Operating Temperature Range..... -40ºC to +70ºC (-40ºF to 160ºF)

Electrical - RF Output (FCC Data)

Operating Frequency ..... 10.525 GHz ± 1 MHz

Frequency Stability..... ±0.2% of Assigned Frequency

Spurious Emission — No Emission Greater Than -44 dB over Entire Frequency Range except at Assigned Frequency

Power Output (RF) ..... 60 mW Maximum (25 mW Minimum)

Nominal Range ..... 150 Feet

Type of Emission..... Continuous Wave (AØ)

Electrical - Signal Bias

Mixer Diode..... -200 MVDC to –1.2 VDC

Electrical - Input Supply

Voltage ..... 95 to 125 VAC

Frequency..... 60 Hz

Power Consumption ..... 12 to 14 Watts

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Because the DR-50 Radar Unit is capable of emitting a signal into the atmosphere, it may not be operated or maintained without the applicable FCC License. This includes the station license and the individual operator's license. Any adjustments affecting power or frequency must be made by, or under the direct supervision of, a person holding a valid second class or higher commercial radiotelephone operator license.

Application for new or modified station license can be obtained by writing the nearest FCC field engineering office.

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3.1 Inspection

Upon removal of the DR-50 from its packing carton, examine the housing for any impact damage or loosened fastener hardware. Then unlatch the cover and examine the chassis for any indication of internal impact damage, loosened or completely separated components, damaged wires and broken or loosened electrical connections. The radar must not be placed into service until any such problems have been remedied. If the damage is not reparable in the field, or the repair not authorized, the radar unit should-be returned to the manufacturer as shipped. (Any unit being stored or reshipped should be kept at temperatures between -40 F. (-40 C) and ±160 F (+70 C)). Consult Section 7.0 of this manual for repair information.

3.2 Operational Tests and Adjustments

NOTE:

Prior to being placed in service, each RF unit must be checked to determine that it is maintaining the proper frequency (10.525 MHz). This frequency is the same for all RF units, although each installation is assigned a different call sign. The frequency must also be rechecked at regular intervals (refer to Part 93 of FCC Rules and Regulations for the applicable information).

3.2.1 General Remarks

This test of the DR-50 Radar Unit requires removal of the subassembly chassis from the protective enclosure. Go to Section 6.1.1 for the required steps.

3.2.2 Frequency Measurement

3.2.2.1 Test Equipment (Or Equivalent) Required

Frequency Meter, Hewlett Packard, Model X-532B
Analyzer, Simpson Model 260
Standard Gain Horn, Narda Model 640
Adjustable Detector Mount, Hewlett Packard, Model X-485B
Crystal, lN23B or lN23C
Thermistor Mount, Hewlett Packard, Model X-487B
Associated Hardware for Assembly
Power Meter, Hewlett Packard, Model 430C, or equivalent

3.2.2.2 On Site Frequency Test Procedure

NOTE:

The 2/56 Set Screw located on the Gunn Diode is pre-set at the factory and should not be adjusted in this part of the test.

1. Apply operating voltage to the RF unit under test.

2. Insert lN23B crystal in detector mount and attach standard gain horn antenna (see Figure 3-1 below). Use coaxial cable, such as RG-58, to connect the Simpson voltmeter to the circuit.

3. Place horn antenna several feet in front of radar unit. Set frequency meter for 10.525 MHz.

4. Turn adjustable detector mount until a maximum indication is seen on the voltmeter DC scale.

5. Adjust frequency meter for a maximum dip on the voltmeter. Read the frequency directly from the frequency meter.

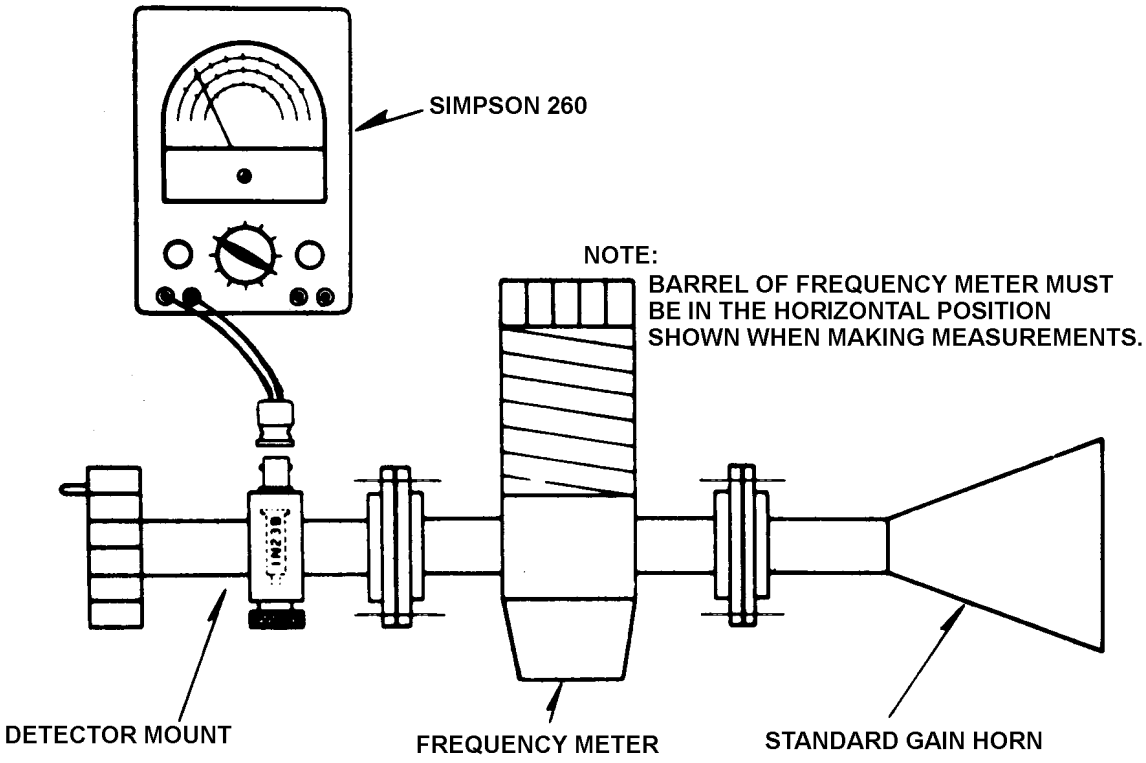

Figure 3-1. Frequency Measuring Test, Portable Set-up

This test indicates the operating frequency only and that the Gunn Unit is functioning. It does not check the amplifier operation.

If the DR-50 Radar Unit does not fall within the specified frequency tolerance, proceed to Section 6.0.

3.2.3 RFK Adjustment

3.2.3.1 Test Equipment (Or Equivalent) Required

Fluke 8120A-01 Digital Voltmeter

3.2.3.2 Procedure

1. Connect voltmeter negative lead to the lower lead of 1KΩ resistor on the Gunn Diode transceiver module, and the positive lead to the higher lead of the same resistor.

2. Apply operating power to the DR-50 unit.

3. Allow a 10-minute temperature stabilization period.

Note

The detector bias shall indicate a negative voltage of -0.2 VDC to -1.2 VDC on the digital voltmeter assuming no movement occurs in the target area. This voltage is set at the factory and should be within the above range. If not, it can be varied by unlocking the 2/56 nut and adjusting the screw located on the Gunn Diode transceiver module. Make certain to retighten the locknut after the adjustment.

Note

Any motion or obstruction in front of the antenna will alter the indicated value and result in an inaccurate calibration. Close proximity to fluorescent lights will also affect the accuracy of this calibration.

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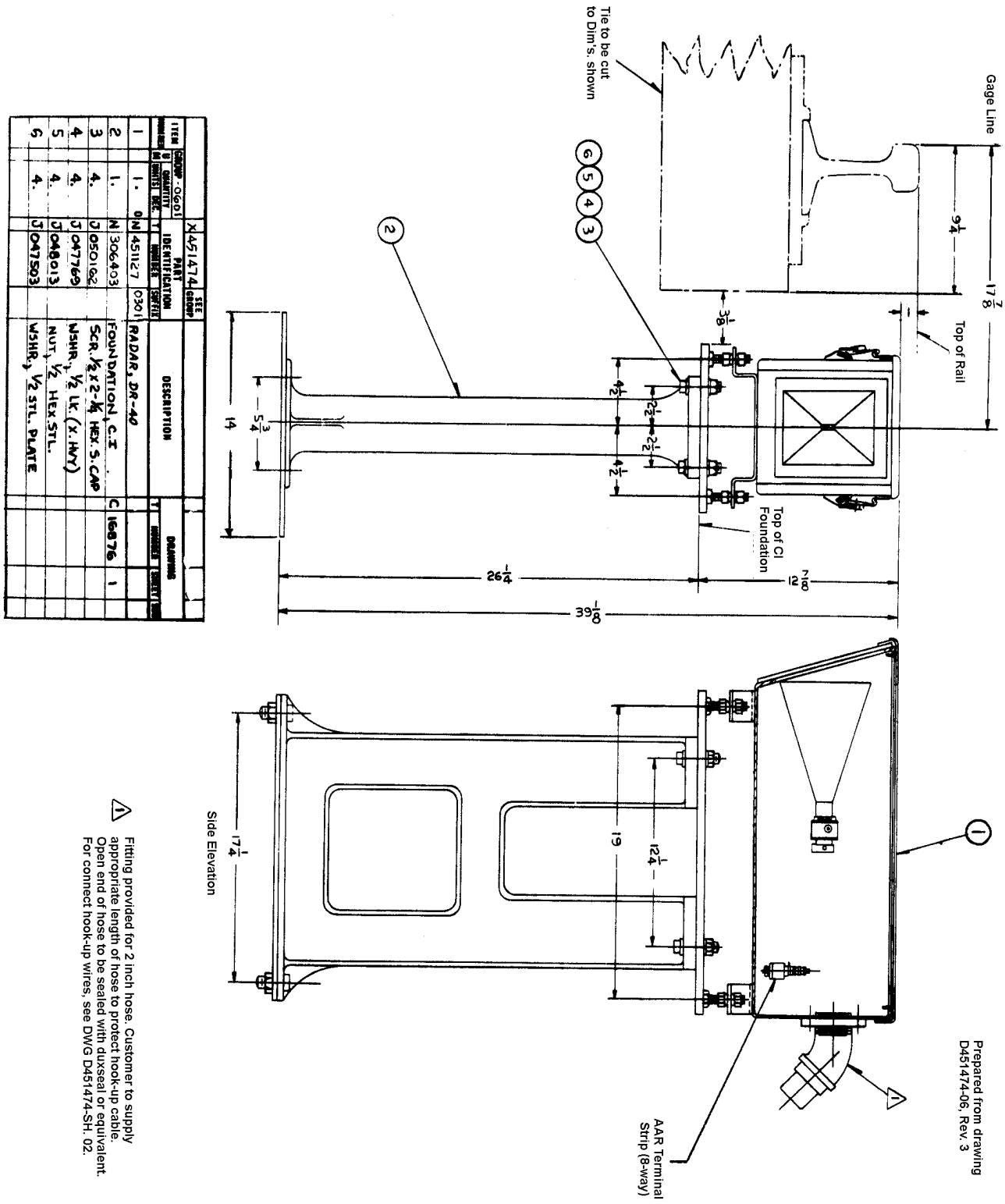
4.1 Basic Application Configurations

The DR-50 Radar Unit may be installed adjacent to or between the rails. Install the DR-50 Radar as indicated by the proper application drawing shown in the table below.

US&S PART NO.	APPLICATION	FOUNDATION	FIGURE NO.	DRAWING D451474-sh.
X451474-0602	Outside of Rails	Ballast	4-1	06
X451474-0702	Between Rails	Ballast	4-2	07
X451474-0802	Between Rails	Concrete	4-3	08
X451474-0901	Between Rails	Ballast	4-4	09*
--	Wiring Configuration	--	4-5	02

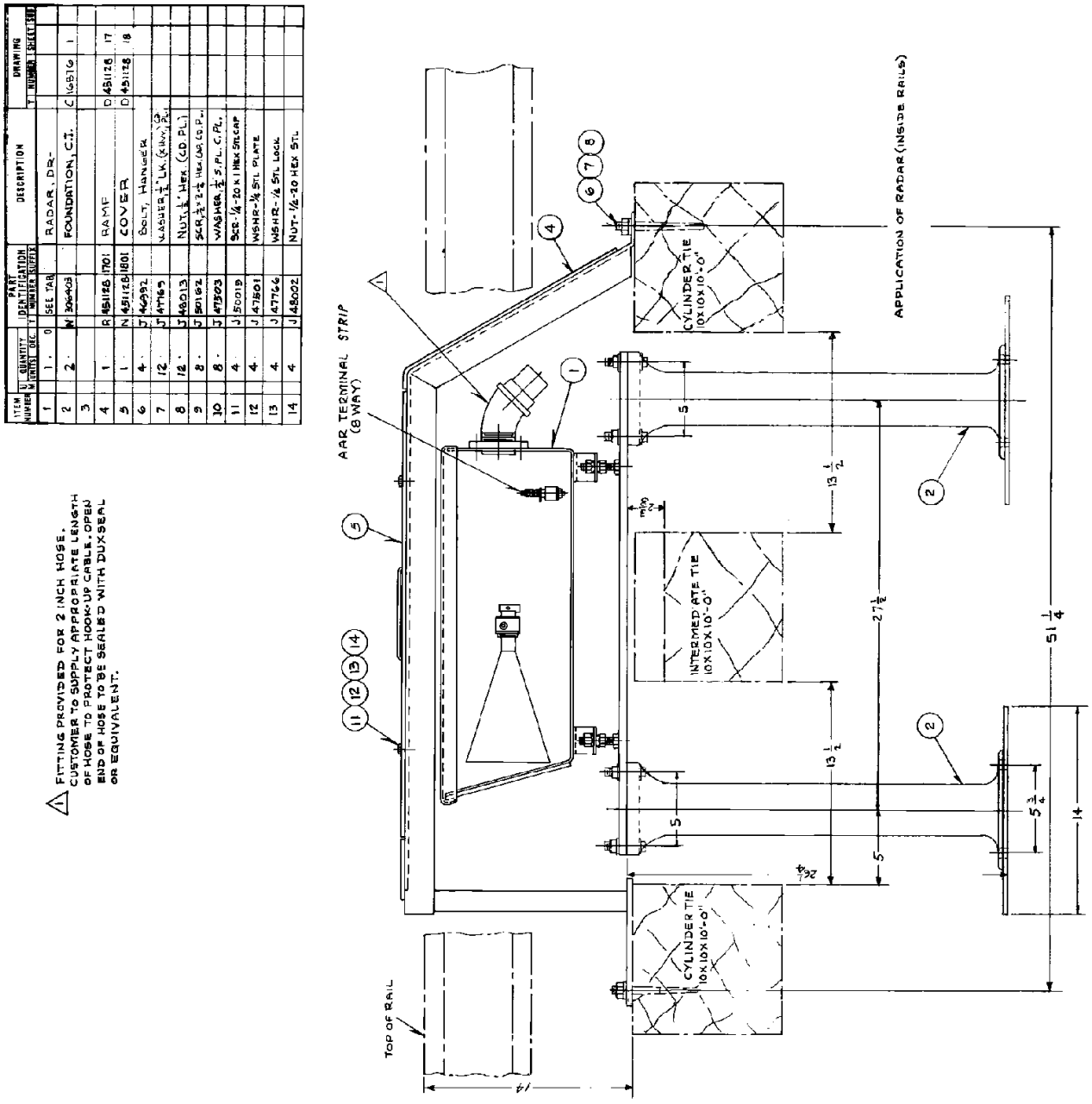
*Two cast iron pylon bases used.

Table 4-1 - Application Guide



ITEM NUMBER	QUANTITY REQ.	PART IDENTIFICATION NUMBER	SUFFIX	DESCRIPTION	DRAWING NUMBER	SHEET
GROUP-0601		X451474	SEE GROUP			
1	1.	ON 451127	0301	RADAR, DR-40	C 16876	1
2	1.	N 306403		FOUNDATION, C.I.		
3	4.	J 050162		SCR. ½ x 2-¼ HEX. S. CAP		
4	4.	J 047769		WSHR, ½ LK. (X. HVY)		
5	4.	J 048013		NUT, ½ HEX. STL.		
6	4.	J 047503		WSHR, ½ STL. PLATE		

Figure 4-1. DR-50 Radar, Application Outside of Rails, Ballast Foundation



ITEM NUMBER	QUANTITY W UNITS	QUANTITY PER UNIT	PART IDENTIFICATION NUMBER	SUFFIX	DESCRIPTION	DRAWING NUMBER	SHEET
1	1.	0	SEE TAB		RADAR, DR-		
2	2.		M 39408		FOUNDATION, C.T.	C 16816	1
3							
4	1		R 451128	1701	RAMP	D 451128	17
5	1		N 451128	1801	COVER	D 451128	18
6	4		J 46992		BOLT, HANGER		
7	12		J 47765		WASHER, $\frac{1}{2}$" LK. (GALV'D)		
8	12		J 46013		NUT, $\frac{1}{2}$" HEX. (CD PL.)		
9	8		J 50162		SCR, $\frac{1}{2}$-13 x $2\frac{1}{2}$ HEX DG (CD PL.)		
10	8		J 47503		WASHER, $\frac{1}{2}$" S.PL. C.PL.		
11	4		J 50019		SCR-$\frac{1}{2}$-20 x 1 HEX SOCAP		
12	4		J 47501		WSHR-$\frac{1}{2}$ STL PLATE		
13	4		J 47746		WSHR-$\frac{1}{2}$ STL LOCK		
14	4		J 48002		NUT-$\frac{1}{2}$-20 HEX STL		

Figure 4-2(a). DR-50 Radar, Application Between Rails, <u>Ballast</u> Foundation

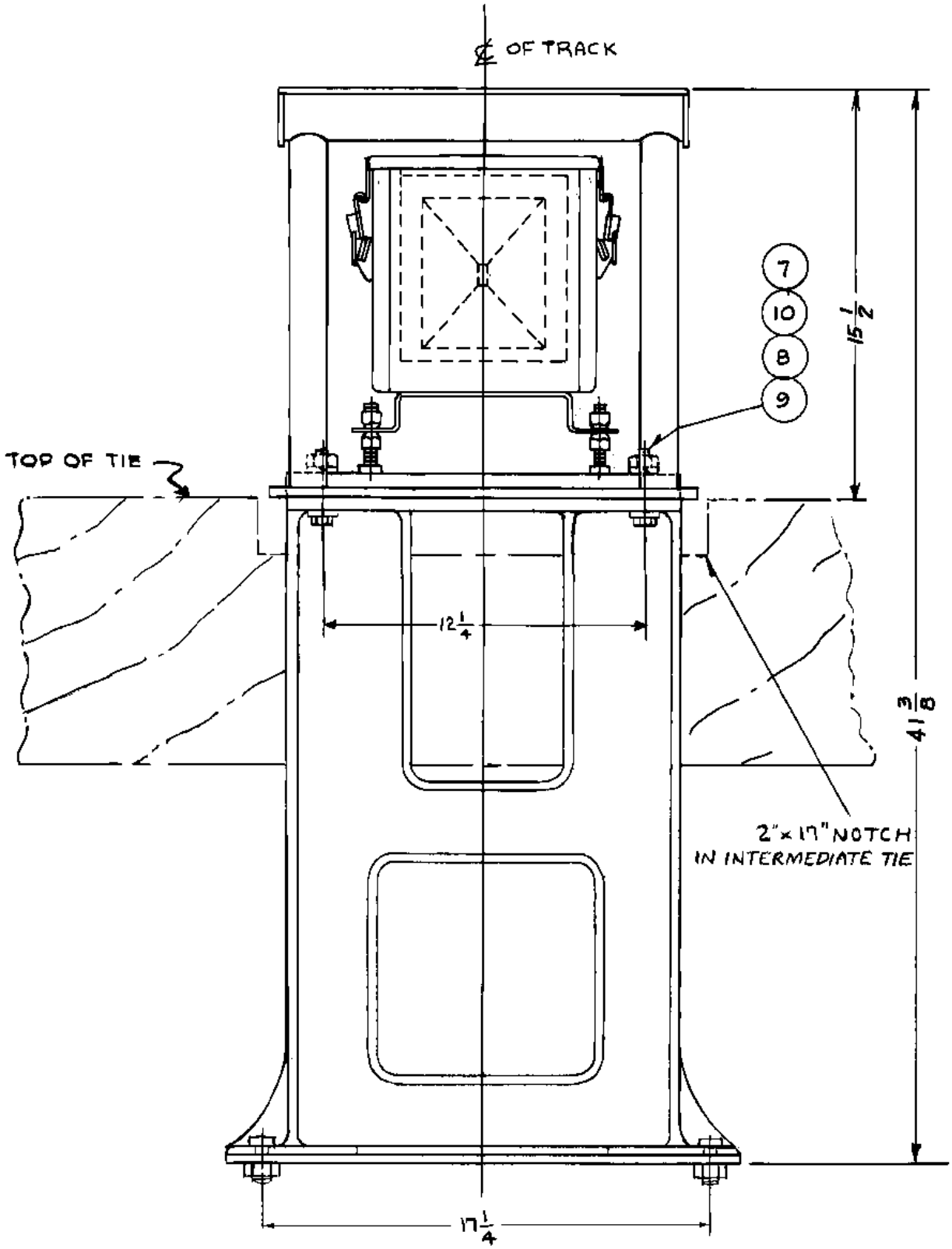
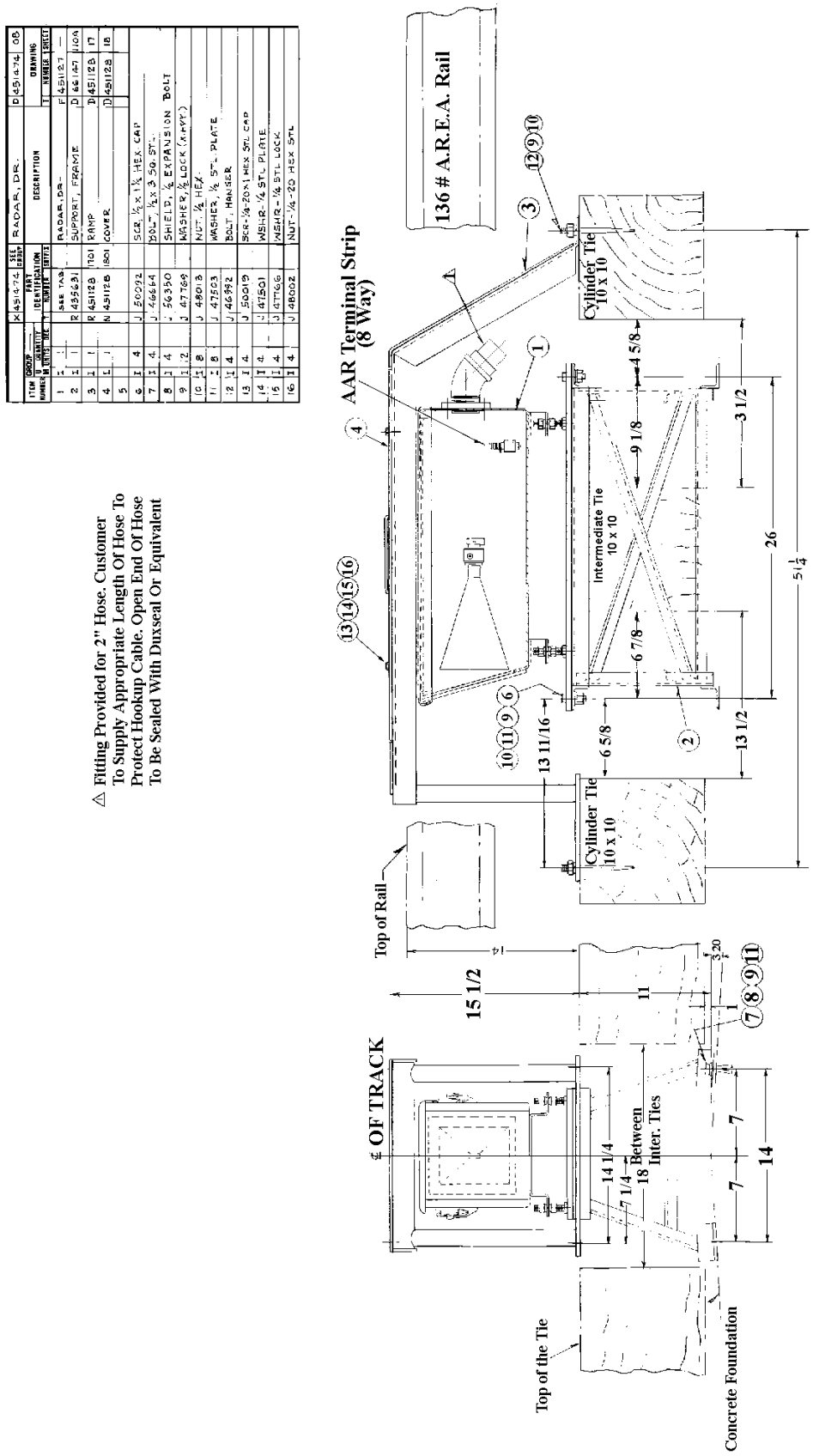


Figure 4-2(b). DR-50 Radar, Application Between Rails, Ballast Foundation



ITEM NUMBER	GROUP ASSY NUMBER	QUANTITY PER ASSY	UNIT OF MEASURE	PART IDENTIFICATION NUMBER	SEE FIG. NO.	DESCRIPTION
				X 451474		RADAR, DR-
1		1	-	SEE TAB	-	RADAR, DR-
2		1	-	R 435681	-	SUPPORT, FRAME
3		1	-	R 451128	1101	RAMP
4		1	-	N 451128	1801	COVER
5						
6		4	-	J 50092	-	SCR, ½-13 x 1½ HEX CAP
7		4	-	J 46664	-	BOLT, ½-13 x 3 SQ. ST.
8		4	-	J 56350	-	SHIELD, ½ EXPANSION BOLT
9		12	-	J 47769	-	WASHER, ½ LOCK (X-HVY)
10		8	-	J 48013	-	NUT, ½ HEX
11		8	-	J 47503	-	WASHER, ½ ST. PLATE
12		4	-	J 46592	-	BOLT, HANGER
13		4	-	J 50019	-	SCR-¼-20 x 1 HEX STL CAP
14		4	-	J 47501	-	WSHR-¼ ST. PLATE
15		4	-	J 47646	-	WSHR-¼ STL LOCK
16		4	-	J 48002	-	NUT-¼-20 HEX STL

ITEM NUMBER	DRAWING NUMBER	SHEET
	451474	08
1	451127	—
2	661147	10A
3	451128	17
4	451128	18

Figure 4-3. DR-50 Radar, Application Between Rails, Concrete Foundation

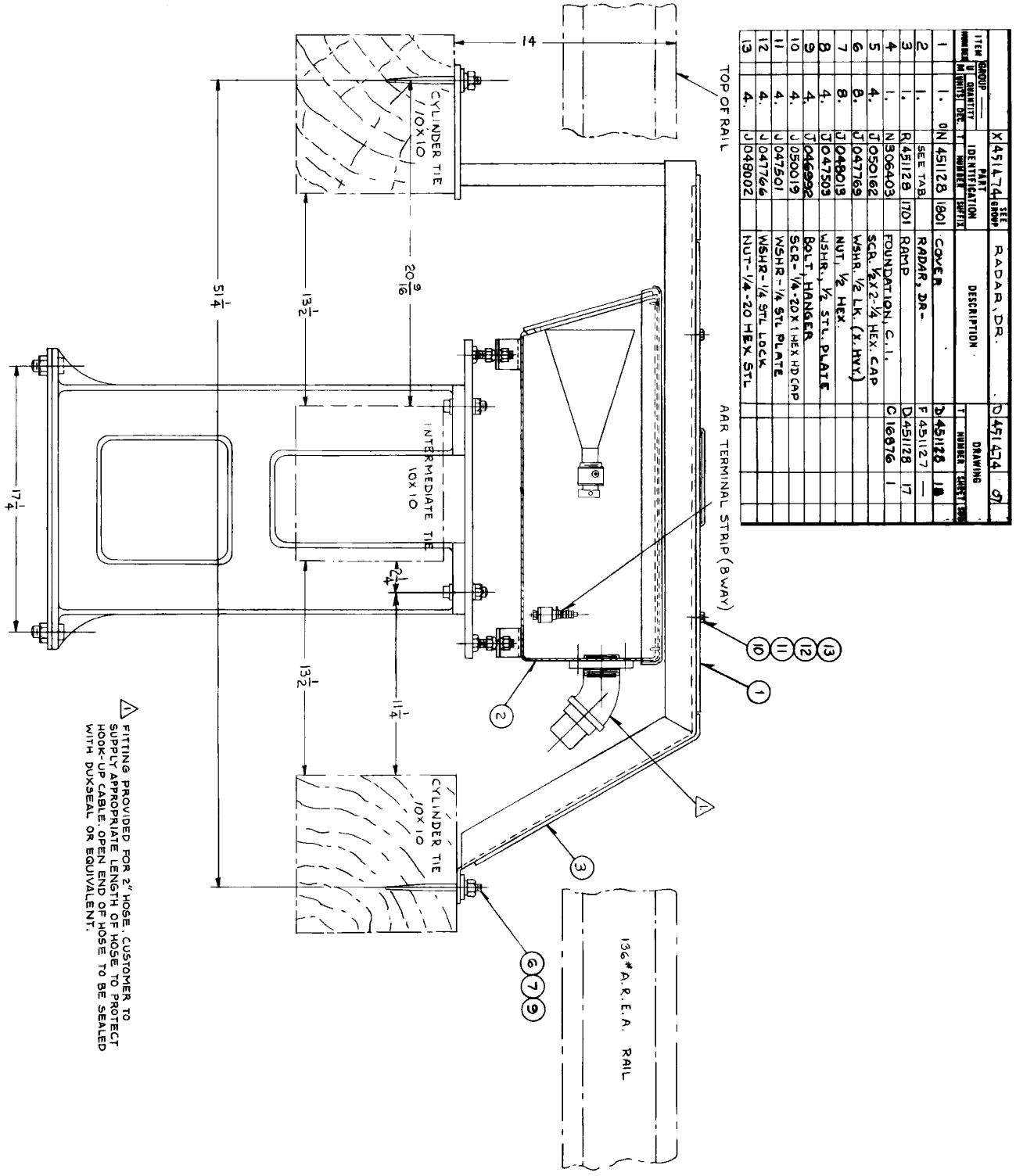


Figure 4-4(a). DR-50 Radar, Application Between Rails, (Single Pylon) Ballast **Foundation**

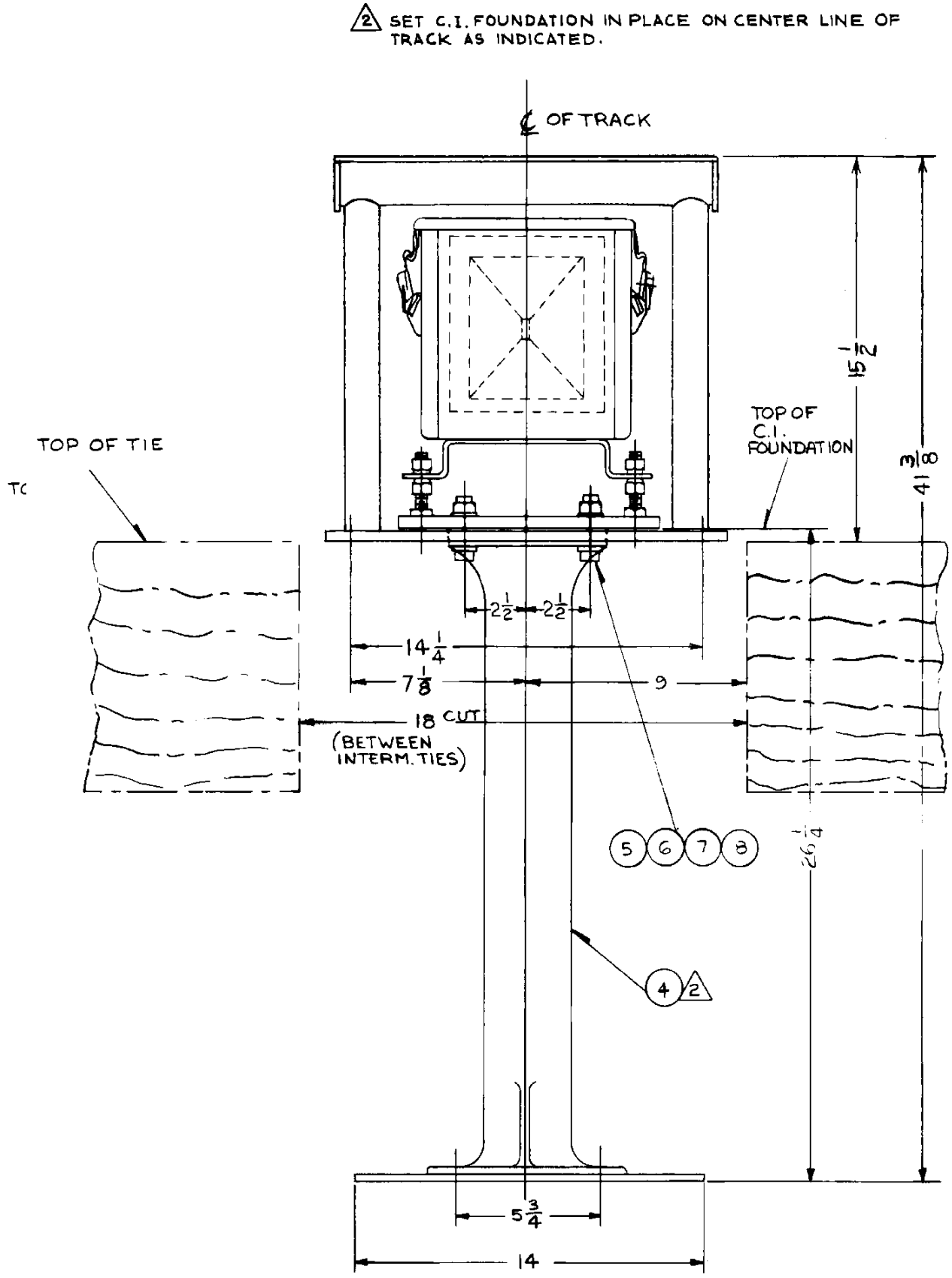


Figure 4-4(b). DR-50 Radar, Application Between Rails, (Single Pylon) Ballast Foundation

Cable Requirements
"Sig. A, Sig. B"

A. Cable shall be twisted pair shielded.
B. Maximum Signal Attenuation 10db.
C. Maximum D.C. Loop Resistance 500 Ohms.

"117 VAC Power"

A. Minimum 25 Watts at AAR Terminal Strip

Characteristics

Power Requirements: 120 VAC ± 10%, 60 Hz. Line voltag at 120 volts, radar unit consumes .1 to .117 amperes or about 12 to 14 volt-amps.

Frequency stability: Minimum stability shall be 0.01% of, 10,525 Mhz ± 1 Mhz.

Radio frequency power output: The band 10,500 to 10,550 Mhz is restricted to AØ type emission with the power to the antenna not to exceed 40 watts. The DR-50 radio frequency power output is approximately 25 to 60 milliwatts.

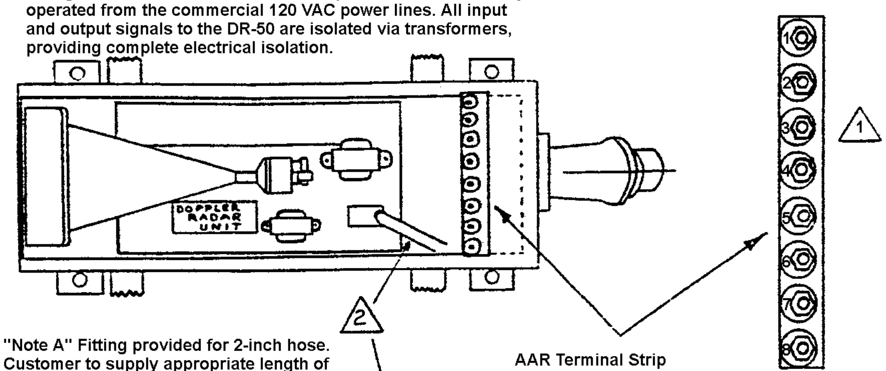
Temperature range: -40°C to 70°C (-40°F to 160°F)

Reference Information

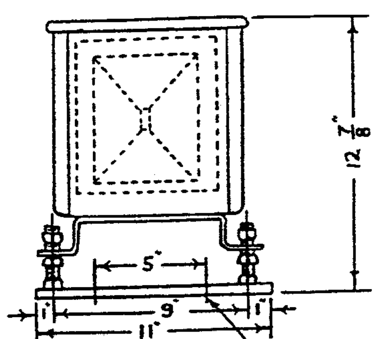
1. DR-50 Radar Unit Part No. (N451127-0301 For Ballast Foundation) • (N451127-0302 For Concrete Foundation)
2. Schematic Diagram - 0451238-Sh. 1201
3. Wiring Diagram - F451238-Sh. 21
4. Electrical Application Dwg. - 451474-Sh. 11 and 12
5. Test Spec. - (EV6275 DR-50 Radar System • EV6276 DR-50 Radar PCB)
6. Service Manual SM6121
7. Gunn Diode Chassis N451128-0201, Dwg. F451128 SH. 21

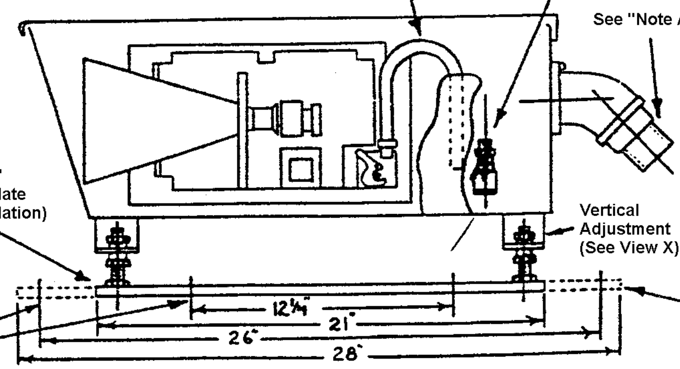
Note: DR-50 Radar Unit must comply with current F.C.C. Rules and Regulations, Part 90, at all times.

The regulated power supply provides all the necessary operating voltages for the various electronic components and is normally operated from the commercial 120 VAC power lines. All input and output signals to the DR-50 are isolated via transformers, providing complete electrical isolation.



"Note A" Fitting provided for 2-inch hose. Customer to supply appropriate length of hose to protect hook-up cable. Open end of hose to be sealed with duxseal or equivalent.





	Color Code	
16-Way Amphenol Connector Pin	Wire Color	Tags Marked
Sig A » 1	Bk } Cable	1
Sig B » 2	Clear	2
Sig Common » 9	Shield	3
Spare » 10	Bk } Twisted	4
Spare » 13	Bk	5
BX 117 VAC » 5	Clear } Cable	6
NX 117 VAC » 12	Bk	7
Chassis GRD. » 7	Shield	8

Horizontal Adjustments

1. Radar to be mounted parallel to rail, 1 inch below top of rail per appropriate application drawing.
2. Horizontal aiming adjustment of unit can be accomplished by loosening 4 mounting plate bolts and rotating unit until it is aimed parallel to rail, then retighten 4 bolts. Horizontal adjustment available = ± 6 ° for N451127-0301 and ± 1° for N451127-0302.
3. Vertical aiming adjustment of unit can be accomplished by loosening 4 nut and washer assemblies located on mounting feet of radar, and raising or lowering one end of unit until it is aimed for best results. Vertical adjustment available is ± 1½°.
4. Nominal range of radar is up to 150 feet.

Figure 4-5(a). DR-50 Radar, Application Notes and Characteristics.

General Information

DR-50 Doppler Radar Unit is a radiolocation system used to measure the velocity of railway vehicles at various points along the railroad track. The DR-50 is a radar transciever utilizing continuous wave (AØ) emission at 10,525 Mhz with a radio frequency power output of approximately 25 milliwatts. DR-50 can be housed in either DR-30 or DR-40 dustproof and waterproof cases. The case is mounted in the railroad trackway or wayside at a point where velocity measurement is desired. The radio frequency output of the DR-50 is directed parallel to the rails and horizontal to grade level. Some small amount of vertical (± 1½ degrees) and horizontal (± 6 degrees) adjustment is permitted by the mounting, and the effective range for velocity measurement is approximately 150 feet. DR-50 is normally applied as part of a speed control system used in Railroad Classification Yards. The speed control system detects the approaching car, applies the requested velocity to the speed control amplifier and initiates the radar to start monitoring the cars actual velocity. The radar output signal of 31.4 Hz per MPH is applied to the velocity meter. The velocity meter converts the radar output to a 0 to 10 VDC output (.4V per MPH) that is applied to the speed control amplifier. The speed control amp compares the requested velocity to the actual velocity and energizes an air relay or an exhaust relay, increasing or decreasing the air applied to the retarder. For optimum operation and maximum sensitivity, avoid installing the DR-50 near strong broadcast station towers, neon signs, fluorescent lights, heavy power lines or in any area in general that has noisy broadcast reception.

Note: The DR-50 unit WILL NOT retrofit into a DR-30 or DR-40 installation, because the Test A/Test B is no longer required.

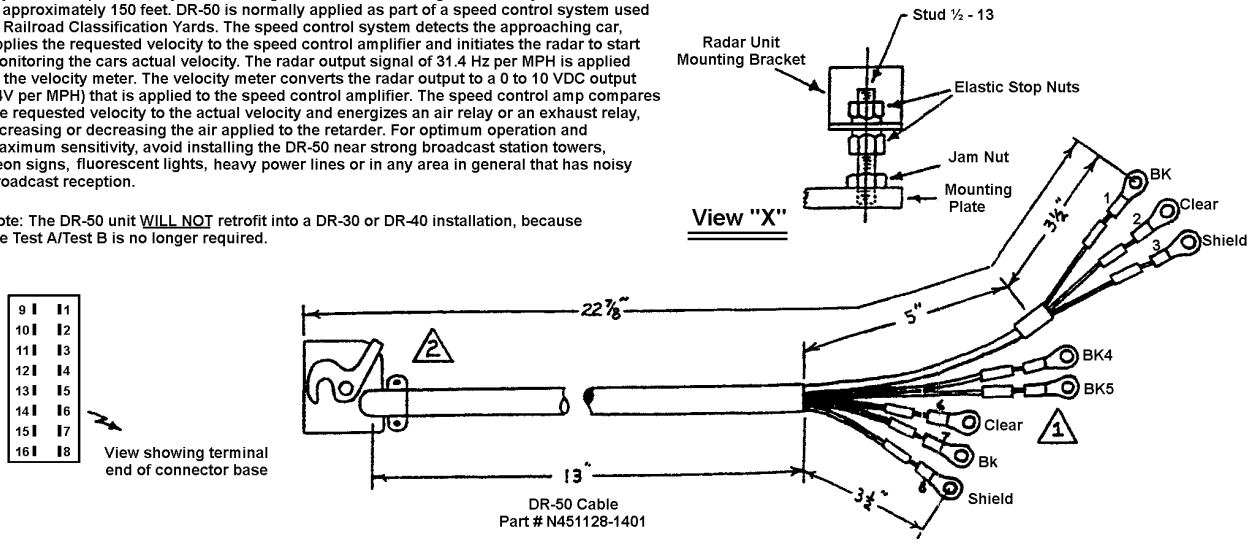


Figure 4-5(b). DR-50 Radar, Application Notes and Characteristics.

4.2 Installation

4.2.1 General Remarks

For optimum operation and maximum sensitivity, avoid installing the DR-50 Radar unit near strong broadcast station towers, fluorescent lights, neon signs, heavy power lines or in general, any areas that have noisy broadcast radio reception.

It should be understood that even when such noise conditions exist and a target comes into range of the DR-50 Radar Unit, the output indications will be the true measured velocity of the target, and the environments noise will in no way be added to the true target velocity.

Using the selected application method (see Section 3.2), reposition and refashion ties, and excavate ballast, as required to allow correct installation of the radar on its mounting base to keep within clearance parameters. Make certain that the modified section of track, as a whole, maintains standards for tie spacing and ballast support.

4.2.2 Cable Requirements, SIG A, SIG B, TEST A, TEST B

a. Maximum signal attenuation shall not exceed 10db at 1000Hz

b. Maximum DC loop resistance - 500 ohms

c. Cable - twisted pair, shielded

4.2.3 Check Signal (785 Hz)

a. Maximum signal attenuation shall not exceed 10db at 1000 Hz

b. Total DC loop resistance - not to exceed 500 ohms

c. Cable - twisted pair, shielded

4.2.4 Power (117 VAC)

a. Cable - must meet all local electrical code requirements

b. Capable of providing a minimum of 25 watts at each AAR Terminal Strip.

4.2.5 Power Requirements

Each DR-50 Radar unit contains all the regulated, electronically filtered power supplies essential to the operation of its various electronic circuits. These power supplies are energized via an internal isolation/stepdown transformer, which is intended to operate from the commercial power lines. The input power requirements for each DR-50 unit are 95 to 125 volts, 60 Hertz and .1 to .117 amperes. Each DR-50 unit does not require more than 12 to 14 watts operating power.

4.2.6 Electrical Interface

All external electrical connections are accomplished by means of a standard eight-way AAR terminal block. This terminal block is-located within the DR-50 Radar enclosure, as shown in Figure 8-1.

After connection of all external wiring to the eight-way AAR terminal block, interconnection to the DR-50 subassembly part number N451128-2101 is provided by means of a cable assembly, part number N451128-1401, which is provided with the unit.

See Figure 6-6 for specific electrical wiring assignments to the DR-50 Radar Unit.

4.2.7 Final Checks

a. Inspect all wiring tags and check that they are on the correct AAR terminals on the DR-50 unit and on the equipment room rack.

b. Check for loose AAR terminal nuts, which would result in intermittent operation.

c. Inspect for stray hardware, which might short between AAR terminals.

d. Check to see if cable plug connectors are secured and properly seated both in the DR-50 unit and in the equipment room.

4.3 Aiming Procedures

4.3.1 Horizontal Adjustment

The horizontal adjustment range for the N451127-0301 unit is ±6 degrees. Adjustment range for the N451127-0302 unit is ±l degree. To adjust horizontally:

1. Loosen the four mounting plate bolts.
2. Rotate unit until parallel with rail.
3. Retighten mounting bolts.

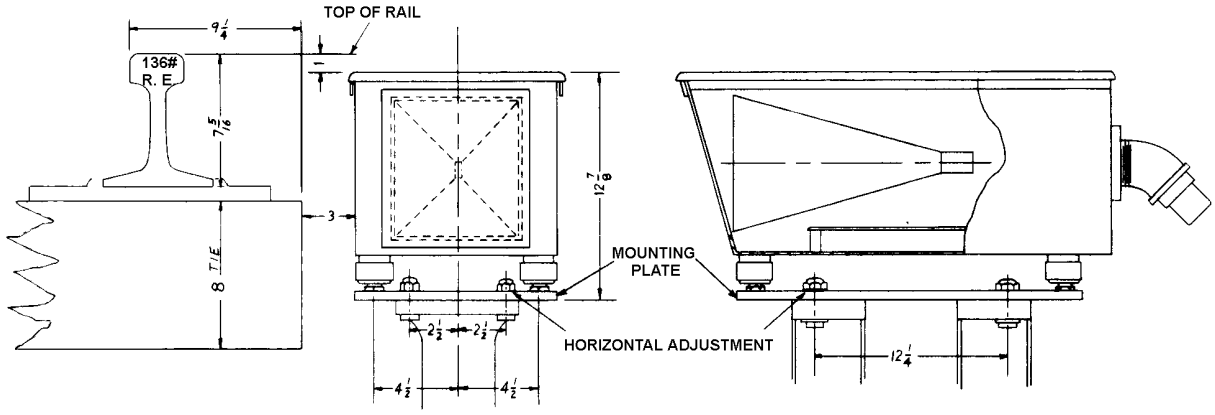


Figure 4-6. DR-50 Radar Horizontal Aiming Adjustments

4.3.2 Vertical Adjustment

The vertical adjustment range for all units is ±1.5 degrees. To adjust vertically:

1. Loosen the four elastic stop nuts or mounting feet of the radar.
2. Raise or lower one end of the unit until it is aimed at the target area.
3. Retighten elastic stop nuts.

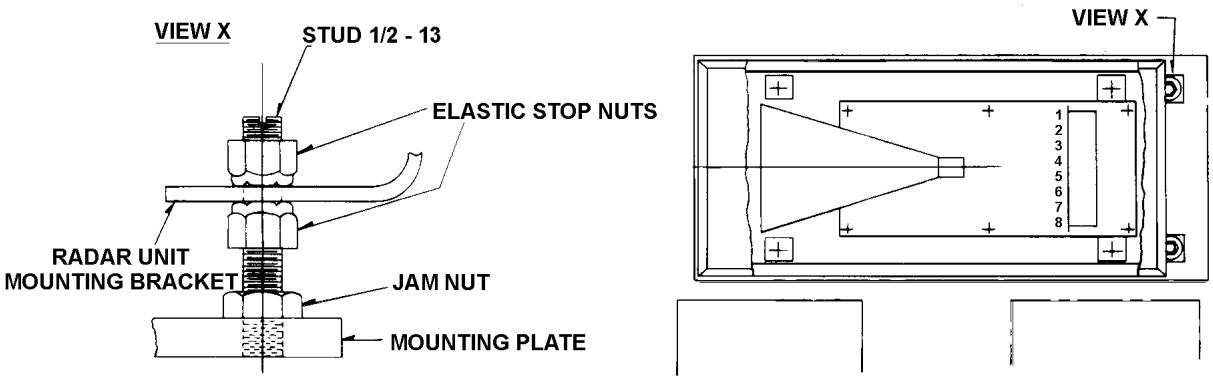


Figure 4-7. DR-50 Radar Vertical Aiming Adjustments

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WARNING

AC power to the radar unit must be disconnected prior to conducting any hands-on maintenance, otherwise personal injury may result.

5.1 Inspection

Make a thorough visual inspection of all wiring and cables for evidence of fraying or burning. Also, test wires to determine if any have worked loose at their connecting points. Check the physical integrity of all other components, looking for indications of burns and cracks, leakage of insulation compounds and general physical damage. Also, check the structural integrity of the printed circuit board and the mounting tightness of all integrated circuit packages. If any of the above general types of problems are discovered, go to Section 6.0 to the appropriate maintenance section.

5.2 Cleaning

CAUTION

Do not attempt to clean P.C. boards, components or other small components with any kind of stiff brush, solvent, vacuum cleaner or compressed air, otherwise damage to these components may result.

1. Remove excessive dust from internal surfaces and components using a **soft-bristle brush** and **low-pressure compressed air jet**.

2. Wipe external surfaces with a soft, damp cloth to remove foreign materials. Do not use any corrosive chemicals that may be potentially destructive to the housing or RF window.

3. Reconnect AC power and replace top cover.

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WARNING

To avoid personal injury, AC power to the radar unit must be disconnected before taking any steps to pull the unit from its mounting in the classification yard.

6.1 Access to Components

6.1.1 Removal of Subassembly

1. Remove topside cover from enclosure.
2. Disconnect J1 connector, as located in Figure 6-1.
3. Using a 3/8" socket drive tool, remove three retaining nuts on base plate, also indicated in Figure 6-1.
4. Carefully lift the subassembly chassis out of the enclosure.

6.1.2 P.C. Board Access

1. Remove four hex head cap screws that attach horn and Doppler transceiver module to subassembly chassis.
2. Disconnect wiring harness dress from chassis.
3. Rotate horn/Doppler transceiver module 90° away from P.C. board side, as indicated in Figure 6-2.

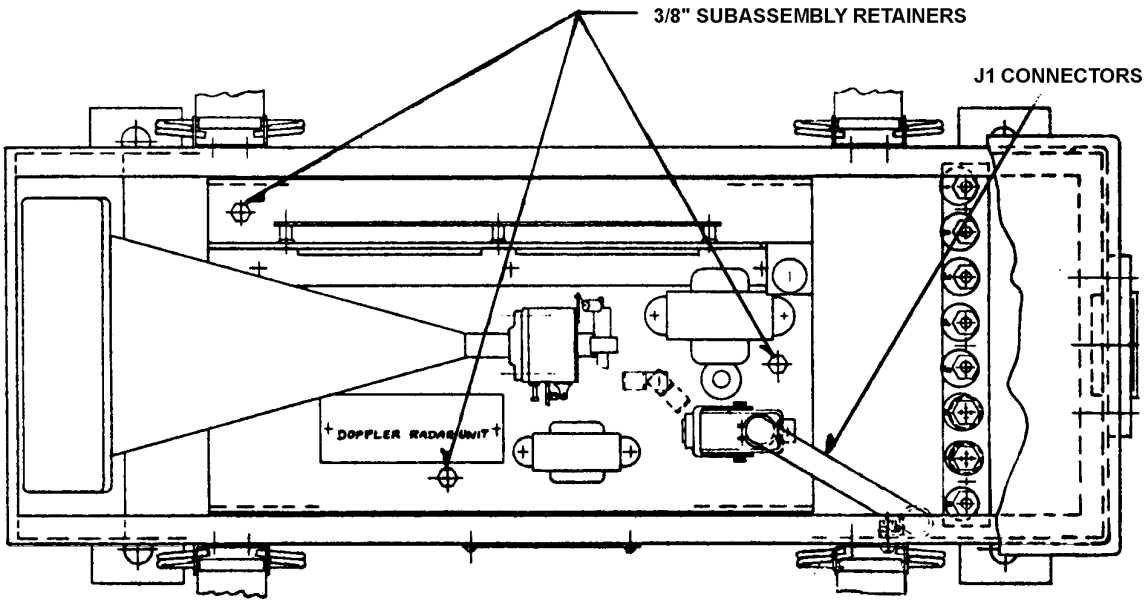

Figure 6-1. DR-50 Disassembly Diagram

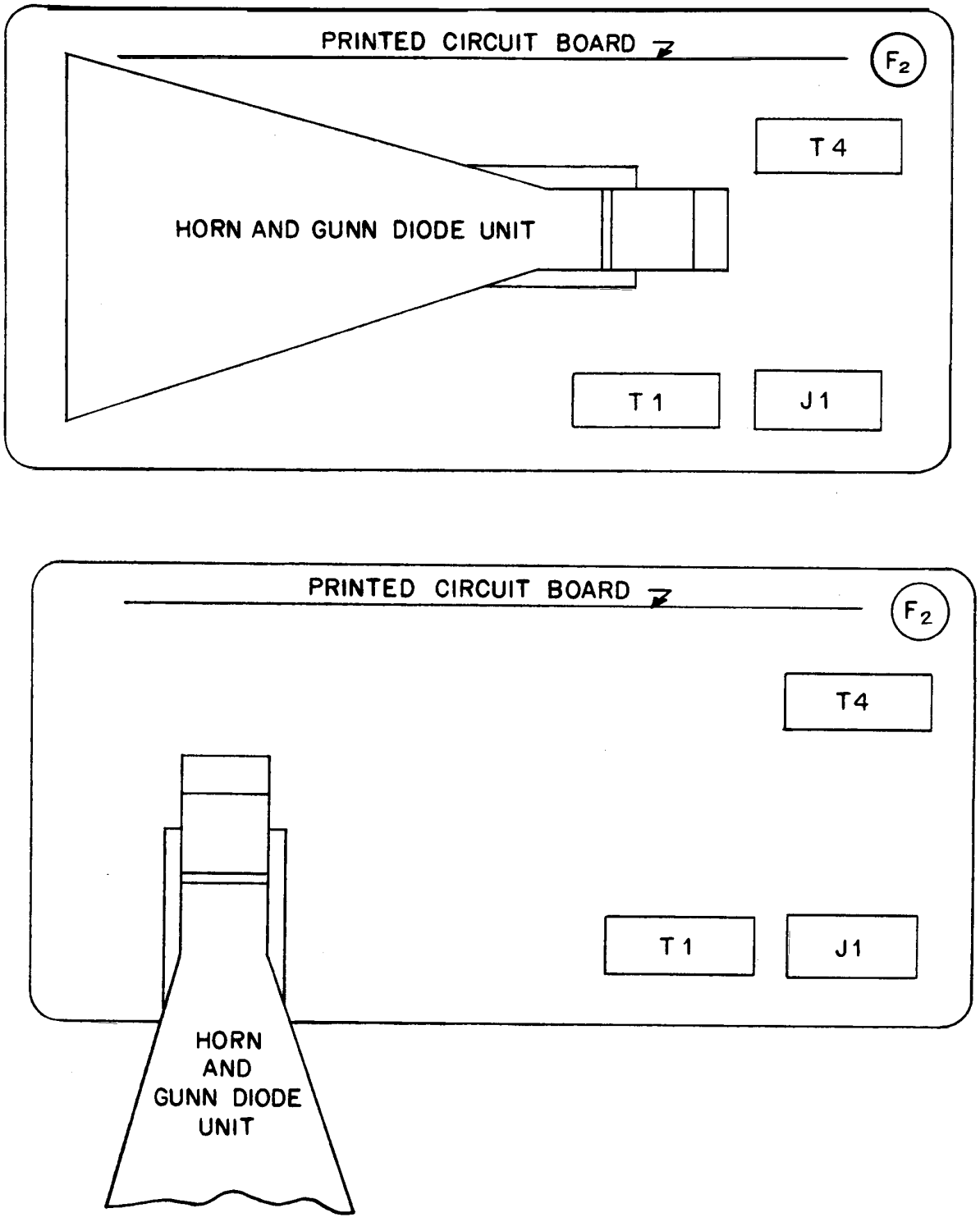

Figure 6-2. Relocation of Horn and Gunn Diode for Service Access

6.2 Detailed Circuit Design and Functional Description

6.2.1 General Remarks

Block and complete circuit schematic diagrams of the DR-50 Radar Unit are shown in Figures 6-3 and 6-4, respectively. Refer to Figure 8-2 for placement of chassis components and Figure 8-3 for printed circuit board components (parts referenced on pages preceding these figures). All electrical inputs and outputs are terminated on a 16-pin Amphenol male connector mounted on the subassembly chassis.

6.2.2 Power Supplies

Voltages: Plus 10.0 VDC (Adjustable 8 to 12 VDC)
Minus 9.0 VDC ± .5 volts

The primary source of power for the DR-50 Doppler Radar Unit is 117 VAC 60 Hz., which is applied to terminals J1-5 and Jl-12 and to feed the primary winding of step-down transformer T-4. The transformer primary is fused (F2) at one ampere. The secondary winding is center tapped and the center tap is tied to the chassis and serves as chassis and signal ground (TP-1). The secondary AC voltage of T4 is rectified by D7 to D10 and filtered by C14 and C13 to produce unregulated voltages of approximately minus 17 volts and plus 16 volts DC at TP-2 and TP-3, respectively.

The Zener reference voltage of D6 and the operation of pass transistor Q2 provide regulation for the negative voltages. This reference voltage of approximately 10.5 volts is filtered by C12 and C11 and is applied to the base of transistor Q2 and produces -9.0 ±0.5 volts at TP-6 by emitter follower action.

Regulation for the positive voltages is provided by IC-6, which is a Monolithic Voltage Regulator type 723 used with external pass transistor Q1. The voltage at TP-4 is adjustable between 8 to 12 volts by the setting of R-26 in order to provide the Gunn Diode voltage with the range of voltages marked on the Doppler Transceiver waveguide packages by the manufacturer. The regulator output is filtered by C16. The 12 VDC IC Regulator VR-1 provides regulation for the positive voltage for the RFK check circuit. The output of the positive regulator is fused at 1½ amperes by F1.

6.2.3 Velocity Measurement Circuitry

The DR-50 has a single printed circuit board that utilizes several types of linear and digital integrated circuits. The DR-50 also uses three style 748 Operational Amplifier Linear integrated circuits. IC-2 through IC-6 are used as amplifiers and line drivers. IC-2 and IC-3 have amplification limiting what is performed by a Beam-Lead Diode Array containing six matched diodes.

The Doppler Transceiver contains a mixer diode that functions as the receiver of the unit. The diode requires forward bias and this bias is developed by diverting a small amount of RF output energy from the Gunn Diode. This is accomplished by a fixed ferrite circulator located in the waveguide unit and a 2 x 56 adjustment screw on the waveguide assembly. The screw adjustment can vary the DC voltage from a –0.2 to –0.4 volts DC at the mixer terminal. The mixer output is fed to two parallel data processing circuit branches. The first of these is the Doppler Output and the second is the RFK output branch.

The Doppler circuit branch input contains a resistor capacitor network that forms a high pass filter input to the first solid-state switch of IC-1. The control input under normal velocity measurement conditions is RLY2 deenergized and, therefore, the Doppler signal is passed without alteration to the first of two identical AC amplifiers made of IC-2 and IC-3. The gain of these amplifiers is set by the ratio of R8 to R7 or R11 to R10, which are approximately 68 per stage. The diode networks formed by the CA3039 packages perform a gain limiting function by conducting on both positive and negative half-cycles when the signal output of IC-2 and IC-3 is sufficient to forward bias the three matched diodes effectively in series.

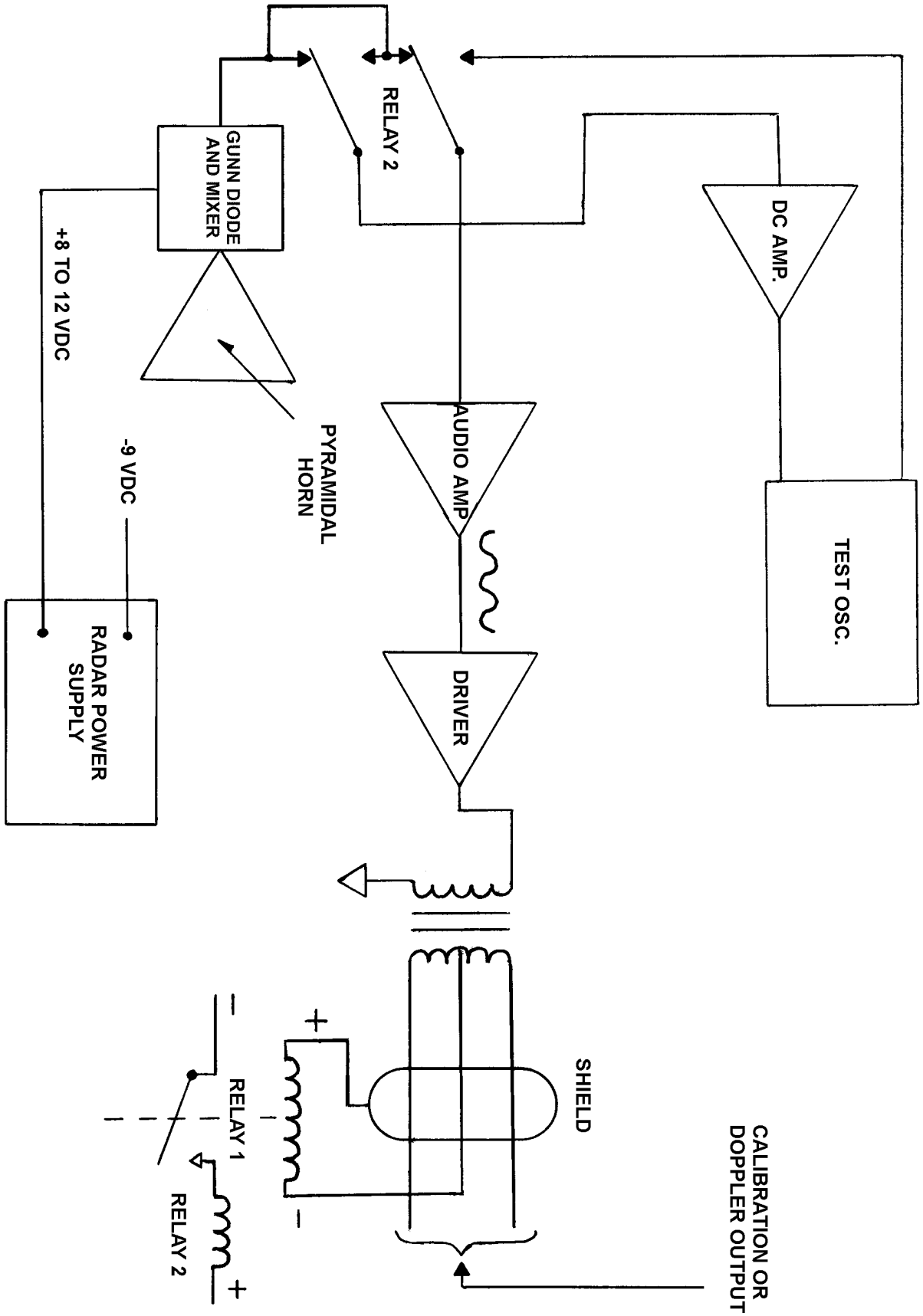

Figure 6-3. DR-50 Radar Block Diagram

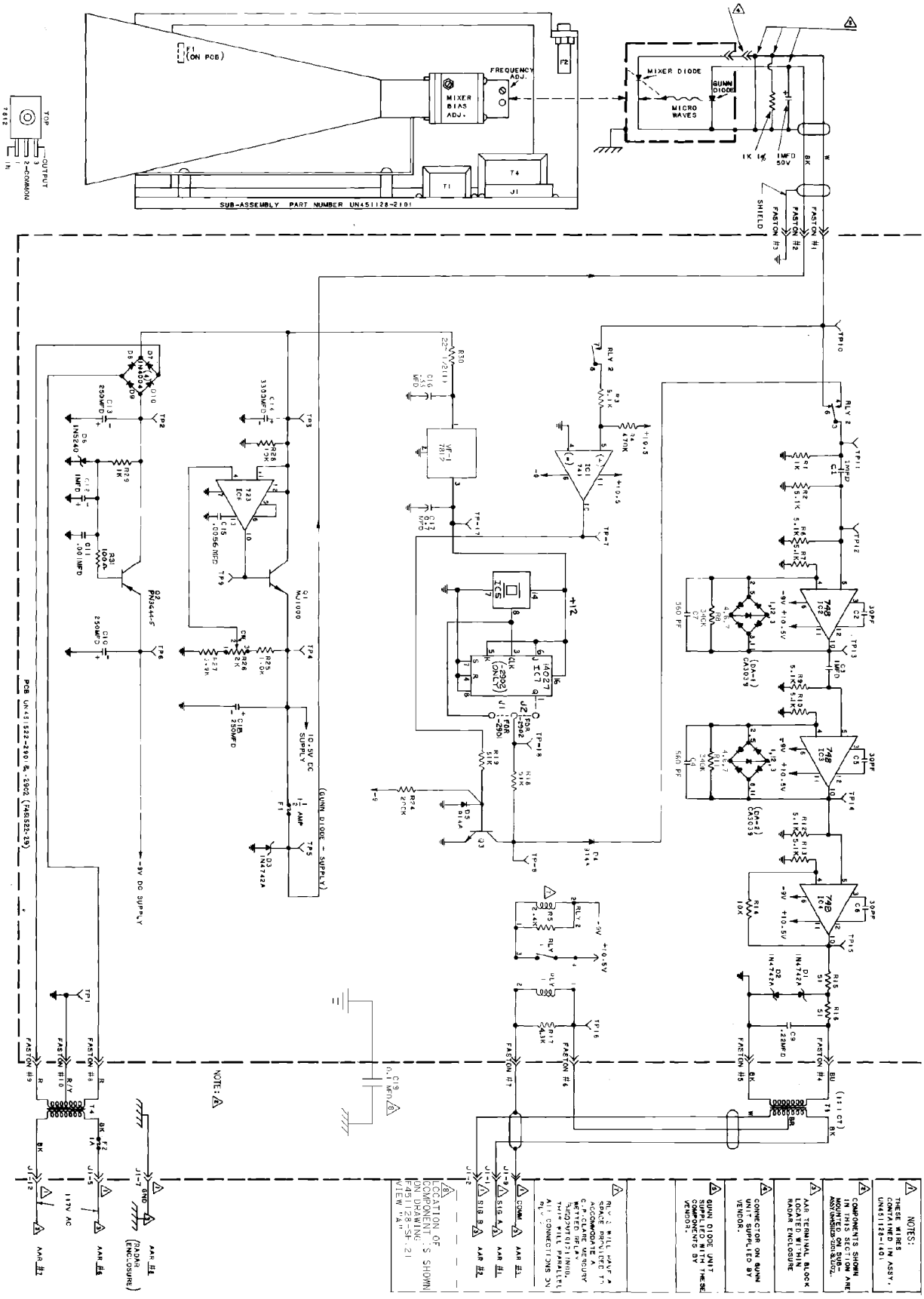

Figure 6-4. DR-50 Radar Schematic Diagram

When conducting, these diodes shunt R8 or R11 and reduce the gain of each stage. The capacitors C7 and C4 set the high frequency gain roll off.

The linear integrated circuit amplifier IC-4 serves as the line driver. It has a gain of approximately three and its output contains back-to-back Zener diodes D1 and D2 for transient suppression. R15, R16 and C9 serve as loading and a low-pass output filter. Transformer T1 couples the Doppler output to the line, which is terminated at the monitoring location by the velocity meter.

The second circuit branch, in parallel with the mixer output, is the RFK branch. The RFK branch's function is to deliver a DC voltage level that is indicative of normal radar transceiver operation to the monitoring circuitry. The signal level at TP-10 is approximately –0.2 VDC or higher.

IC-1 (741 Optional Amplifier) is a DC amplifier that drives the base of transistor Q-3. Transistor Q-3 is used to gate the output of (IC-5) the 784.7 Hz oscillator. This output is used to calibrate the velocity meter at the monitoring point.

Upon installation, it is necessary to check that the DR-50 unit is calibrated and working properly. (Obtain and refer to FCC rules and regulations, manual part 90). This is done, when the retarder zone is not occupied, by applying a 24 VDC signal to the Sig A, Sig B Transformer. This energizes relays 1 and 2 (Figure 6-3). The mixer output voltage is routed through IC-1 and Q-3 and switches 784.7 Hz calibration signal to the amplifier and line driver and out to the monitoring point for velocity meter calibration.

6.3 Troubleshooting Procedures

6.3.1 Preliminary Checks

6.3.1.1 Physical Defects

Check the physical integrity of all components, wires and connections via Section 5.1. If damage or deterioration is found, proceed to Section 7.0 and the appropriate corrective maintenance procedures.

6.3.1.2 Control Settings

Incorrect control settings can create indications of a problem that does not actually exist. Check that all system controls are set properly. (Example: Is power "On" to the unit?)

6.3.1.3 Associated and Connecting Equipment

Make checks of the equipment being used in conjunction with the DR-50, including that associated with the power source. Also, check the physical integrity of all interconnecting cables.

6.3.2 Isolating A Problem Circuit

Check the Faston connectors on the circuit board for correct locations (see Figure 6-7). Faston connectors may be used for circuit isolation.

To isolate trouble to a specific circuit, note the symptom. The symptom often identifies the particular circuit in which the trouble is located. (Example: If speed measurement fails, but check reveals that the RFK voltage is present on Sig A and Sig B, then the problem can be traced to the Doppler portion of the circuitry.)

6.3.3 Power Supply Problem

Incorrect operation of all circuits often indicates trouble on the supply. Check first for the correct voltages of the individual supplies. If correct voltages are indicated, then another component is causing the problem (which also can appear as a power supply problem and thereby affect all other circuits.) Refer to the following table for power supplies tolerances. If tests reveal a misadjusted supply, go to Section 7.5 for adjustment procedures.

Power Supply	Voltmeter Positive Lead	Voltmeter Negative Lead	Tolerance
+ 10.5 volts	TP4-Unfused and TP5-Fused	TP1	Adjustable 8 VDC to 12 VDC
-9.0 Volts	TP6	TP1	± .5 volt
12.0 Volts	TP17	TP1	± 1 Volt

Table II – Power Supply Tolerances

6.3.4 Checking Individual Components

NOTE

Checks described in the following sections for soldered components are best conducted by disconnecting one end of the component to isolate it from surrounding circuitry.

6.3.4.1 Horn and Doppler Transceiver Module Components

Components of the Horn/Doppler Transceiver Module are analyzed for possible defects via the complete substitution of the faulty unit with another that is known to be in working condition. However, the Schottky Mixer Diode can be replaced from the module by unsoldering the 1kΩ resistor and with a pointed pair of needle-nose pliers, unscrew the white plastic plug. **The following precaution must be observed**.

CAUTION

The Gunn Diode unit must not be removed from the Transceiver Module for any purpose. Doing so would result in wide output variations and, therefore, jeopardize FCC type acceptance for the radar and the customer FCC station authorization limits.

CAUTION

Do not make ohmmeter checks on the Gunn diode or Schottky (mixer) diode during bench testing, otherwise damage to these devices may result. Also, the Schottky (mixer) diode is susceptible to damage by static electric discharge. The technician should take steps to discharge all static electricity from his body before handling these diodes. The diodes, whether or not they are suspected of damage, should be stored only in an electrostatically shielded container, such as those they are shipped in.

6.3.4.2 Diodes, Other Than RF

Diodes may be checked for an open or short by measuring resistance between terminals. Use an ohmmeter with an internal source between 300 Millivolts and 3 volts. Faulty diodes will show high resistance in both directions (open) or low resistance in both directions (shorted).

6.3.4.3 Transistors

Transistors that are suspected of having defects are best tested by substituting an identical one for it that is known to be operating properly, then carrying out operational tests. However, it is possible that a circuit fault at another location caused damage to the original transistor and that the same damage may be inflicted on the replacement. Carry out other component and wiring tests if the latter situation is suspected or if the replacement transistor incurs the same apparent problem as the original. If substitute transistors are not available, use a dynamic tester (such as a Tektronix 575 or equivalent). Section 7.0 explains replacement techniques.

6.3.4.4 Resistors

Check resistors with an ohmmeter, using Parts List in Section 8.2 to obtain the correct tolerance for the resistor in question. Replace only those resistors with test values that vary widely with the intended value.

6.3.4.5 Transformers

Transformers are checked for an open or short/partial short in the windings. Use an ohmmeter to check continuity for an open. For shorts, check waveform response by passing high frequency signals through the circuit.

6.3.4.6 Capacitors

A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating for the capacitor. The resistance reading should be high after the initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

6.3.5 Systematic Circuit Troubleshooting

6.3.5.1 General Remarks

The following diagnostic steps must be followed in the indicated order. The individual steps described actions to be taken with the test equipment, ask for verification of test results and recommend where to look for faults based on unsatisfactory test results. The technician should be certain to follow individual step instructions carefully.

Immediately following the numbered test procedures are the correct voltages and waveforms that should be obtained from test points and terminals, as they are individually analyzed in the procedures. The three immediately following Figures (6-5, 6-6 and 6-7) are provided for orientation with the test set up, chassis wiring and Faston locations. Of course, use the general schematic on page 6-5/6 for troubleshooting procedures as well.

NOTE

Test Point 1 (TP1) is used as a common for voltage measurements unless noted otherwise.

(Go to page 6-15 for initiation of test procedures.)

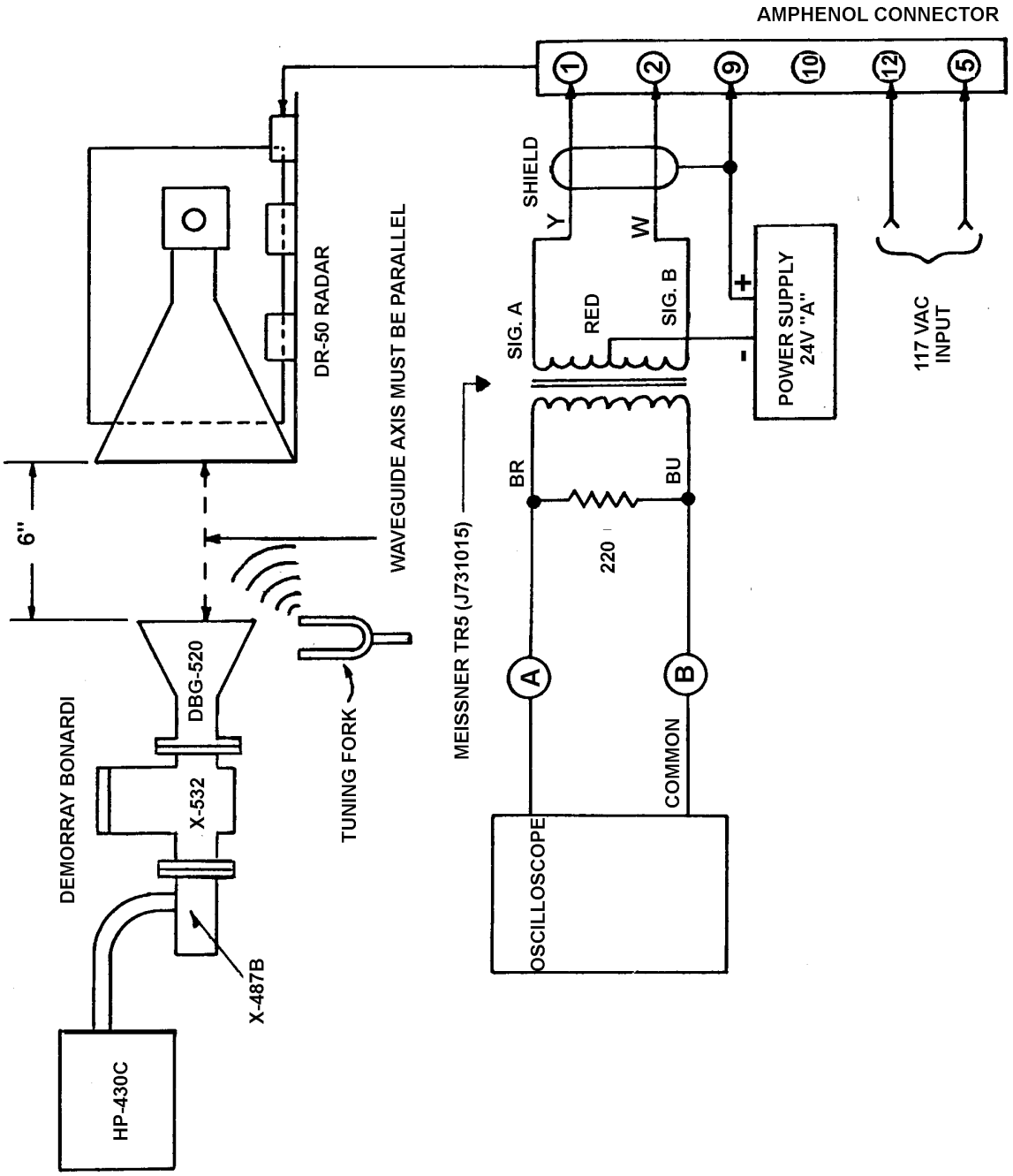

Figure 6-5. DR-50 Radar Test Set Up

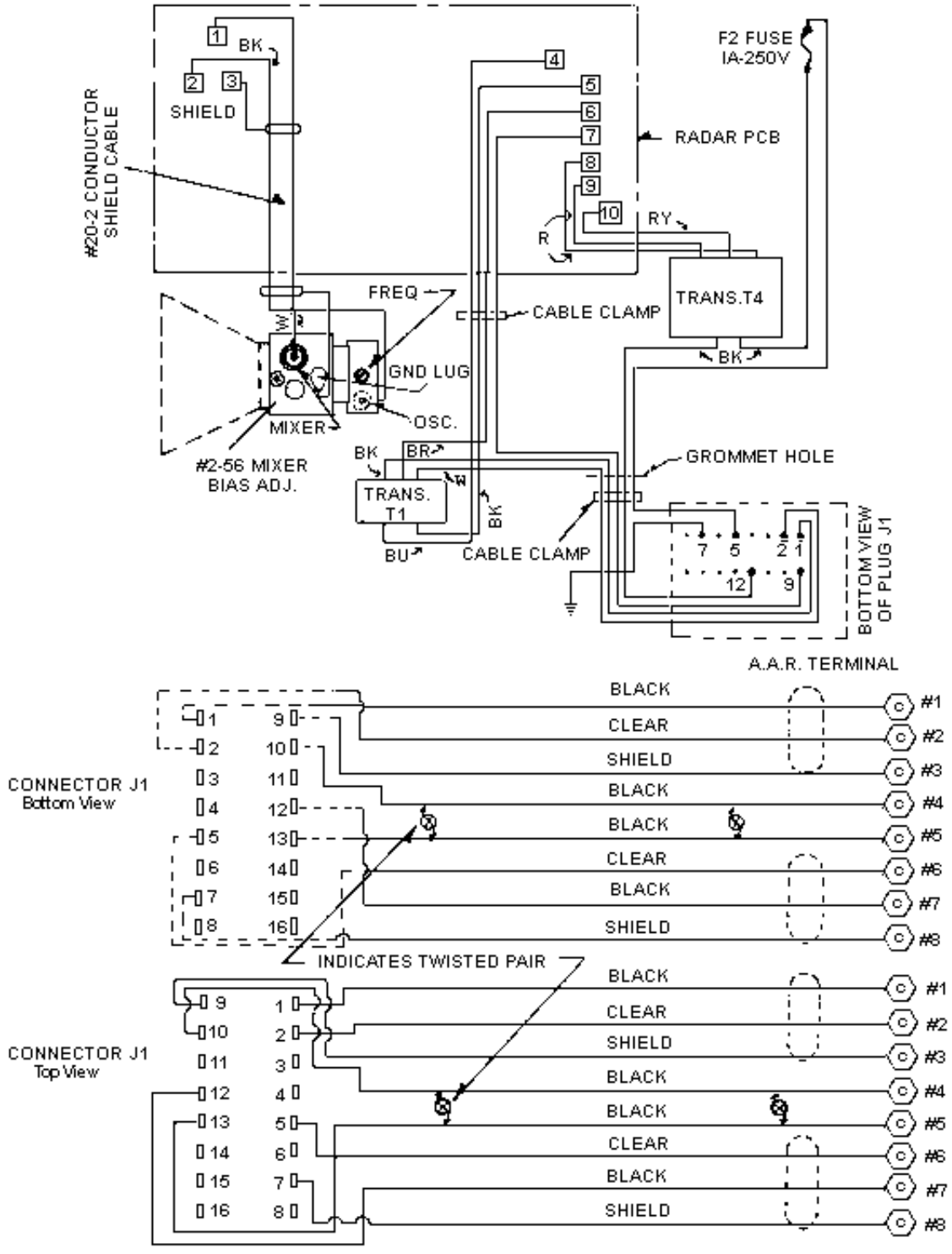

Figure 6-6. DR-50 Wiring Diagrams

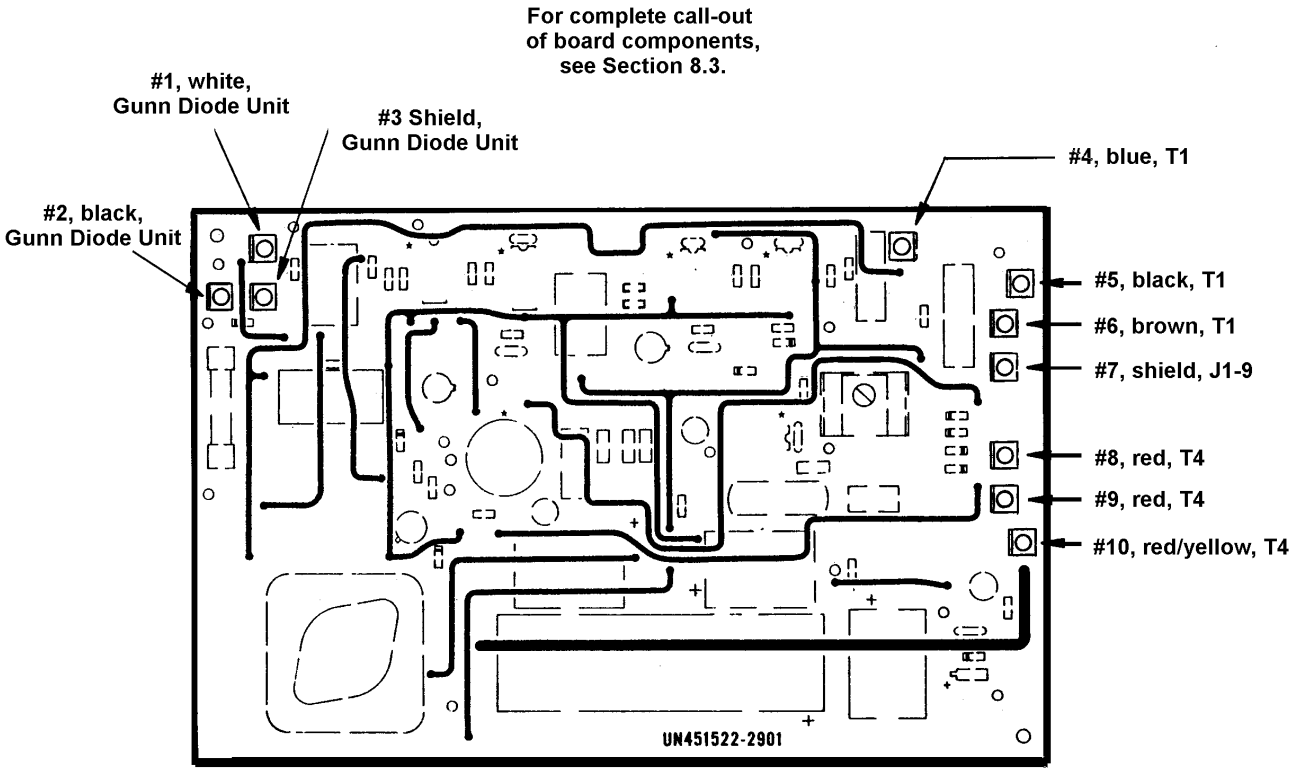

Figure 6-7. DR-50 Faston Location, Identification

6.3.5.2 Test Procedures

1. Connect a voltmeter, set on 150 VAC scale, across AAR terminals #6 and #7. Is voltage indicated on meter between 105 and 125 VAC?

   A. If not, check DR-50's power switch on the Power Distribution Panel. Find where the break, or open, is located and take corrective action. Does this restore speed indication?

   B. If not, go to Step 2.

   C. If it does, maintenance is complete, stop here.

2. Is a substitute DR-50 Unit that is known to be in good operating condition available?

   A. If not, proceed to Step 3.

   B. If it is, replace the defective unit with a unit known to be operational. Does the unit restore speed indication?

   C. If it does, replace and secure the cover.

      This completes the field expedient maintenance. Shop maintenance of the inoperative unit starts at Step 3. If detection is not restored with a known-good unit, the defect is not in the DR-50 chassis: check all interconnecting cabling from equipment room rack to radar case's AAR terminal strip and the 16-way female connector. Make repair and repeat Step 2.

3. Set DR-50 chassis on service bench. Connect the test setup as shown in Figure 6-5. Apply power and allow approximately 30 minutes for warm-up stabilization. Check (with TP-1 as common) that positive and negative power supplies are within tolerance (and don't display excessive ripple): TP5 = 10 VDC (±0.1 VDC), TP-6 = 9 VDC ((±1 VDC) and TP-17 = 12 VDC (±1 VDC).

   A. If voltages are at acceptable levels, go to Step 4.

   B. If voltages are not at acceptable levels, check fuses F1 and F2. Check for 12 VAC (approximately) across Faston #9 and Faston #10, as well as across Fastons #8 and #10.

      (1) If no voltage or an erroneous voltage exists, suspect a short or open within T4 or its connections. Make repairs or replace then retest.

      (2) If voltage exists at transformer output, use standard troubleshooting techniques for power supplies: check rectifier diodes, D7 through D10; check capacitors for shorts; check bad transistors, etc., in components that correspond to the inoperative supply or supplies.

4. Check for 10 VDC (±0.1V) at the Gunn diode itself (on Gunnplexer/Doppler transceiver), connecting the negative (-) lead to the upper lead of the 1μF capacitor on the Gunnplexer and positive (+) lead to the lower capacitor lead (input to Gunn diode).

   A. If proper voltage exists, go to Step 5.

   B. If no supply voltage exists at Gunn diode, check for voltage at TP-5. If no voltage exists, troubleshoot power supply circuitry, as in Step 3.

   C. If voltage exists at TP-5, but not in the Gunn diode, check for open between TP-5 and Gunn diode, either in copper traces or in connecting wire.

5. Check bias voltage at mixer diode on Gunnplexer by moving the voltmeter (+) lead to the upper lead of the 1kΩ resistor on the side of the Gunnplexer. Bias voltage is an indication that the Gunnplexer is emitting RF energy.

   A. If bias is –0.2 VDC or more negative, go to Step 6.

   B. If supply to Gunn diode exists, but improper bias voltage exists, the Schottky mixer diode may be defective. Follow procedure 6.3.4.1 for replacement.

   C. If bias voltage is not restored, the Gunnplexer is suspect and should be checked with an RF power meter, as in procedure 3.2.2.2, Steps 1 through 5. Defective Gunnplexers must be replaced as a unit. When replacing a Gunnplexer, adjust R26 fully clockwise before installation and initial power-up to decrease supply voltage (TP-5 voltage). With the new unit installed, carefully readjust R26 to within ±0.1 VDC of the voltage marked on the new Gunnplexer, using caution not to apply excessive voltage.

6. Activate the self-test circuitry by connecting 24 VDC (power supply "A"), positive (+) to AAR #3, negative (-) to Faston 6. Connect the oscilloscope to AAR #1 and #2. Is a 12 V_{p-p} signal (approximately) present, as in Figure 6-8 below?

   A. If it is, go to Step 9 now.

   B. If no, connect the scope common to TP-1 and the probe to TP-18. Is a 12 V_{p-p} (approximate) signal present (as in Figure 6-9)?

   C. If the 12 V_{p-p} (approximate) signal is present, go to Step 7.

   D. If it is not present, IC-5 or connections to IC-5 are bad. Repair and replace, then retest.

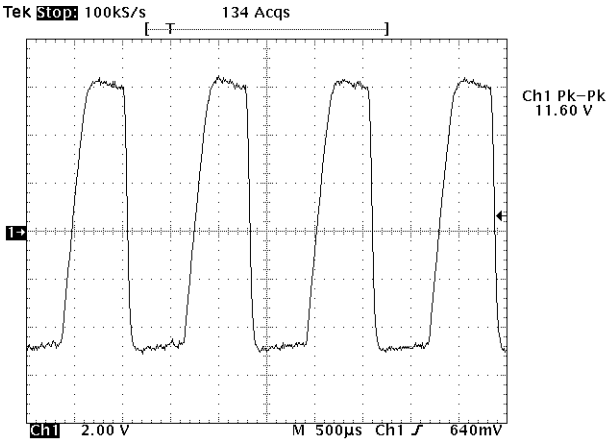

Figure 6-8. AAR#1, AAR #2

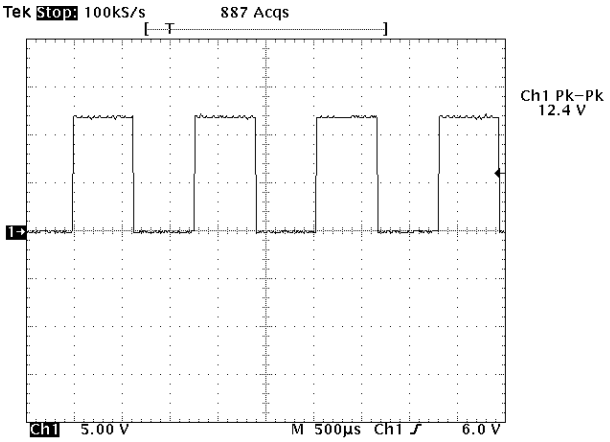

Figure 6-9: TP-18

7. Check for a 900 mV_{p-p} (approximate) @ 784 Hz signal at TP-8 (as in Figure 6-10) while power supply "A" is on.

   A. If this signal exists, go to Step 8 now.

   B. If the signal is not present when the power supply is on, disconnect the scope and connect a voltmeter to TP-7 (common to TP-1).

      (1) There should be –9 VDC (approximately) present.

         (a) If so, check R-19, R-24, D-5 and Q-3 for possible causes. Repair and test.

         (b) If not, check for the mixer bias voltage at TP-10 –0.2 VDC (approximately).

         (c) If present, check the junction of R-3 and RLY-2 for the same voltage.

            (i) If this does not exist, suspect relay #2 circuitry or connections.

            (ii) If an –0.2 VDC (approximately) is present, check R-3, R-4 and IC-1 for possible failure. Repair and repeat this step.

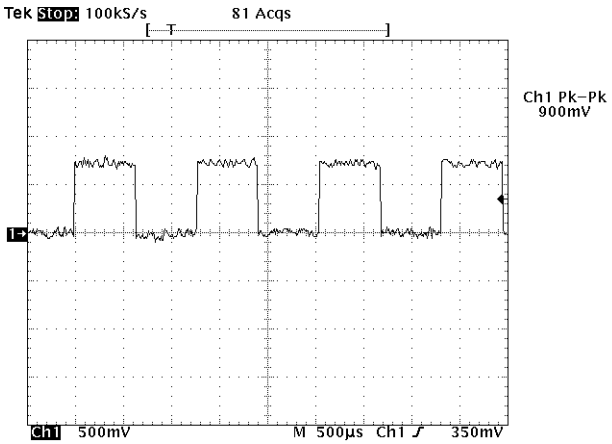

Figure 6-10: TP-8

8. With power supply "A" on, check for 175 mV_{p-p} (approximately) square wave @ 784 Hz at TP-11 (as in Figure 6-11).

   A. If this is not present, relay 2 contacts or connections are suspect: repair and continue.

   B. Check for 784 Hz signal at TP-12, TP-13, TP-14 and TP-15, consecutively (as in Figures 6-12 through 6-15, respectively).

      (1) If the signal deviates from expected results at one test point but not the previous point, the components (or connections) between those two points are suspect: repair as necessary and continue.

      (2) Check output of signal transformer (AAR #1 and #2) for a 12 V_{p-p} signal (approximately), as in Figure 6-8.

         (a) If signal is not present, check continuity in wiring from connector to transformer for open, check primary (Faston #4 and #5) and secondary (J1-1, J1-2 and also AAR connecting wires) of transformer for continuity. Repair and repeat this step.

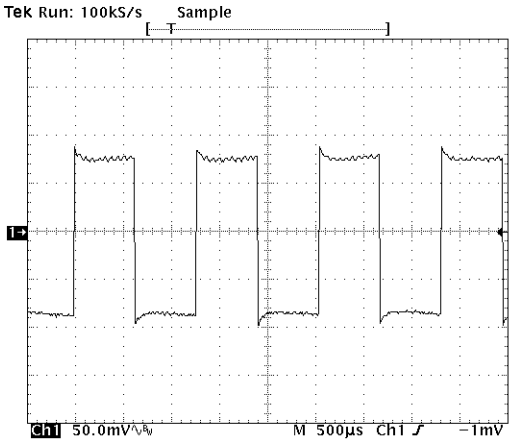

Figure 6-11: TP-11

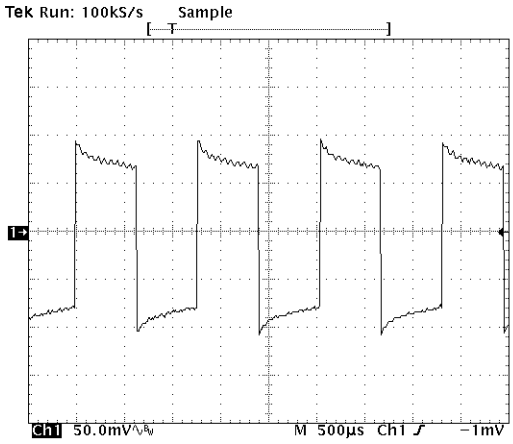

Figure 6-12: TP-12

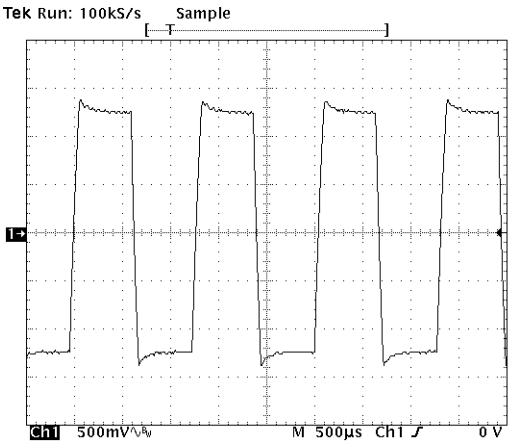

Figure 6-13: TP-13

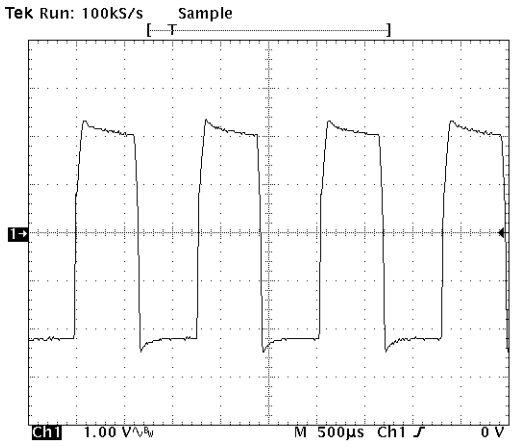

Figure 6-14: TP-14

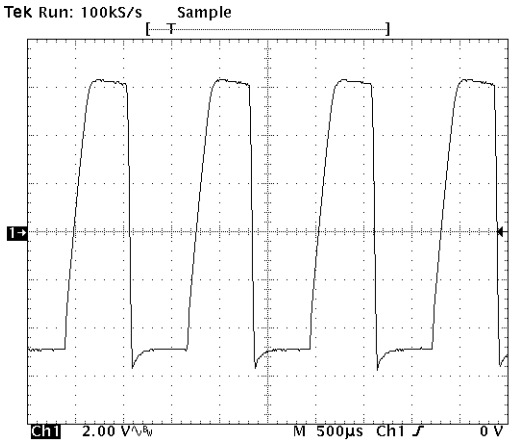

Figure 6-15: TP-15

9. Disconnect the 24-Volt power supply. Connect the scope to AAR #1 and #2. Activate the 440 Hz tuning fork and place it 3" in front of the DR-50's horn (hold stationary with vise or some such device to stabilize signal.) Is a 6 V_{p-p} (approximately) @ 440 Hz signal present (as in Figure 6-16)?

   A. If not, go back to Step 3 and repeat test procedure.

   B. If the signal is present, the UNIT IS OPERATIONAL. Testing and maintenance are complete. Disconnect all test equipment and secure the DR-50 so it may be placed in operation as required.

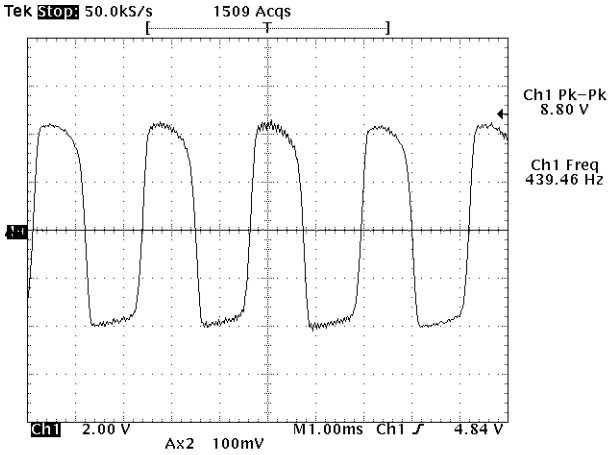

Figure 6-16: Tuning Fork Test (AAR #1, #2)

7.1 General Remarks

Refer to Section 6.1 for steps required to pull subassembly chassis from housing and to temporarily relocate Horn/Gunn Diode Unit for PC board access. Refer to Figures 6-6 and 6-7 for general chassis wiring and PC board Faston locations, respectively. Rating and/or other identification information for individual chassis and PC board components is provided in Section 8.0.

Wiring between chassis components and the PC board is tagged or color-coded to allow correct reconnection when a new component is installed in place of an old one. If any tags are missing, the technician should install new tags (carrying the correct Faston or Amphenol number) on the wires, before disconnecting them in preparation for removal of the component. If the wires are accidentally disoriented after disconnection, carefully follow the wiring diagram on Figure 6-6 to retrace their correct locations.

7.2 Component Removal

7.2.1 Horn and Doppler Transceiver Module Components

NOTE

The transceiver module may be substituted without removing the horn antenna from the chassis.

7.2.1.1 Removal of Horn and Module

1. Unsolder connections to the various external components of the module and to the internally located Schottky Mixer Diode, making certain that the wires can be distinguished for correct reconnection.

2. Remove four screws on underside of chassis that holds horn and module, with spacer posts to chassis.

3. Lift horn and module assembly away from chassis.

7.2.1.2 Removal of Transceiver Module

1. Unsolder connections to the various external components of the module and to the Schottky Mixer Diode, making certain the wires can be distinguished for correct reconnection.

2. Remove the four screws that hold the module on the horn antenna. (These screws are on the antenna side of the module.) Pull the module away from the antenna. Make certain to secure the “O” ring gasket for reuse when the horn and antenna are reassembled.

7.2.1.3 Removal of Schottky Mixer

1. Remove Schottky by unsoldering its external connection and unscrewing the diode (using a pointed pair of needle-nose pliers) from the side of the transceiver module.

7.2.2 Radar Signal Transformer (T-1)

1. Remove harness clips from wire bundles that lead to Tl wire feed holes in chassis plate.

2. Using Figure 6-6, disconnect correct Faston-attached wires on PC board for T-l.

3. Using same figure, unsolder correct T-l wires on underside of T-l Amphenol connector.

4. Remove Tl hold-down screws on chassis plate and pull unit out, making certain to help wires through hole grommets.

7.2.3 Amphenol Connector (J-1)

1. Unsolder all wires to numbered terminals on underside of unit, making certain they can be distinguished for correct reconnection.

2. Remove small nuts and screws and remove J-1 from chassis.

7.2.4 Step Down Transformer (T-4)

1. Remove wire harness clips from wire bundles feeding the transformer.

2. Using Figure 6-6, disconnect correct Faston-attached wires for T-4 at PC board.

3. Cut T-4 wire going to fuse assembly, allowing sufficient wire on either side of the cut for resplicing.

4. Using Figure 6-6, unsolder T-4 wire where it attaches to its numbered terminal on the underside of the Amphenol connector (J-1).

5. Remove two screws that secure T-4 to chassis and remove unit, making certain to help wires through hole grommets.

7.2.5 PC Board

1. Disconnect all Faston connectors, making certain wires can be distinguished for correct reconnection.

2. Remove retaining screws on bottom side (opposite component side) and remove PC board from chassis back.

7.3 Repair Procedures

7.3.1 General Remarks

Warning

Make certain power to the unit is disconnected before making solder repairs. Otherwise, personal injury may result.

Repairs on DR-50 components are limited to resoldering of broken soldered connections and breaks in PC board copper tracks. No attempt should be made to disassemble or conduct repairs on any individual chassis, transceiver module or PC board component. As noted in Section 6, faulty components are replaced with new units for fault correction purposes.

7.3.2 Copper Track Repairs

1. Use a 35 to 40 watt grounded, pencil-type soldering iron and 60/40 rosin core solder for repairs.

2. Clean section of track determined to have opening.

3. Deposit a uniform bead of solder along the track, but do not leave the iron touching so that that excess heat causes the track to buckle and come off the board.

4. Remove any excess solder that could cause a short with an adjacent track or component connection.

7.3.3 Circuit Board Repairs

Use ordinary 60/40 rosin core solder and a 35 to 40 watt grounded pencil-type soldering iron on the circuit boards. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material.

The following technique should be used to replace a component on a circuit board. Most components can be replaced without removing the boards from the instrument.

1. Grip the component lead with long-nosed pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board.

2. When the solder begins to melt, pull the lead out gently. This should leave a clean hole in the board. If not, clean the hole by reheating the solder and placing a sharp object, such as a toothpick, into the hole. A vacuum-type desoldering tool can also be used for this purpose.

3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint; do not apply too much solder. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clip the excess lead that protrudes through the board.

6. Clean the area around the solder connection with a flux-remover solvent. Be careful not to remove information printed on the board.

7.4 Reassembly Procedures

Reassembly of the DR-50 generally consists of reversing the steps described in Sections 6.1 (removal of chassis from enclosure) and 7.2 (removal of components from chassis). As noted in the previous section, the technician should closely observe the identities and exact locations of the wires that are reattached to PC board Fastons, the Amphenol connector and the Horn/Gunn Diode Unit. Wires that were cut for disassembly purposes (such as those going to the fuse assembly) must be spliced, soldered and wrapped with electrical insulating tape or similar insulating material. Make certain that no wire cuttings or other debris remains on the chassis when it is put back into the enclosure.

7.5 Final Test and Calibration

7.5.1 General Remarks

The following procedure must be completed following any type of component replacement or circuit repair performed on the DR-50 Radar. It assures that the unit will operate at the required radio frequency after reinstallation. Use the general circuit schematic on Figure 6-4, the test set-up on Figure 6-5 and the wiring diagram on Figure 6-6 to help carry out the procedure.

7.5.2 Test Equipment (or Equivalent) Required

Electronic Counter, ATEC 5A35
Oscilloscope, Tektronix 454
Oscilloscope, Probe Tektronix P6028 (30 pfd)
Audio Ascillator, Hewlett Packard 204C
Digital Voltmeter, Fluke 8120A-01
Thermistor Mount, Hewlett Packard X487B
Power Meter, Hewlett Packard 430-C
Frequency Meter, Hewlett Packard HP-5326
Standard Horn Antenna, Narda 640
Tuning Fork 440 Hz Middle "A" (Approximately 14 M.P.H.)

7.5.3 Supplementary Hardware

1. Matching Transformer, Meissner TR5 J731015

2. Resistors, 1000 ohm (1k), ½ watt, 5%, Carbon (J720882)

7.5.4 Procedure

Operation	Remarks
1. Arrange a test set up, as per Figure 6-5 and adjust R26 five (5) turns clockwise.	--
2. Apply 117 VAC ±2 VAC to Amp. Pins five (5) and twelve (12).	--
3. Connect Digital Voltmeter to TP-5 and common to TP1 (Faston #3).	Digital Voltmeter set to DC Volts and Auto Ranging.
4. Inspect operating voltage marked on Gunn Diode Oscillator.	--
5. Adjust R26	Operating voltage of Gunn Diode ±.1 volts DC. Seal pot with inspectors lacquer after adjusting.
6. Allow DR-50 Radar Unit to stabilize to operating temperatures	Ten (10) minutes.
7. Inspect frequency of Gunn Diode Oscillator as indicated on HP5326 Frequency Meter.	Frequency shall be 10.525 Ghz ±1 Mhz.

Operation	Remarks
8. Disconnect Digital Voltmeter from TP-5 and TP-1.	--
9. Adjust oscilloscope as follows and connect across AAR #1 and #2: VERT = 5 Volt/Div. HORZ = 1/Msec/Div. SYNC = AUTO COUPLING = DIRECT.	--
10. Activate tuning fork and place it approximately 3" in front of DR-50 horn.	Observe a minimum of $6V_{p-p}$ on oscilloscope.
11. Reactivate tuning fork and place it approximately 3" in front of DR-50 horn.	Signal on oscilloscope will shift from tuning fork frequency to audio (V.C.O.) oscillator test frequency when power supply “A” is turned on.
12. Turn on 24 VDC power supply "A".	--

END OF TEST

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N451127-0301 (For Mtg. On Cast Iron Base)
N451127-0302 (For Mtg. on Concrete Base)
N451127-0303 (For Mtg. On 2 Cast Iron Bases)

8.1 DR-50 Main Assembly (Reference Figure 8-1)

Item No.	Description	Part Number
1	Box	R451128-0901
2	Window, RF	R451128-1102
3	Chassis, Gunn Diode	N451128-2101
4	Shock Mount	J075467
5	Cover	R451128-1301
6	Rubber, ¼ x ¾ Sponge	A750075
7	Plate, Name	M451425-3402
8	Lock, Spring Loaded Link	J562040
9	Plate, Name	M451108-5202
10	Ell, 2 x 45” Str. Galv.	J032603
11	Sleeve	M256315
12	Plate	M451128-1501
13	Block, Term	M223608
14	Washer	J047818
15	Nut	M029103
16	Nut, Binding	M029101
17	Sleeve, Insl.	M210527
18	Tag, Wht Mkg 1	J075510-0128
19	Tag, Wht Mkg 2	J075510-0154
20	Tag, Wht Mkg 3	J075510-0180
21	Tag, Wht Mkg 4	J075510-0197
22	Tag, Wht Mkg 5	J075510-0214
23	Tag, Wht Mkg 6	J075510-0225
24	Tag, Wht Mkg 7	J075510-0236
25	Tag, Wht Mkg 8	J075510-0245
26	Cable	N451128-1401
27	Lead	N262807
28	Clamp, Cable NP-10N	J700588
29	Retainer	M451128-1204
30	Washer, 8 Shprf.Lk 1208	J047714
31	Scr, 10-32 x ½ Flat Stl.	J052091
32	Scr. ¼ -20 x 7/8 Fil. Hd. SST.	J500139-0114
33	Washer, ¼ Split Lock SST.	J475118
34	Nut ¼ - 20 Hex. SST.	J480211-0108
35	Scr, 8-32 x ½ RD. Hd. SST.	J500132-0108
36	Scr, 8-32 x 7/16 Flat Hd. SST.	J525301-0107
37	Washer, 8 Pl Flat SST.	J475120-0109
38	Washer, 8 Lock SST.	J475121-0108
39	Nut, 8-32 Hex. SST.	J480211-0104
40	Scr, 4-40 x ¼ Rd. Stl.	J525011
41	Plate, Mtg. (for –0301 only)	M398923
42	Base, Mtg. (for –0302 only)	R380487
43	Stud, Mtg.	M451128-1206

Item No.	Description	Part Number
44	Cap, Moulded Insl.	J078147
45	Nut, ½-13 Hex. Jam SST.	J480317-0110
46	Nut, ½-13 Elas. Stop	J480217
47	Scr. ¼ - 20 x 1" Hex. Hd. Cap	J500097-0116
48	Plate, Mtg. (For -0303 Only)	M435757
49	Scr. 8-32 x 5/8 Rd Hd SST.	J500132-0110

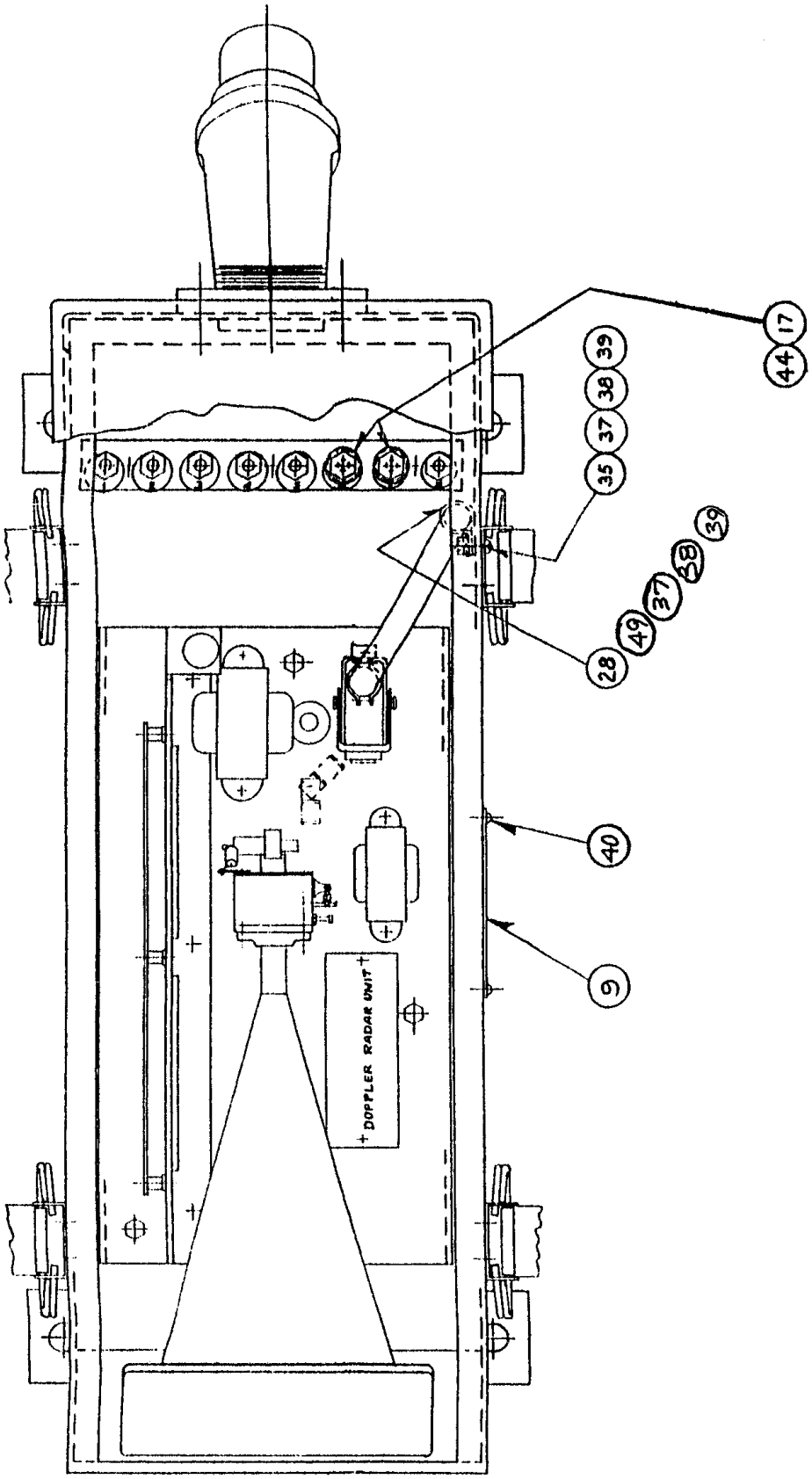

Figure 8-1(a). DR-50 Radar Main Assembly Parts Location.

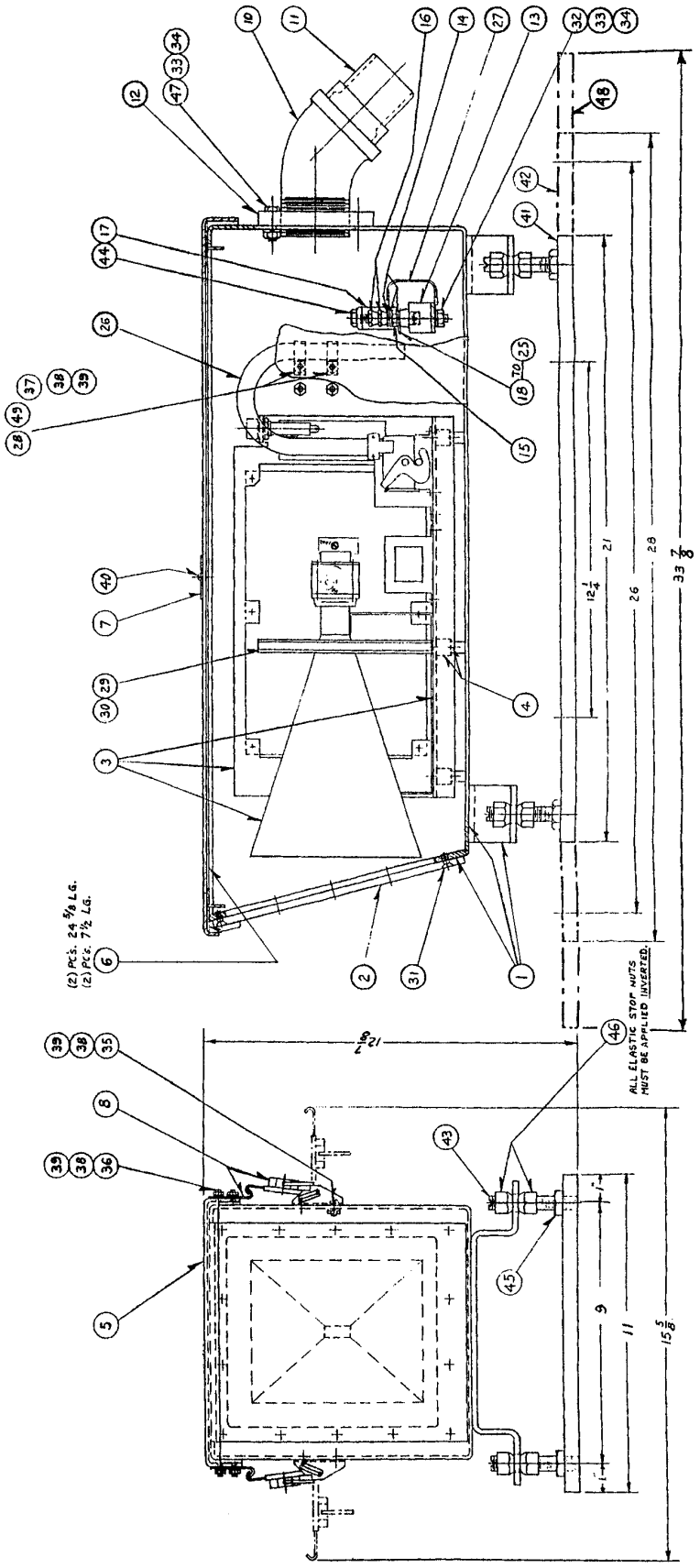

Figure 8-1(b). DR-50 Radar Main Assembly Parts Location.

8.2 CHASSIS N451128-2101 (Standard) Reference Figure 8-2

NOTE

Asterisk (*) items are special components manufactured or selected by US&S to meet specific performance requirements, or are manufactured for US&S in accordance with our specifications. No substitution for these parts should be made, since operation may be affected or may nullify FCC Type Acceptance.

Item No.	Description	Part Number
1	Plate, Mtg.	R451128-0601
2	Bracket, PCS Mtg.	N451128-0701
3	Antenna, X-Band Horn	*J708944-0401
4	Doppler Module	*J731446-0002
5	PDB, Radar (See Figure 9-3 and Tab)	*N451522-2901
6	Transf., Step Down (T4)	*J731400-0004
7	Transf., Radar Signal (T1)	*N451039-0809
8	Conn. Amphenol (J1)	J702689
9	Post, Fuse 342014	J713333
10	Fuse, 1 Amp. 250V (F2)	J710007
11	Tubing, ½" Shrink	A774210
12	Grommet	J751103
13	Scr, ¼ - 20 x ½ Hex Hd SST	J500097-0108
14	Washer, ¼ Plate SST	J475120-0112
15	Washer, ¼, Split Lock SST	J475118
16	Scr. ¼-20 x 5/8" Pan Hd. SST	J507300-0110
17	Scr, 10-32 x ½ Pan Hd. SST	J507296-0108
18	Washer 10 S. Lock	J047733
19	Scr, 8-32 x ½ Pan Hd SST	J5072950108
20	Washer, 8 Spring Lock SST	J475121-0108
21	Scr, 4-40 x 3/8 Rd. Hd SST	J500124-0016
22	Wash, 4 Split LK SST	391-0202-00
23	Nut, 4-40 Hex Hd SST.	J480211-0102
24	Washer, #10 Flat SST	J475120-0138
25	Plate, Name	M451425-3402
26	Plate, Name	M451108-5202
27	Rivet, 1/8 POP SST	J490037-0039
28	Cable, #20-2 Cond. Sh.	A045672
29	Term, Faston 250	J723923
30	Wire, #22 Flex. PVC (Black)	A045662-0000
31	Marker, Wire (1 to 33)	J063646-0011
32	Clamp, Cable (Burndy HP-7N)	J700587
33	SCR, #8-32 x 5/8 RD. Hd. SST	J500132-0110
34	Washer, #8 Flat SST	J475120-0109
35	Nut, #8-32 Hex. SST	J480211-0104
36	Lug, Solder	J731246
37	Clamp, Cable (Burndy HP-3N)	J700970
38	SCR, 10-32 x 1 ¼ Rd Hd SST	J500134-0120
39	Nut 10-32 HEX Hd SST	J480211-0105

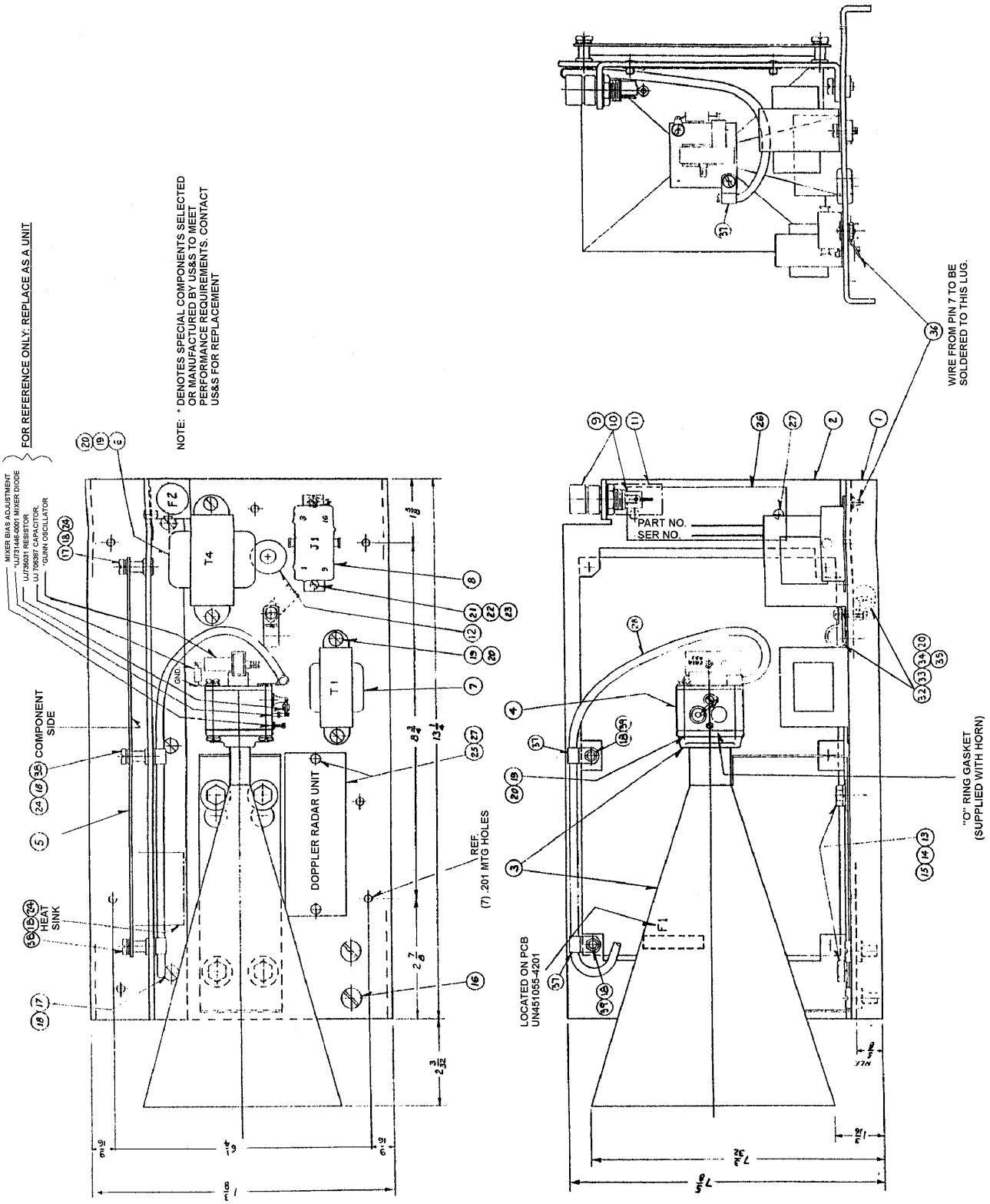

Figure 8-2. DR-50 Radar Chassis Mounted Component Locations

8.3 P.C. Board N451522-2901 (Reference Figure 8-3)

Item No.	Legend	Description	Part Number
1		1/16 Cop. Lam. (6 ¼ x 9 ¼)	
2	IC1	Ckt. Int. 741 DC	J715026
3	IC2, 3, 4	Ckt. Int. 777 DC	J715029-0061
4	IC5	Ckt. Int. SE 566T	J715029-0186
5	IC6	Ckt. Int. 723 DC	J715029-0070
6	Q1	Xstr MJ1000	J731477
7	Q2	Xstr 2N3644	J731383
8	Q3	Xstr 2N2270	J731186
9	IC5	Stabilizer 4ST2-4 (Oven)	J752227
10	Dl, 2, 3	Diode IN4742A	J726133
11	D4,5	Diode IN914A	J726031
12	D6	Diode IN5240B	J726150-0044
13	DA1, DA2	Array, Diode CA3039	J715027
14	D7, 8, 9, 10	Diode IN4004	J723621
15	F4	Clip, Fuse	J576794
16	Fl	Fuse, 3AG 1.5A	J071042
17	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Terminal, Faston	J731391
18	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Rivet, Pop	J490049
19	TP1 thru TP18	Point, Test	J703175
20	Rl, 25, 29	Resistor, 1K Ohm ¼ W	J735031
21	R2, 3, 6, 7, 9, 10, 12, 13	Resistor, 5.lK Ohm ¼ W	J735301
22	R4	Resistor, 470K Ohm ¼ W	J735519-0126
23	R5	Resistor, 2.4K Ohm ¼ W	J735070
24	R8, 11	Resistor 340K Ohm ¼ W	J584987
25	R14, 28	Resistor, 10K Ohm ¼ W	J735053
26	R15, 16	Resistor, 51 Ohm ¼ W	J735407
27	R17	Resistor, 4.3K Ohm ¼ W	J735046
28	R18, 19	Resistor, 51K Ohm ¼ W	J735067
29	R20	Resistor, 1.5K Ohm 1/8 W	J735519-0119
30	R21	Resistor, 10K Ohm 1/8 W	J723793
31	R22	Resistor, 9.09K Ohm 1/8 W	J735098
32	R23	Resistor, 10K Ohm 1/8 W	J620850-0030
33	R24	Resistor, 200K Ohm ¼ W	J735519-0227
34	R26	Pot., 2K Ohm ½ W	J620850-0028
35	R27	Resistor, 3.9K Ohm ¼ W	J735066
36	C1, 3	Cap., 1 mfd, 200V	J706813
37	C2, 5, 6	Cap., 30 pfd 500V	J702815
38	C4, 7	Cap., 560 pfd 500V	J702940-0032
39	C8	Cap., .033 mfd 100V	J709145
40	C9	Cap., .22 mfd 100V	J706858
41	C10, 13, 16	Cap., 250 mfd 50V	J709058
42	C11, 15	Cap., .001 mfd 500V	J706242
43	C12	Cap., 1 mfd 35V	J706387
44	C14	Cap., 3300 mfd 30V	J709010
45	RLY1	Relay, MRBlA24	J726153-0035
46	RLY2	Relay, 922A24C2C	J726153-0033
47	Q2,3	Transipad, Transistor	J752072
48	Q1	Sink, Heat	J792469

Item No.	Legend	Description	Part Number
49	Q1	Screw 6-32 x ¼ 2 DBr	J051622
50	Ql	Wshr. #6 Phos. Br.	J047708
51	Ql	Nut 6-32 Hex. Br.	J048199
52	Heat Sink	Screw 4-40 x 3/8 Rd. Stl.	J525074
53	Heat Sink	Wshr. #4 Stl Lock	J047765
54	Heat Sink	Nut 4-40 Hex Stl.	J480006
55	IC5	Tubing #24. Ins.	A774175
56		Wire, #22 Bare Tin Cop.	A043183
57	R30	Resistor, 22 Ohms ½ W	J735151
58	VRl	Ckt. Int. MC7812CP	J715029-0197
59	VRl	Sink, Heat	J792508-0002
60	VRl	Screw 6-32 x ¼ Rd. Stl.	J525055
61	VRl	Nut 6-32 Hex. Stl.	J048148
62	VRl	Wshr. 6 LK SRPRF	J047713
63	C16	Cap., .33 mfd 100V	J706648
64	C17	Cap., .1 mfd 200V	J706827

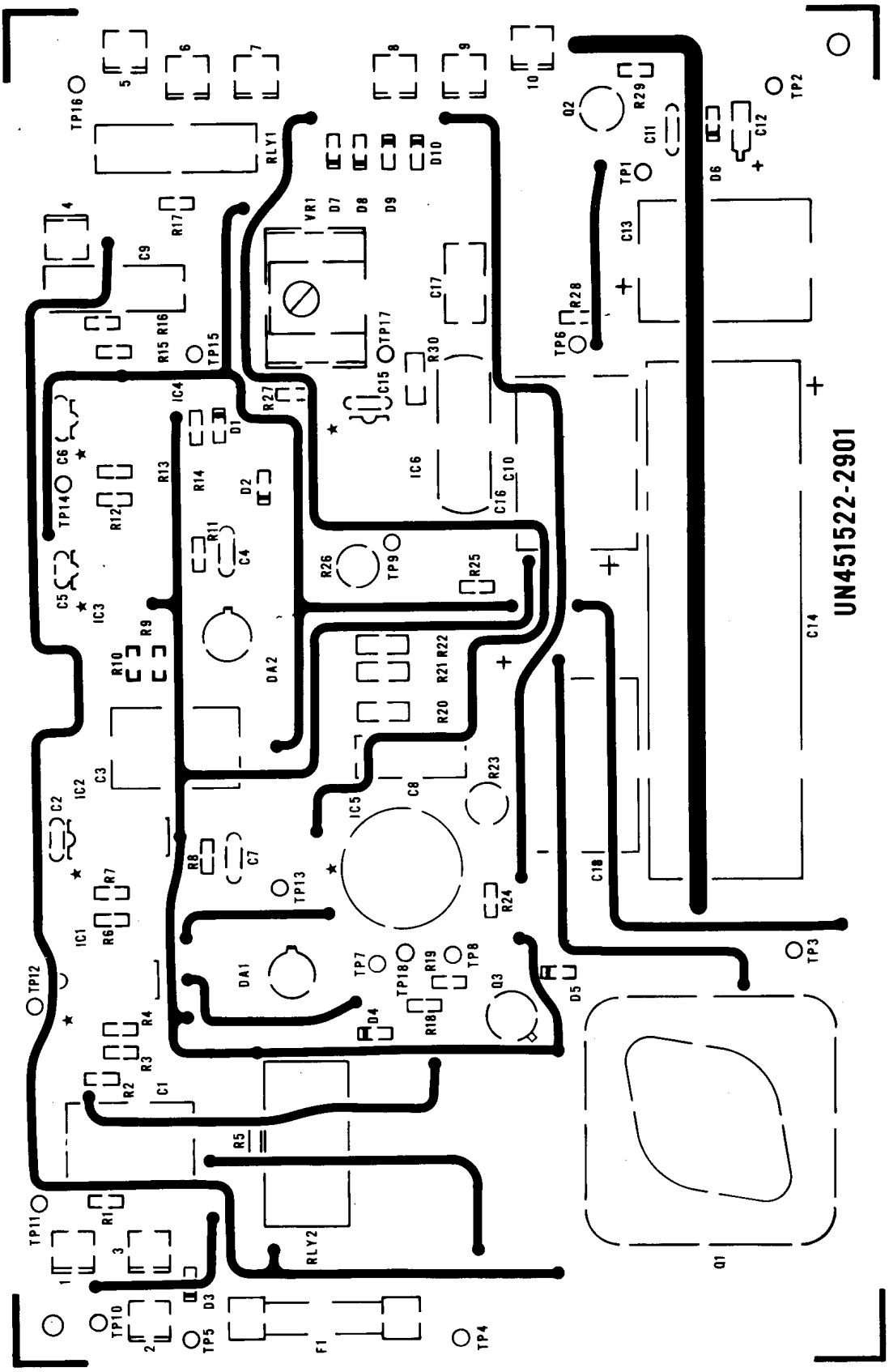

Figure 8-3: DR-50 Radar P.C. Board Component Locations

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9.1 RF Components

All components of the Doppler Transceiver Module marked with an asterisk on Parts List in Section 8.3 must be ordered directly from the manufacturer; no substitutions from outside sources may be made. These have been specially selected and designed to meet specific performance requirements to keep the radar within FCC authorization limits. A substitute component not obtained from the manufacturer could possibly change performance values to the point where the radar no longer operates within these limits.

9.2 Standard Electrical Components

Standard electrical components such as resistors, capacitors etc. may be ordered from the manufacturer, or from outside sources. If ordered outside, take care to note the exact description, value, tolerance, rating etc. of the replacement to make sure that it matches the original component.

When ordering these parts, it is important to remember that the physical size and shape of the component may affect its performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements, unless it is specifically known that a different component will not adversely affect system performance.

9.3 Ordering

When ordering a replacement component, supply the following information:

1. RF unit type, DR-50.

2. Unit serial number.

3. Description of the part, including circuit number for electrical parts.

4. Manufacturer’s part number.

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