SERVICE MANUAL **6015**

DR–40 RADAR

Sept. 1979, WP
C-79-200-1979-3

PRINTED IN U.S.A.

UNION SWITCH & SIGNAL INC.
5800 CORPORATE DRIVE • PITTSBURGH, PA 15237

CONTENTS

Contents Cont'd.

Contents Cont'd.

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION I
INTRODUCTION

1.1 GENERAL DESCRIPTION

The DR-40 Solid State Radar Unit is designed to detect and guage railroad car velocity by means of the Doppler effect. When the transmitted signal from the DR-40 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 to a velocity meter.

The DR-40 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-40 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-40 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-40 enclosure. A plug connector cable connects the AAR terminal strip to the DR-40 subplate assembly.

The DR-40 Radar enclosure is constructed of steel sheeting to resist damage by dragging equipment. A non-metallic plate forms rf window which allows the microwave to pass through while shielding the electronics from dirt and the elements. The DR-40 Radar is available complete with any of three mounting bases: N451127-0201 for mounting on a cast iron foundation and N451127-0202 for mounting on a concrete foundation and N451127-0203 for mounting on two cast iron foundations (see Section IV 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 VIII - Parts List.

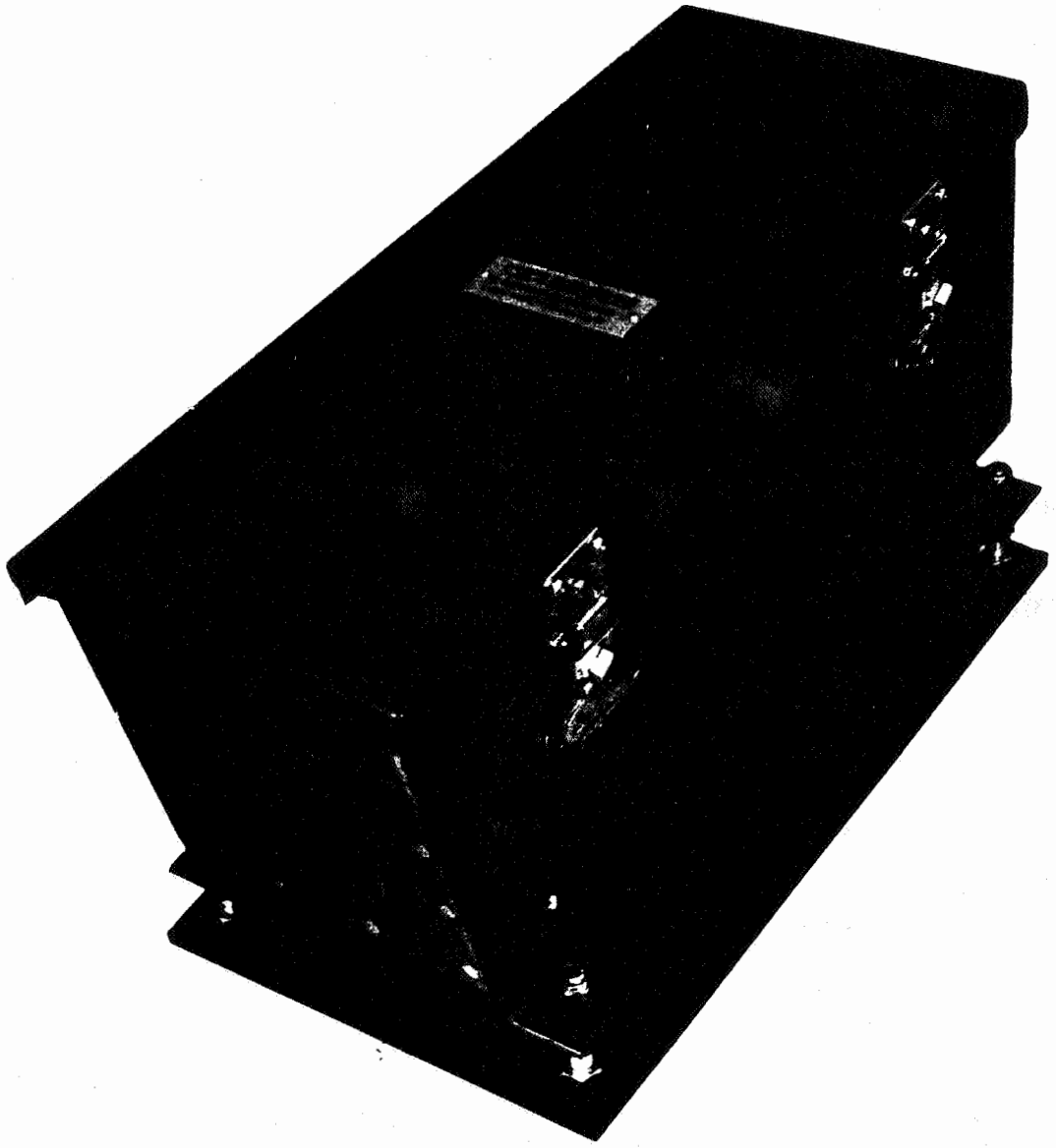


Figure 1-1. DR-40 Weatherproof Enclosure

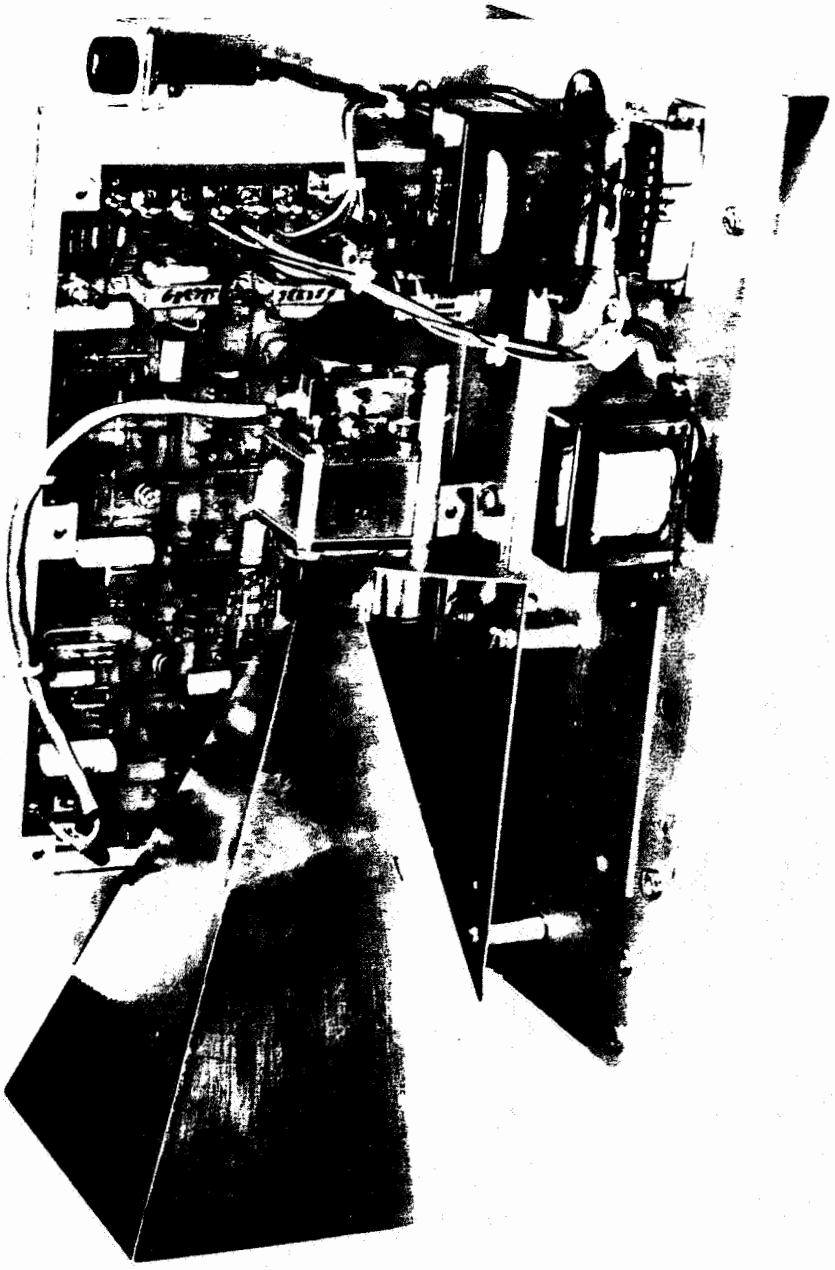


Figure 1-2. DR-40 Radar Subplate Assembly N451128-0801

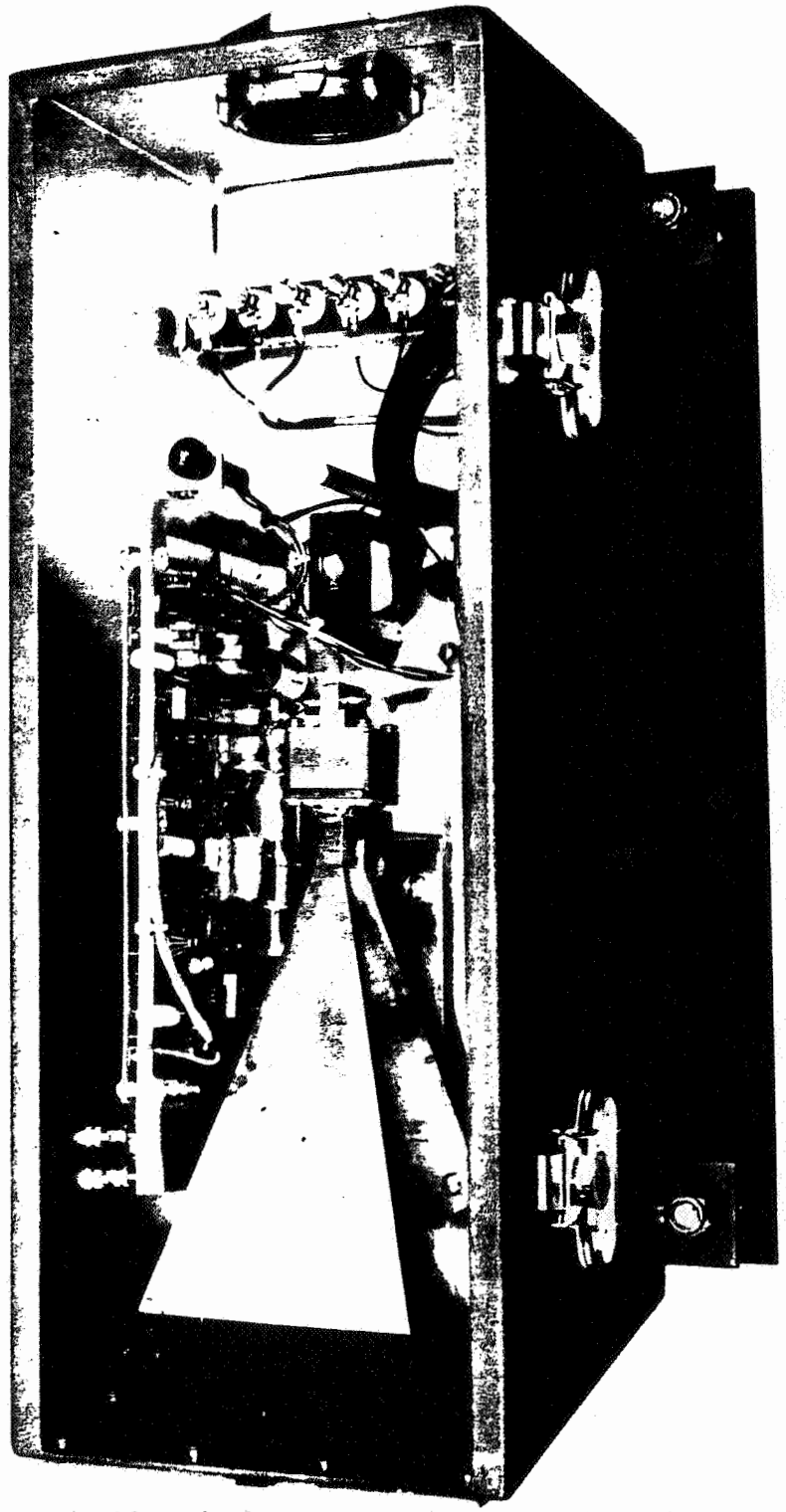


Figure 1-3. DR-40 Subplate Assembly Mounted in DR-40 Enclosure

1.3 GENERAL DESCRIPTION OF CIRCUITS

The WABCO DR-40 unit is a complete self-contained solid state doppler radar transceiver. It operates on a frequency of 10.525 GIGA HERTZ (10,525,000,000 Hz) with a nominal power output of 75 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-40 unit:

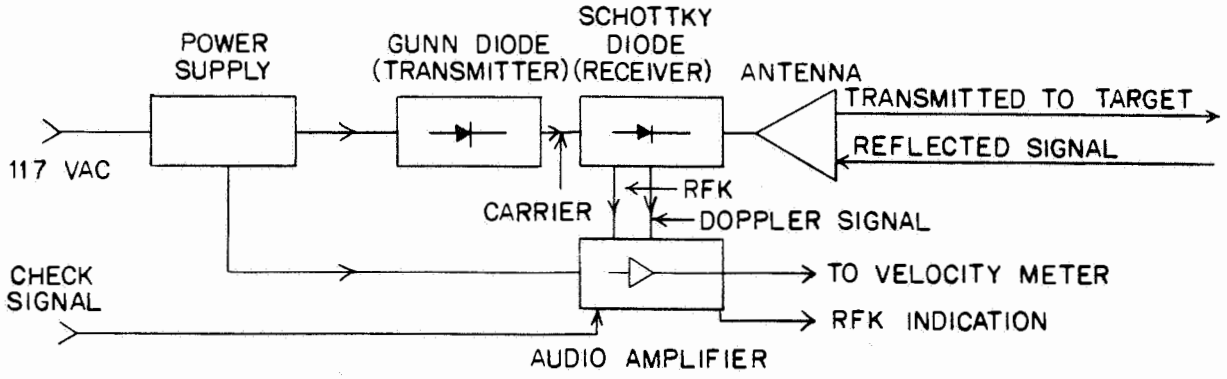


Figure 1-4. DR-40 Basic Block Diagram

The DR-40 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 which oscillates with sufficient rf power output to provide a one step conversion from dc to microwave energy, therby eliminating complex circuitry. The diode opertates 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 which 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 Station

The receiver section is located in the portion of 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 a 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 check amplifier. This circuit provifes a negative dc output when the Gunn Diode is providing microwave energy to sufficiently bias the Schottky detector. This signal assures that the Gunn Diode and detector diode are operating properly.

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 A-C, 60 Hz power lines.

It should be noted that all input and output signals to the DR-40 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.

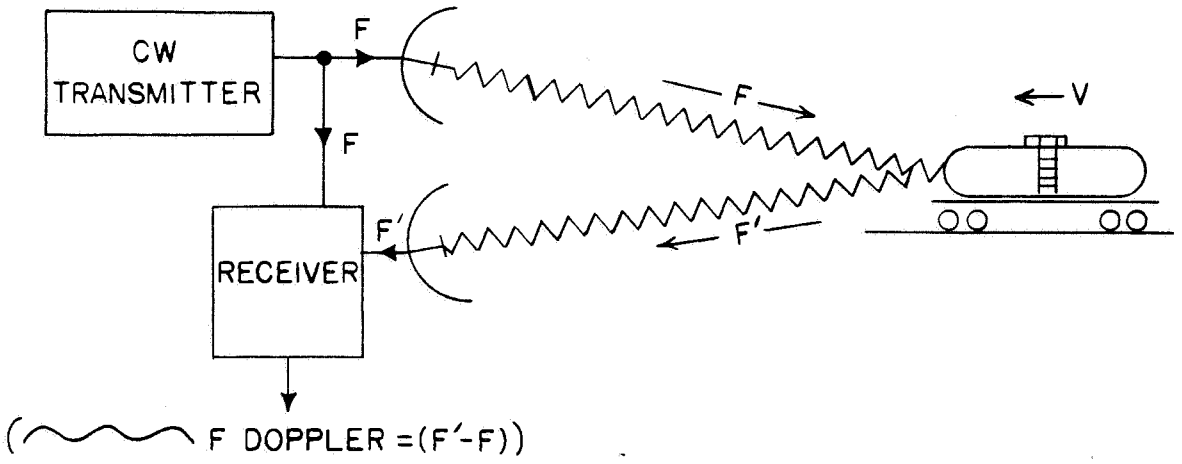


Figure 1-5. Doppler Effect-Incident and Reflected Signal

The DR-40 Doppler Radar unit employs a continuous wave transmitter. The return energy is detected by a Schottky detector diode.

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:

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

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 DR-40 Radar units, operating at 10.525 GHz, the following calculation can be made:

FREQUENCY OF DOPPLER PER MILE PER HOUR =

$$Fd = \frac{2}{(1.86 \times 10^5) \quad (3.6 \times 10^3)} \cdot \frac{(10.525 \times 10^9)}{1} = 31.4 \text{ Hz/MPH}$$

1.5 GENERAL SPECIFICATIONS

PHYSICAL

Dimensions Complete Unit	28"L x 11"W x 12-7/8"H
Dimensions Subplate Unit	15-3/8"L x 7-3/8"W x 7-5/8"H
Weight Complete Unit	44 lb.s (housing included)
Weight Subplate Unit	10.4 lbs.
Operating Temperature Range	-40°C to +70°C (-40°F to +160°F)

ELECTRICAL - RF OUTPUT (FCC Data)

Operating Frequency	10.525 GHz +/- 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)	125 mW Maximum (50 mW Minimum)
Nominal Range	150 Feet
Type of Emission	Continuous Wave (AØ)

ELECTRICAL - SIGNAL VOLTAGES

Doppler Audio	14V p-p (Limited) into 500 ohms
rfk	Greater than -1.0 VDC (-.2V Mixed Bias) into 500 ohms
Check Signal Required	

ELECTRICAL - INPUT SUPPLY

Voltage	95 to 125 VAC
Frequency	60 Hz
Power Consumption	12 to 14 Watts

SECTION II
FCC LICENSING REQUIREMENTS

Because the DR-40 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 radio-telephone operator license.

Application for new or modified station license can be obtained by writing the nearest FCC field engineering office. Request the following forms freom "Engineering-In-Charge" at the office:

FCC Form 400* - Application for Radio Station Authorization in the Safety and Special Radio Services

FCC Form 400-10*- Instructions for Completion of FCC Form 400

NOTE: WABCO DR-40 Radar has been FCC Type accepted.

COMMISSION FIELD ENGINEERING OFFICES

ALABAMA
Mobile 36002

ALASKA
Anchorage 99501
P.O. Box 644

CALIFORNIA
San Diego 92101
San Francisco 94111
Los Angeles 90012

COLORADO
Denver 80202

DISTRICT OF
COLUMBIA 20554

FLORIDA
Miami 33130
Tampa 33602

GEORGIA
Atlanta 30303
Savannah 31402
P.O. Bocx 8004

HAWAII
Honolulu 08808
P.O. Box 1021

ILLINOIS
Chicago 60604

LOUISIANA
New Orleans 70130

MARYLAND
Baltimore 21201

MASSACHUSETTS
Boston 02109

MICHIGAN
Detroit 48226

MISSOURI
Kansas City 64106

NEW YORK
Buffalo 14203
New York 10014

OREGON
Portland 97204

PENNSYLVANIA
Philadelphia 19106

PUERTO RICO
San Juan 00903
P.O. Box 2967

TEXAS
Deaumont 77701
Dallas 75202
Houston 77002

VIRGINIA
Norfolk 23502

WASHINGTON
Seattle 98104

*November, 1971, or later, revision.

SECTION III
INITIAL INSPECTION, TESTS AND ADJUSTMENTS

3.1 INSPECTION

Upon removal of the DR-40 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 VII 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-40 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, 1N23BN or 1N23C
Thermister 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 1N23B 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.

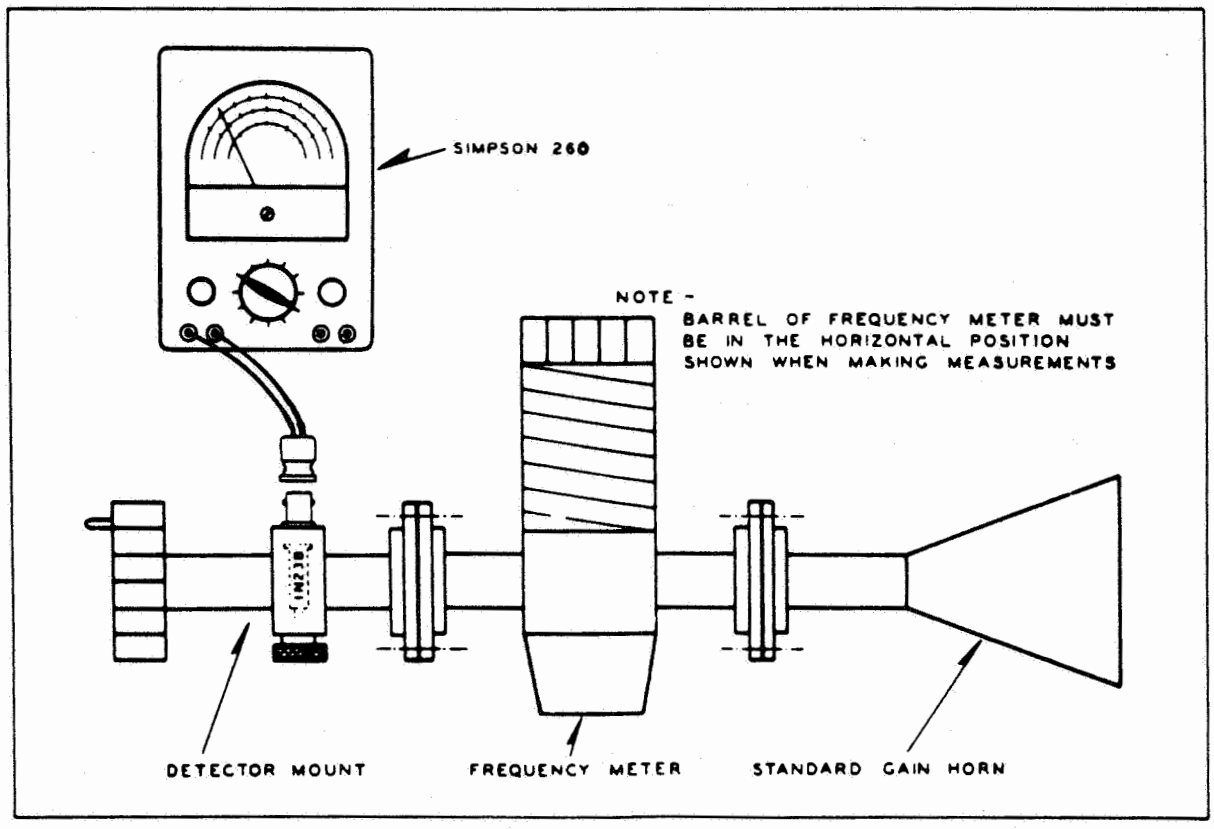


Figure 3-1. Frequency Measuring Test, Portable Set-Up

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 d-c scale.

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

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

If the DR-40 Radar unit does not fall within the specified frequency tolerance, proceed to Section VI.

3.2.2.3 SHOP MAINTENANCE PROCEEDURE

	OPERATION		VERIFICATION
1.	Arrange a test setup as per Fig. 3.2	1.	- -
2.	Adjust R36 5 turns clockwise.	2.	- -
3.	Apply 117VAC ±2 VAC to Amp. connector pins 5 and 12.	3.	- -
4.	Connect a digital voltmeter to TP5 and common to TP1 (Faston #3)	4.	Set digital voltmeter to DC Volts and Auto Ranging.
5.	Inspect operating voltage marked on Gunn Diode Oscillator.	5.	- -
6.	Adjust R36.	6.	Operating voltage of Gunn Diode should be ± .1 volts DC. Seal pot with inspectors laquer after adjusting.
7.	Allow DR-40 Radar Unit to stablize to operating temperature.	7.	Should require 10 minutes.
8.	Inspect frequency of Gunn Diode Oscillator as indicated on HP532B frequency meter.	8.	Frequency should be 10.525 GHz ± 1 MHz.
9.	Adjust "FREQ. ADJ" screw if required.	9.	When the frequency is 10.525 GHz ± 1.0 MHz, seal with inspectors laquer.

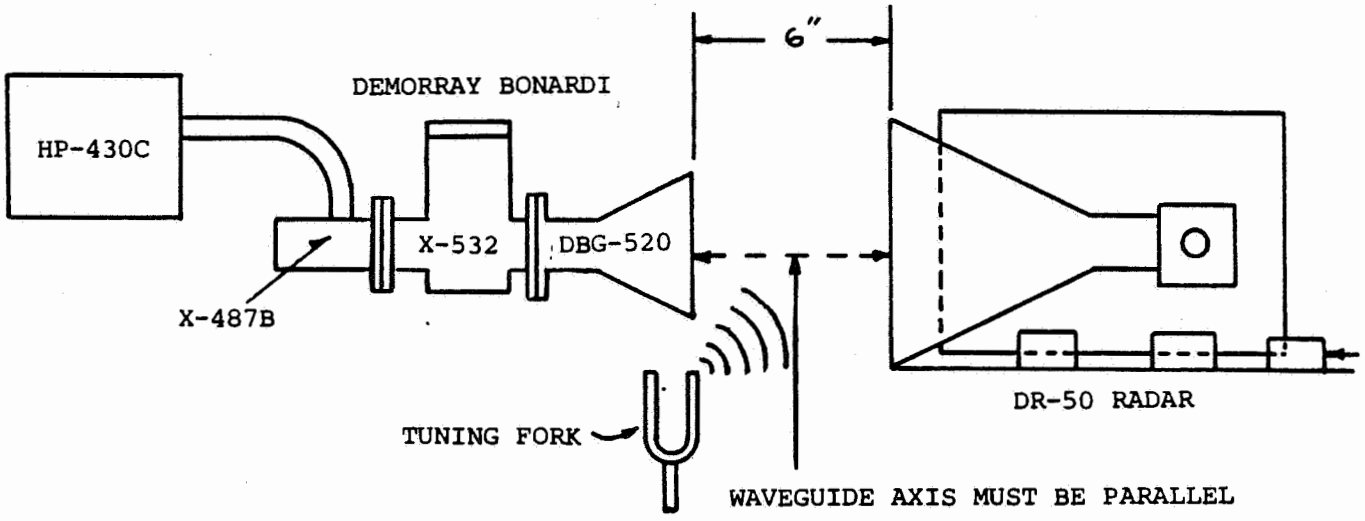


Figure 3-2. Frequency Measuring Test, Shop Set-Up

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 anode and the positive lead to the CATHODE of the 1N759A Zener Diode located on the Gunn Diode transceiver module.

2. Apply operating power to the DR-40 unit.

3. Allow a 10 minute temperature stabilization period.

The detector bias shall indicate -.4 VDC on the digital voltmeter assuming little or no movement occurs in the target area. This voltage can be varied by unlocking the 2/56 nut and adjusting screw located on the Gunn Diode transceiver module. Make certain to retighten the locknut after adjustment.

NOTE:
ANY MOTION OR OBSTRUCTION IN FRONT OF THE ANTENNA WILL ALTER THE INDICATED VALUE AND RESULT IN AN INACCURATE CALIBRATION.

SECTION IV
APPLICATION, INSTALLATION AND AIMING

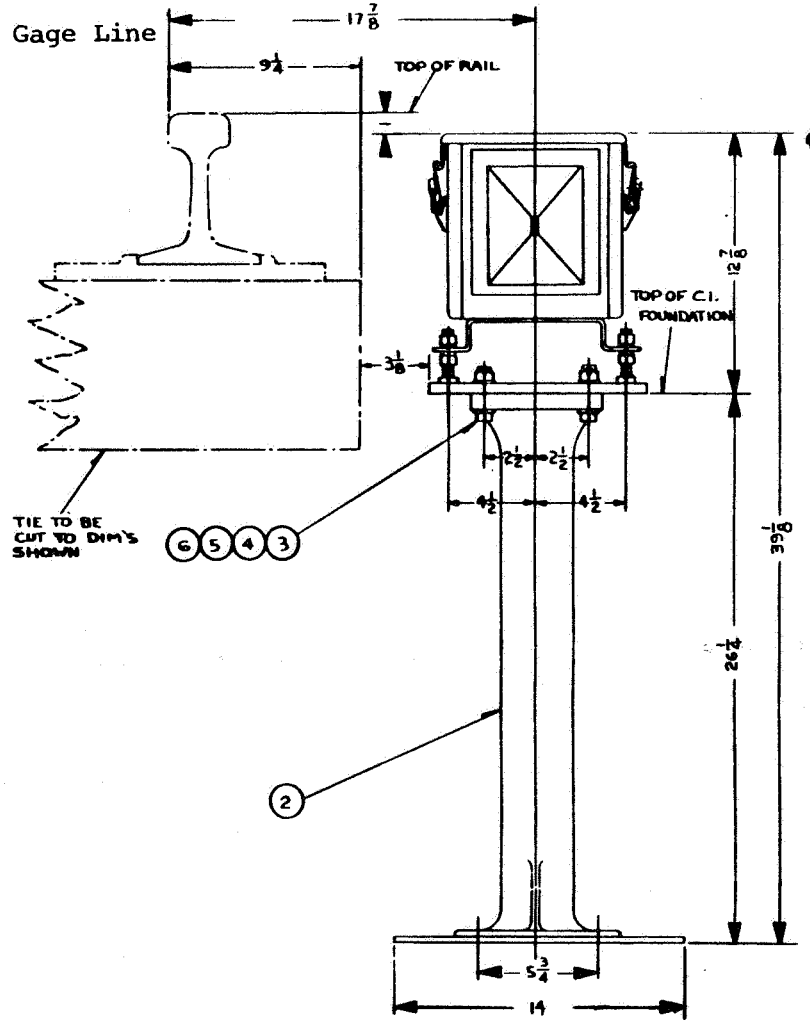
4.1 BASIC APPLICATION CONFIGURATIONS

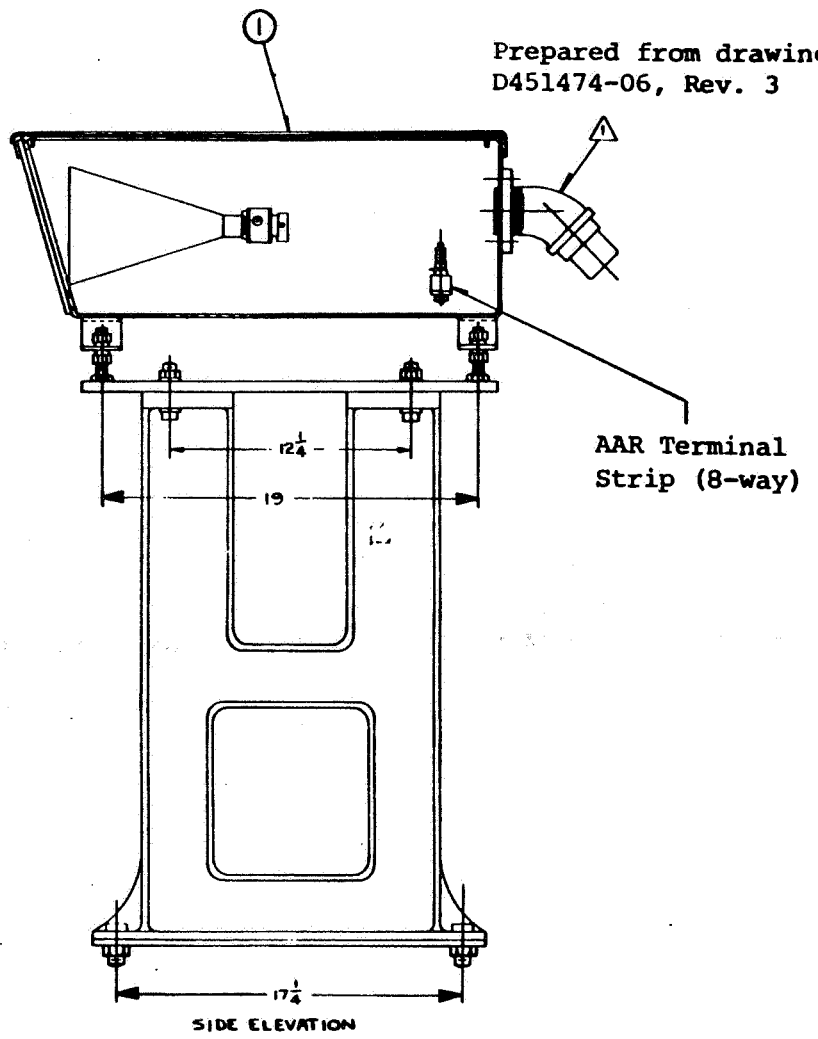
The DR-40 Radar Unit may be installed adjacent to or between the rails. Install the DR-40 Radar as indicated by the proper application drawing shown in the table below.

Table I. Application Guide

WABCO Part No.	Application	Foundation	Figure Number	Drawing D451474 sheet
X451474-0601	Outside of Rails	Ballast	4-1	06
X451474-0701	Between the Rails	Ballast	4-2	07
X451474-0801	Between the Rails	Concrete	4-3	08
X451474-0901	Between the Rails	Ballast	4-4	09*
--	Wiring Configuration	--	4-5	02

*Two cast iron pylon bases used.



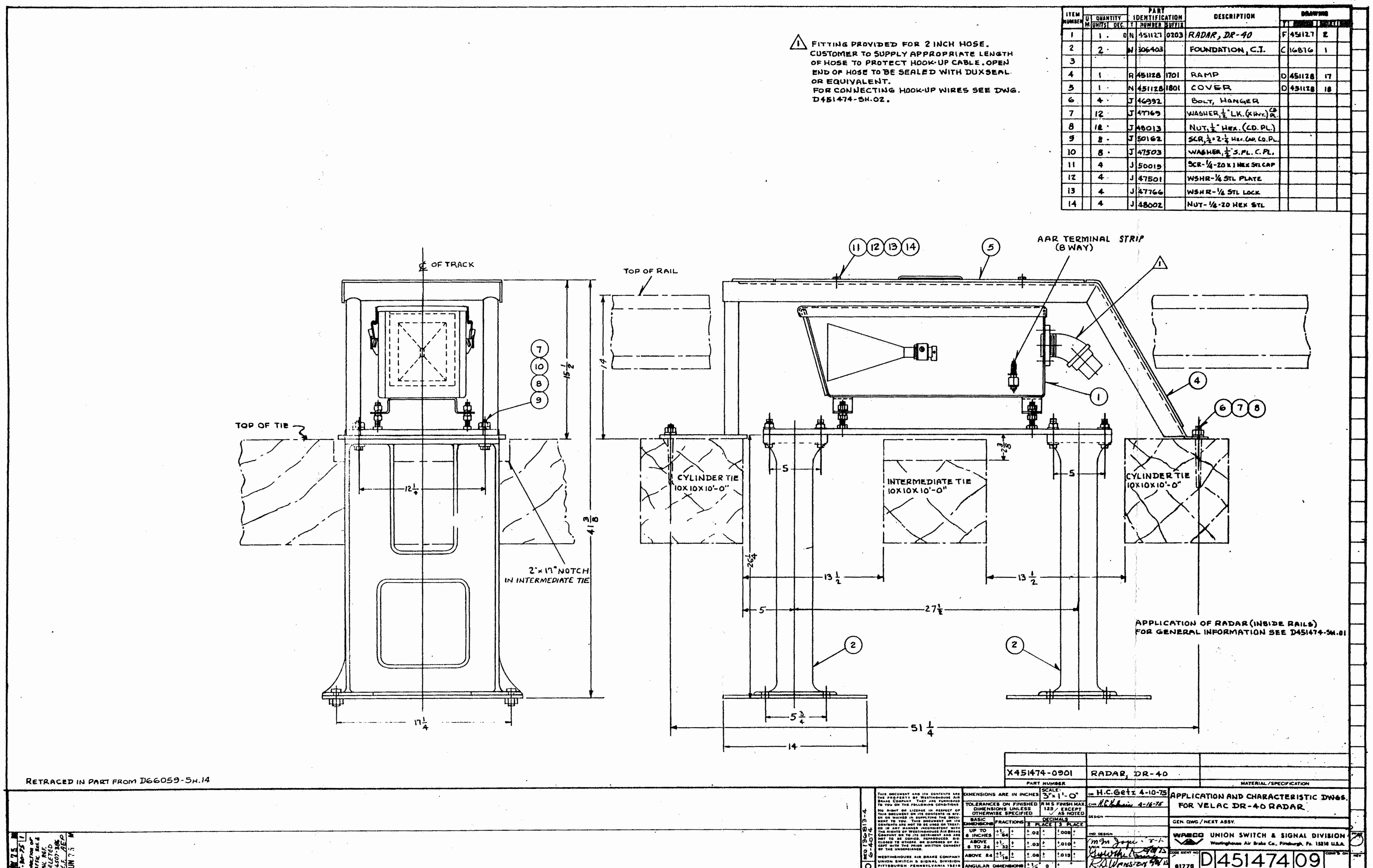


ITEM	QUANTITY PER UNIT	PART IDENTIFICATION	DESCRIPTION
		X451474	
1	1.	451127 0301	RADAR, DR-40
2	1.	306403	FOUNDATION, C.I.
3	4.	050102	SCR. 1/2 x 2-1/4 HEX. S. CAP
4	4.	047769	WSHR., 1/2 LK. (X. HVY)
5	4.	048013	NUT, 1/2 HEX. STL.
6	4.	047503	WSHR., 1/2 STL. PLATE

⚠ FITTING PROVIDED FOR 2" HOSE. CUSTOMER TO SUPPLY APPROPRIATE LENGTH OF HOSE TO PROTECT HOOK-UP CABLE. OPEN END OF HOSE TO BE SEALED WITH DUXSEAL OR EQUIVALENT. FOR CONNECTING HOOK-UP WIRES SEE DWG. D451474-SH.02.

Figure 4-1
DR-40 Radar, Application Outside of Rails, Ballast Foundation

ITEM NUMBER	U/M	QUANTITY UNITS	DEC.	PART IDENTIFICATION T	NUMBER	SUFFIX	DESCRIPTION	DRAWING T	[illegible]	[illegible]
1		1.	0	N	451127	0203	RADAR, DR-40	F	451127	2
2		2.		N	306403		FOUNDATION, C.I.	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	47769		WASHER, 1/2" LK. (X HVY.) CD. PL.			
8		12.		J	48013		NUT, 1/2" HEX. (CD. PL.)			
9		8.		J	50162		SCR, 1/2 x 2-1/4 HEX. CAP. CD. PL.			
10		8.		J	47503		WASHER, 1/2" S. PL. C. PL.			
11		4		J	50019		SCR-1/4-20 x 1 HEX STL CAP			
12		4		J	47501		WSHR-1/4 STL PLATE			
13		4		J	47766		WSHR-1/4 STL LOCK			
14		4		J	48002		NUT-1/4-20 HEX STL			

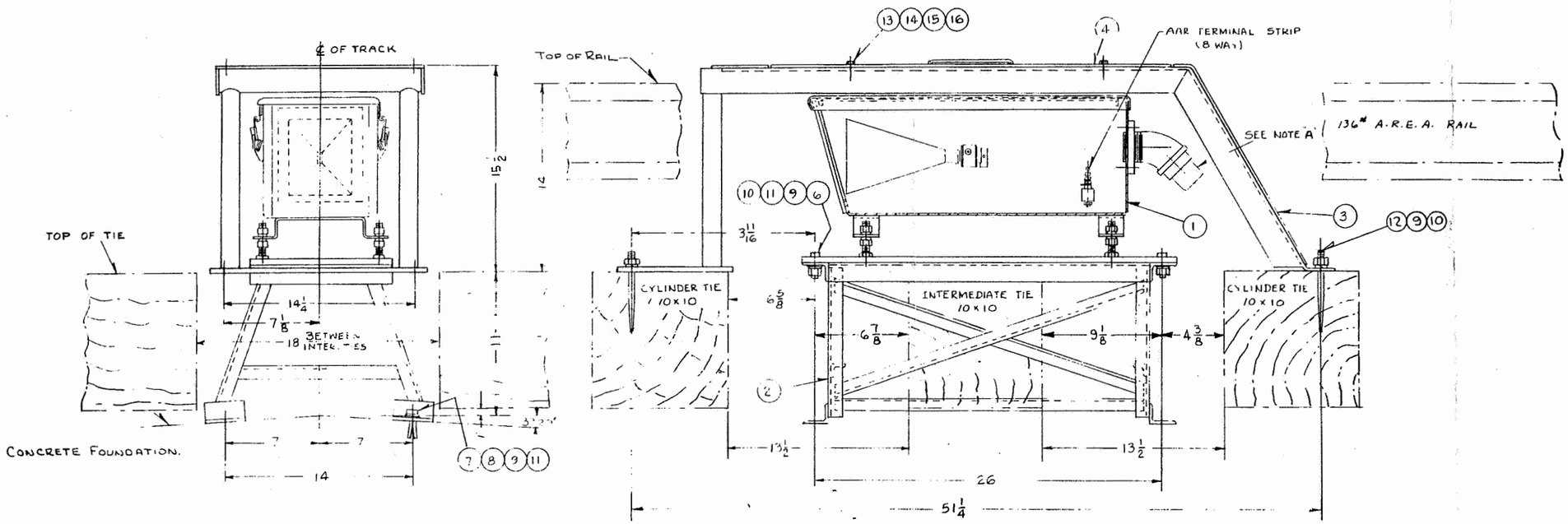


⚠1 FITTING PROVIDED FOR 2 INCH HOSE. CUSTOMER TO SUPPLY APPROPRIATE LENGTH OF HOSE TO PROTECT HOOK-UP CABLE. OPEN END OF HOSE TO BE SEALED WITH DUXSEAL OR EQUIVALENT.
FOR CONNECTING HOOK-UP WIRES SEE DWG. D451474-SH.02.
℄ OF TRACK
TOP OF RAIL
AAR TERMINAL STRIP (8 WAY)
TOP OF TIE
CYLINDER TIE 10X10X10'-0"
INTERMEDIATE TIE 10X10X10'-0"
CYLINDER TIE 10X10X10'-0"
2"x17" NOTCH IN INTERMEDIATE TIE
APPLICATION OF RADAR (INSIDE RAILS)
FOR GENERAL INFORMATION SEE D451474-SH.01
RETRACED IN PART FROM D66059-SH.14
X451474-0901
PART NUMBER
RADAR, DR-40
MATERIAL/SPECIFICATION
DIMENSIONS ARE IN INCHES
SCALE: 3"=1'-0"
TOLERANCES ON FINISHED DIMENSIONS UNLESS OTHERWISE SPECIFIED
RMS FINISH MAX 125 EXCEPT AS NOTED
DR H.C.Getz 4-10-75
APPLICATION AND CHARACTERISTIC DWGS. FOR VELAC DR-40 RADAR
GEN. DWG./NEXT ASSY.
WABCO UNION SWITCH & SIGNAL DIVISION
Westinghouse Air Brake Co., Pittsburgh, Pa. 15218 U.S.A.
61776
D 451474 09

Figure 4-2. Application of the DR-40 Between the Rails (Ballast Foundation)

ITEM NUMBER	GROUP M	GROUP UNITS	GROUP DEC.	PART IDENTIFICATION I	PART IDENTIFICATION NUMBER	PART IDENTIFICATION SUFFIX	SEE GROUP	DESCRIPTION	DRAWING I	DRAWING NUMBER	DRAWING SHEET
1	I	1		N	451127	0202		RADAR, DR-40	F	451127	02
2	I	1		R	435631			SUPPORT, FRAME	D	66147	110A
3	I	1		R	451128	1701		RAMP	D	451128	17
4	I	1		N	451128	1801		COVER	D	451128	18
5											
6	I	4		J	50092			SCR, ½ x 1½ HEX. CAP			
7	I	4		J	46664			BOLT, ½ x 3 SQ. STL.			
8	I	4		J	56350			SHIELD, ½ EXPANSION BOLT			
9	I	12		J	47769			WASHER, ½ LOCK (X.HVY.)			
10	I	8		J	48013			NUT, ½ HEX.			
11	I	8		J	47503			WASHER, ½ STL. PLATE			
12	I	4		J	46992			BOLT, HANGER			
13	I	4		J	50019			SCR-¼-20x1 HEX STL CAP			
14	I	4		J	47501			WSHR-¼ STL PLATE			
15	I	4		J	47766			WSHR-¼ STL LOCK			
16	I	4		J	48002			NUT-¼-20 HEX STL			

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.
FOR CONNECTING HOOK-UP WIRES SEE DWG. D451474-SH.02.



APPLICATION OF RADAR (INSIDE RAILS)

FOR GENERAL APPLICATION INFORMATION SEE D451474-SH.01

PRODUCED IN PART FROM D66059-SH.12

UX451474-0801 PART NUMBER — RADAR, DR-40 DESCRIPTION

APPLICATION & CHARACTERISTIC DWGS. FOR VELAC DR-40 RADAR

WABCO UNION SWITCH & SIGNAL DIVISION Westinghouse Air Brake Co., Pittsburgh, Pa. 15216 U.S.A.

61775 D 451474 08 09

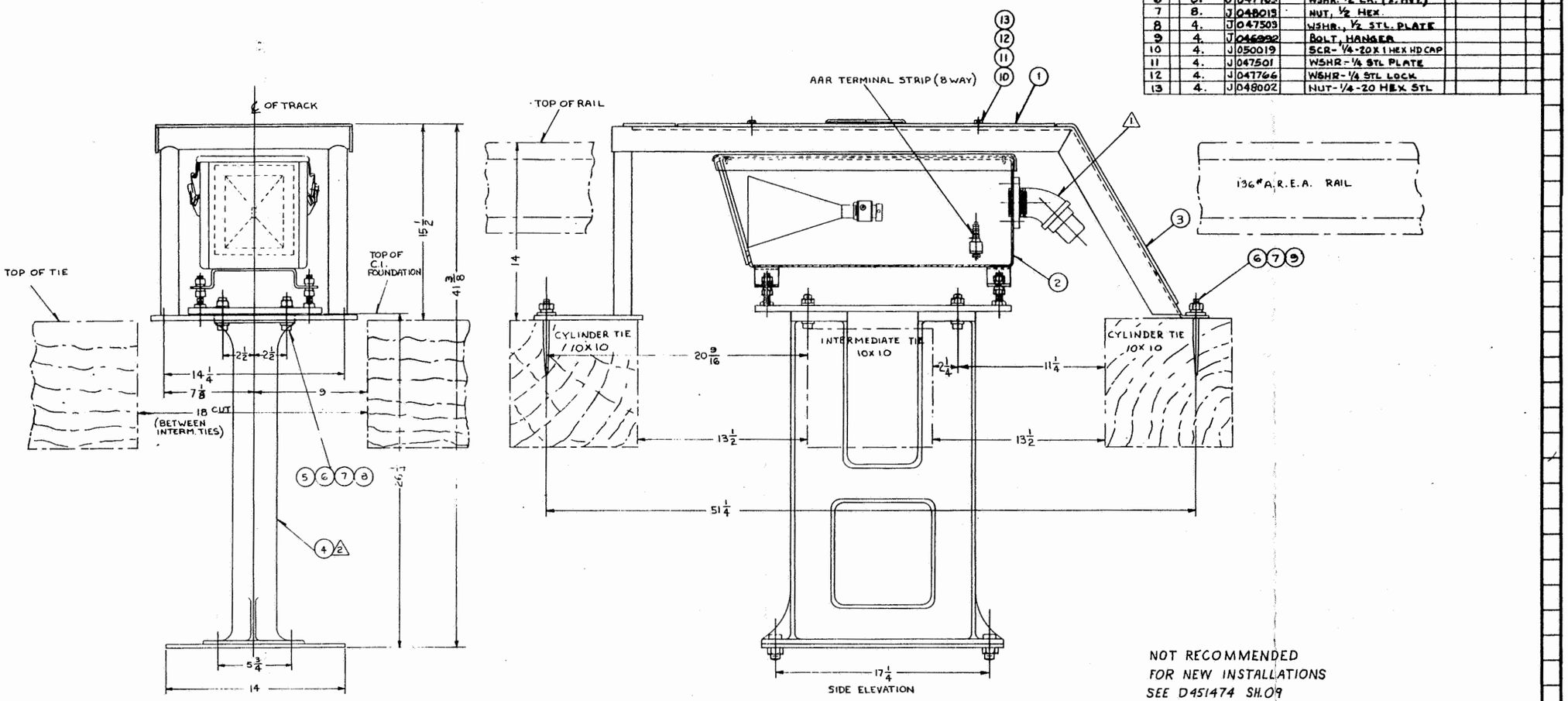
Figure 4-3. Application of DR-40 Radar Between the Rails - On Concrete Foundation

1. FITTING PROVIDED FOR 2" HOSE. CUSTOMER TO SUPPLY APPROPRIATE LENGTH OF HOSE TO PROTECT HOOK-UP CABLE. OPEN END OF HOSE TO BE SEALED WITH DUXSEAL OR EQUIVALENT. FOR CONNECTING HOOK-UP WIRES SEE DWG. D451474 - SH. 02.

2. SET C.I. FOUNDATION IN PLACE ON CENTER LINE OF TRACK AS INDICATED.

ITEM	GROUP-0701 QUANTITY			PART IDENTIFICATION			DESCRIPTION	DRAWING		
	REQ'D	UNIT	DEC	T	NUMBER	SUFFIX		T	NUMBER	SHEET(S)
1	1.		ON	451128	1801		COVER	D	451128	AB
2	1.		N	451127	0201		RADAR, DR-40	F	451127	02
3	1.		R	451128	1701		RAMP	D	451128	17
4	1.		N	306403			FOUNDATION, C.I.	C	16876	1
5	4.		J	050182			SCR. 1/2X2-1/4 HEX. CAP			
6	8.		J	047769			WSHR. 1/2 LK. (X. HVY)			
7	8.		J	048015			NUT, 1/2 HEX.			
8	4.		J	047509			WSHR., 1/2 STL. PLATE			
9	4.		J	046992			BOLT, HANGER			
10	4.		J	050019			SCR-1/4-20 X 1 HEX HD CAP			
11	4.		J	047501			WSHR-1/4 STL PLATE			
12	4.		J	047766			WSHR-1/4 STL LOCK			
13	4.		J	048002			NUT-1/4-20 HEX STL			

X 451474 SEE GROUP — D 451474 07



NOT RECOMMENDED FOR NEW INSTALLATIONS SEE D451474 SH.09

APPLICATION OF RADAR (INSIDE RAILS)
FOR GENERAL APPLICATION INFORMATION SEE D451474-SH.01

PRODUCED IN PART FROM D66059-SH.11

REVISIONS			
JUN 74			
10-74	E	4-8-74	ADDED NOTE 3 AND SUBSEQUENT NOTE REFERENCES TO MAKE THIS DWG. A COMPLETE SET OF INSTALLATION DWGS. FOR THE DR-40 RADAR.
MAY 75	F	5-30-75	THIS WORK ADDED & NEW INSTL. REF. NOTE ADDED. 36307-38L 36307-38R
JUN 75			

				X451474-0701	RADAR, DR-40	
				PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION
				DRN D.O'Rourke 5/29/74	APPLICATION & CHARACTERISTIC DWGS. FOR VELAC DR-40 RADAR	
				CHK A.E.Ehrett 5/30/74	GEN. DWG/NEXT ASSY	
				DESIGN		
				ENG DESIGN Wm Dugan 9-9-74	WABCO UNION SWITCH & SIGNAL DIVISION Westinghouse Air Brake Co., Pittsburgh, Pa. 15218 U.S.A.	
				APPD Richard Winston 9-9-74	CODE IDENT NO. 81775 SIZE D 451474 SHEET 07 SHEETS 08	

DIMENSIONS ARE IN INCHES — SCALE 1/4

TOLERANCES ON FINISHED DIMENSIONS UNLESS OTHERWISE SPECIFIED	FRACTIONS	DECIMALS 2 PLACE	DECIMALS 3 PLACE
BASIC DIMENSIONS		±	±
UP TO 6 INCHES	±1/64	±.02	±.005
ABOVE 6 TO 24	±1/32	±.03	±.010
ABOVE 24	±1/16	±.06	±.015
ANGULAR DIMENSIONS	±1/2°	°	°

WITHIN 185 FROM MAX. EXCEPT AS NOTED

THIS DOCUMENT AND ITS CONTENTS ARE THE PROPERTY OF WESTINGHOUSE AIR BRAKE COMPANY. PERMISSION TO USE OR BE FURNISHED DOCUMENTS, DO NOT BY LICENSE IN RESPECT OF ANY INVENTION OR ITS CONTENTS A GRANT OF RIGHTS IN SUPPLYING THE DOCUMENT TO YOU. THE RECIPIENT BY ITS ACCEPTANCE AGREES NOT TO USE THE DOCUMENT OR ITS CONTENTS FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SPECIFICALLY FURNISHED NOR TO COPY OR REPRODUCE THE SAME NOR TO GIVE OR DISCLOSE ANY INFORMATION CONTAINED THEREIN TO ANY THIRD PARTY WITHOUT THE EXPRESS WRITTEN PERMISSION OF WESTINGHOUSE AIR BRAKE COMPANY. THE RECIPIENT AGREES TO INDEMNIFY WESTINGHOUSE AIR BRAKE COMPANY FOR ALL DAMAGES SUFFERED BY THE RECIPIENT OR WESTINGHOUSE AIR BRAKE COMPANY RESULTING FROM THE IMPROPER USE OR DISCLOSURE OF THE DOCUMENT OR ITS CONTENTS OR ANY INFORMATION THEREIN CONTAINED. ACCEPTANCE OF THIS DOCUMENT SHALL CONSTITUTE AGREEMENT WITH AND ASSENT TO THE FOREGOING STATEMENTS.

Figure 4-4. Application of DR-40 Radar Between the Rails - On Ballast Foundation

Reference Information

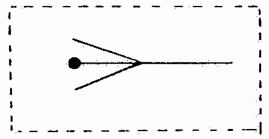
1. DR-40 Radar Unit Part No { N451127-0201 (for Ballast Foundation) / N451127-0202 (for Concrete Foundation) }
2. Schematic Diagram - D451238 - SH 1001
3. Wiring Diagram - F451128 - SH. 8
4. Electrical Application Dwg. D451474 - SH. 02
5. Test Spec. – EU. 5981 DR-40 Radar System; EU. 5982 DR-40 Radar P.C.B.
6. Service Manual - SM 6015
7. Gunn Diode Chassis N451128-0801 Dwg. F451128 SH. 8
8. Retrofit Chassis - N451128-0802 Dwg. F451128 SH 8

Note: DR-40 Radar unit must comply with current F.C.C. Rules & Regulations Part 93 at all times.
The regulated power supply provides all the necessary operating voltages for the various electronic components, & is normally operated from the commercial 117 Volt power lines. All input and output signals to the DR 40, are isolated via transformer, providing complete electrical isolation

Tabulation of Applications

Ref. No.	Dwg.	Sh.	Application	
X451474-0601	D451474	06	Outside of Rails	Ballast
X451474-0701	D451474	07	Between Rails	Ballast
X451474-0801	D451474	08	Between Rails	Concrete

Circuit Symbol



Cable Requirements

"Sig. A, Sig. B; Test A, Test B"
- A. Cable shall be twisted pair shielded
- B. Maximum signal attenuation 10 db
- C. Maximum D.C. loop resistance 500 ohms

"117V AC Power"
- A. Minimum 25 watts at AAR terminal strip

Characteristics

Power Requirements: 120 volts ± 10%, 60 Hz.
Line voltage at 120V AC radar unit draws .100 to .117 Amp. or about 12 to 14 V.A.

Frequency Stability: Minimum stability shall be ± 0.2% of 10,525 MHz = 21.05 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-40 radio frequency power output is approximately 100 to 125 milliwatts.

Temp. Range: -40°C to 70°C (-40°F to 160°F)

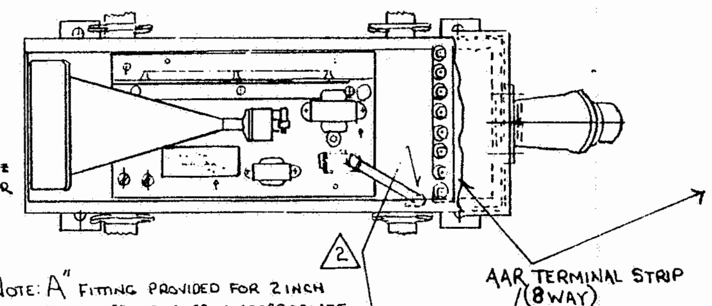
General Information

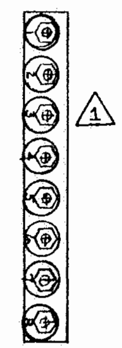
DR-40 Doppler Radar Unit is a radiolocation system used to measure the velocity of railway vehicles at various points along the railroad trackway. DR-40 is a radar transceiver utilizing continuous wave (AØ) emission at 10,525 MHz. with a radio frequency power output of approximately 100 milliwatts. DR-40 can be housed in either DR-30 or DR-40 dustproof & 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-40 is directed parallel to the rails and horizontal to grade level. Some small amount of vertical (±1-1/2 degrees) & horizontal (±6 degrees) adjustment is permitted by the mounting and the effective range for velocity measurement is approximately 150 feet.

⚠1 The circuitry of the DR-40 is designed to be both mechanically and electrically compatible with DR-30 installations. It is anticipated that the DR-40 will be installed at railroad yards using existing DR-30 units and the old & new systems operating together. See Retrofit Drawing N.8.8.8 Sh. 15, and adjustment of the DR-40 is covered by Service Manual 6015.

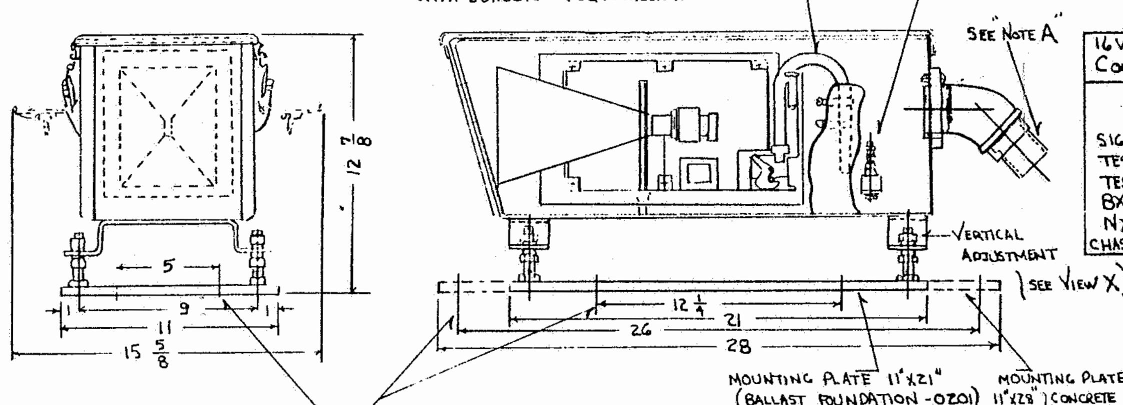
DR-40 is normally applied as part of a speed control system used in railroad classification yards. The speed control system detects the approaching car & applies the requested velocity to the speed control amplifier & initiates the radar to start monitoring the cars actual velocity. The radar output 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 V.DC output (0.4 V = 1 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 & maximum sensitivity, avoid installing DR-40 near strong broadcast station towers, neon signs, heavy power lines or in general any area which have noisy broadcast radio reception.



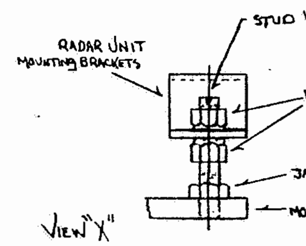


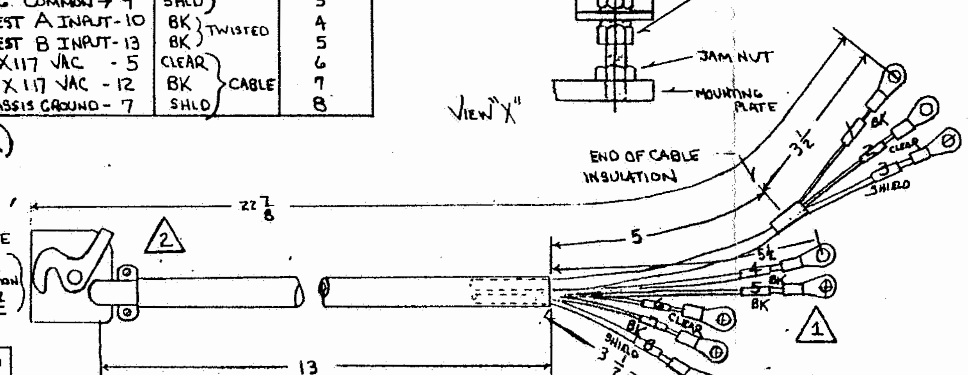
"Note: A" Fitting provided for 2 inch hose. Customer to supply appropriate length of hose to protect hook-up cable. Open end of hose to be sealed with Duxseal or equivalent.



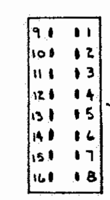
Color Code ⚠2 ⚠1

16 Way Amphenol Connector Pin	Wire Color		Tags Marked
Sig. A → 1	BK	Cable	1
Sig. B → 2	Clear	Cable	2
Sig. Common → 9	SHLD	Cable	3
Test A Input - 10	BK	Twisted	4
Test B Input - 13	BK	Twisted	5
BX 117 VAC - 5	Clear	Cable	6
NX 117 VAC - 12	BK	Cable	7
Chassis Ground - 7	SHLD	Cable	8





DR-40 Cable
Part #. Ref. N451128-1401



View showing terminal end of connector base

1. Radar to be mounted parallel to rail, 1 inch below top of rail per appropriate Application Dwg.
2. Horizontal aiming adjustment of unit can be accomplished by loosing 4 mounting plate bolts and rotating unit until it is aimed parallel to rail, then retighted 4 bolts. Horizontal adjustment available = ± 6° for N451127-0201 and ± 1° for N451127-0202.
3. Vertical aiming adjustment of unit can be accomplished by loosening 4 nuts & washers assemblies located on mounting feet of radar, and raising or lower one end of unit until it is aimed parallel to rail, vertical adjustment available is ± 1 1/2°
4. Nominal range of radar is up to 150 feet.

DR-40 Radar Unit

Revisions	
Revised to agree with production drawings. 136330-17 RAB 11-25-74	RF power output & supply consumption increased per allowed higher RF output.

The operation of the circuits and equipment represented hereon cannot be finally checked until connected to form a complete system or a section of such a system. Such system or section must undergo circuit contact selection (breakdown) and service (operation) tests prior to being placed into regular service. — Signal & Communications Division, Westinghouse Air Brake Company, Pittsburgh, PA.

References: EU Spec - 5981 & 5982; EJ-15968; SM-6015

Designed: RAB 11-8-74; Checked: 10-29-74

Equipment Characteristics and Application Notes

WABCO Signal & Communications Division, Westinghouse Air Brake Company, Pittsburgh, PA.

SH. 14 — Cont'd on 15 — N8.8.8

Figure 4-5. DR-40 Characteristics

4.2 INSTALLATION

4.2.1 General Remarks

For optimum operation and maximum sensitivity, avoid installing the DR-40 Radar unit near strong broadcast station towers, neon signs, heavy power lines or in general, any areas which have noisy broadcast radio reception.

It should be understood, however, that even when such noise conditions exist, and a target comes into range of the DR-40 Radar unit, the output indications will be the true measured velocity of the target, and the environments noise will in no way be additive 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 10 db at 1000 Hz.
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 10 db at 1000 Hz.
b. Total dc loop resistance - shall not 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-40 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-40 unit are 95 to 125 volts*, 60 Hertz and .1 to .117 ampheres. Each DR-40 unit does not require more than 12 to 14 watts operating power.

*r.m.s.

4.2.6 Electrical Interface

All extertnal electrical connections are accomplished by means of a standard 8-way AAR terminal block. This terminal block is located within the DR-40 Radar enclosure as shown in Figure 8-1 on page 8-3/4.

After connection of all external wiring to the 8-way AAR terminal block, interconnection to the DR-40 subassembly part number N451128-0801 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-40 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-40 unit and on the equipment room rack.

b. Check for loose AAR terminals 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 secure and properly seated both in the DR-40 unit and in the equipment room.

4.3 AIMING PROCEDURES

4.3.1 Horizontal Adjustment

The horizontal adjustment range for the N451127-0201 unit is +/- 6 degrees. Adjustment range for the N451127-0202 unit is +/- 1 degrees. To adjust horizontally:

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

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 parallel to the rail.
3. Regighten elastic stop nuts.

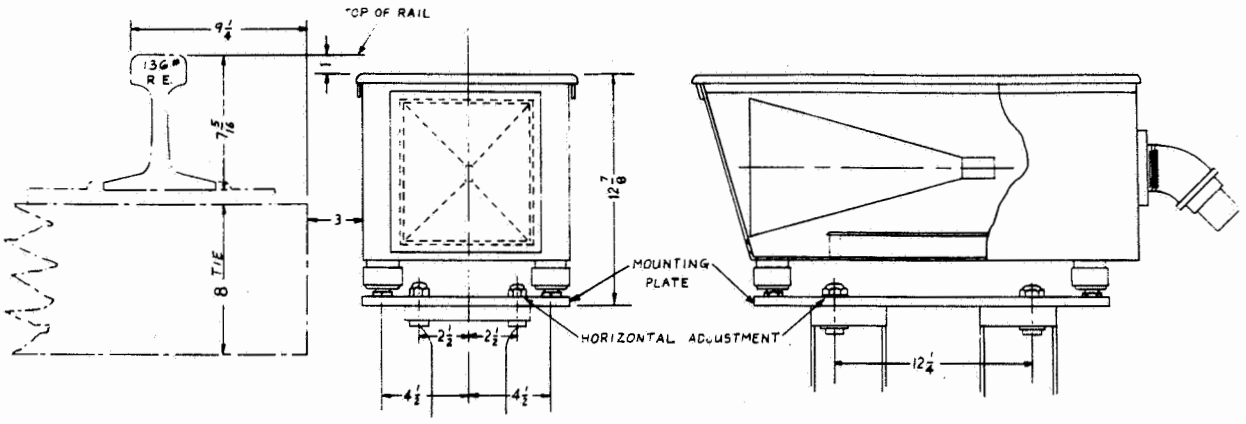


Figure 4-6. DR-40 Radar Horizontal Aiming Adjustments

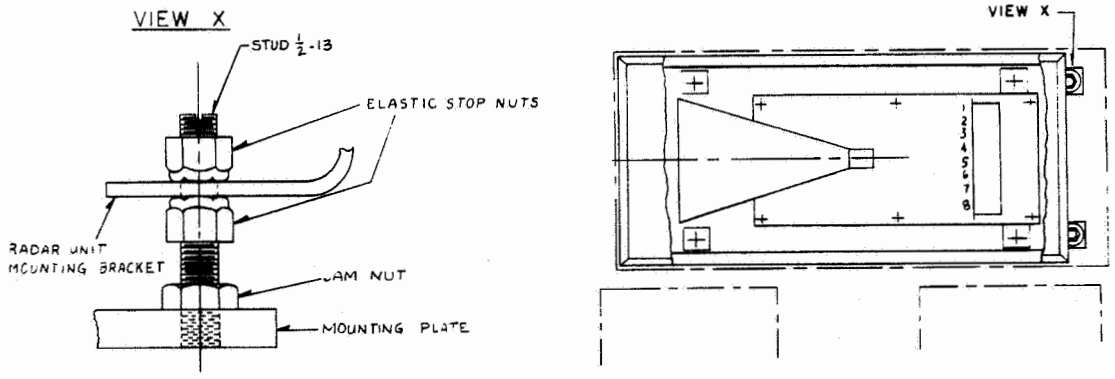


Figure 4-7. DR-40 Radar Vertical Aiming Adjustments

SECTION V
PERIODIC PREVENTIVE MAINTENANCE (5-6 MONTHS)

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 VI 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, SOLVENTS, 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 which may be potentially destructive to the housing or rf window.

3. Reconnect ac power and replace top cover.

SECTION VI
IN-DEPTH CIRCUIT DESCREIPTION AND TROUBLESHOOTING

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 3 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 which 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.

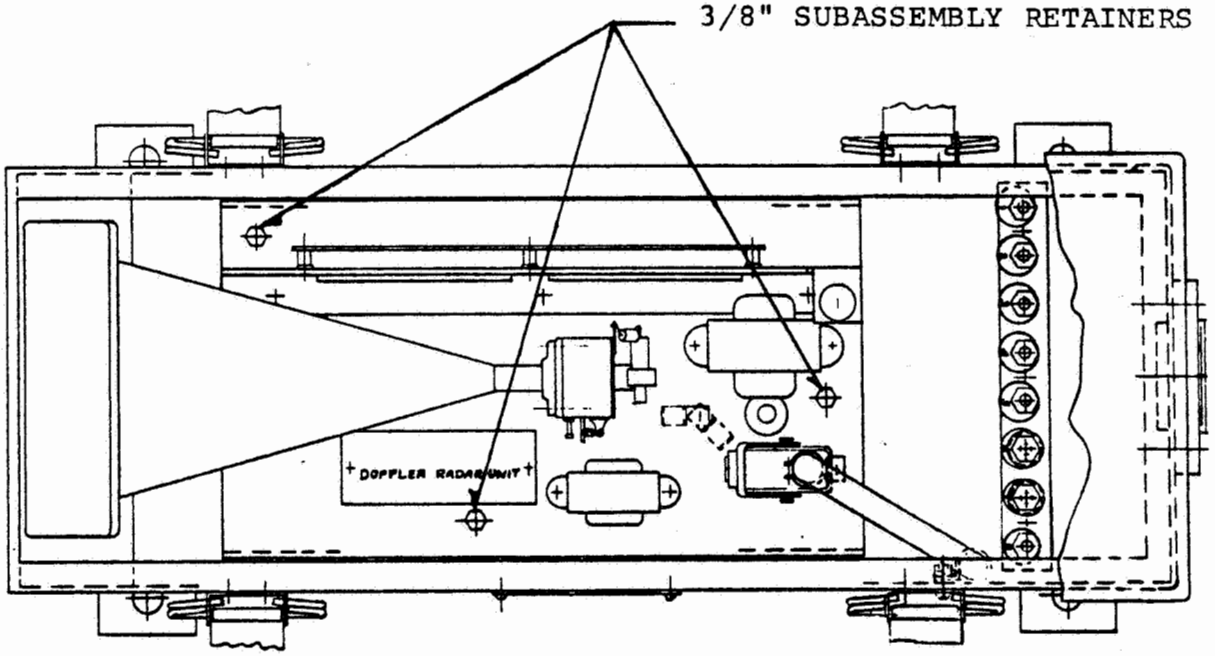


Figure 6-1. DR-40 Disassembly Diagram

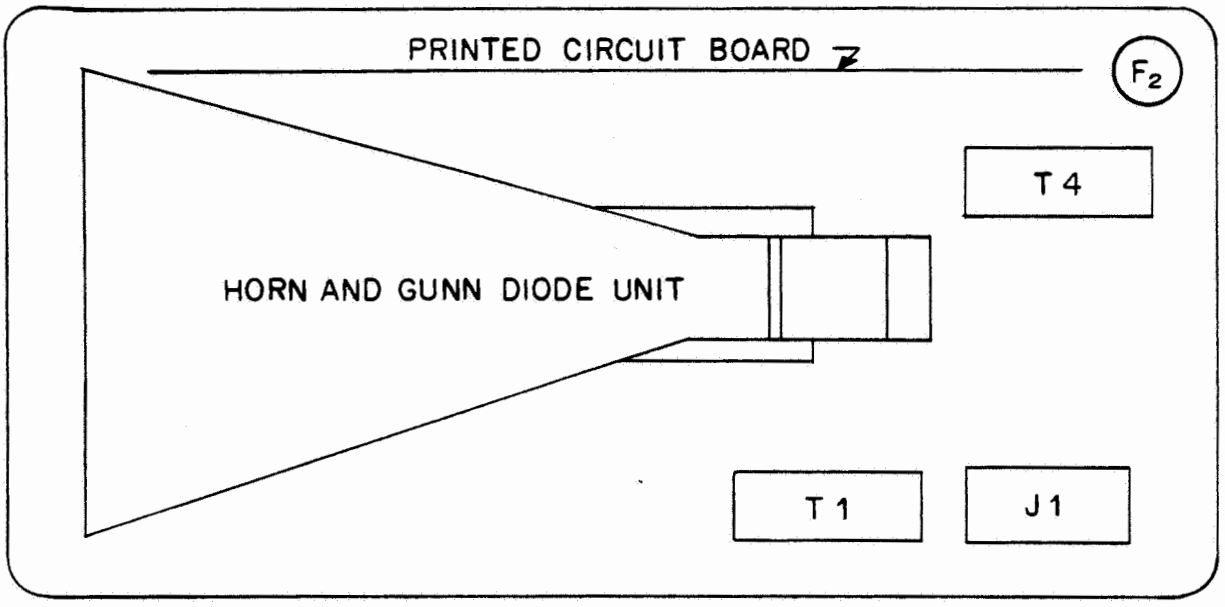


Figure 6-2

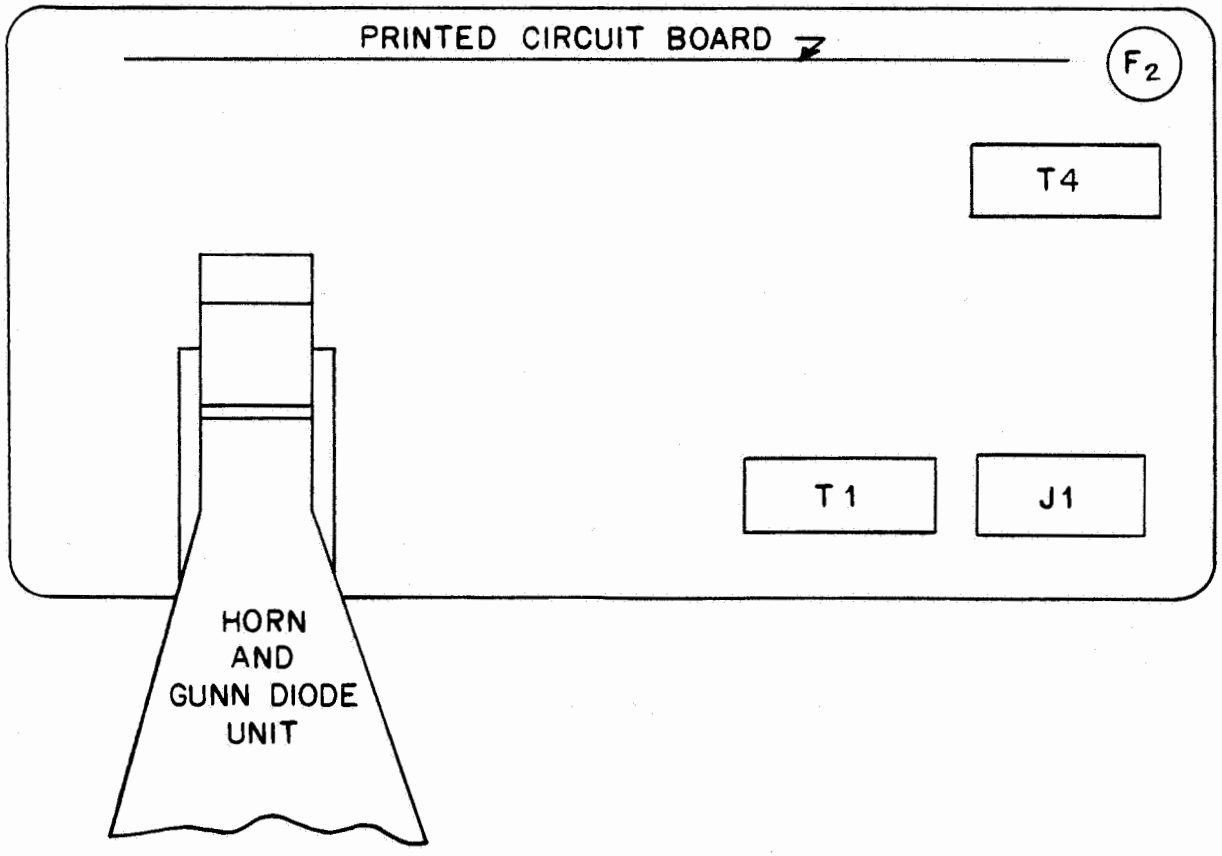


Figure 6-2
Relocation of Horn and Gunn Diode For Service Access

6.2 DETAILED CIRCUIT DESIGN AND FUNCTIONAL DESCRIPTION

6.2.1 General Remarks

Block and complete circuit schematic diagrams of the DR-40 Radar unit are shown in Figures 6-3 and 6-4, respectively. Refer to Figure 9-2 for placement of chassis components and 9-3 for printed circuit board components (partrs called out 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: (+) and (-) 5.6 VDC to (+/-) 0.5V.
Plus 10.5 VDC (Adjustable 8 to 12 VDC).
Minus 9.0 VDC +/-.5 volts.

The primary source of power for the DR-40 Doppler Radar Unit is 117 VAC 60 hz., which is applied to terminals J1-5 and J1-12 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 D12 to D15 and filtered by C19 and C20 to produce unregulated voltages of approximately minus 17 volts and plus 16 volts dc at TP-2 and TP-3, respectively.

Regulation for the negative voltages is provided by the zener reference voltage of D11 and the operation of pass transistor Q2. This reference voltage of approximately 10.5 volts is filtered by C18 and C23 and is applied to the base transistor Q2 and produces -9.0 +/-.5 volts at TP-6 by emitter follower action. The 5.6 volts supply is established at TP-7 by zener diode D10, whose output is filtered by C14.

Regulation for the positive voltages is provided by IC-8 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-36 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 and zener diode D9 is used to establish the +5.6 VDC output which is again filtered by C13. Since the Gunn Diode is susceptible to voltage transients larger than the recommended supply voltage, a zener diode (D8) is used to prevent such transients from destroying the Gunn Diode. The output of the positive regulator is fused at 1-1/2 ampheres by F1.

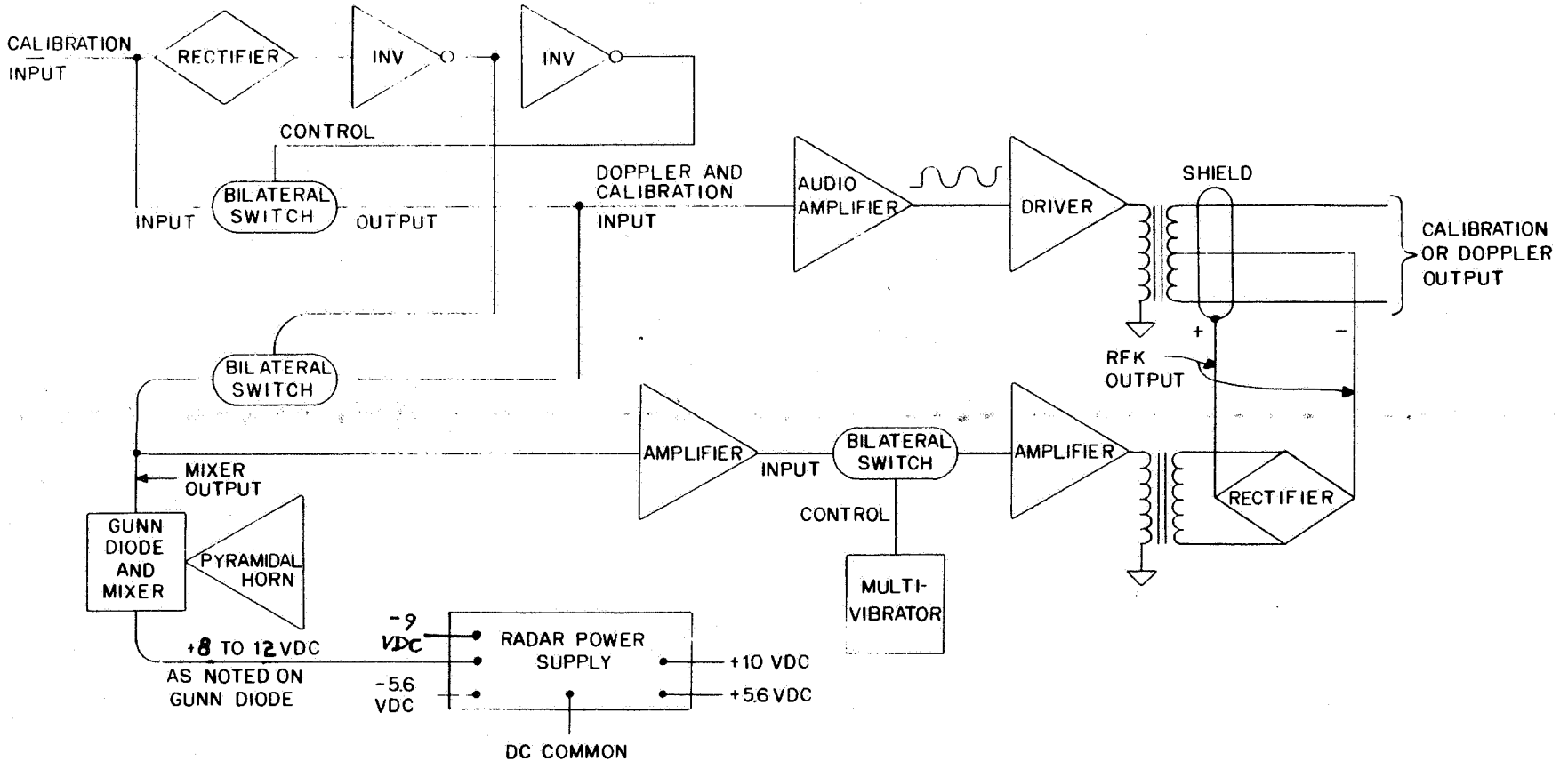


Figure 6-3. DR-40 Radar Block Diagram

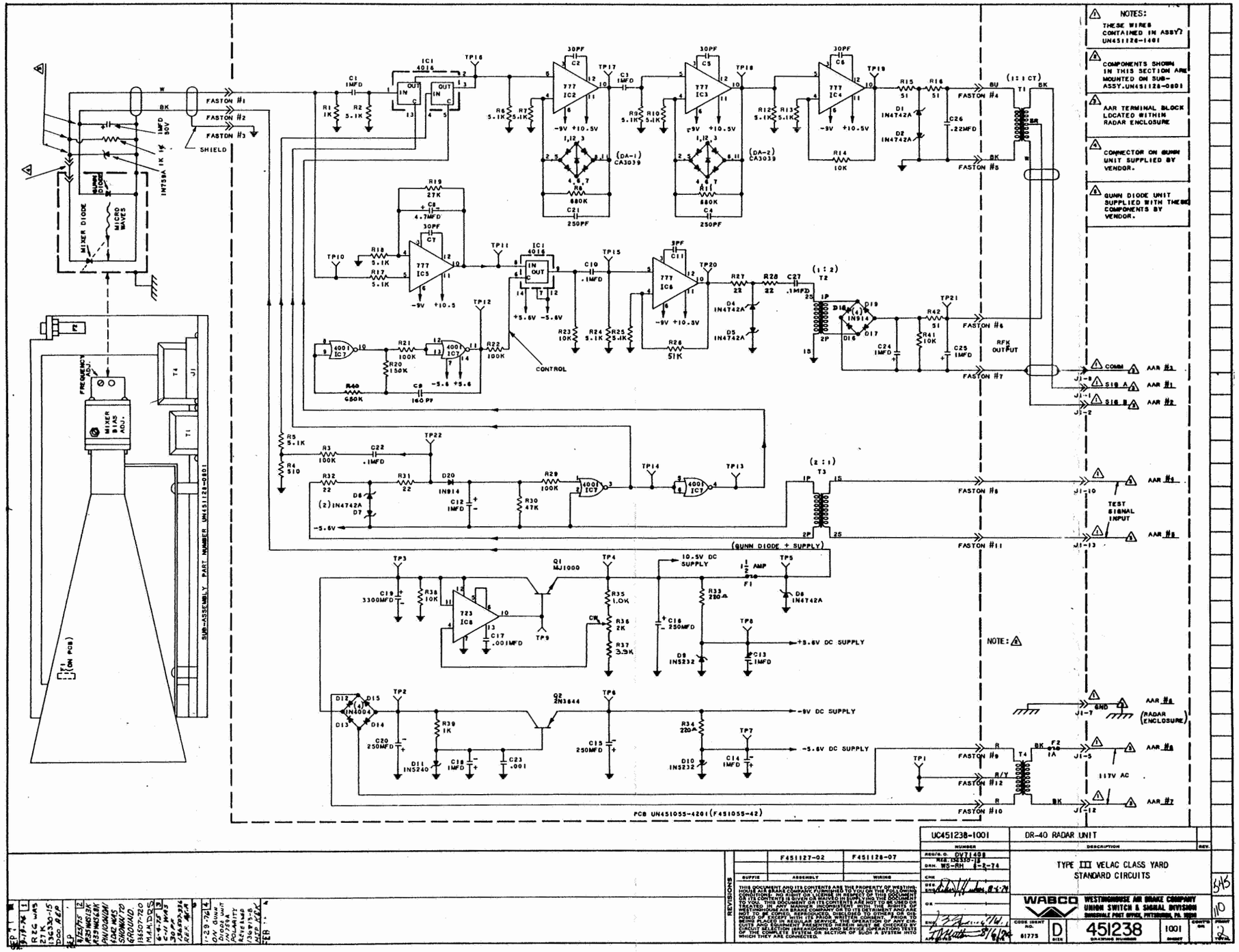


Figure 6-4. Schematic Diagram - DR-40 Radar

6.2.3 Velocity Measurement Circuitry

The DR-40 has a single printed circuit board which utilizes several types of linear and digital integrated circuits.

The printed circuit board contains a single CD 4016 AE which is a COS/MOS (Complementary-Symmetry Metal Oxide Semiconductor) Quad Bilateral Switch. Three of the four solid-state switches on the single chip are used. Each switch is made up of an input, an output, and a control connection. Whenever a positive voltage or a high logic level appears on the "control" input, the switch is in the "on" state and whenever the "control" input is at a zero or a low logic level, the switch is in the "off" state.

The printed circuit board also contains a COS/MOS CD 4001AE Quad 2 Input NOR gate. Two of the gates are used to form a multivibrator and the other two are used as logic level inverters.

The DR-40 also uses five style 777 Operational Amplifier Linear integrated circuits. IC2 through IC6 are used as amplifiers and line driver. IC2 and IC3 have amplification limiting which is performed by a Beam-Lead Diode Array containing 6 matched diodes.

The Doppler Transceiver contains a mixer diode which functions as the receiver of the unit. The diode requires forward bias amd 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 2/56 adjustment screw marked "mixer" 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 which loads and forms a high pass filter input to the first solid state switch of IC1. The control input under normal velocity measurement conditions is at a high logic level and, therefore, the Doppler signal is passed without alteration to the first of two identical ac amplifiers made up of IC2 and IC3. The low signal level and low frequency gain of these amplifiers is set by the ratio of R8 to R78 or R11 to R10, which is approximately 130 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 IC2 and IC3 is sufficient to forward bias the three matched diodes effectively in series.

These diodes, when conducting, shunt R8 or R11 and reduce the gain of each stage. The capacitors C21 and C4 set the high frequency gain roll off. The output of IC2 and IC3 is limited to about 2.2 volts peak-to-peak under normal Doppler signal input.

The linear integrated circuit amplifier IC4 serves as the line driver. It has a gain of approximately two and its output contains back-to-back zener diodes D1 and D2 for transients suppression. The output level at TP-19 is about 5 volts peak-to-peak. R15, R16, and C26 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, to the monitoring circuitry, a DC voltage level that is indicative of normal radar transceiver operation. The signal level at TP-10 is approximately 0.3 volts dc. IC5 is a amplifier with a gain of about 59, so the signal level at TP-11 is about 1.5 VDC. Two NOR gates of IC7 are connected to form a multivibrator whose output at TP-12 is a 10 V. p-p squarewave at about 11 KHz. This signal is applied to the control input of the solid state switch IC1, which alternately activates deactivates the switch. The output at TP-15 is essentially the same level applied to the solid state switch input but chopped at the multivibrator rate. IC6 is an ac amplifier with a gain of about seven. Its output contains transient suppression (diodes D4 and D5) and is transformer coupled to a diode bridge. The dc voltage developed by the bridge rectifier (D16, 17, 18, 19 and filter C24) is applied between the shield wire of the velocity output cable and the center tap of transformer T1. The dc velocity is recovered at the monitoring point by connection to the center tap of the transformer at the receiving end of the line and the shield.

Upon installation, it is necessary to calibrate the velocity meter at the monitoring point (obtain and refer to FCC Rules and Regulations Manual, Part 90.). This is done by applying a calibration signal of 784.7 Hertz to the calibration line and transformer T3. This input contains transient suppression (D6 and D7) and the signal is fed to both the input of the solid state switch at pin 4 and is half-wave rectified by D20 and filtered by C12 and activates a NOR gate of IC7. The output without a calibration signal is at a high logic level, and the presence of a calibration signal causes it to switch to a low logic level (TP-14). This action opens the switch in the Doppler signal input path and causes the output of TP-13 to go to the high logic level, activating the control input of the solid state switch at IC1 - Pin 5, and applying the 784.7 Hertz signal to the audio amplifier and line driver. The calibration signal is then applied to the line and delivered 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 VII 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 Connecting Equipment

Make checks of the equipment being used in conjunction with the DR-40, including that associated with the power source. Also, check the physical integrity of all interconnecting cables.

6.3.2 Isolating a Problem Circuit

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.)

After the trouble has been isolated to a particular circuit, check the Faston connectors on the circuit board for correct locations (see Figure 6-7). Faston connectors may be used for circuit isolation.

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 (p. 7-4) for adjustment procedures.

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, so as to isolate it from surrounding circuitry.

Table II. Power Supply Tolerances

Power Supply	Voltmeter Positive	Voltmeter Lead	Tolerance
+ 10.5 Volt	TP4-Unfused and TP5-Fused	TP1	Adjustable 8 VDC to 12 VDC
-9.0 Volt	TP6	TP1	+/-.5 Volt
+5.6 Volt	TP8	TP1	+/-.5 Volt
-5.6 Vlt	TP7	TP1	+/- .5 Volt

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 which is known to be in working condition. However, disassembly for this purpose is restricted to the externally mounted Zener Diode and Schottky Mixer Diode.

NOTE

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. Refer to Section 7.2.1 for allowed disassembly steps for these components, and to Section 6.3.5 for allowed troubleshooting procedures.

CAUTION

DO NOT MAKE OHMMETER CHECKS ON THE RF DIODES OR INTEGRATED CIRCUITS 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 STATIS 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 SHIEDED 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 800 millivolts and 3 volts. A normal diode will show a high resistance in one instance and a relatively lower resistance when the meter leads are reversed. Faulty diodes will show high resistance in both directions (open) or low resistance in both directions (shorted).

6.3.4.3 Transistors

Transistors suspected of having a defect are best tested by substituting an identical one for it which 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 components and wiring tests if this 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). Refer to Section VII for replacement techniques.

6.3.4.4 Resistors

Check resistors with an ohmmeter, using Parts List to obtain the correct tolerances for the resistors in question. Replace only those resistors with test values which 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 cspacitor can best be detected with a cspacitance meter or checking whether the capacitor passes ac signals.

6.3.5 Systematic Circuit Troubleshooting

6.3.5.1 General Remarks

The following diagnostic routine consists of a series of consecutive subroutines which must be followed in the indicated order. The individual steps describe 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. Some also recommend how to deal with faults. In general, it may be assumed that if a step yields a "yes" answer to a particular question, or gives no special "go to" instructions, then the routine may proceed to the next consecutive step. When the word "STOP" is reached, a subroutine has been completed. The proceeding would then continue onto the next subroutine if no fault or variance in test results is found. Note that "go to" instructions for "no" answers to test results may take the procedure over to steps in other subroutines. The technician should be careful to observe variations in this general approach and to follow individual step instructions carefully. A useful aid in this procedure is to mark down the number of completed steps so that procedure is followed in the proper order.

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 on to page 6-16 for initiation of test procedures.)

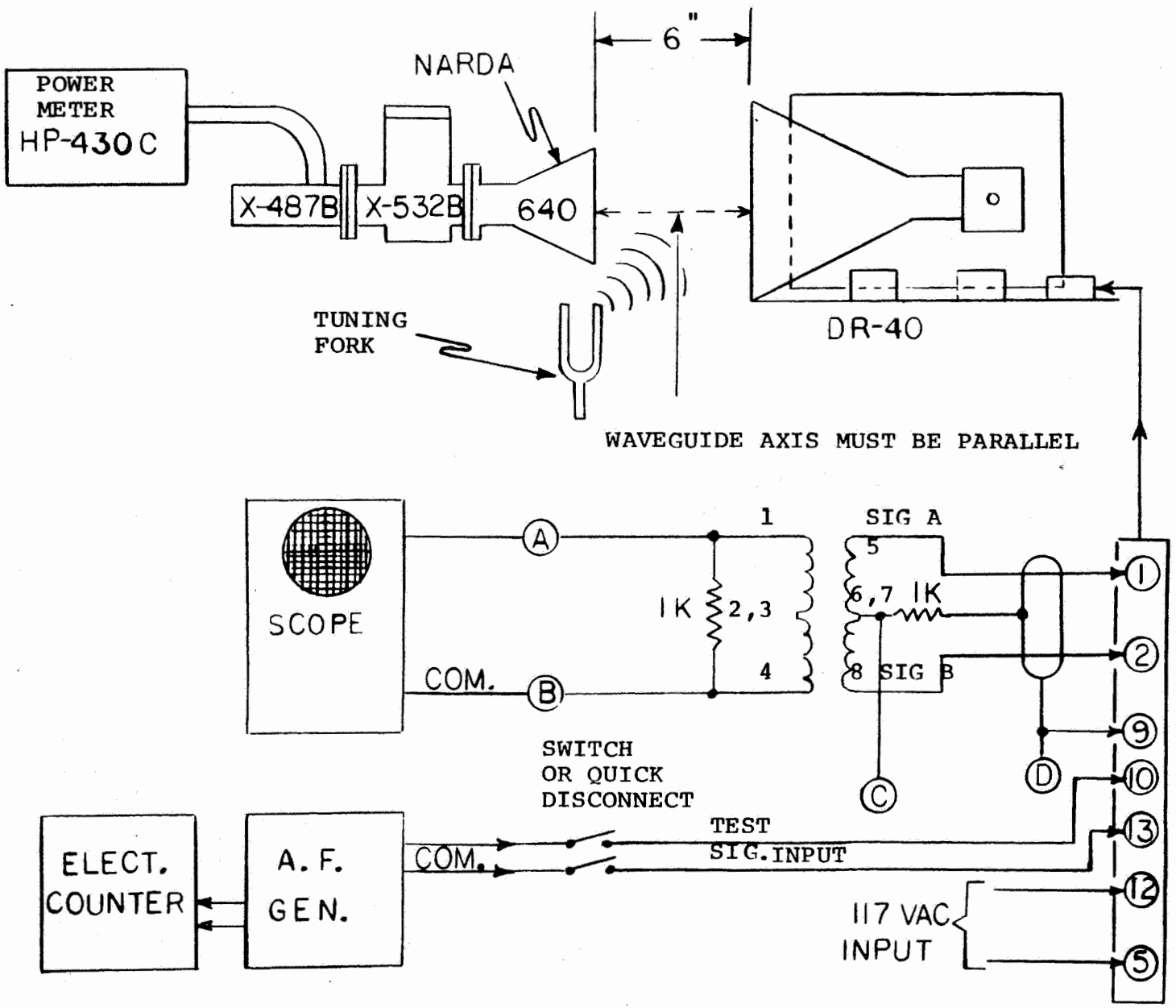
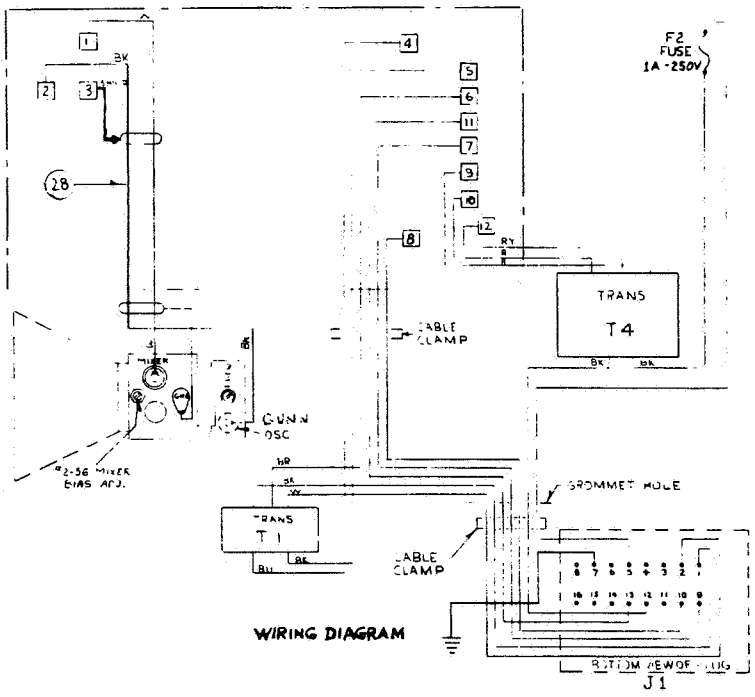
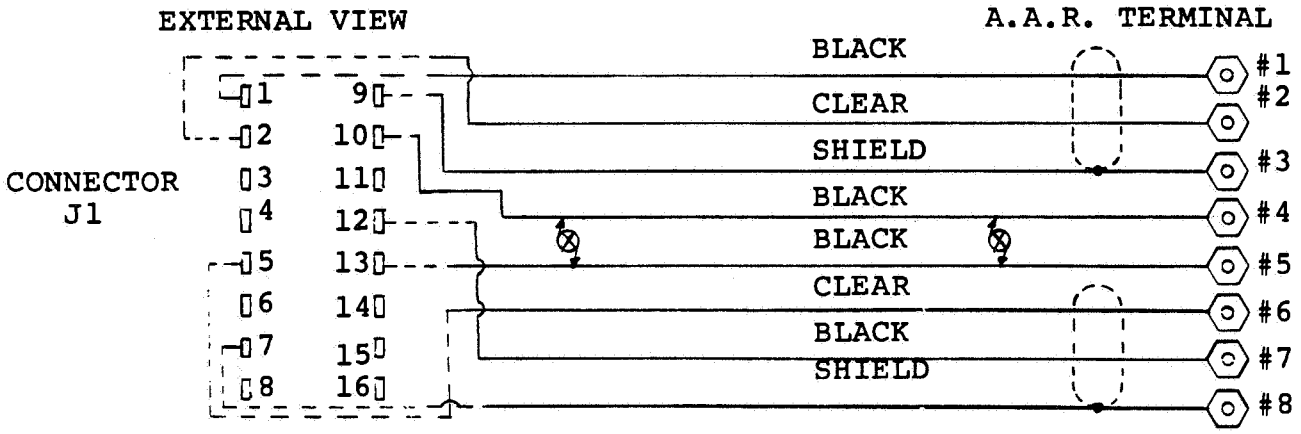
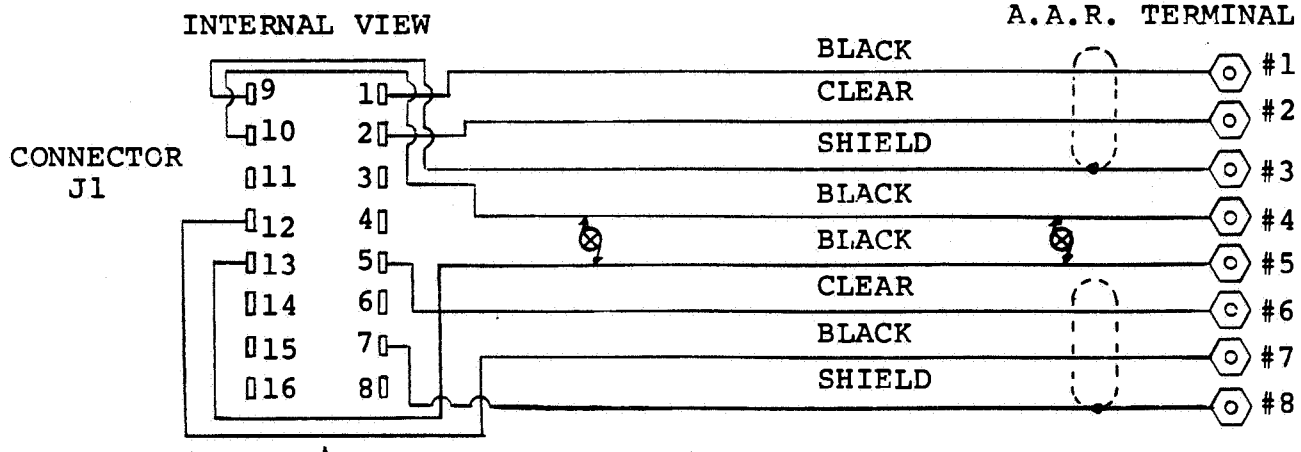


Figure 6-5. DR-40 Radar Test Set-Up

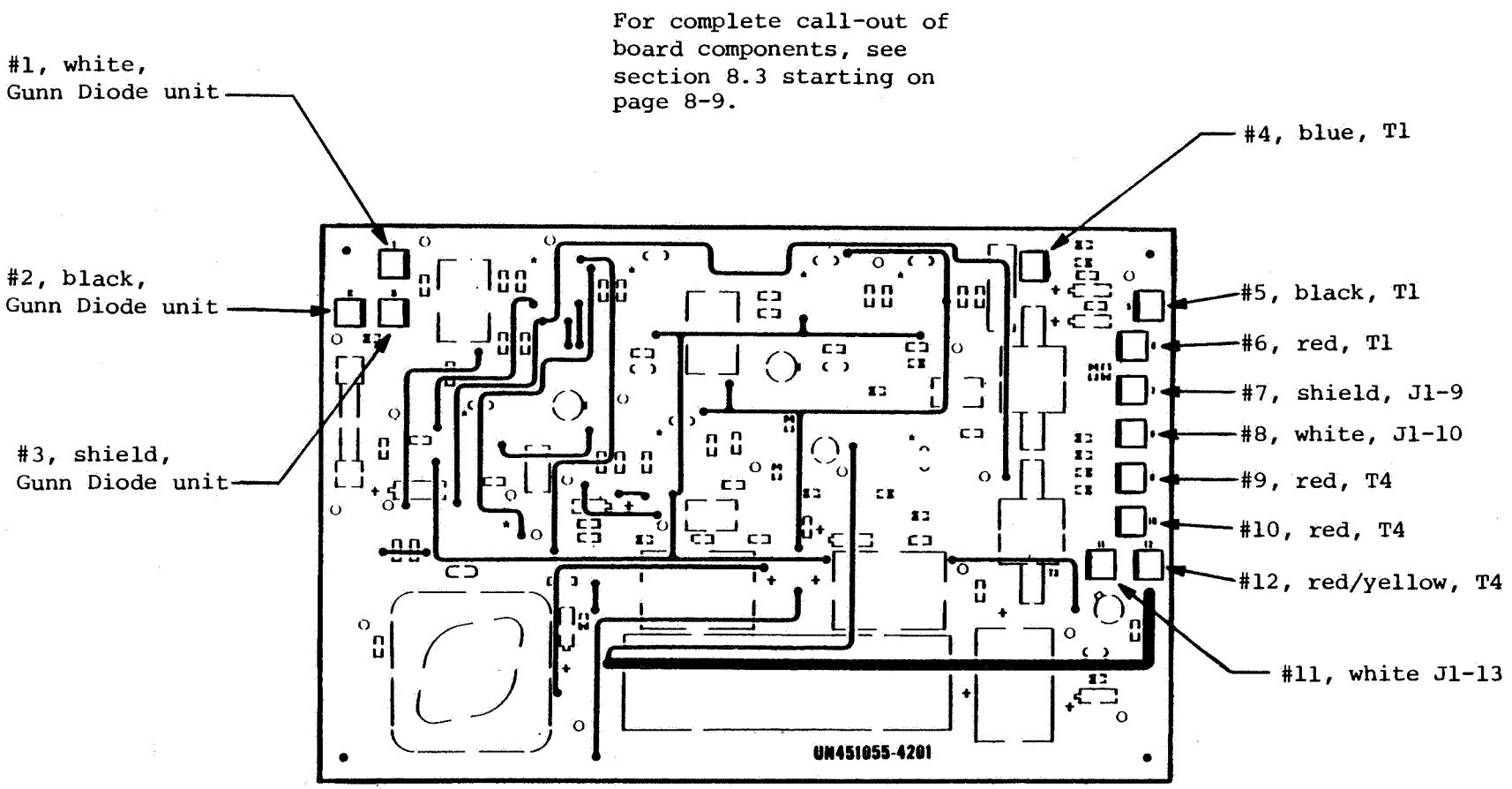






NOTES: ⊗ Indicates Twisted Pair

Figure 6-6. DR-40 Wiring Diagrams



(Viewed from component side)

Call-out order: Faston No., wire color, destination

Figure 6-7. DR-40 Faston Location, Identification

6.3.5.2 Test Procedure

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

   If no, go to step 72.

2. Is a substitute DR-40 unit, which is known to be in good operating condition, available?

   If no, go to step 4.

3. Replace the defective unit with a unit known to be operational. Does the unit restore speed indication?

   If no, go to step 73.

4. Secure and replace the cover. This completes field expedient maintenance. Shop maintenance of the inoperative unit starts at step 5.

5. Set DR-40 Chassis on service bench. Connect the test set-up as shown in Figure 6-5. Go to step 6.

6. Apply power and allow approximately 30 min. for warmup stabilization. Go to step 7.

7. Connect the digital voltmeter's common lead to J1-9 and the input lead to J1-1. Aim the DR-40 into a maximum unobstructed distance. With no movement of uniy and no movement in target area is a rfk storage of approximately -3.7 VDC indicated on meter?

   If no, go to step 12.

8. Disconnect the voltmeter lead from J1-1 and place it on J1-2. Again with no movement of unit, nor movement within target area, is a rfk voltage of approximately -3.7 VDC indicated on meter?

   If no, go to step 14.

9. Disconnect the voltmeter from the unit. Connect the audio signal generator to J1-10 and J1-13 set output to 785 Hz (6V peak-to-peak (p-p). Connect the oscilloscope to J1-1 and J1-2. Is a 7.2V p-p signal (approx.) present as shown in operation "BB" on page 6-31/32.

   If no, go to step 33.

10. Disconnect audio frequency signal generator. Activate the 440 Hz tuning fork and place it 3 inches in front of DR-40's antenna. Is the 7.2 (approx.) volt p-p signal present? If no, go to step 74.

11. UNIT IS OPERATIONAL. Disconnect all test equipment and secure the DR-40 so it may be placed back in operation when required.

STOP

12. Disconnect the voltmeter lead from J1-1 and place it on J1-2. Again with no movement of unit, nor movement within the target area, is a rfk voltage of approximately -3.7 VDC indicated on meter?

    If no, go to step 15.

13. Check wiring run from J1-1 to T1 center tap. Check T1 secondary for an open. Make repair. Return to step 7 to confirm unit is operational.

STOP

14. Check wiring run from J1-2 to transformer T1 for an open. Check secondary of T1 for an open. Make repair. Return to step 7 to confirm operation.

STOP

15. Disconnect the digital voltmeter. Activste one of the tuning forks and place it 3 inches in front on the DR-40's horn antenna. Is a minimum 10V p-p signal present on the oscilloscope?

    If yes, go to step 16.
    If no, go to step 10.

16. Place the tuning fork aside. Connect the digital voltmeter's input lead (+) to Faston 7, on DR-40 PC Board, and the common lead (-) to Test Point 21 (TP21). Does the voltmeter read -3.7 VDC (approx.)?

    If no, go to step 51.

17. Turn power to unit off. Check wiring and connections between TP21 and transformer T1 center tap. Check also continuity of wiring from Faston 7 through the cable shield to AAR terminal 3 if unit is being serviced in the field. Make necessary repair. Go to step 75.

STOP

18. Connect the audio signal generator, set for 6V p-p at 785 Hz, to Faston 8 and Faston 11. Does the scope show an approximately 7.2V p-p signal, as in operation "BB" on page 6-31/32.

    If no, go to step 40.

19. Connect the digital voltmeter common to TP1 and input to TP7. Is a reading of between +5.1 and +6.1 VDC present?

    If no, go to step 63.

20. Mark this step number down. Connect the test set-up as shown in Figure 3-1. Set test set-up approximately 6 inches in front of the DR-40's horn antenna. Perform procedure 3.2.2.2 steps 1 through 5. Is the Gunn Diode producing rf energy (as determined by an indication on the power meter)?

    If yes, go to step 21.
    If no, go to step 69.

21. Remove the digital voltmeter grom the previous position. Connect the common to Faston 3 and input (+) to Faston 1. is a -0.3 VDC +/-0.1 volt present?

    If no, go to step 23.

22. Check track (copper) for open between Faston 1 and R1-R17 junction, also between Faston 3 and ground buss. Check also C1, R1, R2 and IC1. Make repair. Go to step 7.

STOP

23. Move the voltmeter lead from Faston 1 to mixer diode on Doppler module. Is -0.3 VDC +/-0.1 VDC present?

    If no, go to step 25.

24. Check white conductor for open in coaxial cable between PC Board and Doppler module. Make repair. Go to step 7.

STOP

25. Is voltage either low or zero?

    If no, go to step 30.

26. Turn power off. Check zener (mounted on Doppler module) for short or changed value. Is the zener test good?

    If no, go to step 29.

27. Check mixer diode by substitution. Turn power on. The new diode will restore bias. Go to step 28.

28. Adjust the bias for -0.3 VDC. Disconnect test equipment and restore the DR-40 to operational status.

29. Replace the defective zener diode. Check that mixer diode bias is restored with zener replacement.

STOP

30. Turn bias adjustment screw. Does bias adjustment give a reading of -0.3 VDC +/-1V?

    If no, go to step 32.

31. Make setting. Carefully tighten locking nut, not to change setting, and seal with inspector's lacquer. Recheck rfk voltage to confirm operation of rfk section of the radar.

    STOP

32. Turn off power to DR-40 unit. Check the 1000 ohm (1K) resistor and the zener diode, mounted on the Doppler module, for an open or changed value. Check also for shorted inner conductors of cabling to Doppler module. Make repair and go to step 75.

    STOP

33. Connect the scope common to TP1 and the probe to TP22. Is an approximately 11V p-p signal present as shown in operation "AA" on page 6-31/32

    If yes, go to step 34.
    If no, go to step 41.

34. Disconnect scope from previous position. Connect digital voltmeter to TP13 (+) and TP1 (-). Is a high level (+5.1 VDC approx.) present?

    If no, go to step 37.

35. Disconnect digital voltmeter lead from TP13 and connect it to TP14. Is a low level (-3.96 VDC) present?

    If no, go to step 38.

36. Turn power off. Check R3, R4, R5, C22 and IC1. Replace defective component, turn power on, and go to step 42.

    STOP

37. Disconnect the digital voltmeter lead from TP13 and connect it to TP14. Is a low level present (-3.96 VDC on the voltmeter)?

    If no, go to step 39.

38. IC7, or the connections to IC7, is defective. Confirm which by testing. Make repair and go to step 42.

    STOP

39. Check "-5.6 VDC Supply". Voltage should be -5.1 to -6.1 VDC. Turn power off and check also IC7, R26, R30, C12 and D20. Make repair. Turn power on and go to step 42.

40. Check all voltages against Table II. Check ground buss for open. Are all voltages within tolerances?

    If yes, go to step 67.
    If no, go to step 62.

STOP

41. Check "-5.6 VDC Supply". Voltage should be -5.1 to -6.1 VDC. Turn power off and check also TP3, R31, R32, D6, D7 and D20. Make repair. Turn power on and go to step 42.

STOP

42. Now connect the scope probe to TP19. Is a 17V p-p signal present similar to that shown in operation "X" on page 6-30.

    If no, go to step 44.

43. Turn power off. Check D1, D2, R15, R16, C26 and T1. Check all wiring in proximity of this circuit. Make repair. Go to step 75.

STOP

44. Remove scope probe from TP19 and connect it to TP17. Is a 2.8V p-p signal present similar to that shown in operation "T" on page 6-29

    If no, go to step 47.

45. Remove the scope probe from TP17 and connect it to TP18. Is a 7V p-p signal present, as shown in operation "V" on page 6-29.

    If no, go to step 49.

46. Turn power to unit off. Check R12, R13, R14, C6 and IC4. Check all associated interconnecting wiring on-board. Make repair and go to step 75.

STOP

47. Remove scope probe from TP17 and connect it to TP16. Is a minimum 10V p-p signal (at 785 Hz) present?

    If no, go to step 50.

48. Turn power to unit off. Check R6, R7, R8, C2, C3, C21, DA1 and IC2 plus all associated interconnecting wiring. Make repair. Go to step 75.

STOP

49. Turn power to unit off. Check IC3, IC4, C3, C4, C5, R9, R10, R11, and DA2. Check all interconnecting and associated wiring. Make repair and go to step 75.

STOP

50. Turn power off. Check C1, R1, R2 and IC1. Check all associated track. Make repair and go to step 75.

STOP

51. Disconnect the digital voltmeter from the PC Board. Connect the oscilloscope probe to TP15, and the ground lead to TP1. Set vertical on scope to 0.2V/Div. and horiz. sweep to 2.0 microseconds/div. Does the scope pattern displayed approximate that shown in operation "P" on page 6-28

If no, go to step 55.

52. Remove scope probe from TP15 and connect it to TP20. Is the 5.2V p-p signal present as shown in operation "y" on page 6-30.

If no, go to step 54.

53. Turn power off. Defect lies in circuitry between TP20 and TP21. Check: R27, R28, R41, R42, D4, D5 and D16 through D19, C24, C25, C27 and T2. Check track (copper side) on board. Sections 6.3 and 7.3 give guidelines on component testing and replacement. When repair is made go to step 75.

STOP

54. Turn power off. Check IC6, C11, R25 and R26. Check all associated copper and make repair. Then go to step 75.

STOP

55. Disconnect the oscilloscope from the previous position. Now connect the digital voltmeter to TP10 (common to TP1 ground). Is the voltage on meter +0.25 VDC (+/-0.05V)?

If no, go to step 59.

56. Disconnect the voltmeter lead from TP10 and reconnect it to TP11. Does the meter indicate -1.4 VDC (+/-0.1V)?

If no, go to step 60.

57. Disconnect the voltmeter. Connect the scope to TP12. Is a 10V p-p squarewave at approximately 11 KHz present on scope as shown in operation "K" on page 6-27.

If no, go to step 61.

58. Turn power to unit off. Check IC1, IC6, C10, R22, R23, R24 and all track (copper) on-board in this area. Make repair and go to Step 75.

STOP

59. Turn power to unit off. Check track (copper) of board for open between TP10 and R1-R17 junction. Check also from Faston 3 and ground buss. Make repair, then go to step 75.

STOP

60. Turn power to unit off. Check IC1, IC5, R17, R18, R19 and C7. Check all track connections in the area of this circuitry. Go to step 75.

STOP

61. Turn power to unit off. Check IC1, IC7, R20, R21 and R22. Make repair. Go to step 75.

STOP

62. Are any of the supply voltages within the tolerance values?

If no, go to step 64.

63. Using the voltages and waveforms supplied, perform trouble analysis anD repair the affected supply. When repair is made, confirm operation with tuning fork test and rfk measurements.

STOP

64. Connect the Simpson analyzer, set on 50VAC range, across Faston 9 and Faston 10. Is 24 VAC measured on meter?

If no, go to step 66.

65. Check ground connection at TP1. Check bridge rectifier (D12 through D15) and all associated track (copper). When repair is made confirm operation with tuning fork test and rfk measurements.

STOP

66. Check fuse F2, transformer T4 and all associated wiring and track (copper). Check wiring between AAR terminal 6 and J1-5 also between AAR 7 and J1-12. Make repair and confirm operation with tuning fork and rfk voltage checks.

STOP

67. Connect A test set-up as shown in Figure 6-5. Set test set-up approximately 6 inches in front of the DR-40's horn antenna. Perform procedure 3.2.2.3 steps 2 through 9. Is the Gunn Diode producing rr energy (determined by an indication on the power meter)?

    If no, go to step 69.

68. Put test set-up aside. Turn power to unit off. Check the mixer diode by substituting another mixer diode which is known to be in working condition and of the same type. Check also the zener and 1k resistor on the Doppler module. Does this restore rfk voltage and Doppler output?

    If yes, discard defective component and go to step 75.
    If no, go to step 74.

69. Place the horn-frequency meter-thermistor mount test set-up aside. Connect a dc voltmeter positive lead to Faston 2 and the negative lead to Faston 3. is a voltage of between +8.5 and +11 VDC present?

    If no, go to step 71.

70. Decrease supply voltage to Gunn Diode by adjusting potentiometer R36 (this is done so as not to apply excessive voltage to a new Gunn Diode). TURN POWER TO UNIT OFF. Substitute another Transceiver unity (J731446) which is known to be in working condition. Turn power to unit ON. Adjust R36 to supply a voltage which is within +/-0.1 VDC of the voltage marked on the new module. DR-40 unit should now be operational. Check frequency and power using test procedure outlined in Sections 3.2.2.3.

STOP

71. Check for open in track (copper) on PC Board either between TP5 and Faston 2 or an open between ground buss and Faston 3. Make repair and go to step 75.

STOP

72. Check DR-40's power switch on the Power Distribution Panel. Find where the break, or open, is located and take corrective action. Does this restore operation? Can be confirmed with tuning fork test described in step 3. Go to step 2.

STOP

73. Defect is not in DR-40 chassis. Check all interconnecting cabling from equipment room rack to radar cases AAR terminal strip. Check also interconnecting cable between radar case's AAR terminal strip and the 16-way female connector. Make repair.

STOP

74. Turn power to unit off. Check IC1, C1, R1 and R2. Check all associated track (copper) and make repair. Go to step 75.

STOP

75. When repair is made disconnect all test equipment and restore all hareware on the DR-40 unit so it can be placed back in service when needed.

6.4 VOLTAGES AND WAVEFORMS FOR TEST POINTS AND TERMINALS

NOTE

TP1 used as common ground for all measurements unless noted otherwise.

Oscilloscope is set for:

NORMAL	- Horizontal Time Base Mode
AUTOMATIC	- Horizontal Time Base Trigger
NON-STORE	- Display

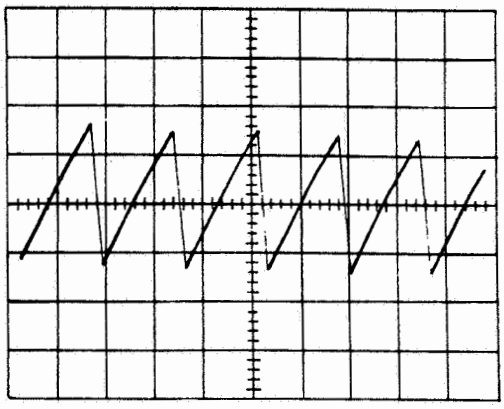
For all displays shown which follow.

Operation

Verification

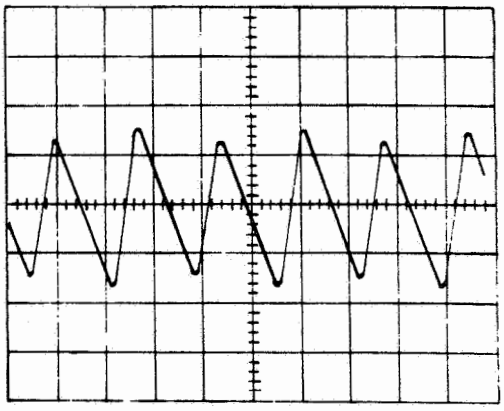
A. Output at Test Point 2 (TP2)
Scope Setting

1. Vert. Attn. CH. #1
0.02v/Div.
2. Vert. Attn. Ch. #2
3. Vert. Mode CH-1 Coupling AC
4. Horiz. Time Base
5 millisec/Div.
5. Probe - 10:1



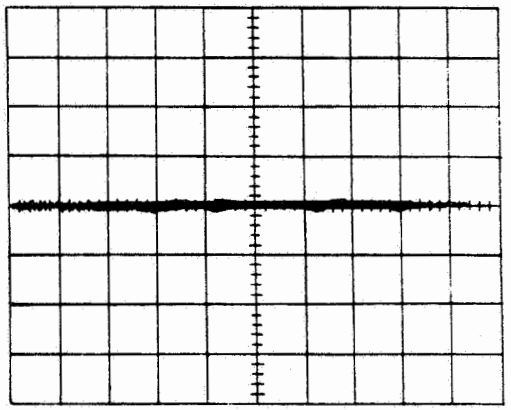
B. Output at Test Point 3 (TP3)
Scope Setting

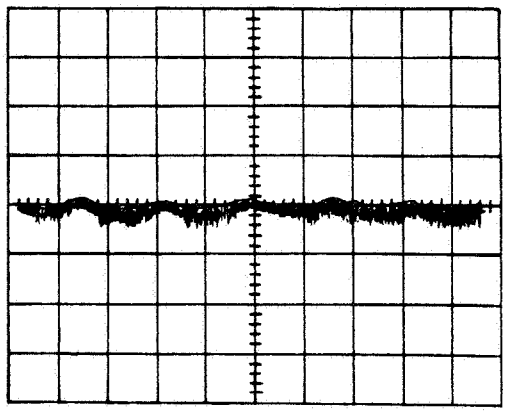
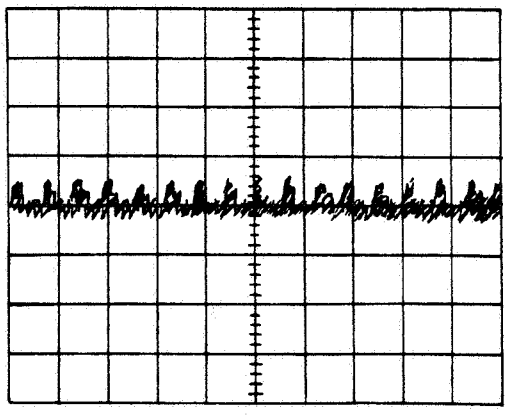
1. Vert. Attn. CH. #1
0.02v/Div.
2. Vert. Attn. Ch. #2 ------
3. Vert. Mode CH-1 Coupling AC
4. Horiz. Time Base
5 millisec/Div.
5. Probe - 10:1

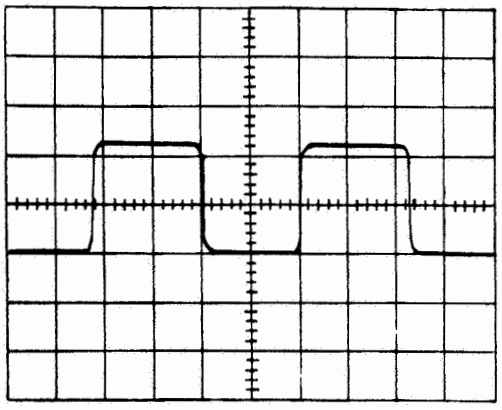


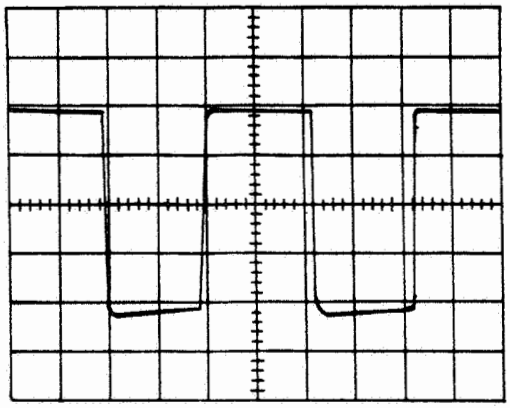
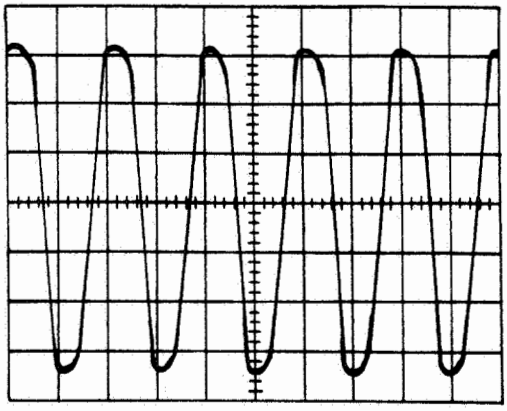
C. Output at Test Point 4 (TP4)
Scope Setting

1. Vert. Attn. CH. #1
10 milli volt/Div.
2. Vert. Attn. Ch. #2 ------
3. Vert. Mode CH-1 Coupling AC
4. Horiz. Time Base
5 millisec/Div.
5. Probe - (Direct)



Operation	Verification
D. Voltage at TP5 (GND at TP1) Normal Operating Condition	Dig. Voltmeter Reading +10.503
E. Output at TP6 Scope Setting 1. Vert. Attn. CH. #1 10 milli volt/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling AC 4. Horiz. Time Base 5 millisec/Div. 5. Probe - (Direct)	
F. Voltage at TP7 (GND at TP1) Normal Operating Condition	Dig. Voltmeter Reading -5.514
G. Voltage at TP8 (GND at TP1) Normal Operating Condition	Dig. Voltmeter Reading +5.298
H. Output at TP9 Scope Setting 1. Vert. Attn. CH. #1 0.01 volt/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling AC 4. Horiz. Time Base 0.2 millisec/Div. 5. Probe - (Direct)	

	Operation	Verification
I.	Voltage at TP10 (GND at TP1) Normal Operating Condition	Dig. Voltmeter Reading +0.20
J.	Voltage at TP11 (GND at TP1) Normal Operating Condition	Dig. Voltmeter Reading -1.30
K.	Output at TP12 Scope Setting 1. Vert. Attn. CH. #1 5 volt/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling AC 4. Horiz. Time Base 20 micro sec/Div. 5. Probe - (Direct)	
L.	Voltage at TP13 (GND at TP1) Normal Operating Condition	Dig. Voltmeter Reading -5.4
M.	Voltage at TP13 (GND at TP1) With 785 Hz Test Signal	Dig. Voltmeter Reading +5.1
N.	Voltage at TP14 (GND at TP1) Normal Operating Condition	Dig. Voltmeter Reading +5.27
O.	Voltage at TP14 (GND at TP1) With 785 Hz Test Signal	Dig. Voltmeter Reading -3.96

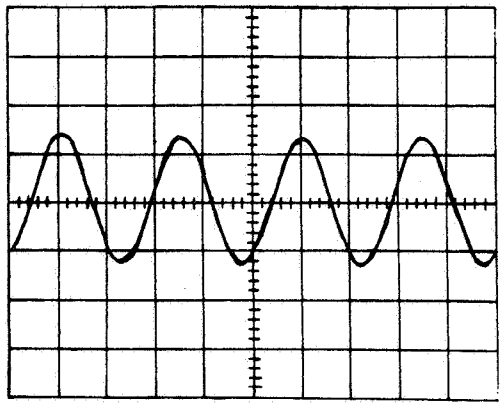
Operation	Verification
P. Output at TP15 Scope Setting 1. Vert. Attn. CH. #1 0.2 volt/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling DC 4. Horiz. Time Base 2 micro sec/Div. 5. Probe - (Direct)	
Q. Voltage at TP16 (GND at TP1) Normal Operating Condition	AC Voltmeter Reading Low Level AC signal amplitude dependent on target return.
R. Voltage at TP16 (GND at TP1) With 785 Hz Test Signal	AC Voltmeter Reading 2 VAC Approx.
S. Output at TP17 With 8 mph Tuning Fork Signal Scope Setting 1. Vert. Attn. CH #1 0.05 v/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling AC 4. Horiz. Time Base 2 milli sec/Div. 5. Probe - 10:1	

Operation

Verification

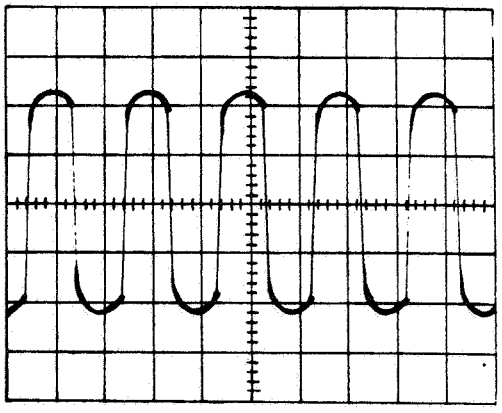
T. Output at TP17
With 785 Hz Test Signal
Scope Setting

1. Vert. Attn. CH #1
   0.1 v/Div.
2. Vert. Attn. Ch. #2 ------
3. Vert. Mode CH-1 Coupling AC
4. Horiz. Time Base
   0.5 milli sec/Div.
5. Probe - 10:1



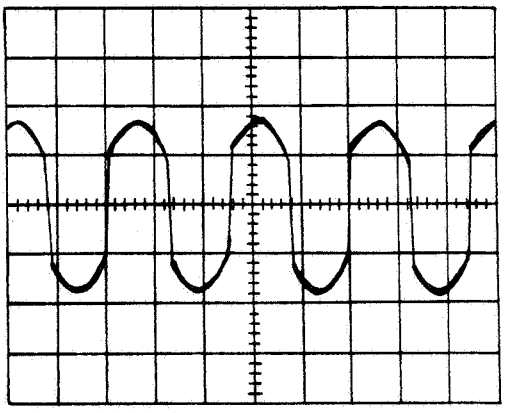
U. Output at TP18
With 8 mph Tuning Fork Signal
Scope Setting

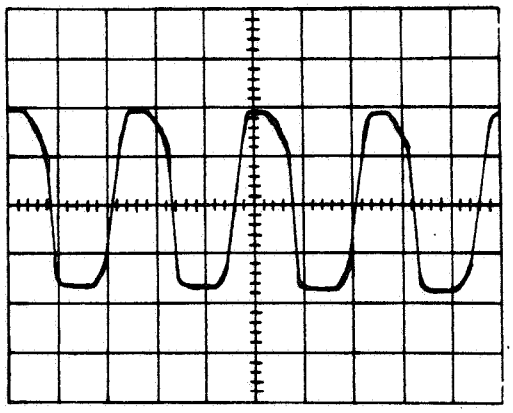
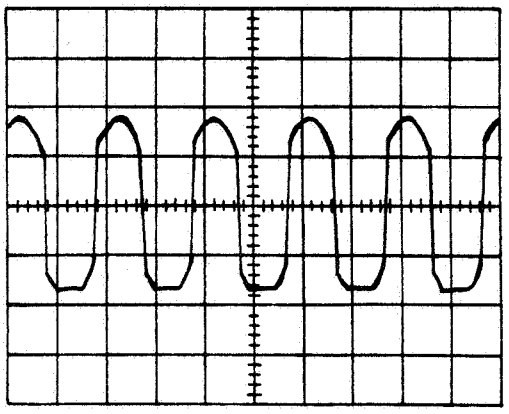
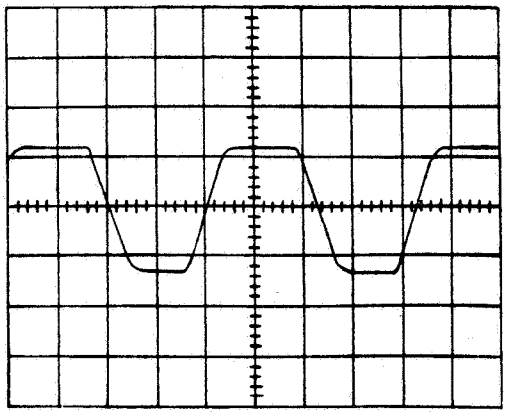
1. Vert. Attn. CH #1
   0.01 v/Div.
2. Vert. Attn. Ch. #2 ------
3. Vert. Mode CH-1 Coupling AC
4. Horiz. Time Base
   2 milli sec/Div.
5. Probe - 10:1



V. Output at TP18
With 785 Hz Test Signal
Scope Setting

1. Vert. Attn. CH #1
   0.2 v/Div.
2. Vert. Attn. Ch. #2 ------
3. Vert. Mode CH-1 Coupling AC
4. Horiz. Time Base
   0.5 milli sec/Div.
5. Probe - 10:1

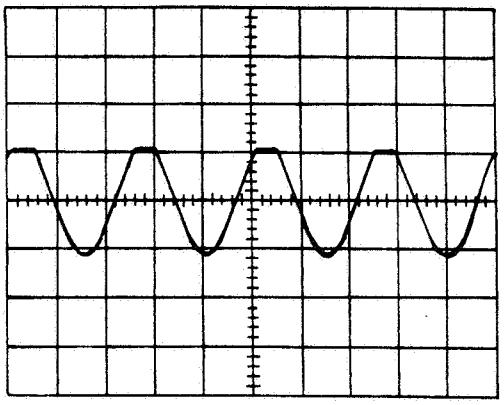


Operation	Verification
W. Output at TP19 With 8 mph Tuning Fork Test Signal Scope Setting 1. Vert. Attn. CH #1 0.5 v/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling AC 4. Horiz. Time Base 2 milli sec/Div. 5. Probe - 10:1	
X. Output at TP19 With 785 Hz Test Signal Scope Setting 1. Vert. Attn. CH #1 0.01 v/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling AC 4. Horiz. Time Base .5 milli sec/Div. 5. Probe - 10:1	
Y. Output at TP20 Scope Setting 1. Vert. Attn. CH #1 2 v/Div. 2. Vert. Attn. Ch. #2 ------ 3. Vert. Mode CH-1 Coupling DC 4. Horiz. Time Base 20 micro sec/Div. 5. Probe - (Direct)	

	Operation	Verification
Z.	Voltage at TP21 (GND at Faston 7) Normal Operating Conditions	Dig. Voltmeter Reading -3.7

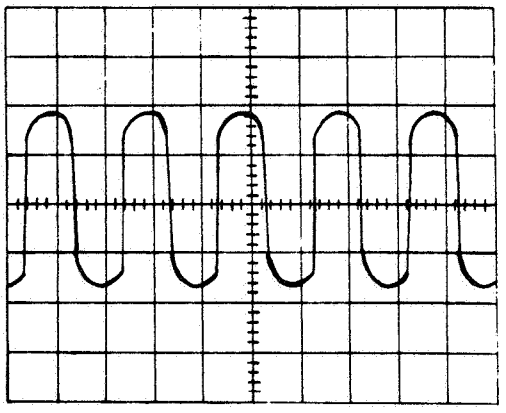
AA. Output at TP22
With 785 Hz Test Signal (6V p-p)
Scope Setting

1. Vert. Attn. CH #1
   0.5 v/div.
2. Vet. Attn. CH #2 ------
3. Vert. Mode CH-1 Coupling AC
4. Horiz. Time Base
5. Probe - 10:1



BB. Output J1-1, J1-2 (J1-9 GND)
Scope Setting

1. Vert. Attn. CH #1
   0.2 v/div. Inverted
2. Vert. Attn. CH #2 ------
   0.2 v/div.
3. Vert. Mode Added Coupling AC
4. Horiz. Time Base
   2.0 milli sec/div.
5. Probe - 10:1



SECTION VII
CORRECTIVE MAINTENANCE AND CALIBRATION

7.1 GENERAL REMARKS

Refer to Section 6.1 (p. 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 (pages 6-13, 6-14) 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 VIII.

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 which hold 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 which hold the module on the horn antenna (these screws are on the antenna side of the module) and 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 and Zener Diodes

1. Remove Schottky by unsoldering its external connection and unscrewing the diode (using a sharp, wide blade screwdriver) from the side of the transceiver module.

2. Remove Zener by unsoldering end wires.

7.2.2 Radar Signal Transformer (T1)

1. Remove harness clips from wire bundles which lead to T1 wire feed holes in chassis plate.

2. Using Figure 6-6, disconnect correct Faston-attached wires on PC Board for T1.

3. Using same figure, unsolder correct T1 wires on underside of T1 Amphenol connector.

4. Remove T1 hold-down screws on chassis plate and pull unit out, making certain to help wires through hole grommets.

7.2.3 Amphenol Connector (J1)

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 J1 from chassis.

7.2.4 Step Down Transformer (T4)

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

2. Using Figure 6-6, disconnect correct Faston-attached wires for T4 at PC Board.

3. Cut T4 wire going to fuse assembly, allowing sufficient wire on either side of the cut for resplicing.

4. Using Figure 6-6, unsolder T4 wire where it attaches to its numbered terminal on the underside of the Amphenol connector (J1).

5. Remove two screws which secure T4 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 UNIT IS DISCONNECTED BEFORE MAKING SOLDER REPAIRS.

Repairs on DR-40 components are limited to resoldering of broken soldered connections and breaks in PC board copper track. 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 open.

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

4. Remove any excess which 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-nose 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, the hole can be cleaned by reheating the solder and placing a sharp object such as a toothpick into the hole to clean it out. 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-40 generally consists of reversing the steps described in Sections 6.1 (removal of chassis from enclosure) and 7.3 (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 attached 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 replacemnt or cirucit repair performed on the DR-40 Radar. It assures that the unit will operate at the required radio frequency after reinstalltion. Use the general circuit schematic on page 6-5/6 (Figure 6-4), the test set-up on page 6-13 (Figure 6-5) and the wiring diagram on page 6-14 (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) (J043495)
Audio Oscillator, Hewlett Packard 204C
Digital Voltmeter, Fluke 8120A-01
Thermistor Mount, Hewlett Packard X-487B
Power Meter, Hewlett Packard 430-C
Frequency Meter, Hewlett Packard HP-5326
Standard Horn Antenna, Narda 640
Tuning Fork 440 Hz Middle "A" (Approx. 14 M.P.H.)

7.5.3 Supplementary Hardware

(1) - Matching Transformer, Meissner TR5 J731015
(2) - Resistors, 1000 ohm (1K), 1/2 Watt, 5%, Carbon (J720882)

7.5.4 Procedure

Operation	Remarks
1. Arrange a test set-up as per Figure 6-5.	--
2. Apply 117 VAC +/-2 VAC to Amphenol Pins 5 and 12.	--
3. Connect Digital Voltmeter to TP5 and common to TP1 (Faston 3).	3. Digital Voltmeter set to DC Volts and Auto Ranging.
4. Inspect operating voltage marked on Gunn Diode Oscillator.	--
5. Adjust R36.	5. Operating voltage of Gunn Diode +/-.1 volts dc. Seal pot with inspectors lacquer after adjusting.
6 Allow equipment to stabilize for 30 minutes +/- 5 min.	6. Room temperature (68^{o}F to 77^{o}F) (20^{o}C to 25^{o}C)
7. Inspect frequency of Gunn Diode Oscillator as indicated on the Frequency Meter.	7. Frequency shall be 10.525 Ghz +/-1 MHz.
7A. Adjust "FREQ ADJ" Screw if required.	7A. 10.525 Ghz +/-1.0 MHz and seal with inspectors lacquer.

8.	Disconnect Digital Voltmeter lead from TP5 and connect it to Faston 1.	--
9.	Aim unit into maximum unobstructed distance, with no movement in unit or target area, adjust the 2-56 screw on Gunn unit.	9. (A) Minus (-) .4 VDC +/-.05(*) (B) Retighten locking nut and screw, then seal with inspectors lacquer after adjustment (with unit in operating position).
9A.	Recheck Gunn Diode frequency	9A. 10.525 GHz +/- 1.0 MHz.
10.	Disconnect Digital Voltmeter from TP5 and TP1.	10. --
11.	Connect Digital Voltmeter to points C and D as indicated in Figure 6-5.	11. Greater than -1.0 VDC with 25 feet of unobstructed target area.
12.	Adjust oscilloscope as follows: VERT = 5v/div. HORZ = 1/Msec/div SYNC = AUTO COUPLING = DIRECT	12. --
13.	Activate tuning fork and place it approximately 3 inches in front of DR-40 horn.	13. Observe a minimum of 10V p-p on oscilloscope.
14.	Adjust audio oscillator for 6V p-p at a 785 Hz +/-5 Hz sinewave output and connect output to Fastons 8 and 11.	14. --
15.	Reactivate funing fork and place it approximately 3 inches in front of DR-40 horn while simultaneously increasing amplitude of audio oscillator.	15. Signal on oscilloscope will shift from tuning fork frequency to audio oscillator test frequency when audio oscillator amplitude equals 6V p-p +/-1 p-p.

END OF TEST

SECTION VIII
PARTS LIST

N451127-0203 (For Mtg. On 2 Cast Iron Bases)
N451127-0202 (For Mtg. On Concrete Base)
N451127-0201 (For Mtg. On 2 Cast Iron Bases)

8.1 DR-40 MAIN ASSEMBLY (Reference Figure 8-1)

Item No.	Description	Part Number
1	Box	R451128-0901
2	Window, RF	M451128-1102
3	Chassis, Gunn Diode	N451128-0801
4	Shock Mount	J075467
5	Cover	R451128-1301
6.	Rubber, 1/4 x 3/4 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	M451118-1501
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	N700588
29.	Retainer	M451128-1204
30.	Washer, 8 Shprf. Lk 1208	J047714
31.	Scr., 10-32 x 1/2 Flat Stl.	J052091
32.	Scr., 1/4-20 x 7/8 Fil. Stl.	J052202
33.	Washer, 1/4 M.S.LK	J047775
34.	Nut, 1/4-20 Hex. Stl.	J048002
35.	Scr., 8-32 x 1/2 Rd. Stl.	J052531
36.	Scr., 8-32 x 7/16 Flat Stl.	J521081
37.	Washer, 8 Stl. Plate	J047745
38.	Washer, 8 M. Stl. Lock	J047681
39.	Nut, 8-32 Hex. Stl.	J048166
40.	Scr., 4-40 x 1/4 Rd. Stl.	J525011
41.	Plate, Mtg. (For -0201 Only)	M398923
42.	Base, Mtg. (For -0202 Only)	R380487
43.	Stud. Mtg.	M451128-1206
44.	Cap, Moulded Insl.	J078147
45.	Nut, 1/2-13 Hex.	J048016
46.	Nut, 1/2-13 Elas. Top	J048217
47.	Scr., 1/4 x 1" Hes. Hd. Cap	J050019
48.	Plate, Mtg. (For -0203 Only)	M435757

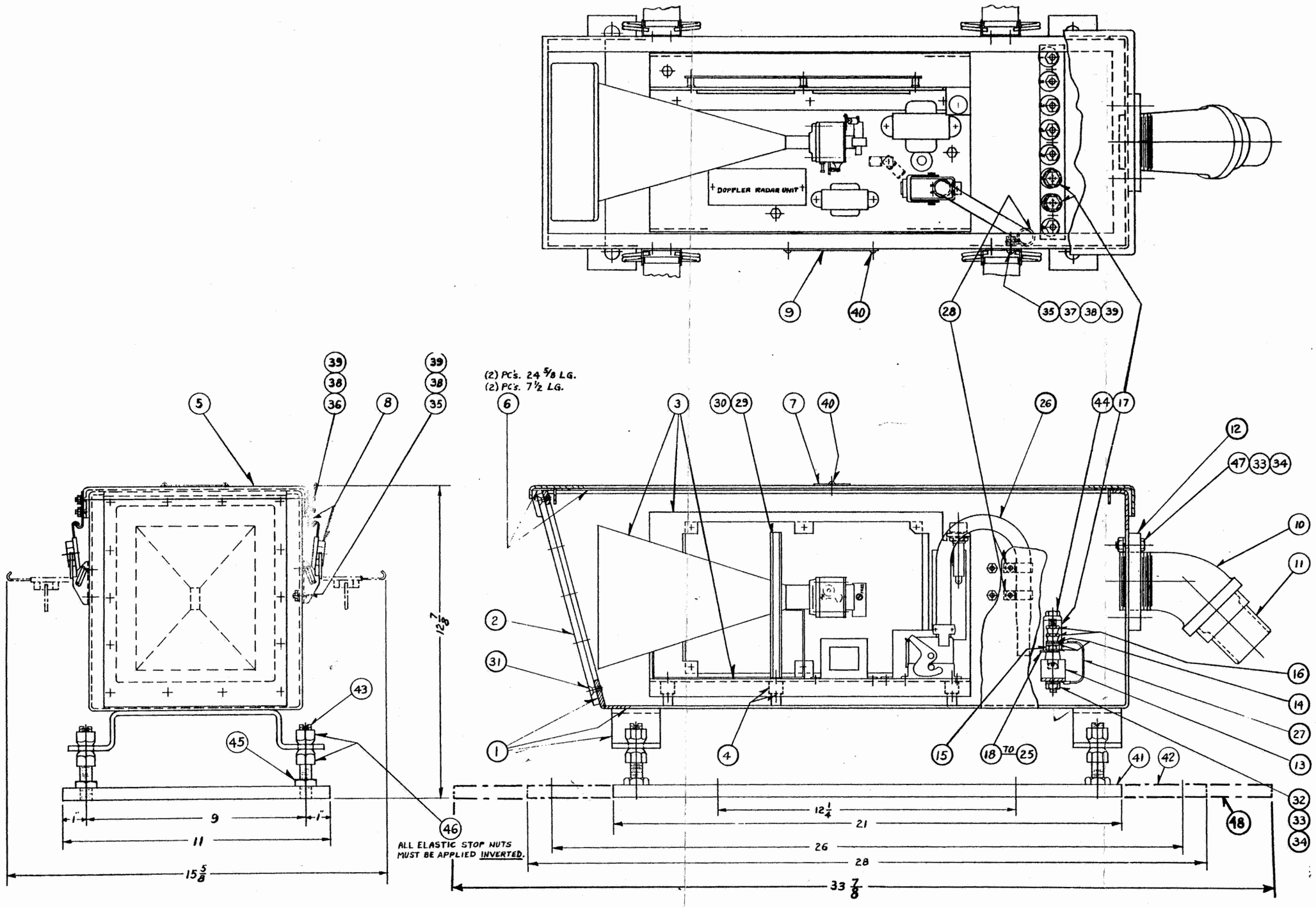
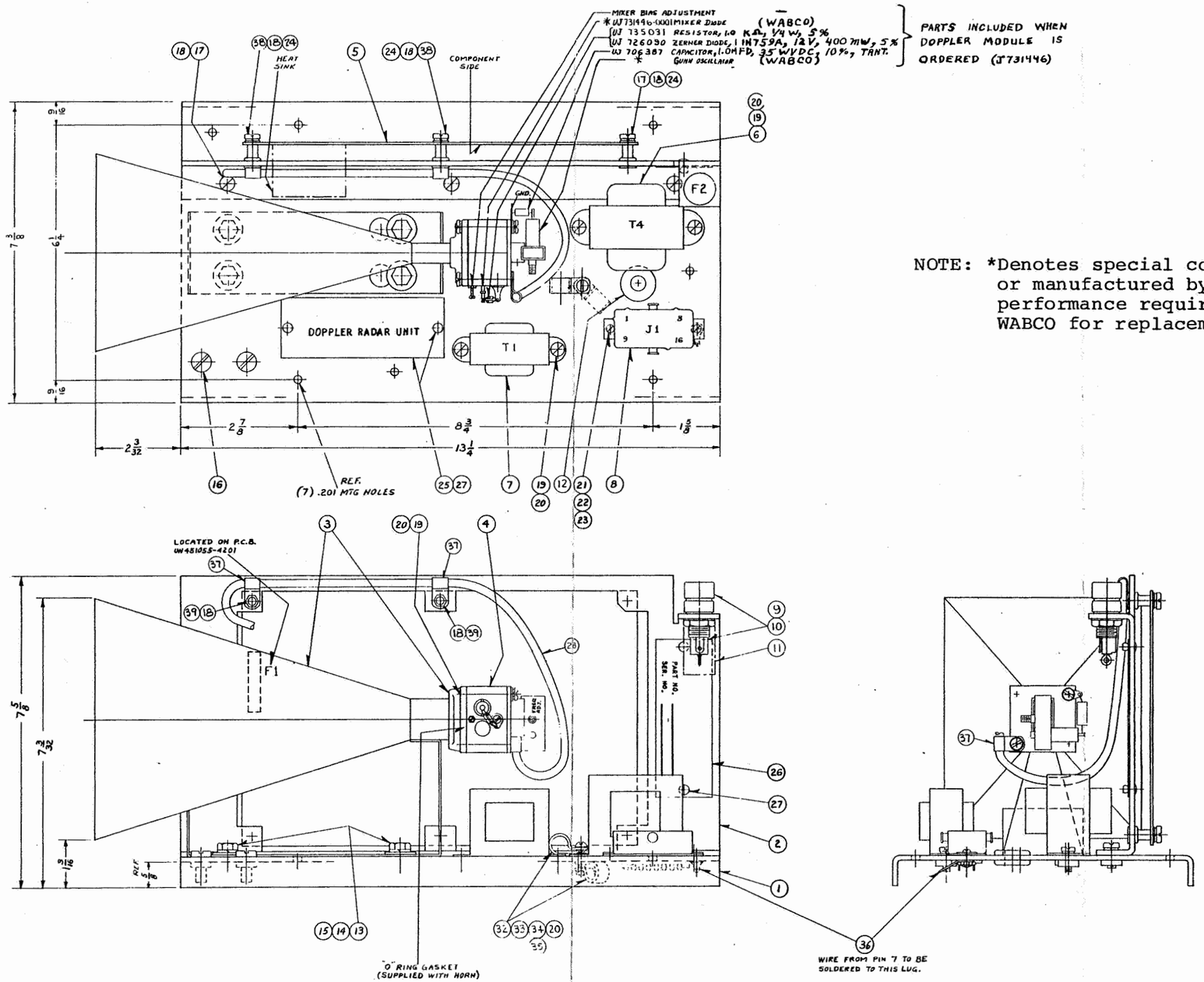


Figure 8-1. DR-40 Main Assembly Parts Location

8.2 CHASSIS N451128-0801 (Standard) (Reference Figure 8-2)

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
5.	PCB, Radar	*N451055-4201
6.	Tranf, Step Down (T4)	*J731400-0004
7.	Tranf, Radar Signal (T1)	*N451039-0809
8.	Conn. Amphenol (J1)	J702689
9.	Post, Fuse 342014	J713333
10.	Fuse, 1 Amp. 250V (F2)	J710007
11.	Tubing, 1/2" Shrink	A774210
12.	Grommet	J751103
13.	Scr. 1/4-20 x 1/2 Hex Cap	J050012
14.	Washer, 1/4 S. Plate	J047501
15.	Washer, 1/4 S. Lock	J047775
16.	Scr., 1/4-20 x 5/8" Pan S.	J507263
17.	Scr., 10-32 x 1/2 Bing S.	J050980
18.	Washer, 10 S. Lock	J047733
19.	Scr., 8-32 x 1/2 Bind S.	J050992
20.	Washer, 8 S. Lock	J047681
21.	Scr., 4-40 x 3/8 Rd. S.	J525074
22.	Wash, 4 Shpr LK 1204	J047729
23.	Nut, 4-40 Hex S.	J480006
24.	Washer, #10 Flat	M073129
25.	Plate, Name	M451425-3402
26.	Plate, Name	M451108-5202
27.	Rivet, 1/8 POP	J490034
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	J700587
33.	Scr., #8-32 x 5/8 Rd. Hd.	J052602
34.	Washer, #8 Flat	J047745
35.	Nut, #8-32 Hex. Stl.	J048166
36.	Lug, Solder	J731246

* Items are special components manufactured or selected to meet specific performance requirements. No outside substitutions should be made for these parts since operation may be affected or may nullify FCC Type Acceptance.



NOTE: *Denotes special components selected or manufactured by WABCO to meet performance requirements. Contact WABCO for replacement.

Figure 8-2. Chassis Mounted Component Location

8.3 P.C. BOARD N451055-4201 (Reference Figure 8-3)

Item No.	Legend	Description	Part Number
10	IC1	Ckt. Int. 4016 Function Quad, Package Type #C, DC Supply Voltage -0.5 to +15	J715029-0088
15	IC2,3,4,5,6	Ckt. Int. 777DC Function Precision, Supply VDC +/-22, operational amplifiers	J715029-0061
20	IC7	Ckt. Int. 4001 Function Quad, 2 Inp. Package Type #C, DC Supply Voltage -0.5 to +15	J715029-0089
25	IC8	Ckt. Int. 723, Output Voltage 2.o - 37; Input Voltage 9.5 - 40	J715029-0070
30	D1,2,4,5,6,7,8	Diode, 1N4742A, Vz (nom) 12, 1ZT (ma) 21, 5%, 1 watt	J726133
35	D16,17,18,19,20	Diode, 1N914A,PRV 75, VF 1.0, IF 20, IR 5uA, Silicon	J726031
40	D9,10	Diode, 1N5232, VZ (nom) 5.6, 1ZT (ma) 20, 5%, 500 mw.	J726150-0043
45	D11	Diode, 1N5240, VZ (nom) 10, 1ZT (ma) 20, 5%, 500 mw.	J726150-0044
50	D12,13,14,15	Diode, 1N4004 VR 400, VF Avg. 1.1, Io (amps) Avg. 1.0, Ir (ma). Avg. 10uA	J723621
55	DA1,DA2	Array Diode CA3039	J715027
60	R4	Resistor, 510 ohm, Mfr. AB, 5%, .250 watt, Type CB5115	J735159
65	R2,5,6,7,9,10,12 13,17,18,24,25	Resistor, 5.1K, Mfr. AB, 5%,.250 watt, CB5125 Type	J735301
70	R3,21,22,23	Resistor,100K, Mfr. AB, 5%, .250 watt, CB1045 Type	J735137
75	R8,11,40	Resistor, 680K, Mfr. AB, 5%, .250 watt, CB6845 Type	J735399
80	R14,23,38,41	Resistor, 10K, Mfr. AB, 5%, .250 watt, CB1035 Type	J735053
85	R15,16,42	Resistor, 51 ohm, 1/4 watt, 5%	J735407
90	R19	Resistor, .27K, .250 watt, 5%	J735065

Item No.	Legend	Description	Part Number
95	R20	Resistor, 150K, 1/4 watt, 5%	J735040
100	R27,28,31,32	Resistor, 22 ohm 1/4 watt, 5%	J735059
105	R30	Resistor, 47K, 1/4 watt, 5%	J735035
110	R1,35,39	Resistor 1K, 1/4 watt, 5%	J730031
120	R36	Potentiometer, 2K, 20% .5 watt	J620850-0028
125	R37	Resistor 3.9K, 1.4 watt, 5%	J735066
130	R26	Resistor 51K, 1/4 watt, 5%	J735067
135	C1,C3	Capacitor, 1 Mfd., Mfr. TWC, 5% Mylar 200 VDC	J706813
140	C2,5,6,7	Capacitor, 30 pf, Mfr. CD, 5%, Mica 500 VDC	J702815
145	C4,21	Capacitor, 250pf, Elmehco, 2%, Mica 500VDC	J700604
150	C8	Capacitor 4.7 pf. Mfr. Srague or Mallory, 10% 35 VDC	J706422
155	C9	Capacitor, 160 pf.	J706935
160	C10,22,27	Capacitor, .1Mfd. Mfr. TWC, 5%, 200 VDC, Mylar	J706827
165	C12,13,14,18, 24,25	Capacitor, 1 Mfd.	J706387
170	C15,16,20	Capacitor, 250 Mfd. Mfr. Sprague, Tol. -10 +75, 50 VDC	J709058
175	C17,23	Capacitor, .001 Mfd. Mfr. Erie, Tol. 10%, 500 VDC	J706242
180	C19	Capacitor, 3300 Mfd. Mfr. Erie, Tol. -10+75, 25 VDC	J709010
185	Q1	Transistor, MJ-1000, Motorola	J731427
190	Q2	Transistor, 2N3644, Silicon PNP, VcB 45, Mfr. Fairchild	J731283
195	F1	Clip, fuse	J576794
200	T2,3	Transformer	N386389
205	R33,34	Resistor, 220 ohms, 1/4 watt, 5%	J735071
275	C26	Capacitor, .22 Mfd; TRW, 10%, 100VDC	J706858
280	C11	Capacitor, 5 P.F., 5000 VDC, Tol. +/- P.F. Mfr. Cornell Dub.	J706931

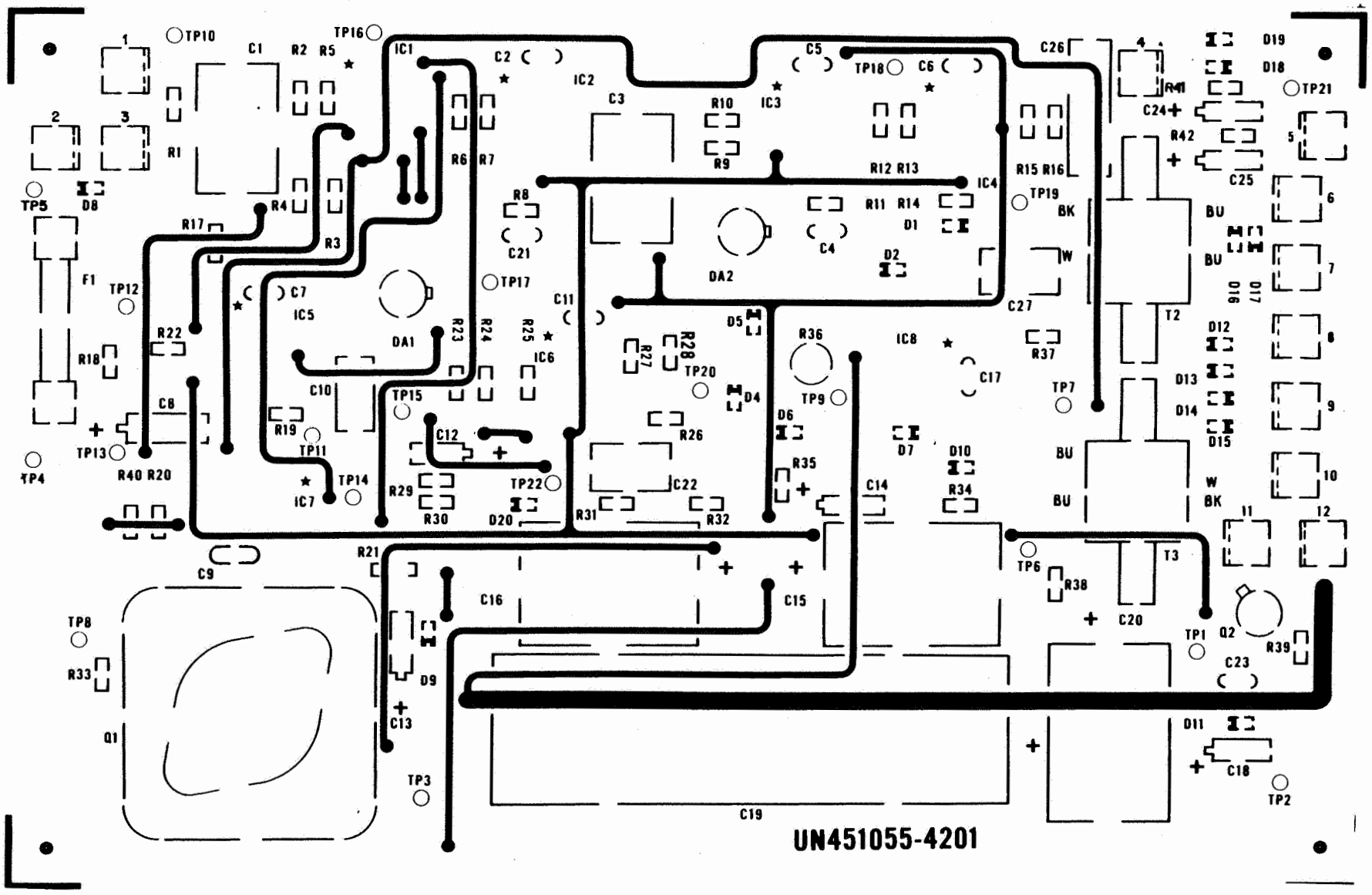


Figure 8-3. Dr-40 Radar P.C. Board Component Locations

SECTION IX
PARTS REPLACEMENT AND ORDERING

9.1 RF COMPONENTS

All components of the Doppler Transceiver Module (marked with an asterisk on the list on parts list page 8-5/6) 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 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-40.
2. Unit serial number.
3. Description of the part, including circuit number for electrical parts.
4. Manufacturer's part number.

SECTION X

Replacement of DR-5 & DR-40 Radars with DR-40. Retrofit of DR-40 Into DR-20 & DR-30 Radar Systems

The DR-40 Radar is capable of being substituted in place of DR-5 and DR-10 Radar systems in classification yards equipped with the older systems. It is also capable of being retrofitted into DR-20 and DR-30 Radar assemblies. Consult the three following general information sheets (Figures 10-2, 10-3 and 10-4) for all pertinent information regarding the above system modifications. Figure 10-1 shows a DR-40 Gunn Diode chassis retrofitted into a DR-30 protective enclosure.

WARNING

MAKE CERTAIN THAT AC POWER TO THE OLD RADAR UNITS (DR-5, DR-10, DR-20 or DR-30) HAS BEEN DISCONNECTED BEFORE BEGINNING ANY DISMANTLING OF EQUIPMENT. MAKE CERTAIN THAT AC POWER REMAINS OFF UNTIL THE DR-40 INSTALLATION HAS BEEN COMPLETED. IF POWER REMAINS ON DURING DR-40 RETROFIT WORK, PERSONAL INJURY MAY RESULT.

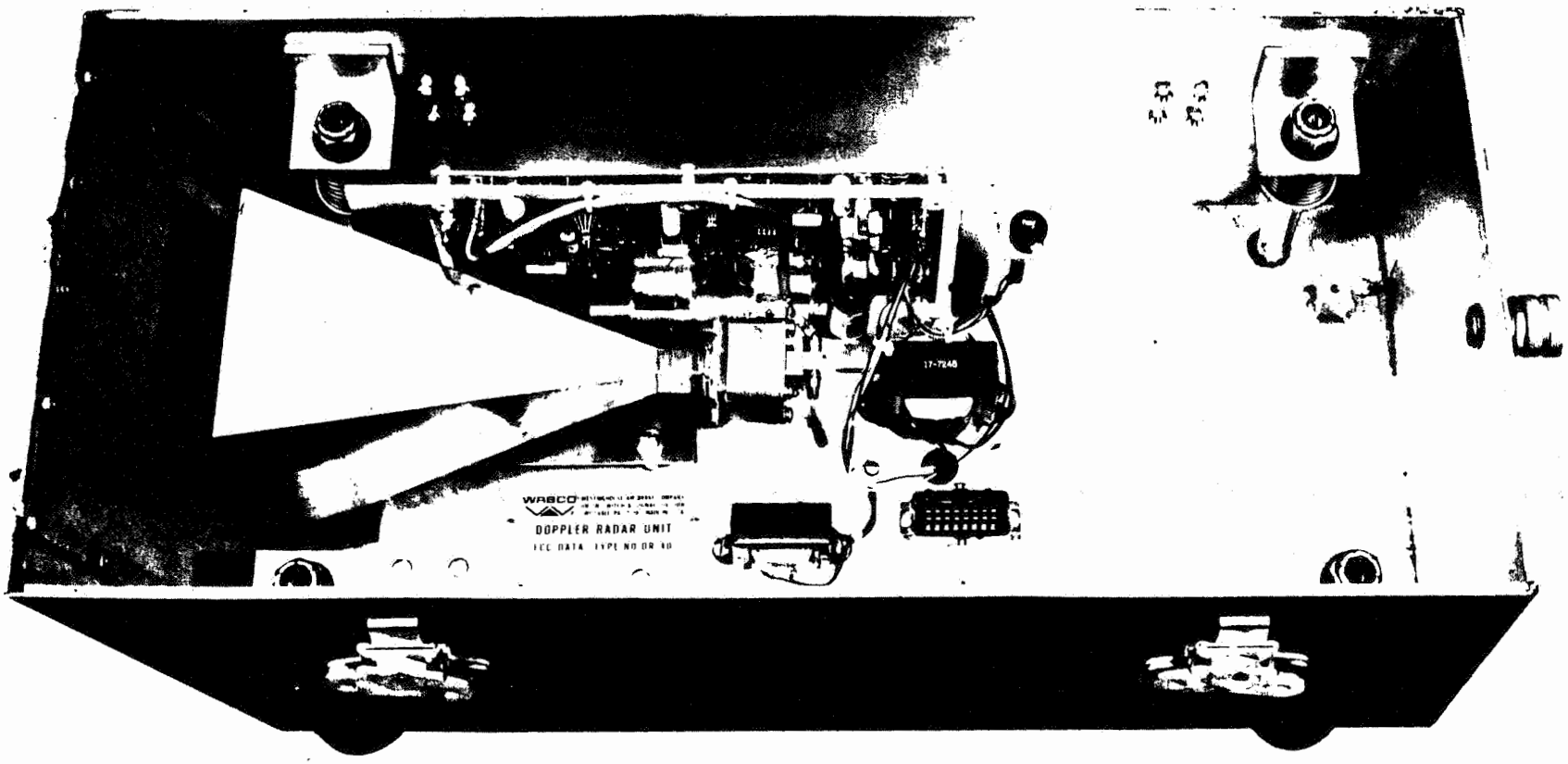
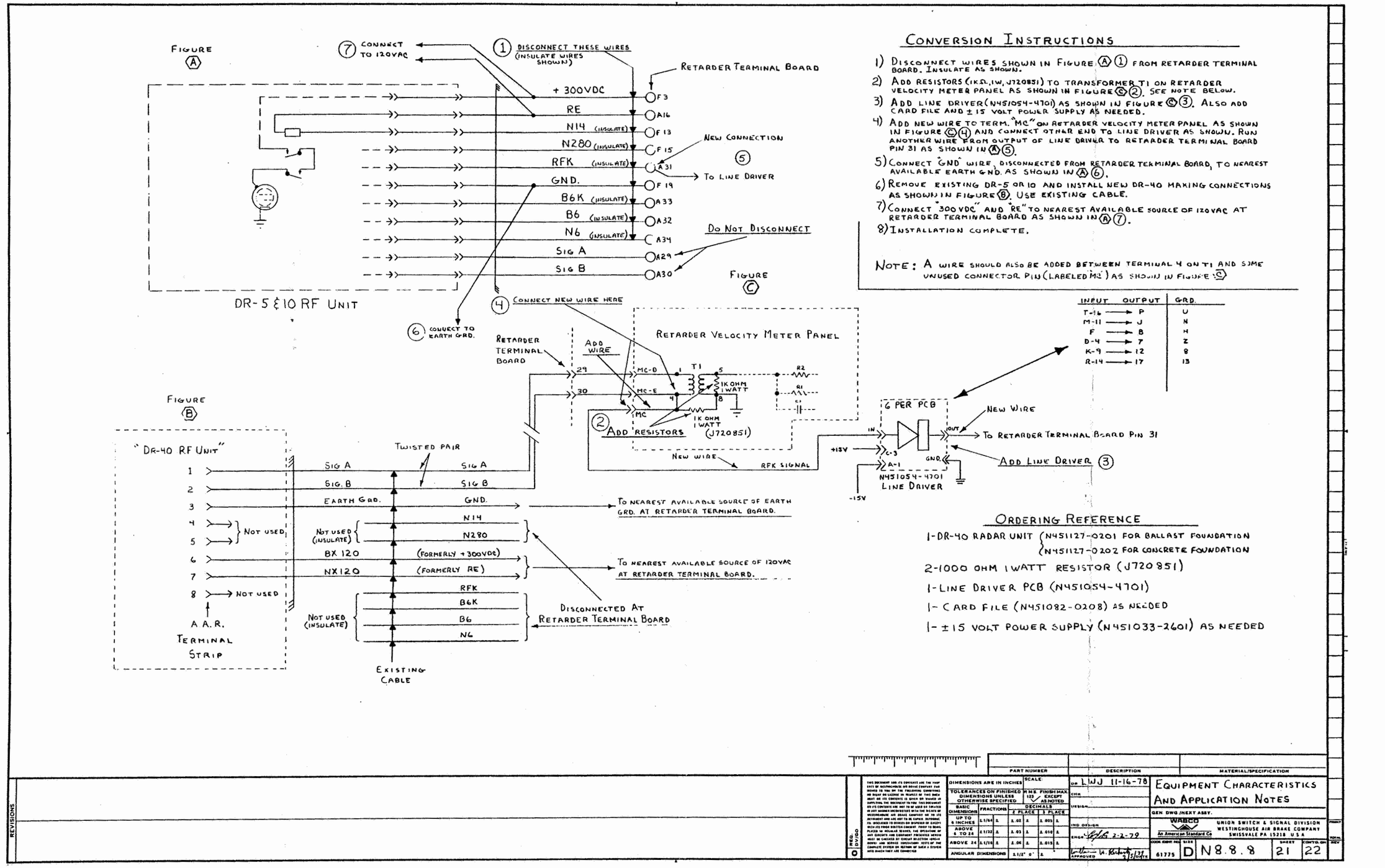


Figure 10-1. DR-40 Retrofit in DR-30.



CONVERSION INSTRUCTIONS

1) DISCONNECT WIRES SHOWN IN FIGURE (A)(1) FROM RETARDER TERMINAL BOARD. INSULATE AS SHOWN.
2) ADD RESISTORS (1KΩ, 1W, J720851) TO TRANSFORMER T1 ON RETARDER VELOCITY METER PANEL AS SHOWN IN FIGURE (C)(2). SEE NOTE BELOW.
3) ADD LINE DRIVER (N451054-4701) AS SHOWN IN FIGURE (C)(3). ALSO ADD CARD FILE AND ±15 VOLT POWER SUPPLY AS NEEDED.
4) ADD NEW WIRE TO TERM. "MC" ON RETARDER VELOCITY METER PANEL AS SHOWN IN FIGURE (C)(4) AND CONNECT OTHER END TO LINE DRIVER AS SHOWN. RUN ANOTHER WIRE FROM OUTPUT OF LINE DRIVER TO RETARDER TERMINAL BOARD PIN 31 AS SHOWN IN (A)(5).
5) CONNECT "GND" WIRE, DISCONNECTED FROM RETARDER TERMINAL BOARD, TO NEAREST AVAILABLE EARTH GND. AS SHOWN IN (A)(6).
6) REMOVE EXISTING DR-5 OR 10 AND INSTALL NEW DR-40 MAKING CONNECTIONS AS SHOWN IN FIGURE (B). USE EXISTING CABLE.
7) CONNECT "300 VDC" AND "RE" TO NEAREST AVAILABLE SOURCE OF 120VAC AT RETARDER TERMINAL BOARD AS SHOWN IN (A)(7).
8) INSTALLATION COMPLETE.

NOTE: A WIRE SHOULD ALSO BE ADDED BETWEEN TERMINAL 4 ON T1 AND SOME UNUSED CONNECTOR PIN (LABELED MC) AS SHOWN IN FIGURE (C).

ORDERING REFERENCE

1-DR-40 RADAR UNIT { N451127-0201 FOR BALLAST FOUNDATION / N451127-0202 FOR CONCRETE FOUNDATION }
2-1000 OHM 1 WATT RESISTOR (J720851)
1-LINE DRIVER PCB (N451054-4701)
1- CARD FILE (N451082-0208) AS NEEDED
1- ±15 VOLT POWER SUPPLY (N451033-2601) AS NEEDED

REVISIONS	PART NUMBER	DESCRIPTION	MATERIAL/SPECIFICATION
REV. DESIGNO		DR LWJ 11-16-78	EQUIPMENT CHARACTERISTICS AND APPLICATION NOTES

DIMENSIONS ARE IN INCHES — SCALE: — FINISH MAX 125 / EXCEPT AS NOTED

TOLERANCES ON FINISHED DIMENSIONS UNLESS OTHERWISE SPECIFIED		DECIMALS 2 PLACE	DECIMALS 3 PLACE
BASIC DIMENSIONS	FRACTIONS		
UP TO 6 INCHES	±1/64	±.02	±.005
ABOVE 6 TO 24	±1/32	±.03	±.010
ABOVE 24	±1/16	±.06	±.015
ANGULAR DIMENSIONS	±1/2°		

CHK. — DESIGN — IND DESIGN — ENGR 2-2-79 — APPROVED 2/5/79

GEN. DWG./NEXT ASSY.

WABCO — An American Standard Co — UNION SWITCH & SIGNAL DIVISION, WESTINGHOUSE AIR BRAKE COMPANY, SWISSVALE PA 15218 U.S.A.

CODE IDENT NO.	SIZE		SHEET	CONTD. ON
61775	D	N8.8.8	21	22

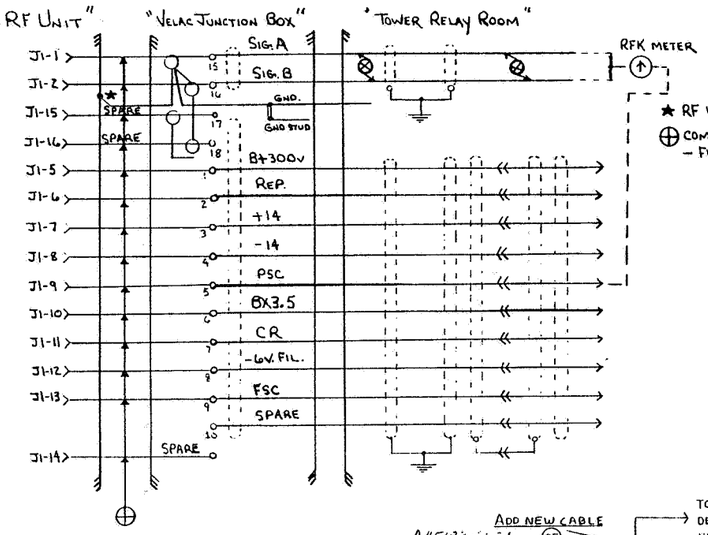
Figure 10-2. DR-5, 10 Radar Replacement with DR:40 Procedures, Wiring Modifications and References

RETROFIT OF DR-40 RADAR UNIT INTO EXISTING DR-20 INSTALLATIONS

(USING EXISTING DR-20 BOX AND CABLE*)

(FOR NEW INSTALLATIONS OF DR-40, N451127-02XX, SEE N8.8.8 SH.14)

FIGURE (A) TYPICAL DR-20 CIRCUIT CONFIGURATION



★ RF UNIT CASE GROUNDED THROUGH 10 COND. CABLE SHIELD

⊕ COMPOSITE CABLE FROM VELAC JUNCTION BOX TO RF UNIT – FURNISHED BY U.S.&S. DIVISION.

THE DR-40 RADAR UNIT WAS DESIGNED TO BE COMPATIBLE WITH THE DR-20 UNIT. THE PHYSICAL SIZE, MOUNTING ARRANGEMENTS AND CABLE CONNECTIONS FOR THE DR-40 UNITS WERE CHOSEN SO THAT IT COULD BE MOUNTED IN AN EXISTING DR-20 ENCLOSURE WITH NO PACKAGING ALTERATIONS. THE SIGNAL INPUTS AND OUTPUTS OF THE DR-40 UNIT ARE DIRECTLY COMPATIBLE WITH THE EXISTING VELAC VRI SPEED MEASUREMENT AND CONTROL EQUIPMENT WITH A MINOR MODIFICATION OF THE RFK CONNECTION IN THE VELAC RACKS. THE MAIN DIFFERENCE BETWEEN THE UNITS IS IN THE POWER SUPPLY CONNECTIONS. A SPECIAL POWER SUPPLY IS NOT REQUIRED BY THE DR-40; FOLLOWING IS A STEP BY STEP PROCEDURE FOR RETROFITING DR-40 UNITS IN EXISTING DR-20 INSTALLATIONS

DR-40 to DR-20 RF UNIT RETROFIT INSTRUCTIONS (USING EXISTING DR-20 BOX, & CABLE*)

1) REMOVE JONES PLUG MARKED (1) IN FIGURE (B) AND RELABEL WITH TAGS SUPPLIED WITH RETROFIT PACKAGE.

1A) INSTALL RESISTOR (30), SHIELDED CABLE (25) AND LINE DRIVER WITH FREQ STD. PCB (F). FOR MORE DETAILS SEE N8.8.8 SH15.

2.) AT SELECTED LOCATION, REMOVE THE DR-20 SUB-ASSEMBLY AND REPLACE WITH DR-40 SUB-ASSEMBLY. FOLLOW INSTRUCTIONS GIVEN IN SERVICE MANUAL 6015

NOTE: THE EXTRA WIRE MUST BE REMOVED FROM THE DR-20 CABLE ASSEMBLY AS SHOWN IN FIGURE (E) & (B)

3) WIRE BX117, NX117 AND EARTH GROUND. SEE REF. (3) IN FIGURE (B), CONNECT WIRES TO RELAY RACK PER CONVERSION TABLE. SEE REF. (4) IN FIGURE (B)

4) TURN ON POWER, CHECK MIXER DIODE BIAS ACCORDING TO SERVICE MANUAL 6015

5) DR-40 RADAR WILL BE COMPLETELY OPERATIONAL.

FIGURE (B) TYPICAL DR-40 RETROFIT TO DR-20 CIRCUIT CONFIGURATION

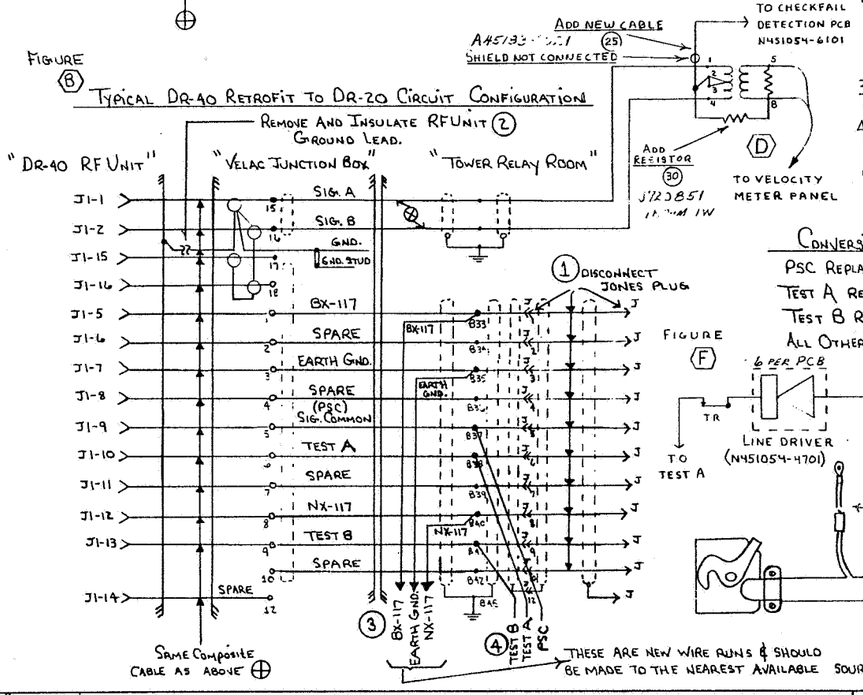
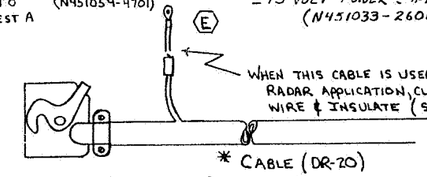


FIGURE (F)

JUMPER PINS 16 AND 11 ON FREQ STD. PCB. (UN451054-4601)

±15 VOLT POWER SUPPLY REQUIRED (N451033-2601)

(E)



WHEN THIS CABLE IS USED IN A DR-40 RADAR APPLICATION, CUT THIS GROUND WIRE & INSULATE (SEE REF. (2) IN FIGURE (B))

* CABLE (DR-20)
PC.# REF. N380657 10 FT. 8 IN.
N380658 5 FT. 8 IN.

CONVERSION TABLE (4)

PSC REPLACES PSC
TEST A REPLACES BX3.5
TEST B REPLACES FSC
ALL OTHER TERMINALS ARE UNCONNECTED.

ORDERING REFERENCE

RETROFIT CHASSIS "N451128-0802" - DWG. F451128-SH.8
CONSISTS OF:
1 GUNN DIODE CHASSIS N451128-0801 - DWG F451128 - SH. 8
1 SERVICE MANUAL SM6015 PER G.D. REQUIREMENT
4 SCREWS - 10-32 x 1/2 BOGH JO50980
4 WASHER - 10 SPL M1060-75 JO47733
4 WASHER M073129-007826 - SH. 180
3 TAG JO75824-0071 (BX117)
3 TAG JO75824-0072 (SPARE-6)
3 TAG JO75824-0073 (EARTH GND)
3 TAG JO75824-0074 (SPARE-8)
3 TAG JO75824-0075 (SIG. COMMON)
3 TAG JO75824-0076 (TEST A)
3 TAG JO75824-0077 (SPARE-11)
3 TAG JO75824-0078 (NX-117)
3 TAG JO75824-0079 (TEST B)
PLACED IN A CLOTH PARTS BAG J65003 AND TIED TO CHASSIS.

REVISIONS: REVISED ABOVE FIGURES (B) AND (E) AT SEE STEP 1A. LWJ 10-23-78

THE OPERATION OF THE CIRCUITS AND EQUIPMENT REPRESENTED HEREON CANNOT BE FINALLY CHECKED UNTIL CONNECTED TO FORM A COMPLETE SYSTEM OR A SECTION OF SUCH A SYSTEM. SUCH SYSTEM OR SECTION MUST UNDERGO CIRCUIT CONTACT SELECTION (BREAKDOWN) AND SERVICE (OPERATION) TESTS PRIOR TO BEING PLACED INTO REGULAR SERVICE.

SIGNAL & COMMUNICATIONS DIVISION
WESTINGHOUSE AIR BRAKE COMPANY PITTSBURGH, PA. 15218

REFERENCES: SERVICE MANUAL 6015

SCALE: G.O.
DESIGNED: RAB 5-6-75
DRAWN:
TRACED:
CHECKED: 5-12-7
O K FOR WIRING

EQUIPMENT CHARACTERISTICS AND APPLICATION NOTES

APPROVED: William L Ricketts 5/12/75 DATE

SH. 17 CONT'D ON

WABCO SIGNAL & COMMUNICATIONS DIVISION WESTINGHOUSE AIR BRAKE COMPANY PITTSBURGH, PA. 15218

N8.8.8

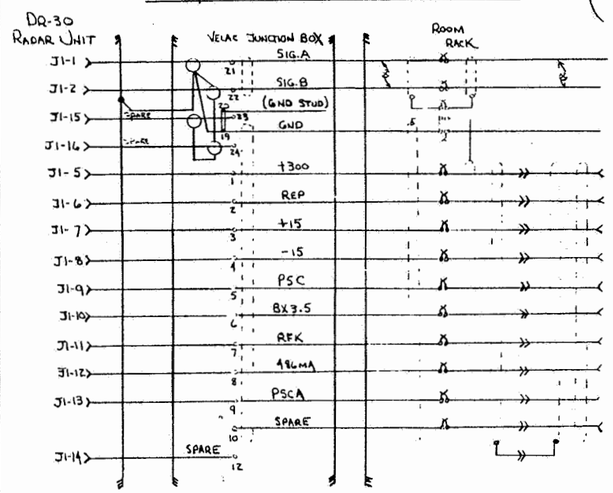
DR-40 TO DR-20 RETROFIT

Figure 10-3. DR-20 to DR-40 Retrofit Procedures, Wiring Modifications and References.

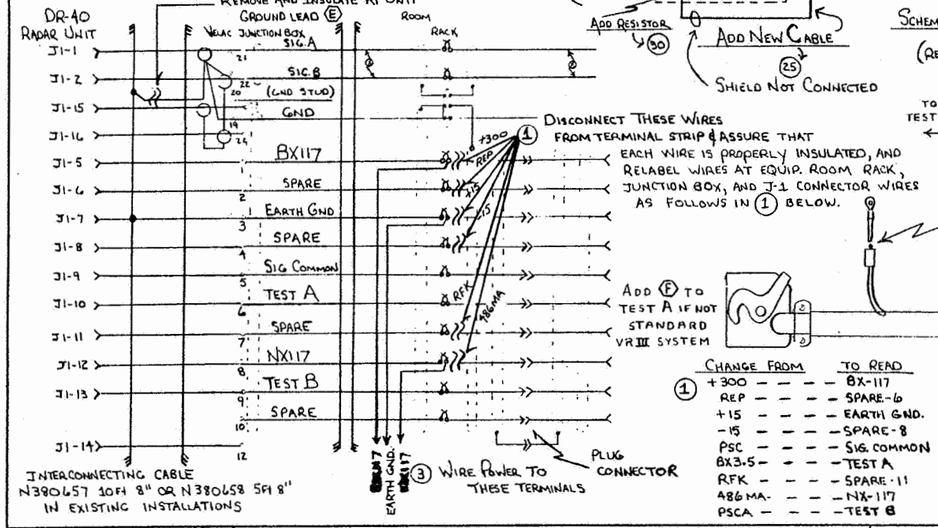
"RETROFIT OF DR-40 RADAR UNIT INTO EXISTING DR-30 INSTALLATION"

(DR-40 CHASSIS IN DR-30 BOX, FOR NEW INSTALLATIONS OF DR-40, "N451127-02XX" SEE N8.8.8 SH.14)

(A) TYPICAL DR-30 CIRCUIT CONFIGURATION

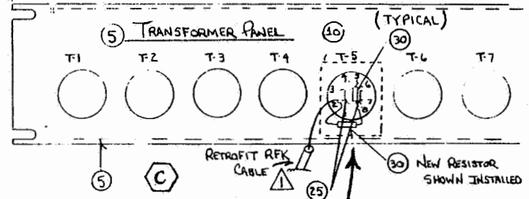


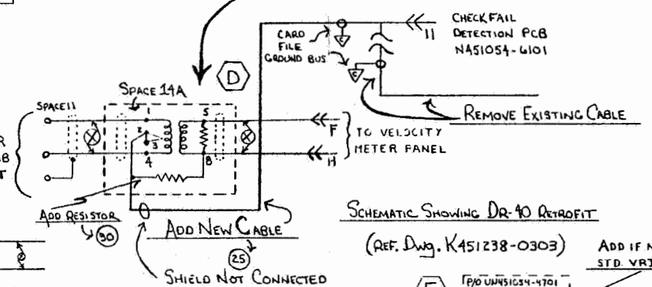
(B) "TYPICAL DR-40 RETROFIT TO DR-30 CIRCUIT CONFIGURATION"



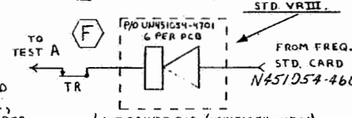
(5) M451198-0901 PANEL
(10) J730910 TRANSFORMER
(25) A043180 WIRE #19 BARE TINNED
(30) J720851 RESISTOR, 1K, 1W

STD. VRIII.
"SPACE 14A"





SCHEMATIC SHOWING DR-40 RETROFIT
(REF. DWG. K451238-0303)



ADD (F) TO TEST A IF NOT STANDARD VRIII SYSTEM

CABLE (DR-30)
PT. # REF. N380657 10FT. 8 IN.
N380658 5FT. 8 IN.

CHANGE FROM	TO READ
(1) +300	BX-117
REP	SPARE-6
+15	EARTH GND.
-15	SPARE-8
PSC	SIG. COMMON
8X3.5	TEST A
RFK	SPARE-11
486 MA.	NX-117
PSCA	TEST B

THE DR-40 RADAR UNIT WAS DESIGNED TO BE COMPATABLE WITH THE DR30 UNIT. THE PHYSICAL SIZE, MOUNTING ARRANGEMENTS AND CABLE CONNECTIONS FOR THE DR-40 UNITS WERE CHOSEN SO THAT IT COULD BE MOUNTED IN AN EXISTING DR-30 ENCLOSURE WITH NO PACKAGING ALTERATIONS. THE SIGNAL INPUTS AND OUTPUTS OF THE DR-40 UNIT ARE DIRECTLY COMPATIBLE WITH THE EXISTING VELAC VRIII SPEED MEASUREMENT AND CONTROL EQUIPMENT WITH A MINOR MODIFICATION OF THE RFK CONNECTION IN THE VELAC RACKS. THE MAIN DIFFERENCE BETWEEN THE UNITS IS IN THE POWER SUPPLY CONNECTIONS. A SPECIAL POWER SUPPLY IS NOT REQUIRED BY THE DR-40. FOLLOWING IS A STEP BY STEP PROCEDURE FOR RETROFITING DR-40 UNITS IN EXISTING DR-30 INSTALLATIONS.

DR-40 to DR-30 RF UNIT RETROFIT INSTRUCTIONS

1. REMOVE AND INSULATE WIRES MARKED "(1)" IN FIGURE (B)
2. INSTALL A 1KΩ, 1 WATT CARBON RESISTOR (J720851) ACROSS TERMINALS 2 AND 8 ON SIGNAL TRANSFORMER(S), LOCATED ON TRANSFORMER PANEL (5) IN RACK POSITION 14A, FIGURE (C)
3. ⚠ CONNECT THE CENTER LEAD OF A LENGTH OF SINGLE CONDUCTOR SHIELDED CABLE (A45183-0021 BLACK #22 SHIELDED OR EQUIVALENT) TO PIN 2 OF THE RETROFIT SIGNAL TRANSFORMER(S). PROPERLY DRESS THE SHIELD(S) OF THESE CABLE(S) TO INSULATE THEM AS THEY ARE NOT CONNECTED AT THE TRANSFORMER END. FIGURE (C)
4. ON THE CHECK FAIL DETECTION PCB (N451054-6101), THAT IS USED TO MONITOR THE RETROFITTED RADAR LOCATION(S), REMOVE THE SHIELDED WIRE CONNECTED TO PIN 11 AND CARDFILE GROUND BUSS AT RACK LOCATION. FIGURE (D)
5. WIRE THE NEW SHIELDED CABLE(S), PREVIOUSLY CONNECTED TO THE RETROFIT RADAR SIGNAL TRANSFORMER(S) ⚠, TO PIN 11 AND SHIELD TO CARD FILE GROUND BUSS ON THE ASSOCIATED CHECK FAIL DETECTION PCB, (N451054-6101). ALSO SEE (F).
6. AT THE SELECTED LOCATION, REMOVE THE DR-30 SUB-ASSEMBLY AND REPLACE WITH DR-40 SUB-ASSEMBLY. FOLLOW INSTRUCTIONS GIVEN IN SERVICE MANUAL 6015.

NOTE: THE EXTRA WIRE MUST BE REMOVED FROM THE DR-30 CABLE ASSEMBLY AS SHOWN IN FIGURE (E).

7. WIRE BX117, NX117, AND EARTH GROUND. SEE REF. (3) IN FIGURE (B)
8. TURN ON POWER, CHECK MIXER DIODE BIAS ACCORDING TO SERVICE MANUAL 6015
9. DR-40 RADAR WILL BE COMPLETELY OPERATIONAL.

ORDERING REFERENCE

N451128-0802 RETROFIT CHASSIS
DWG. F451128 SH-8

DR40 to DR-30 RETROFIT

REVISIONS		
	REVISED TO AGREE WITH PRODUCTION DRAWINGS 1362390-11	RAB 11-25-74
	REVISED "ONE FROM 4 TO READ" ADDED TAGS ADDED TO ORDERING REF.	RAB 4-15-75
	REVISED ADDED FIGURE (F) AND ALSO SEE (F) STEP 3 OF INSTRUCTIONS	LWJ 10-23-75

THE OPERATION OF THE CIRCUITS AND EQUIPMENT REPRESENTED HEREON CANNOT BE FINALLY CHECKED UNTIL CONNECTED TO FORM A COMPLETE SYSTEM OR A SECTION OF SUCH A SYSTEM. SUCH SYSTEM OR SECTION MUST INCLUDE: CIRCUIT CONTACT SELECTION (INTERLOCKING) AND SERVICE (OPERATIONAL) TESTS PRIOR TO BEING PLACED INTO REGULAR SERVICE.

UNION SWITCH & SIGNAL DIVISION
WESTINGHOUSE AIR BRAKE COMPANY PITTSBURGH, PA. 15218

REFERENCES: SERVICE MANUAL 6015

SCALE: E.O. — DRAWN — TRACED — CHECKED — O K FOR WIRING — DATE 11-8-74 — 11-26-74

EQUIPMENT CHARACTERISTICS AND APPLICATION NOTES

WABCO UNION SWITCH & SIGNAL DIVISION
WESTINGHOUSE AIR BRAKE COMPANY PITTSBURGH, PA. 15218

APPROVED DATE: William L. Pelnik 11/8/74
SH. 15 CONT'D ON —
N8.8.8

Figure 10-4. DR-32 and DR-40 Retrofit Procedures, Wiring Modifications and References.