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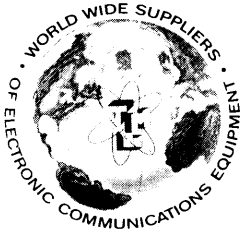
## **TECHNICAL MANUAL**

### **LF/MF/HF Vertical Receiving Antenna**

#### **VRA Series**

**(Models VRA-5, VRA-6, VRA-7, VRA-8, VRA-9, VRA-10)**

**The Technical Materiel Corporation**  
700 Fenimore Road  
Mamaroneck, New York 10543-0142 U.S.A.



**PLEASE READ THIS FIRST**

Dear **TMC** Product User:

Thank you for purchasing the TMC Model VRA Vertical Receiving Antenna. This antenna provides antenna and RF impedance matching to a monitor receiver operating in one of three frequency ranges. The VRA-5 and VRA-8 models operate from 200 to 800KHz; the VRA-6 and VRA-9 models operate from 2 to 32MHz; and the VRA-7 and VRA-10 models operate from 3 to 15MHz. Two basic types of antenna are used: a telescopic-type aluminum antenna and a multi-section fiberglass antenna. The type of antenna is dependent on the VRA model selected.

The vertical antenna is described in detail in the enclosed technical manual. Product bulletins and application notes, as appropriate to the VRA series, are also included. These publications provide important information about using TMC equipment. Please read them.

Since the VRA series require mating connectors and coaxial cables to operate properly, a catalog on TMC's connector products is included. If you need additional data or some specific technical information, please give our Customer Service a call at (914) 698-4800 or return the business reply card provided in this package. Our FAX (facsimilie) number is (914) 698-4805 and our TELEX number is 137-358 TECHMAT MECK.

If you are missing any items, please contact TMC directly or through your local sales office.

Thank you for selecting the VRA series of vertical receiving antennas.

**The Technical Materiel Corporation**

Product Marketing

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### **LF/MF/HF Vertical Receiving Antenna**

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## Warranty

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The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment - except electron tubes, semi-conductor devices, fuses, lamps, batteries, and articles made of glass or other fragile or expendable materials - purchased hereunder to be free from defect in workmanship and materials under normal use and service, when used for the purposes for which the same is designed, for a period of ONE YEAR from the date of delivery FOB factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, FOB factory, which may fail within the stated warranty period, provided:

- Any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction;
- The defect is not the result of damage incurred in shipment from or to the factory;
- The equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise; and
- Any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

At TMC's option, any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid and the TMC RETURN AUTHORIZATION number clearly marked on the package. Electron tube warranty claims should be made directly to the manufacturer of such tubes since tubes furnished by TMC bear only the manufacturer's warranty.

No warranties, expressed or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the purchaser's sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of such equipment, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

All inquiries should be directed to the following:

### **THE TECHNICAL MATERIEL CORPORATION**

Customer Service  
700 Fenimore Road  
Mamaroneck, New York 10543 U.S.A.

Telephone 914-698-4800  
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Telex 137-358 TECHMAT MECK



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# LF/MF/HF VERTICAL RECEIVING ANTENNA

## VRA Series

Product Bulletin 103035

- **Multiple Operating Ranges:**

- > 15 to 300KHz
- > 100KHz to 30MHz
- > 200 to 800KHz
- > 2 to 30MHz
- > 3 to 15MHz

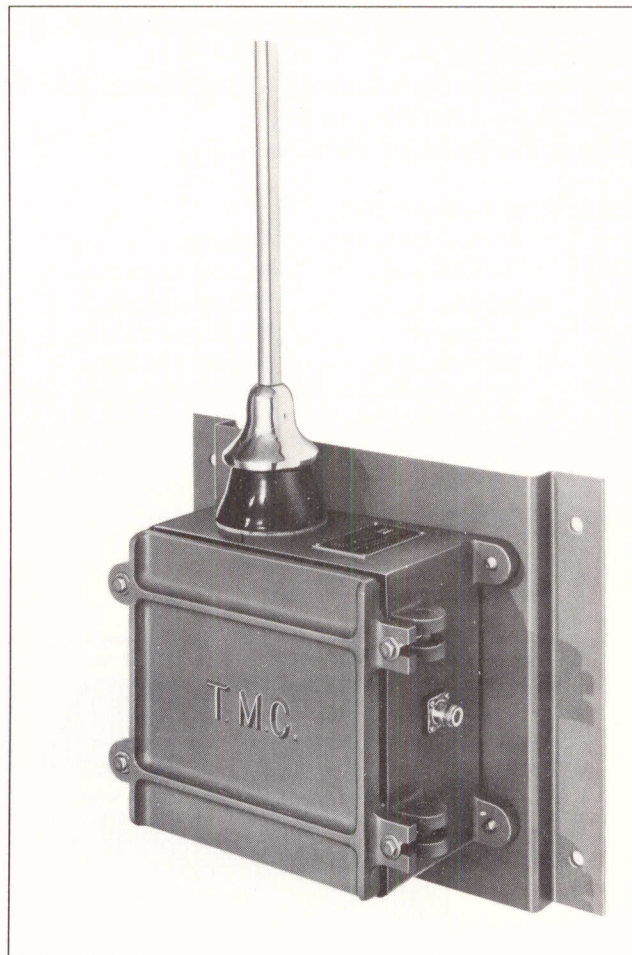
- **Broadband - No Tuning**

- **Flat Response Curve**

- **Weatherproofed Case**

The VRA Series of vertical receiving antennas are used in all practical communication systems, whether on shipboard, in fixed shore stations, or on transportable facilities. The immediate adaptability of this high-capacity RF antenna system to all environments in both military and commercial applications is readily apparent. The VRA series offer immediate installation by a single, untrained individual. They can be dis-assembled quickly and stored in a compact "fly-away" case. Both aluminum and fiberglass whips are available and can be supplied to suit any environmental operating condition. The fiberglass models in particular are multi-section with embedded parallel copper wires to simulate a cylinder. Extra epoxy is added to prevent corrosion and maximize strength since these free-standing whips must often withstand winds up to 100mph (166km/h).

Users are given added flexibility with these units since the unbalanced RF coaxial cables used at receiver sites are easier to install and re-route. They can easily be terminated on switching patch panels, such as the QDS Series of Connector Products manufactured by TMC. The ap-



Model VRA-6

propriate RF path can then be selected either to the antenna, a receiving multicoupler or a receiver. The frequency response of the matching unit is flat within  $\pm 1.5$ dB over the operating range. Field tests show that the compensating networks significantly improve the overall electrical characteristics of the antenna. It should be noted that matching any impedance over a wide frequency range is of necessity a compromise. Consequently, the VRA Series was designed to provide an optimum match near the center of the band with less efficiency noted at

the high and low ends. Typical response curves for the antennas are depicted on the next page. This well-engineered TMC product requires minimal maintenance to perform consistently within specification over its service life. The broadband matching transformers are individually sealed and securely anchored in rugged, weatherproof cases that are constructed of cast aluminum alloys to assure protection from hostile environments. In the event of damage to the transformer, they are easily replaced in the field by removal of mounting screws.



## TECHNICAL SPECIFICATIONS

**Frequency Range** 10KHz to 32MHz, based on model  
**Nominal Gain** +1dB except at 1/4-wave points.  
**Impedance** Matches into 70 ohms nominal  
**RF Fittings** See Unbalanced Connector Assemblies  
**Equipment Case** All-weather cast aluminum  
**Mounting** Bulkhead or pole mount using four heavy-duty cast mounting flanges  
**Safety Feature** Spark gap for protection from lightning/static discharge  
**Case Dimensions** 9H x 11.5W x 5.5D inches, 27 lbs. 22.9H x 29.2W x 14D cm, 12.3Kg.  
**Operating Temperature** -40oC to +75oC

## ORDERING INFORMATION

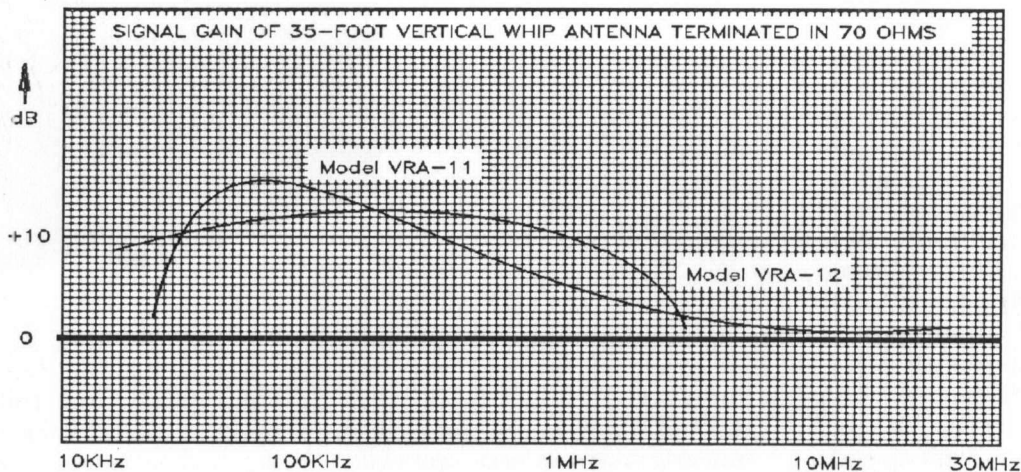
Model	Frequency Range	Antenna
VRA-5	200-800KHz	18-foot Aluminum
VRA-6	2-32MHz	18-foot Aluminum
VRA-7	3-15MHz	35-foot Aluminum
VRA-8	200-800KHz	16-foot Fiberglass
VRA-9	2-32MHz	16-foot Fiberglass
VRA-10	3-15MHz	32-foot Fiberglass
VRA-11	100KHz-30MHz	35-foot Fiberglass
VRA-12	15-300KHz	35-foot Fiberglass
VRA-13	500KHz-30MHz	32-foot Fiberglass

## REPLACEMENT TRANSFORMERS

TR042	For VRA-5, VRA-8
TR044	For VRA-6, VRA-9
TR080	For VRA-11, VRA-13
TR081	For VRA-12
TR160	For VRA-7, VRA-10

## UNBALANCED CONNECTOR ASSEMBLIES

Option 283-1	BN type
284-1	BNC type
286-1	C type
285-1	HN type
287-1	LC type/50-ohm
287-5	LC type/70-ohm
259-1	N type
273-1	QDL type
289-1	QDS type
281-1	UHF type
282-1	UHF-Twin type
256-1	UHF (L) type
274-1	RG-85U Coax Flange
276-1	3-1/8" EIA to LC adapter/50-ohm
277-1	3-1/8" EIA to LC adapter/70-ohm
5875	7/8" Styroflex End Seal/50-ohm
7875	7/8" Styroflex End Seal/70-ohm



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## Section 1 - General Description

### 1.1 Functional Description

#### 1.1.1 Overview

The VRA Series of Vertical Receiving Antennas are vertical receiving whip antenna units that are used in installations where a convenient broadband device is needed to provide an antenna and impedance match to a monitor receiver operating over a wide receiving range in the LF, MF and HF spectrum.

#### 1.1.2 Models VRA-5 and VRA-8

The VRA-5 and VRA-8 are vertical receiving antennas with impedance matching devices that are used with receivers operating in the 200-800KHz frequency range. The VRA-5 antenna consists of 18 feet of seamless aluminum tubing in three sections that telescope into one another to reduce the overall size of the antenna when transporting it. The VRA-8 antenna consists of 16 feet of fiberglass rod in four sections that are joined by screw threads.

#### 1.1.3 Models VRA-6 and VRA-9

The VRA-6 and VRA-9 are vertical receiving antennas with impedance matching devices that are used with receivers operating in the 2-32MHz frequency range. The VRA-6 uses the same antenna as the VRA-5, which consists of 18 feet of seamless aluminum tubing in three sections that telescope into one another to reduce the overall size of the antenna when transporting it. The VRA-9 uses the same antenna as the VRA-8, which consists of 16 feet of fiberglass rod in four sections that are joined by screw threads.

#### 1.1.4 Models VRA-7 and VRA-10

The VRA-7 and VRA-10 are vertical receiving antennas with impedance matching devices that are used with receivers operating in the 3-15MHz frequency range. The VRA-7 antenna consists of 35 feet of seamless aluminum tubing in six sections that telescope into one another to reduce the overall size of the antenna when transporting it. The VRA-10 antenna consists of 32 feet of fiberglass rod in two sections that are joined by screw threads.

#### 1.1.5 Typical Frequency Response

The coupling transformer in the models VRA-5 and VRA-8 has a frequency response which is flat within  $\pm 1.5$ dB over the operating range. However, it is important to remember that impedance matching over such a wide frequency range, using a fixed-length antenna, is of necessity a compromise. In this case, the optimum match is provided at 400KHz and the efficiency on either side of this point is somewhat less. Similar matching at an optimum point is provided in the other models.

## **1.2 Physical Description**

### **1.2.1 General**

The VRA whip antenna systems consist of a broadband impedance matching transformer coupling an aluminum or fiberglass whip antenna to a weatherproof connector receptacle. It is housed in a weather-resistant cast-aluminum alloy case. An internal spark gap assembly is incorporated to provide protection of the receiver and personnel from lightning hazards. Connection of the VRA to a receiver is made through a standard weatherproof connector receptacle mounted on the side of the case. A mating cable connector can be provided for connection to an unbalanced coaxial cable from the VRA to the monitor receiver.

### **1.2.2 Major Assemblies**

The antenna consists of two basic assemblies: the antenna rod and the impedance matching circuits housed in a weather-resistant case. Depending on the model selected, the antenna can be a free-standing fiberglass whip, a free-standing aluminum whip, or a guyed aluminum whip. The aluminum antennas are telescopic (one section is inserted into the larger section preceding it) and the fiberglass antennas are provided in sections that screw securely together.

### **1.2.3 Impedance Characteristics**

The characteristic impedance of the VRA is 50 ohms. Optionally, 70-ohm impedance units can be provided.

### **1.2.1 Equipment Mounting**

The VRA can be mounted with a plate assembly attached to it, facilitating attachment to a bulkhead, or with steel strap for pole mounting. Due to the placement of the input and output connectors, the case may also be mounted vertically on a horizontal plate for roof-top mounting.

## 1.3

### Technical Specifications

#### Frequency Range

Model VRA-5 and VRA-8	200-800KHz	Transformer: TR042
Model VRA-6 and VRA-9	2-32MHz	Transformer: TR044
Model VRA-7 and VRA-10	3-15MHz	Transformer: TR160

#### Frequency Response

Model VRA-5 and VRA-8	Flat within +/-1.5dB, Optimum match at 400KHz
Model VRA-6, VRA-7, VRA-9 and VRA-10	Flat with +/-1.5dB over range.

#### Output Impedance

Nominal 50 ohms, unbalanced. 70 ohms is available. See Section 1.4 for connectors. Standard connector provided is N-type (AX259-1).

#### Mean-Time-Between-Failure

Nominally 50,000 hours per RADC reliability tables.

#### Antenna

Vertical aluminum or fiberglass sections that extend to 16, 32 or 35 feet depending on the model VRA selected. (See chart).

### Operating Features

#### Cooling

Convection, no fans or moving parts

#### Ambient Conditions

0°C to +50°C; Up to 95% R.H. Storage -30°C to +80°C

#### Size and Weight

9.25H x 11.25W x 5.75D inches, 27lbs/12.3Kg

Antenna mount, including insulator assembly and post, adds 8 inches to height.

#### Shipping Weight

50 pounds, 2.3 cu.ft.

### Special Features

#### Safety

Receiver and personnel protection by means of adjustable internal spark gap, preventing circuit failure from high voltages at the input..

#### Components and Construction

Totally solid state circuits mounted to an all-weather aluminum alloy case. External hardware is stainless steel.

## 1.4

### VRA Product Group

VRA-5	Vertical Receiving Antenna, 200-800KHz	18-foot Aluminum mast
VRA-6	Vertical Receiving Antenna, 2-32MHz	18-foot Aluminum mast
VRA-7	Vertical Receiving Antenna, 3-15MHz	35-foot Aluminum mast
VRA-8	Vertical Receiving Antenna, 200-800KHz	16-foot Fiberglass mast
VRA-9	Vertical Receiving Antenna, 2-32MHz	16-foot Fiberglass mast
VRA-10	Vertical Receiving Antenna, 3-15MHz	32-foot Fiberglass mast
VRA-11	Vertical Receiving Antenna, 100KHz-30MHz	35-foot Fiberglass mast
VRA-12	Vertical Receiving Antenna, 15-300KHz	35-foot Fiberglass mast

#### 50-Ohm Connector Options:

- 256-1 UHF(L) Type connector assembly
  - 259-1 N Type connector assembly
  - 274-1 RG-85U coaxial flange assembly
  - 276-1 3-1/8" EIA to LC Type adapter assembly
  - 281-1 UHF Type connector assembly
  - 282-1 UHF Twin Type connector assembly
  - 283-1 BN Type connector assembly
  - 284-1 BNC Type connector assembly
  - 285-1 HN Type connector assembly
  - 286-1 C Type connector assembly
  - 287-1 LC Type connector assembly
  - 289-1 QDS Type connector assembly
  - 875-1 7/8" Styroflex end seal assembly
- Other connectors are available to suit specific applications.

#### 70-Ohm Connector Options:

- 277-1 3-1/8" EIA to LC Type adapter assembly
  - 287-5 LC Type connector assembly
  - 875-2 7/8" Styroflex end seal assembly
- Other connectors are available to suit specific applications.

**When ordering, specify both model and option. Example: VRA-6/259-1**

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## Section 2 - Installation

### 2.1 Initial Inspection

#### 2.1.1 General

Every VRA undergoes a thorough testing and calibration prior to shipment. Upon receipt of the unit, check the packing case and its contents for obvious damage. Unpack the equipment carefully to reduce the risk of damage and to avoid misplacing any parts shipped as loose items. See Table 2.1 for a list of the loose items.

#### 2.1.2 Damage By Carrier

With respect to equipment damage for which the carrier is liable, TMC will assist in describing methods of repair as well as furnishing replacement parts.

### 2.2 Electrical Installation

#### 2.2.1 Antenna

The antenna is extended or attached in sections, depending on the model selected. The fiberglass sections are screwed together while the aluminum sections are extended and secured by turning the bushings located along its length. Once extended, the antenna rod must be inserted onto the antenna post located on the top of the antenna case. Align the holes at the base of the rod with the holes on the post. Anchor the antenna with the bolts provided by inserting the bolts in the holes at right angles to each other.

#### 2.2.2 Ground

Connect the outer case to a good physical ground, preferably a simple counter-poise or at least one eight-foot, copper ground rod imbedded in moist earth. The connector assembly on the side of the case is normally the best location to attach this ground.

#### 2.2.3 Output

Connect the output of the VRA to the associated receiver via the RF connector mounted on the side of the case. An RF coaxial cable, terminated with the proper mating connector, is required for this connection. See Figures 3.1 and 3.2 for schematic diagrams depicting the electrical connections required for the antenna.

### 2.3 Mechanical Installation

The VRA is designed for mounting on a wall, roof, pole or vehicle. For pole mounting, two straps and the necessary lag bolts are provided as optional hardware. For vertical plane mounting or horizontal plane mounting, a universal mounting plate is provided. This is the configuration provided for in the standard VRA. Figures 2.1 and 2.2 depict installation details and outline dimensions, respectively, and should be studied to determine the best mounting for the desired location of the antenna.

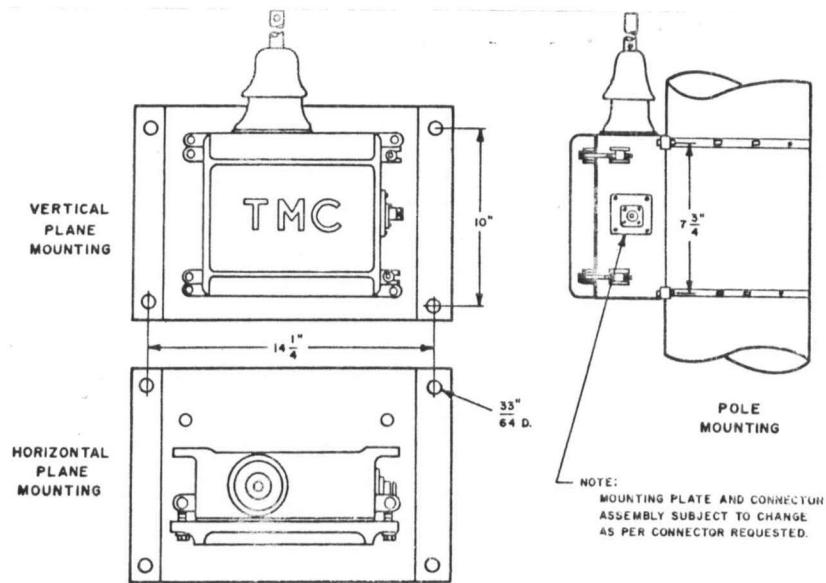


Figure 2.1 VRA Installation Diagram

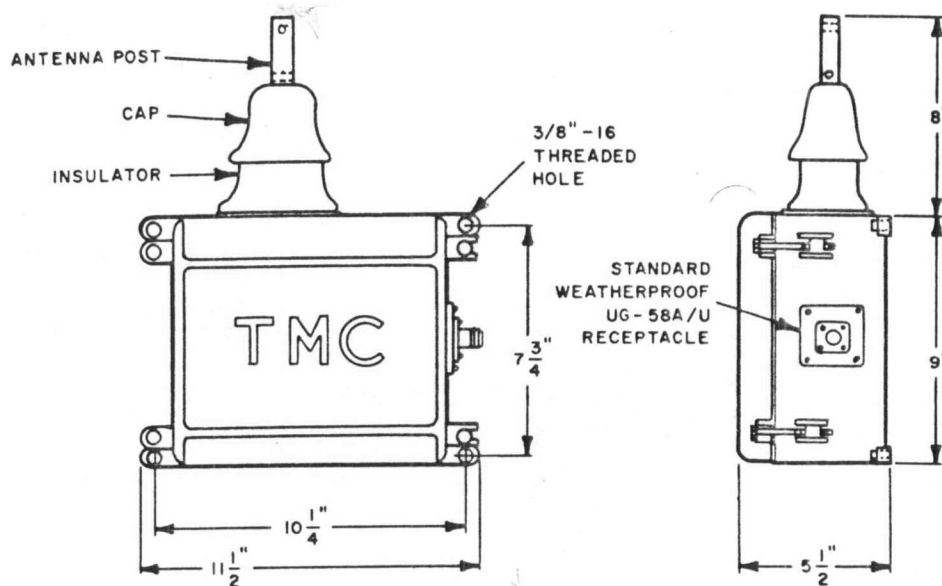


Figure 2.2 VRA Outline Dimensional Drawing

## 2.4 Performance Check

When the appropriate electrical connections have been made to the VRA, it is fully operational and ready for immediate operation. Since all components are fixed, no adjustments are needed and no further checks are required.

**Table 2.1 - Loose Items Supplied**

LW537MSS	Split Washer	4 each
MS543	Plate Mounting Unit	1 each
MS619	Brackets for Mounting Unit	4 each
SC111-2	Lag Bolts	16 each
SCHH3716	Machine Bolts	4 each
203035	Technical Manual	1 each
UGxxx/U	Mating Connector	Optional extra



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## Section 3 - Maintenance

### 3.1 General

#### 3.1.1 Test Equipment Requirements

This section describes preventive maintenance, trouble-shooting and repair procedures for the VRA. The following equipment is suggested in order to perform these procedures properly:

- RF Signal Generator, H/P Model 651B or equivalent
- Standard Volt-Ohmmeter

#### 3.1.2 Component Location

For aid in the location of components, refer to Figure 4.1.

### 3.2 Preventive Maintenance

#### 3.2.1 General Cleaning Methods

Preventive maintenance for the VRA consists of routine functions such as visual inspection and cleaning. Periodic cleaning is recommended as dust may build up on components, reducing the unit's efficiency and possibly causing circuit failure. To facilitate cleaning, use a vacuum cleaner or a low-pressure filtered compressed-air supply.

#### 3.2.2 Visual Check and Adjustment

A simple visual check of the unit when it is opened up for servicing or cleaning will often reveal potential trouble spots and thereby reduce downtime due to component failure. Signs of trouble may be found in discoloration, brittle or cracked O-ring seals and damaged wiring or cables. Any deteriorating component should be replaced immediately. All hardware should be checked during preventive maintenance inspections.

#### 3.2.3 Dessicant Replacement or Restoration

The dessicant package, held in place inside the antenna case by a flexible metal strap, should be changed every six months. If this is not possible, the bag should be removed from the case and dried in an oven for one hour at a temperature of 250°F.

#### 3.2.4 Spark Gap Setting

To maintain proper protection of the VRA, the spark gap needle should be checked for spacing between its tip and the circular metal wafer at the base of the antenna post. It should be adjusted by loosening the set screw on its support post and positioning the needle no greater than 1/32 inches (0.032") from the wafer. Make certain the set screw on the post is tightened after the needle is adjusted.

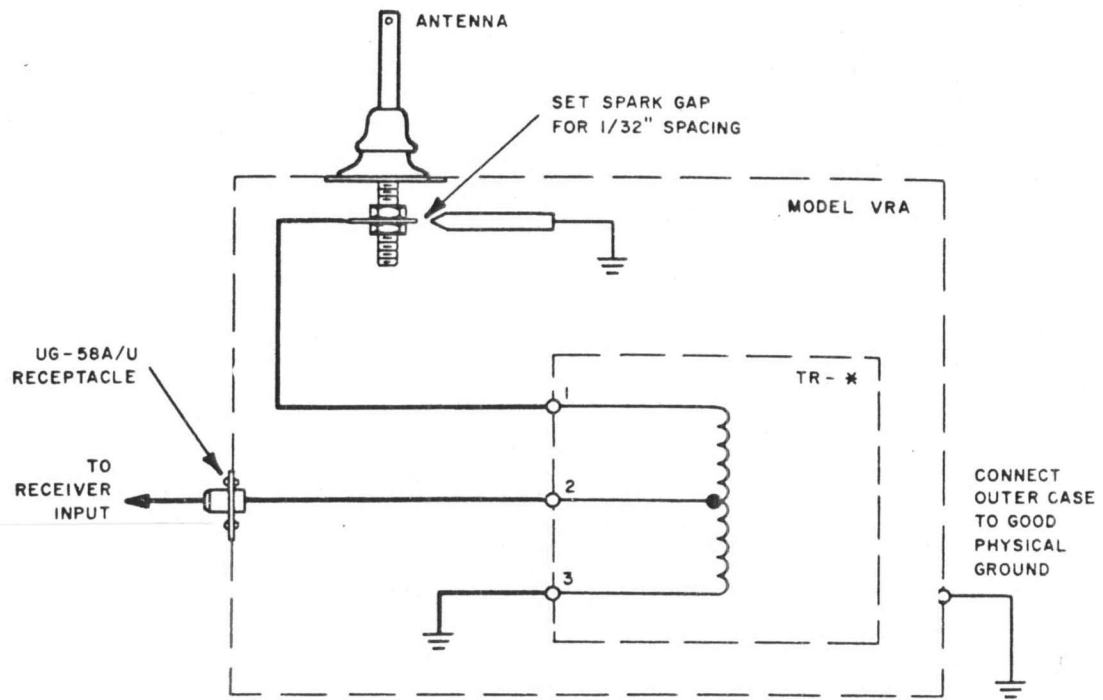


Figure 3.1 Simplified Schematic Diagram, Typical

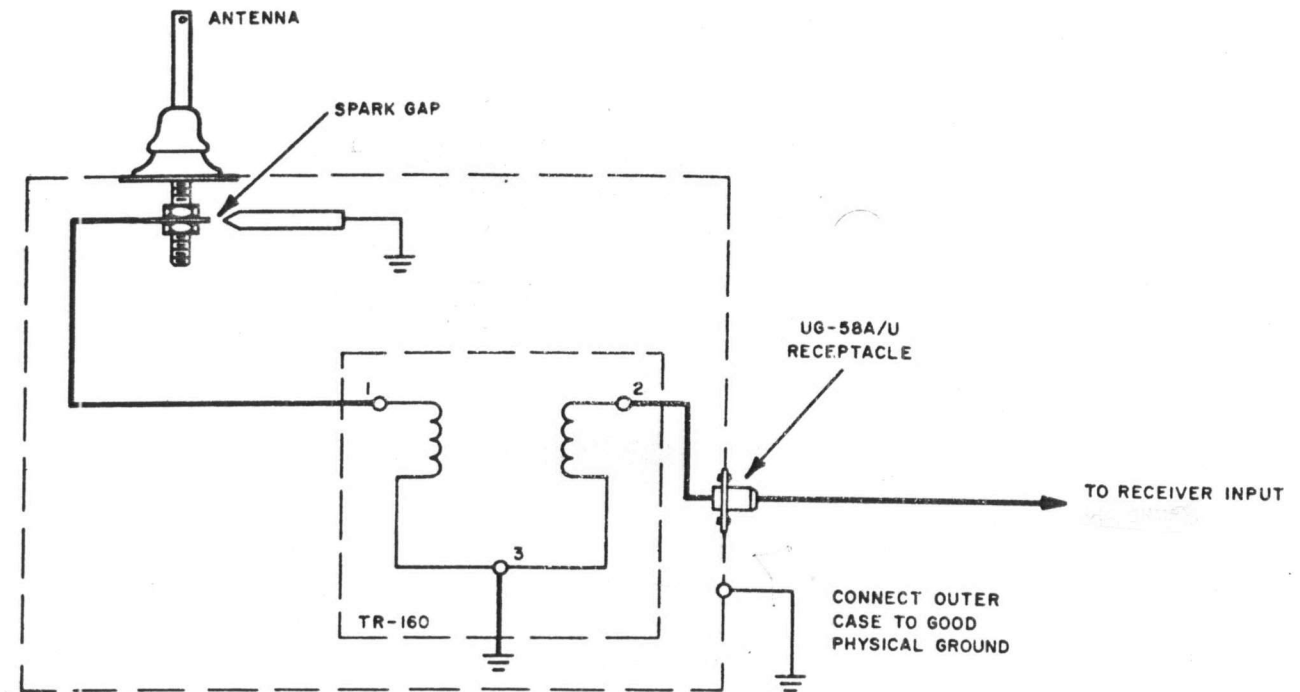


Figure 3.2 Simplified Schematic Diagram, VRA-7 and VRA-10

### 3.3 Troubleshooting

#### 3.3.1 General Failure Symptoms

During operation of the VRA, the following failure symptoms may be observed:

- No signal output from receiver.
- Weak or noisy signals in receiver.

#### 3.3.2 Fault Localization

The primary objective of the troubleshooting procedure is to localize the fault to a particular section of the coupler unit. Table 3.1 provides a guide to locating and correcting the possible failures. Figures 3.1 through 3.5 are useful in taking voltage measurements on the VRA series as a means for determining the electrical condition of the matching transformer.

**Table 3.1 - Troubleshooting Procedures**

**Symptom: No signal output at receiver**

Possible Cause:	Receiver failure
Remedial Action:	Refer to receiver manual
Possible Cause:	Interconnection, antenna to receiver
Remedial Action:	Check the RF cable between the receiver and antenna
Possible Cause:	Failure of matching transformer
Remedial Action:	Replace matching transformer (See Parts List, Section 4)

**Symptom: Weak or noisy signals to receiver**

Possible Cause:	Antenna fault
Remedial Action:	Check for a fault in the antenna system where it is anchored to the antenna post. Connections should be free of any dirt.
Possible Cause:	Faulty matching transformer
Remedial Action:	If the cause is not attributable to the antenna, possible failure of a component in the matching transformer is indicated. Removal, testing and repair of the transformer assembly will be necessary. Testing is accomplished with the test set-ups depicted in Figures 3.3, 3.4 and 3.5.
Possible Cause:	Receiver noise
Remedial Action:	Refer to receiver manual
Possible Cause:	Interconnection, antenna to receiver
Remedial Action:	Check the RF cable between the antenna and receiver.

### **3.4 Repair**

Repair work generally consists of replacing the defective component. The following cautions should be observed:

- Make sure the replacement component is an exact duplicate of the defective one. This is particularly important in the amplifier modules.
- Place any new component in the same location as the component it replaces. The dressing of any wire runs should not be altered.
- Observe standard practice when replacing semiconductor components by using a low-wattage soldering iron and appropriate heat-sink tools.
- Avoid damage to the printed circuit wiring when handling or repairing amplifier and regulator modules.

### **3.5 Adjustments**

The antenna does not require any adjustment since all components are of fixed values. Note that the spark gap must be set at 1/32" before returning the antenna to service.

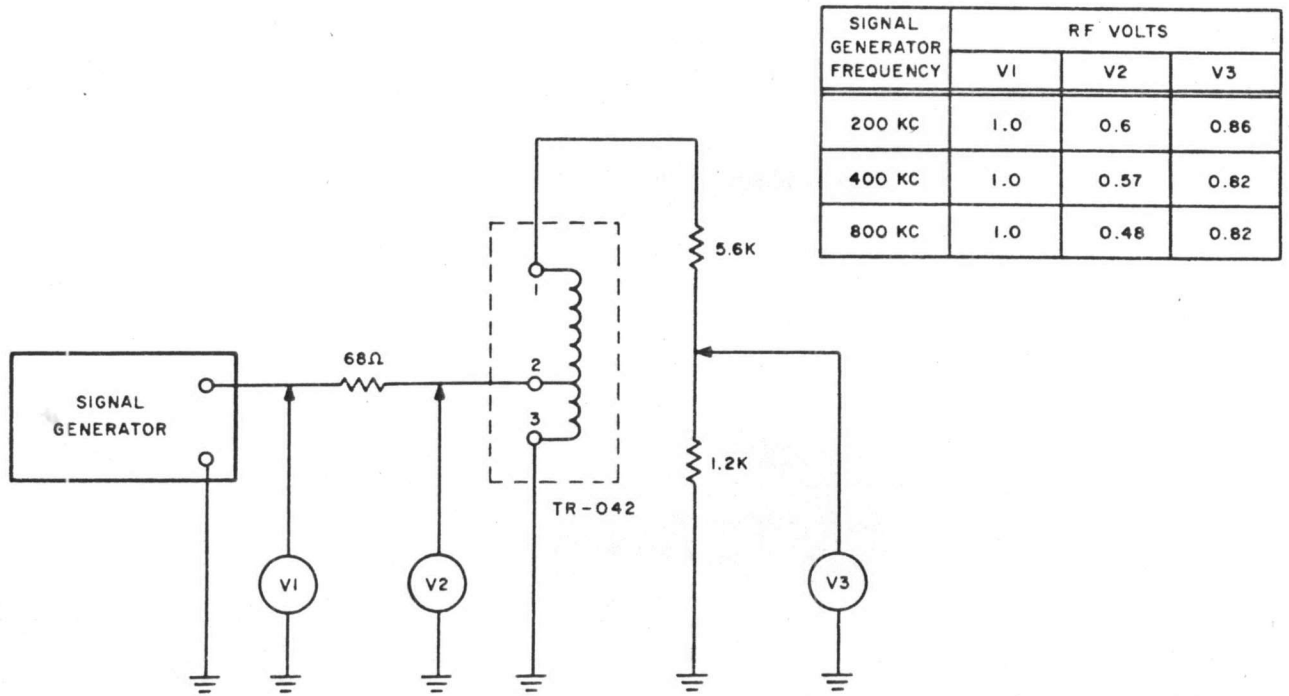


Figure 3.3 Test Set-Up, VRA-5 and VRA-8

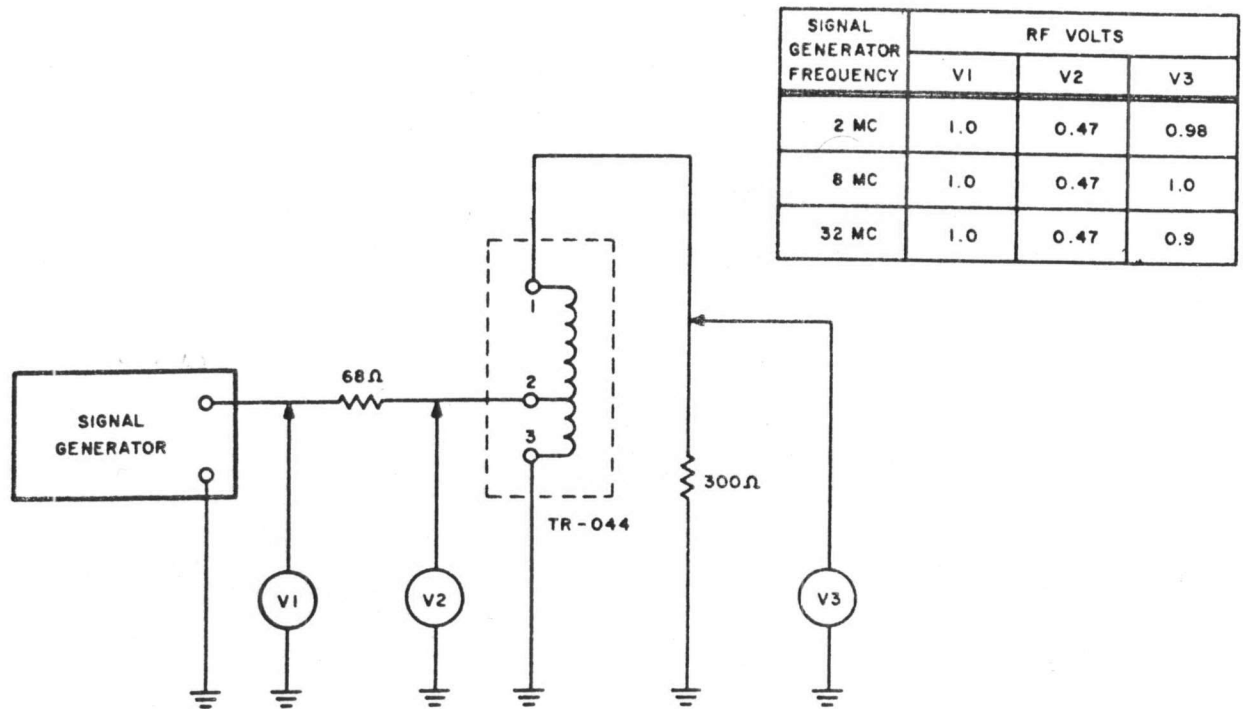


Figure 3.4 Test Set-Up, VRA-6 and VRA-9

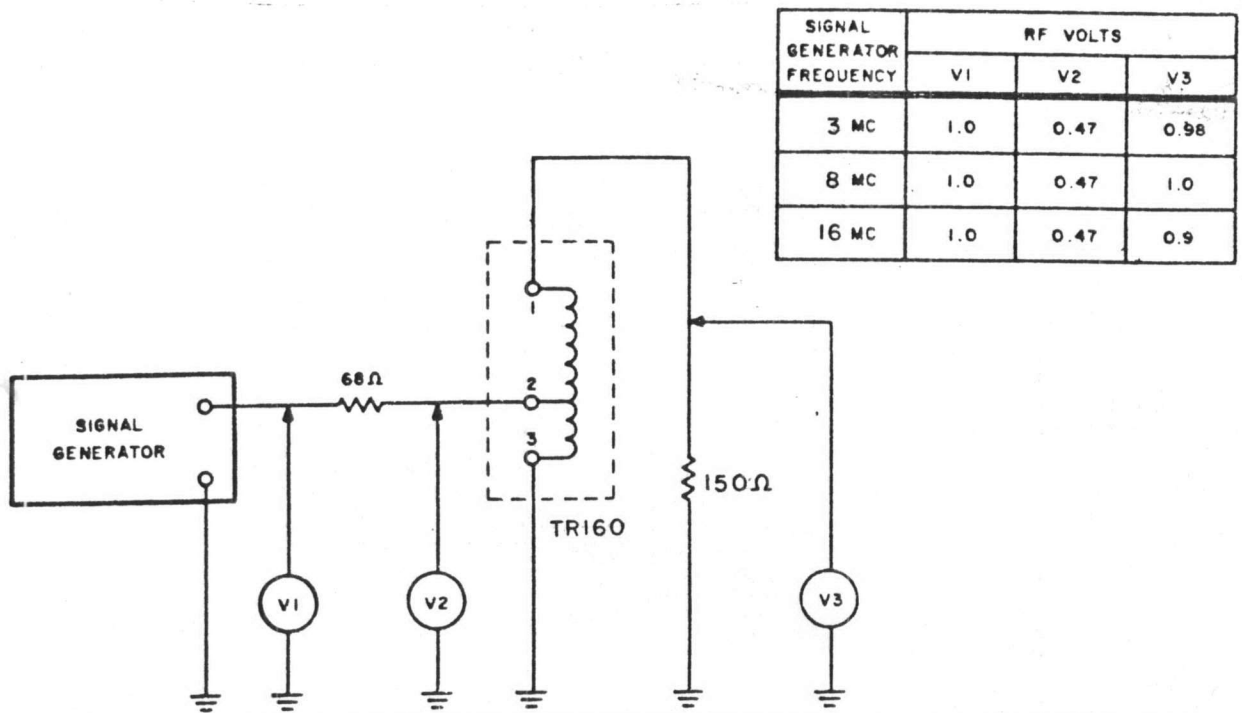


Figure 3.5 Test Set-Up, VRA-7 and VRA-10

## **Section 4 - Parts Lists**

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**Final Assembly Components, Typical VRA**

**Loose Items, Models VRA-5, VRA-6 and VRA-7**

**Loose Items, Models VRA-8, VRA-9, and VRA-10**

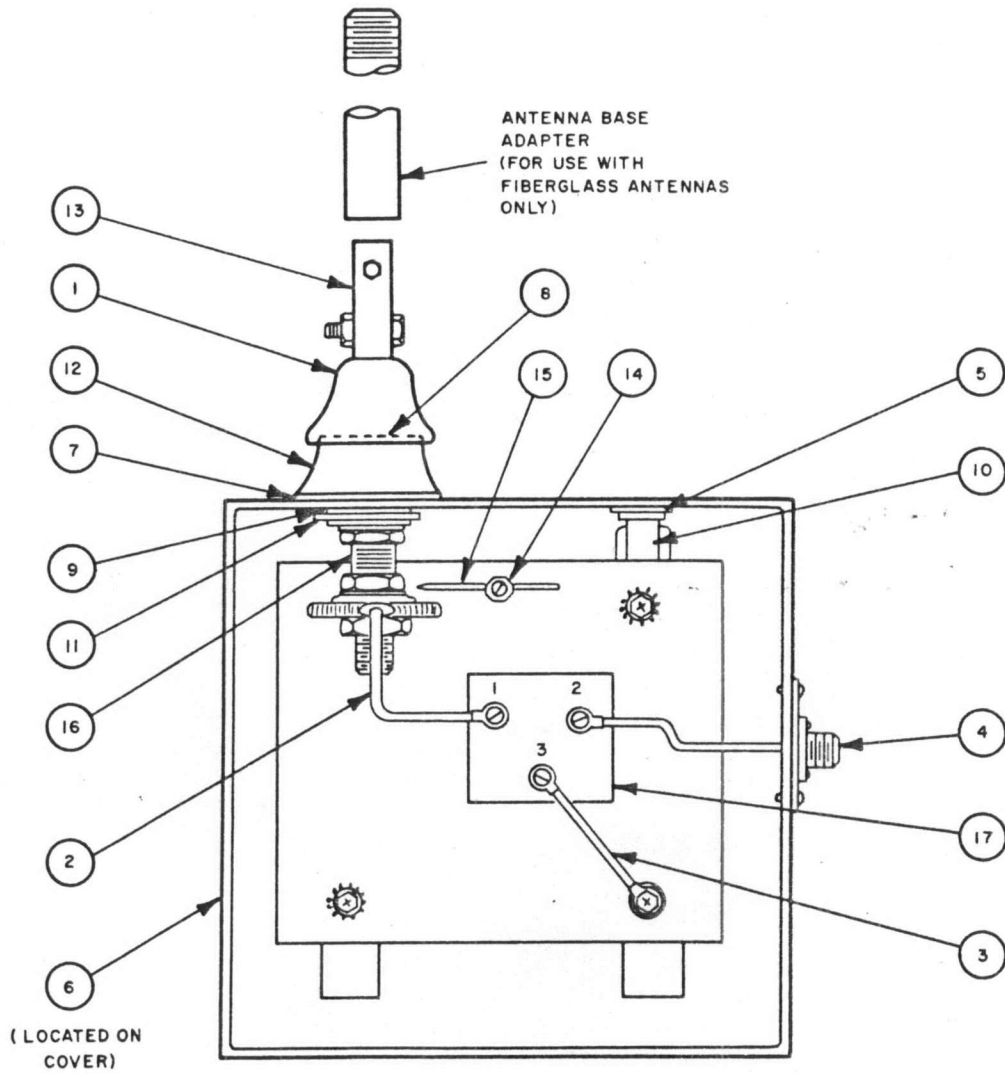


Figure 4.1 VRA Line Drawing (Internal Component Location)



ITEM (FIGURE)	DESCRIPTION	QUANTITY PER UNIT	TMC PART NO.
1	Cap	1	PO-215-3
2	Connector, Antenna	1	CA 852
3	Connector, Ground	1	FP-144
4	Connector, Output	1	UG-58A/U
5	Dessicant	1	AD-101-1/6
6	Gasket, Cover	1	GA-103
7	Gasket, Insulator	1	GA-138-4
8	Gasket, Insulator, Cap	1	GA-138-3
9	Gasket, Insulator, Support	1	GA-138-5
10	Holder, Dessicant	1	MS-933
11	Insulator, Mast Support	1	PX-612
12	Insulator, Porcelain	1	NS-131
13	Post, Antenna	1	See Loose Items List
14	Post, Spark Rod	1	PM721-3BN1.75
15	Rod, Spark	1	PM-103
16	Stud, Insulator	1	SM-149
17	Transformer, RF (Models VRA-5, VRA-8)	1	TR-042
	Transformer, RF (Models VRA-6, VRA-9)	1	TR-044
	Transformer, RF (Models VRA-7, VRA-10)	1	TR-160

Final Assembly Components, Typical VRA

LOOSE ITEMS  
MODELS VRA-5, VRA-6, VRA-7

DESCRIPTION	QUANTITY PER UNIT	TMC PART NO.
Antenna Whip, Aluminum (Models VRA-5, VRA-6)	1	AW-100-3
Post, Antenna (Models VRA-5, VRA-6)	1	PO-216
Antenna Whip, Aluminum (Model VRA-7)	1	AW-100-6
Post, Antenna (Model VRA-7)	1	PM-1119
Bolt, Lag	8	SC-111-2
Bolt, Machine	4	SCHR57 16SS16
Bracket, Unit Mounting	4	MS-619
Plate, Unit	1	MS-545
Washer, Lock Split	4	LW37MSS

LOOSE ITEMS  
MODELS VRA-8, VRA-9, VRA-10

DESCRIPTION	QUANTITY PER UNIT	TMC PART NO.
Antenna Whip, Fiberglass (Models VRA-8, VRA-9)	1	AW-103
Antenna Whip, Fiberglass (Model VRA-10)	1	AW-103-2
Post, Antenna	1	PM-1018
Bolt, Lag	8	SC-111-2
Bolt, Machine	4	SCHR57 16SS16
Bracket, Unit Mounting	4	MS-619
Plate, Unit	1	MS-545
Washer, Lock Split	4	LW37MSS

**PLEASE READ THIS FIRST**

Dear **TMC** Product User:

Thank you for purchasing the TMC Model VRA Vertical Receiving Antenna. This antenna provides antenna and RF impedance matching to a monitor receiver operating in one of three frequency ranges. The VRA-5 and VRA-8 models operate from 200 to 800KHz; the VRA-6 and VRA-9 models operate from 2 to 32MHz; the VRA-7 and VRA-10 models operate from 3 to 15MHz; the VRA-11 operates from 100KHz to 30MHz; the VRA-12 operates from 10 to 300KHz; and the VRA-13 operates from 500KHz to 30MHz. Two basic types of antenna are used: a telescopic-type aluminum antenna and a multi-section fiberglass antenna. The type of antenna is dependent on the VRA model selected.

The vertical antenna is described in detail in the enclosed technical manual. Product bulletins and application notes, as appropriate to the VRA series, are also included. These publications provide important information about using TMC equipment. Please read them.

If you need additional data or some specific technical information, please give our Customer Service a call at (914) 698-4800 or return the business reply card provided in this package. Our FAX (facsimilie) number is (914) 698-4805.

If you are missing any items, please contact TMC directly or through your local sales office.

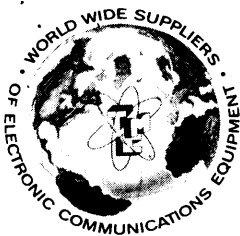
Thank you for selecting the VRA series of vertical receiving antennas.

***The Technical Materiel Corporation***  
Product Marketing

**THE CONTENTS AND INFORMATION CONTAINED IN THIS INSTRUCTION MANUAL IS PROPRIETARY TO THE TECHNICAL MATERIEL CORPORATION TO BE USED AS A GUIDE TO THE OPERATION AND MAINTENANCE OF THE EQUIPMENT FOR WHICH THE MANUAL IS ISSUED AND MAY NOT BE DUPLICATED EITHER IN WHOLE OR IN PART BY ANY MEANS WHATSOEVER WITHOUT THE WRITTEN CONSENT OF THE CORPORATION.**

## **RECORD OF REVISIONS**

Revision 1
Revision 2
Revision 3
Revision 4
Revision 5
Revision 6
Revision 7
Revision 8



## WARRANTY

**The Technical Materiel Corporation**, hereinafter referred to as TMC, warrants the equipment - except electron tubes, semi-conductor devices, fuses, lamps, batteries, and articles made of glass or other fragile or expendable materials - purchased hereunder to be free from defect in workmanship and materials under normal use and service, when used for the purposes for which the same is designed, for a period of ONE YEAR from the date of delivery FOB factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, FOB factory, which may fail within the stated warranty period, PROVIDED: 1) that any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction; 2) that the defect is not the result of damage incurred in shipment from or to the factory; 3) that the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise; and 4) that any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

At TMC's option, any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid and RETURN AUTHORIZATION number clearly marked on the package. Electron tube warranty claims should be made directly to the manufacturer of such tubes since tubes furnished by TMC bear only the manufacturer's warranty.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Purchaser's sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of such equipment, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

All inquiries should be directed to the following:

**THE TECHNICAL MATERIEL CORPORATION**  
Customer Service  
700 Fenimore Road  
Mamaroneck, NY 10543 U.S.A.

Telephone: 914-698-4800 Telex: 137-358

**THE TECHNICAL MATERIEL CORPORATION**  
COMMUNICATIONS ENGINEERS

## ***VRA Series Vertical Receiving Antennas***

<b><i>Model</i></b>	<b><i>Range</i></b>	<b><i>Antenna</i></b>
<b>VRA-5</b>	200-800KHz	Aluminum 18-foot
<b>VRA-6</b>	2-32MHz	Aluminum 18-foot
<b>VRA-7</b>	3-15MHz	Aluminum 35-foot
<b>VRA-8</b>	200-800KHz	Fiberglass 16-foot
<b>VRA-9</b>	2-32MHz	Fiberglass 16-foot
<b>VRA-10</b>	3-15MHz	Fiberglass 32-foot
<b>VRA-11</b>	0.1 - 30MHz	Fiberglass 35-foot
<b>VRA-12</b>	10 - 300KHz	Fiberglass 35-foot
<b>VRA-13</b>	0.5 - 30MHz	Fiberglass 32-foot

***Model VRA-5  
Model VRA-6  
Model VRA-7***

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# Section 1 - General Description

---

## 1.1 Functional Description

### 1.1.1 Overview

The VRA Series of Vertical Receiving Antennas are vertical receiving whip antenna units that are used in installations where a convenient broadband device is needed to provide an antenna and impedance match to a monitor receiver operating over a wide receiving range in the LF, MF and HF spectrum.

### 1.1.2 Models VRA-5 and VRA-8

The VRA-5 and VRA-8 are vertical receiving antennas with impedance matching devices that are used with receivers operating in the 200-800KHz frequency range. The VRA-5 antenna consists of 18 feet of seamless aluminum tubing in three sections that telescope into one another to reduce the overall size of the antenna when transporting it. The VRA-8 antenna consists of 16 feet of fiberglass rod in four sections that are joined by screw threads.

### 1.1.3 Models VRA-6 and VRA-9

The VRA-6 and VRA-9 are vertical receiving antennas with impedance matching devices that are used with receivers operating in the 2-32MHz frequency range. The VRA-6 uses the same antenna as the VRA-5, which consists of 18 feet of seamless aluminum tubing in three sections that telescope into one another to reduce the overall size of the antenna when transporting it. The VRA-9 uses the same antenna as the VRA-8, which consists of 16 feet of fiberglass rod in four sections that are joined by screw threads.

### 1.1.4 Models VRA-7 and VRA-10

The VRA-7 and VRA-10 are vertical receiving antennas with impedance matching devices that are used with receivers operating in the 3-15MHz frequency range. The VRA-7 antenna consists of 35 feet of seamless aluminum tubing in six sections that telescope into one another to reduce the overall size of the antenna when transporting it. The VRA-10 antenna consists of 32 feet of fiberglass rod in two sections that are joined by screw threads.

### 1.1.5 Model VRA-11, VRA-12 and VRA-13

The VRA-11 and VRA-12 are vertical receiving antenna with impedance matching devices for use with receivers operating in the MF/HF (100KHz-30MHz) and LF (100-300KHz, useable to 10KHz) frequency ranges. In addition to a separate case enclosing the matching unit, both antennas feature 35-foot fiberglass free-standing whips coupled in two sections and anchored at the base to a heavy-gauge, steel plate. The VRA-13 is similar in design with the exception that the antenna mast is a 32-foot fiberglass whip and the matching unit is optimized for 500KHz - 30MHz.

### **1.1.5 Typical Frequency Response**

The coupling transformer in the models VRA-5 and VRA-8 has a frequency response which is flat within +/-1.5dB over the operating range. However, it is important to remember that impedance matching over such a wide frequency range, using a fixed-length antenna, is of necessity a compromise. In this case, the optimum match is provided at 400KHz and the efficiency on either side of this point is somewhat less. Similar matching at an optimum point is provided in the other models.

## **1.2 Physical Description**

### **1.2.1 General**

The VRA whip antenna systems consist of a broadband impedance matching transformer coupling an aluminum or fiberglass whip antenna to a weatherproof connector receptacle. It is housed in a weather-resistant cast-aluminum alloy case. An internal spark gap assembly is incorporated to provide protection of the receiver and personnel from lightning hazards. Connection of the VRA to a receiver is made through a standard weatherproof connector receptacle mounted on the side of the case. A mating cable connector can be provided for connection to an unbalanced coaxial cable from the VRA to the monitor receiver.

### **1.2.2 Major Assemblies**

The antenna consists of two basic assemblies: the antenna rod and the impedance matching circuits housed in a weather-resistant case. Depending on the model selected, the antenna can be a free-standing fiberglass whip, a free-standing aluminum whip, or a guyed aluminum whip. The aluminum antennas are telescopic (one section is inserted into the larger section preceding it) and the fiberglass antennas are provided in sections that screw securely together.

### **1.2.3 Impedance Characteristics**

The characteristic impedance of the VRA is 50 ohms. Optionally, 70-ohm impedance units can be provided.

### **1.2.1 Equipment Mounting**

The VRA can be mounted with a plate assembly attached to it, facilitating attachment to a bulkhead, or with steel strap for pole mounting. Due to the placement of the input and output connectors, the case may also be mounted vertically on a horizontal plate for roof-top mounting.

## 1.3 Technical Specifications

### Frequency Range

VRA-5, VRA-8	200-800KHz	TR042
VRA-6, VRA-9	2-32MHz	TR044
VRA-7, VRA-10	3-15MHz	TR160
VRA-11	100KHz-30MHz	TR080
VRA-12	10-300KHz	TR081
VRA-13	500KHz-30MHz	TR080 (comp)

**Frequency Response** Flat within +/-1.5dB, Optimum match at 400KHz for VRA-5 and VRA-8.

**Output Impedance** Nominal 50 ohms, unbalanced. 70 ohms is available. See Section 1.4 for connectors. Standard connector provided is N-type (AX259-1).

**Mean-Time-Between-Failure** Nominally 50,000 hours per RADC reliability tables.

**Antenna Mast** Vertical aluminum or fiberglass sections that extend to 16, 32 or 35 feet depending on the model VRA selected. (See chart).

### Operating Features

**Cooling** Convection, no fans or moving parts

**Ambient Conditions** 0°C to +50°C; Up to 95% R.H. Storage -30°C to +80°C

**Size and Weight** 9.25H x 11.25W x 5.75D inches, 27lbs/12.3Kg. Antenna mount, including insulator assembly and post, adds 8 inches to height.

### Shipping data

Matching unit: 43 pounds, 2.3 cu.ft.

Antenna mast: Short 22 pounds, 4-inch diameter tube (14'-0")  
Long 130 pounds, 9-inch diameter tube (18'-6")

### Special Features

**Safety** Receiver and personnel protection by means of adjustable internal spark gap, preventing circuit failure from high voltages at the input..

**Components and Construction** Totally solid state circuits mounted to an all-weather aluminum alloy case. External hardware is stainless steel.

## 1.4 Vertical Receiving Antenna (VRA) Product Group

VRA-5	200-800kHz	18-foot Aluminum mast
VRA-6	2-32MHz	18-foot Aluminum mast
VRA-7	3-15MHz	35-foot Aluminum mast
VRA-8	200-800kHz	16-foot Fiberglass mast
VRA-9	2-32MHz	16-foot Fiberglass mast
VRA-10	3-15MHz	32-foot Fiberglass mast
VRA-11	100kHz-30MHz	35-foot Fiberglass mast
VRA-12	10-300kHz	35-foot Fiberglass mast
VRA-13	500kHz-30MHz	32-foot Fiberglass mast

### Input Connector Assembly Options (50-ohm unless specified otherwise):

• /UHFL	UHF(L) Type connector assembly	AX256-1
• /N	N Type connector assembly	AX259-1
• /RG85	RG-85U coaxial flange assembly	AX274-1
• /5SA	3-1/8" EIA to LC Type adapter assembly	AX276-1
• /7SA*	3-1/8" EIA to LC Type adapter assembly	AX277-1
• /UHF	UHF Type connector assembly	AX281-1
• /UHFT	UHF Twin Type connector assembly	AX282-1
• /BN	BN Type connector assembly	AX283-1
• /BNC	BNC Type connector assembly	AX284-1
• /HN	HN Type connector assembly	AX285-1
• /C	C Type connector assembly	AX286-1
• /5LC	LC Type connector assembly	AX287-1
• /7LC*	LC Type connector assembly	AX287-5
• /QDS	QDS Type connector assembly	AX289-1
• /5ES	7/8" Styroflex end seal assembly	--
• /7ES*	7/8" Styroflex end seal assembly	--

\* 70-Ohm Input Connector Assmbly

Note: Other connectors are available to suit specific applications.

**When ordering, specify both model and option. Example: VRA-6/N**

## Section 2 - Installation

---

### 2.1 Initial Inspection

#### 2.1.1 General

Every VRA undergoes a thorough testing and calibration prior to shipment. Upon receipt of the unit, check the packing case and its contents for obvious damage. Unpack the equipment carefully to reduce the risk of damage and to avoid misplacing any parts shipped as loose items. See Table 2.1 for a list of the loose items.

#### 2.1.2 Damage By Carrier

With respect to equipment damage for which the carrier is liable, TMC will assist in describing methods of repair as well as furnishing replacement parts.

### 2.2 Electrical Installation

#### 2.2.1 Antenna

The antenna is extended or attached in sections, depending on the model selected. The fiberglass sections are screwed together while the aluminum sections are extended and secured by turning the bushings located along its length. Once extended, the antenna rod must be inserted onto the antenna post located on the top of the antenna case. Align the holes at the base of the rod with the holes on the post. Anchor the antenna with the bolts provided by inserting the bolts in the holes at right angles to each other.

#### 2.2.2 Ground

Connect the outer case to a good physical ground, preferably a simple counterpoise or at least one eight-foot, copper ground rod imbedded in moist earth. The connector assembly on the side of the case is normally the best location to attach this ground.

#### 2.2.3 Output

Connect the output of the VRA to the associated receiver via the RF connector mounted on the side of the case. An RF coaxial cable, terminated with the proper mating connector, is required for this connection. See Figures 3.1 and 3.2 for schematic diagrams depicting the electrical connections required for the antenna.

### 2.3 Mechanical Installation

The VRA is designed for mounting on a wall, roof, pole or vehicle. For pole mounting, two straps and the necessary lag bolts are provided as optional hardware. For vertical plane mounting or horizontal plane mounting, a universal mounting plate is provided. This is the configuration provided for in the standard VRA. Figures 2.1 and 2.2 depict installation details and outline dimensions, respectively, and should be studied to determine the best mounting for the desired location of the antenna.

## 2.4 Performance Check

When the appropriate electrical connections have been made to the VRA, it is fully operational and ready for immediate operation. Since all components are fixed, no adjustments are needed and no further checks are required.

**Table 2.1 - Loose Items Supplied**

LW537MSS	Split Washer	4 each
MS543	Plate Mounting Unit	1 each
MS619	Brackets for Mounting Unit	4 each
SC111-2	Lag Bolts	16 each
SCHH3716	Machine Bolts	4 each
203035	Technical Manual	1 each
UGxxx/U	Mating Connector	Optional extra

## Section 3 - Maintenance

---

### 3.1 General

#### 3.1.1 Test Equipment Requirements

This section describes preventive maintenance, trouble-shooting and repair procedures for the VRA. The following equipment is suggested in order to perform these procedures properly:

- RF Signal Generator, H/P Model 651B or equivalent
- Standard Volt-Ohmmeter

#### 3.1.2 Component Location

For aid in the location of components, refer to Figure 4.1.

### 3.2 Preventive Maintenance

#### 3.2.1 General Cleaning Methods

Preventive maintenance for the VRA consists of routine functions such as visual inspection and cleaning. Periodic cleaning is recommended as dust may build up on components, reducing the unit's efficiency and possibly causing circuit failure. To facilitate cleaning, use a vacuum cleaner or a low-pressure filtered compressed-air supply.

#### 3.2.2 Visual Check and Adjustment

A simple visual check of the unit when it is opened up for servicing or cleaning will often reveal potential trouble spots and thereby reduce downtime due to component failure. Signs of trouble may be found in discoloration, brittle or cracked O-ring seals and damaged wiring or cables. Any deteriorating component should be replaced immediately. All hardware should be checked during preventive maintenance inspections.

#### 3.2.3 Dessicant Replacement or Restoration

The dessicant package, held in place inside the antenna case by a flexible metal strap, should be changed every six months. If this is not possible, the bag should be removed from the case and dried in an oven for one hour at a temperature of 250°F.

#### 3.2.4 Spark Gap Setting

To maintain proper protection of the VRA, the spark gap needle should be checked for spacing between its tip and the circular metal wafer at the base of the antenna post. It should be adjusted by loosening the set screw on its support post and positioning the needle no greater than 1/32 inches (0.032") from the wafer. Make certain the set screw on the post is tightened after the needle is adjusted.

### 3.3 Troubleshooting

#### 3.3.1 General Failure Symptoms

During operation of the VRA, the following failure symptoms may be observed:

- No signal output from receiver.
- Weak or noisy signals in receiver.

#### 3.3.2 Fault Localization

The primary objective of the troubleshooting procedure is to localize the fault to a particular section of the coupler unit. Table 3.1 provides a guide to locating and correcting the possible failures. Figures 3.1 through 3.5 are useful in taking voltage measurements on the VRA series as a means for determining the electrical condition of the matching transformer.

**Table 3.1 - Troubleshooting Procedures**

##### **Symptom: No signal output at receiver**

Possible Cause:	Receiver failure
Remedial Action:	Refer to receiver manual
Possible Cause:	Interconnection, antenna to receiver
Remedial Action:	Check the RF cable between the receiver and antenna
Possible Cause:	Failure of matching transformer
Remedial Action:	Replace matching transformer (See Parts List, Section 4)

##### **Symptom: Weak or noisy signals to receiver**

Possible Cause:	Antenna fault
Remedial Action:	Check for a fault in the antenna system where it is anchored to the antenna post. Connections should be free of any dirt.
Possible Cause:	Faulty matching transformer
Remedial Action:	If the cause is not attributable to the antenna, possible failure of a component in the matching transformer is indicated. Removal, testing and repair of the transformer assembly will be necessary. Testing is accomplished with the test set-ups depicted in Figures 3.3, 3.4 and 3.5.
Possible Cause:	Receiver noise
Remedial Action:	Refer to receiver manual
Possible Cause:	Interconnection, antenna to receiver
Remedial Action:	Check the RF cable between the antenna and receiver.



**Table 3.2 - Test Results on TR081 for VRA-12**

<b>Frequency (kHz)</b>	<b>V<sub>1</sub></b>	<b>V<sub>2</sub></b>	<b>V<sub>3</sub></b>
10.0	1.0	0.5	2.5
20.0	1.0	0.5	2.5
30.0	1.0	0.5	2.5
40.0	1.0	0.5	3.0
60.0	1.0	0.5	3.1
75.0	1.0	0.5	3.0
100.0	1.0	0.5	2.9
150.0	1.0	0.5	3.0
200.0	1.0	0.6	3.0
250.0	1.0	0.5	2.9
300.0	1.0	0.5	3.0
400.0	1.0	0.5	3.0
500.0	1.0	0.5	3.0
700.0	1.0	0.5	2.8
900.0	1.0	0.6	2.9
1,000.0	1.0	0.6	2.7
1,250.0	1.0	0.6	3.0
1,500.0	1.0	0.6	2.8
2,000.0	1.0	0.5	2.8
3,000.0	1.0	0.4	2.5
4,000.0	1.0	0.3	2.0

### **3.4 Repair**

Repair work generally consists of replacing the defective component. The following cautions should be observed:

- Make sure the replacement component is an exact duplicate of the defective one. This is particularly important in the amplifier modules.
- Place any new component in the same location as the component it replaces. The dressing of any wire runs should not be altered.
- Observe standard practice when replacing semiconductor components by using a low-wattage soldering iron and appropriate heat-sink tools.
- Avoid damage to the printed circuit wiring when handling or repairing amplifier and regulator modules.

### **3.5 Adjustments**

The antenna does not require any adjustment since all components are of fixed values. Note that the spark gap must be set at 1/32" before returning the antenna to service.

## **Section 4 - Parts Lists and Diagrams**

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**Final Assembly Components**

**Loose Items, Models VRA-5, VRA-6 and VRA-7**

**Loose Items, Models VRA-8, VRA-9, and VRA-10**

**Loose Items, Models VRA-11, VRA-12 and VRA-13**

**Component Location, Matching Unit**

**(Includes antenna mounting for VRA-5,6,7)**

**Component Location, Fiberglass Mast**