TDS-536
TV Dipole Set
Operation Manual

REV C

TABLE OF CONTENTS

INTRODUCTION

PARTS LIST – TDS-536

QTY	Model Number	Part Number	Description
1	TSC-536	2573	Transit Storage Case
2	N/A	N/A	Keys
1	TV-1	2572	Tuned Dipole Antenna (50 MHz – 220 MHz)
2	N/A	2336-17	17” Extension Elements
2	N/A	2337-2	Telescoping Elements
1	TV-2	2580	Tuned Dipole Antenna (325 MHz – 1000 MHz)
1	SAC-213	2111	3 Meter Cable, N(m) to N(m)
1	ABC-TD	2332-1	Clamp
1	N/A	2346	Tape Measure

INTENDED PURPOSES

This equipment is intended for indoor and outdoor use in a wide variety of industrial and scientific applications, and designed to be used in the process of generating, controlling and measuring high levels of electromagnetic Radio Frequency (RF) energy. It is the responsibility of the user to assure that the device is operated in a location which will control the radiated energy such that it will not cause injury and will not violate regulatory levels of electromagnetic interference.

RANGE OF ENVIRONMENTAL CONDITIONS

This equipment is designed to be safe under the following environmental conditions:

Indoor use

Altitude up to 2000M

Temperature of 5°C to 40°C

Maximum relative humidity 80 % for temperatures up to 31°C. Decreasing linearly to 50% at 40°C

Pollution degree 2: Normally non-conductive with occasional condensation.

While the equipment will not cause hazardous condition over this environmental range, performance may vary.

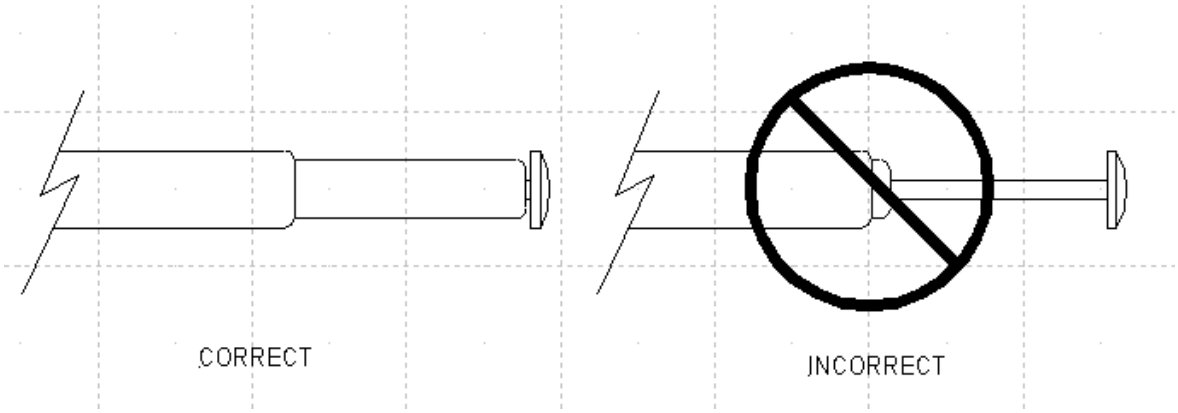
GENERAL INFORMATION

GENERAL DESCRIPTION

The tuned dipole antenna set is designed for radiated emissions measurements over the 50 MHz – 222 MHz and 325 MHz – 1000 MHz frequency ranges. The antenna set consists of two baluns and one set of adjustable elements. A tape measure is also included for the user's convenience. A mounting clamp is included for attaching the dipoles to a tripod or any other mounting device that has a ¼-20 threaded screw. Review this manual and become familiar with all safety markings and instructions. Verify that the equipment impedance is compatible with the receiver impedance.

Using your antennas

To use your antennas, you must set them up either on a tripod for informal testing or on a mast for site attenuation and/or compliance testing. The telescoping elements should be adjusted to the resonant frequency. When adjusting the elements make sure that the largest OD is exposed.



When adjusting the elements for frequency in-between those data points provided, linear extrapolation can be used. The output of the antennas should be plugged into a 50-ohm receiver or spectrum analyzer.

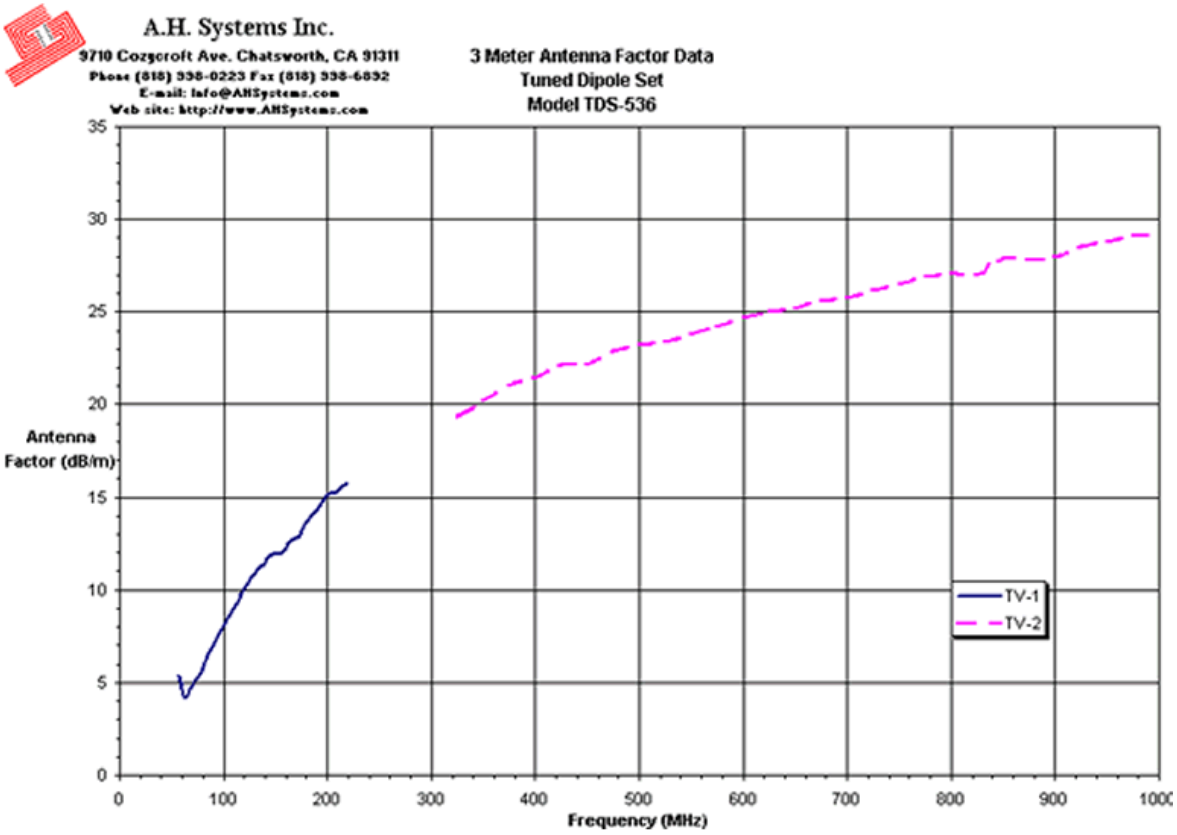
ANTENNA SPECIFICATIONS

The TV-1 Dipole Antenna specifications:

Frequency Range .....50 MHz - 220 MHz
Maximum Continuous Power .....60 Watts
Antenna Factor ..... 4 to 16 dB/m
Gain .....0 to 2 dBi
Average VSWR .....< 2:1
Impedance ..... 50 Ω
Connector Type..... N-type Female
Weight ..... 0.7 lbs.
.....318 grams
Size (W x H x D) ..... ……65" X 17.5" X 1.5"
..... ……165cm X 44cm X 3.8cm

The TV-2 Dipole Antenna specifications:

Frequency Range .....325 MHz - 1000 MHz
Maximum Continuous Power .....60 Watts
Antenna Factor ..... 19 to 29 dB/m
Gain .....0 to 2 dBi
Average VSWR .....< 2:1
Impedance ..... 50 Ω
Connector Type..... N-type Female
Weight ..... 0.4 lbs.
.....181 grams
Size (W x H x D) ..... 16" X 9" X 1.5"
.....41cm X 23cm X 3.8cm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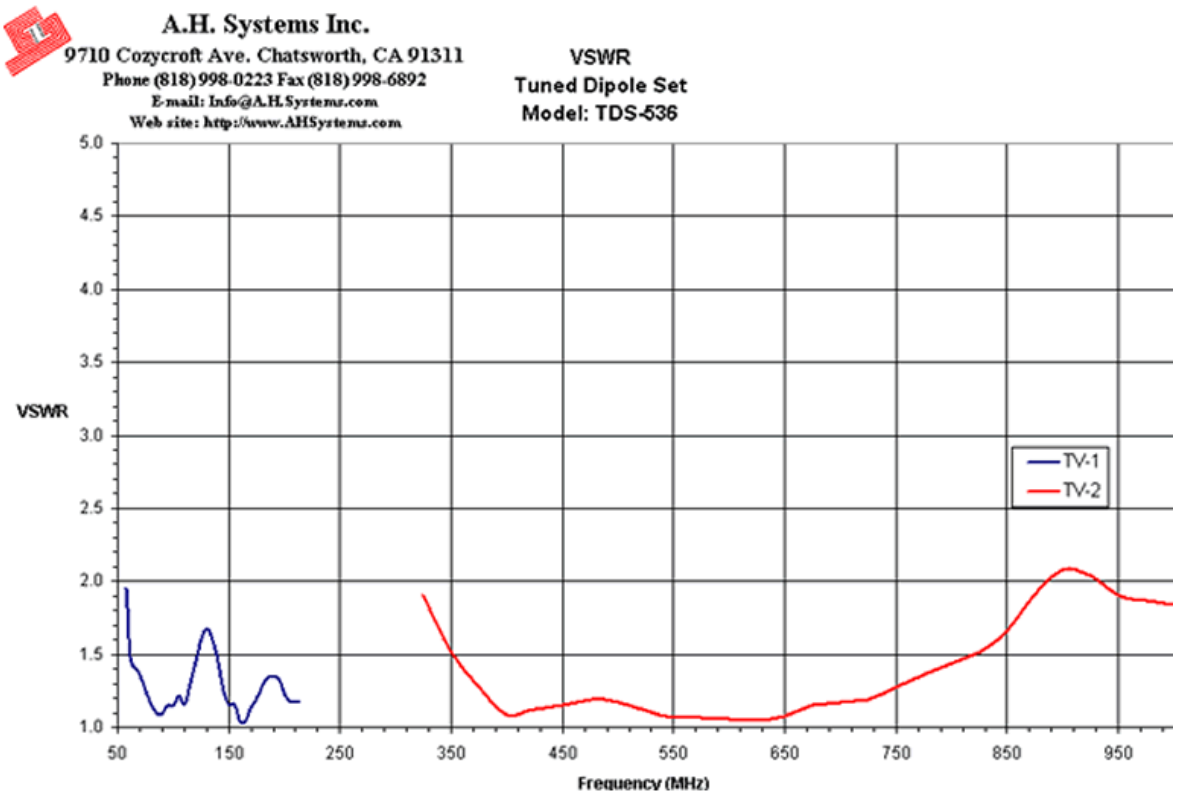
3 Meter Antenna Factor Data
Tuned Dipole Set
Model TDS-536
Antenna Factor (dB/m)
Frequency (MHz)
TV-1
TV-2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VSWR
Tuned Dipole Set
Model: TDS-536
VSWR
Frequency (MHz)
TV-1
TV-2

OPERATING INSTRUCTIONS

ASSEMBLY INSTRUCTIONS

To prepare the antenna for operation, attach the appropriate elements to the balun, which covers the frequency of desired operation. See the table below for details. Screw elements on opposite ends of the top portion of the balun to make a symmetrical dipole. Attach the supplied 50-ohm cable from the antenna balun to any receiver.

Dipole Antenna	Frequency	Elements	Length
TV-1	50 MHz – 220 MHz	2 Extension elements 2 detachable elements	Adjustable 8” to 65”
TV-2	325 MHz – 1000 MHz	2 fixed elements	Adjustable 3” to 8”

MOUNTING INSTRUCTIONS

Mount the ABC-TD to any ¼-20 screw. Insert the balun into the balun clamp and tighten the ¼-20 wing nut.

GENERAL USE INSTRUCTIONS

The calibration tables that follow in this manual provide a list of the frequencies of operation for each antenna. Listed next to each frequency is the antenna factor, gain (dBi) and the element tuning length (L/2) for each frequency.

The “L/2” lengths given in the data tables are the half length of the dipole at each frequency. “L/2” is the length measured from the notch in the center of the antenna to each tip of the two elements. The overall tip to tip dipole element length will be 2 X “L/2” in length (L= ½ wavelength in frequency).

> NOTE: Due to the finite diameter of the antenna elements, the optimum or tuned length of the dipole is found to be slightly less than the half-wavelength determined by calculations.

When making a measurement, mount the antenna on an appropriate mast or tripod. Point the main lobe of the dipole toward the transmission source.

ELEMENT LENGTHS

Frequency (MHz)	Element Length
TV-I	
57	48
63	48
69	43
79	36.75
85	33.75
90	32.625
95	30.625
100	28.75
105	27.25
108	26.5625
110	25.875
114	25
115	24.625
116	24.3125
118	23.6875
120	23.375
125	22.375
130	21.5
135	20.75
140	20.125
145	19.375
150	18.75
155	18
160	17.125
165	16.625
170	16.125
175	15.625
177	15.25
183	14.75
189	14.3125
195	14.0625
201	13.625
207	13.25
213	12.5
219	12.25
224	11.75
229	11.16667

Frequency (MHz)	Element Length
FCC-4	
325	8 1/8
350	7 3/4
375	7 1/2
400	7 1/8
425	6 9/16
450	6 1/8
475	5 5/8
500	5 1/4
525	4 15/16
550	4 3/4
575	4 1/2
600	4 3/8
625	4 1/8
650	4
675	3 13/16
700	3 11/16
725	3 7/16
750	3 1/4
775	3 1/8
800	3
825	2 15/16
850	2 7/8
875	2 11/16
900	2 5/8
925	2 5/8
950	2 5/8
975	2 5/8
1000	2 5/8

ANTENNA FORMULAS AND CALCULATIONS

A specific antenna factor is associated with each frequency. This number is to be added to the receiver reading (in dBuV) to convert to field intensity in dBuV/Meter.

EXAMPLE:
Assume the transmitter to be measured is operating at 160 MHz and the receiver reading indicates 44.0 dBuV

AF (dB/m) = 11.4
Receiver reading (dBuV) = 44 dBuV
Cable loss (dB) = 0.7

Field Intensity = AF + receiver reading + cable loss
Field Intensity = 11.4 + 44.0 + 0.7
Field Intensity = 56.1 dBuV/Meter

CALCULATIONS

EMISSIONS TESTING

Individual calibration data for the log periodic antenna is supplied at appropriate distances (3, and 10 meter) to comply with various emissions test requirements. For emissions measurements, add antenna factor plus cable loss to receiver reading in dBμV to convert to field strength in dBμV/meter.

Field Strength(dBuV/m) = SA(dBuV) + AF(dB/m) + cable loss (dB)

SA = Spectrum Analyzer or Receiver voltage reading

AF = Antenna Correction Factor

CL = Cable Loss in dB

IMMUNITY TESTING

For Immunity measurements, the generated electric field strength can be calculated by:

FS = Approximate Field Strength in (V/m)

$$FS\ (V/m) = \frac{\sqrt{30Pg}}{d}$$

P = Power in watts
g = Numeric Gain
d = Distance in meters

TYPICAL CONVERSION FORMULAS

LOG -> LINEAR VOLTAGE

dBμV to Volts	$V = 10^{((dB\mu V - 120) / 20)}$
Volts to dBμV	$dB\mu V = 20 \log(V) + 120$
dBV to Volts	$V = 10^{(dBV / 20)}$
Volts to dBV	$dBV = 20\log(V)$
dBV to dBμV	$dB\mu V = dBV + 120$
dBμV to dBV	$dBV = dB\mu V - 120$

LOG -> LINEAR CURRENT

dBμA to uA	$\mu A = 10^{(dB\mu A / 20)}$
μA to dBμA	$dB\mu A = 20 \log(\mu A)$
dBA to A	$A = 10^{(dBA / 20)}$
A to dBA	$dBA = 20\log(A)$
dBA to dBμA	$dB\mu A = dBA + 120$
dBμA to dBA	$dBA = dB\mu A - 120$

LOG -> LINEAR POWER

dBm to Watts	$W = 10^{((dBm - 30)/10)}$
Watts to dBm	$dBm = 10\log(W) + 30$
dBW to Watts	$W = 10^{(dBW / 10)}$
Watts to dBW	$dBW = 10\log(W)$
dBW to dBm	$dBm = dBW + 30$
dBm to dBW	$dBW = dBm - 30$

TERM CONVERSIONS

dBm to dBμV	$dB\mu V = dBm + 107$ (50Ω) *$dB\mu V = 90 + 10\log(Z) + dBm$*
dBμV to dBm	$dBm = dB\mu V - 73$ (50Ω) *$dBm = dB\mu V - 90 - 10\log(Z)$*
dBm to dBμA	$dB\mu A = dBm - 107$ (50Ω) *$dB\mu A = dBm - 10\log(Z) + 90$*
dBμA to dBm	$dBm = dB\mu A - 73$ (50Ω) *$dBm = dB\mu A + 10\log(Z) - 90$*
dBμA to dBμV	$dB\mu V = dB\mu A + 34$ (50Ω) *$dB\mu V = dB\mu A + 20\log(Z)$*
dBμV to dBμA	$dB\mu A = dB\mu V - 34$ (50Ω) *$dB\mu A = dB\mu V - 20\log(Z)$*

FIELD STRENGTH & POWER DENSITY

dBμV/m to V/m	$V/m = 10^{(((dB\mu V/m) - 120) / 20)}$
V/m to dBμV/m	$dB\mu V/m = 20 \log(V/m) + 120$
dBμV/m to dBmW/m²	$dBmW/m^2 = dB\mu V/m - 115.8$
dBmW/m² to dBμV/m	$dB\mu V/m = dBmW/m^2 + 115.8$
dBμV/m to dBμA/m	$dB\mu A/m = dB\mu V/m - 51.5$
dBμA/m to dBμV/m	$dB\mu V/m = dB\mu A + 51.5$
dBμA/m to dBpT	$DBpT = dB\mu A/m + 2$
dBpT to dBμA/m	$dB\mu A/m = dBpT - 2$
W/m² to V/m	$V/m = SQRT(W/m^2 * 377)$
V/m to W/m²	$W/m^2 = (V/m)^2 / 377$
μT to A/m	$A/m = \mu T / 1.25$
A/m to μT	$\mu T = 1.25 * A/m$

E-FIELD ANTENNAS

Correction Factor	$dB\mu V/m = dB\mu V + AF$
Field Strength	$V/m = \sqrt{\frac{30 * watts * Gain_{numeric}}{meters}}$
Required Power	$Watts = \frac{(V/m * meters)^2}{30 * Gain_{numeric}}$

LOOP ANTENNAS

Correction Factors	$dB\mu A/m = dB\mu V + AF$
Assumed E-field for shielded loops	$dB\mu V/m = dB\mu A/m + 51.5$
	$dBpT = dB\mu V + dBpT/\mu V$

CURRENT PROBES

Correction Factor	$dB\mu A = dB\mu V - dB_{(ohm)}$

Power needed for injection probe given voltage(V) into 50Ω load and Probe Insertion Loss (I_L)

$$Watts = 10^{((I_L + 10\log(V^2/50))/10)}$$

MAINTENANCE

MAINTENANCE PROCEDURES

Proper antenna maintenance should include:

- Visual inspection of RF connectors
- Check for bent and loose elements
- Check for loose or missing hardware
- Corrosion near the element joints

At least once a month it is a good idea to wipe down the antenna with a damp rag.

ANNUAL CALIBRATION

To ensure reliable and repeatable long-term performance, annual re-calibration of your antennas, preamplifiers and current probes by A.H. Systems experienced technicians is recommended. Our staff can calibrate almost any type or brand of antenna.

It is always up to the user to determine the appropriate interval for calibration certification based on the requirements of the end user's specific test/application. The calibration of EMC antennas is important for those conforming to compatibility standard. Radiated emissions testing for electromagnetic compatibility (EMC) requires the measurement of electric field (E-field) strength, which is compared with a limit level. The output voltage of an antenna is converted to E-field strength via its antenna factor, the measurement of which must include the uncertainty components related to that particular antenna, taking into consideration the environment in which the antenna is to be used for the testing. Most standards will specify the appropriate interval for re-calibration of your EMC antenna.

In some cases, these antennas are used for a manufacturer's pre-compliance testing, field monitoring, surveillance and/or other applications where the exact field intensity of the received signal is not of importance. For those customers a yearly re-calibration is not necessary, however it is recommended that an interval for maintenance be performed.

For more information about our calibration services or to place an order for antenna calibration visit our website at http://www.AHSystems.com
or call 1(818) 998-0223.

TROUBLESHOOTING

Problem	Possible Cause	Possible Solution
No or low response	No transmitted signal	Investigate transmitter
	Signal level below noise floor	Add a preamplifier
	Incorrectly adjusted elements	Ensure that the elements are adjusted to the proper length per element lengths table (page 9)
	Bad balun	Contact A.H. Systems, inc.

SERVICE INFORMATION

If you have any questions or comments regarding this unit's operation or you need technical advice, repair, or genuine factory replacement parts, please contact our Customer Service Department or visit our website at www.AHSystems.com.

WARRANTY INFORMATION

A.H. Systems Inc., warrants that our Antennas, Sensors and Probes will be free from defects in materials and workmanship for a period of three (3) years. All other products delivered under contract will be warranted for a period of two (2) years. Damage caused by excessive signals at the product's input is not covered under the warranty. A.H. Systems' obligation under this warranty shall be limited to repairing or replacing, F.O.B. Chatsworth, California, each part of the product which is defective, provided that the buyer gives A.H. Systems notice of such defect within the warranty period commencing with the delivery of the product by A.H. Systems.

The remedy set forth herein shall be the only remedy available to the buyer, and in no event shall A.H. Systems be liable for direct, indirect, incidental or consequential damages.

This warranty shall not apply to any part of the product which, without fault of A.H. Systems has been subject to alteration, failure caused by a part not supplied by A.H. Systems, accident, fire or other casualty, negligence, misuse or normal wear of materials.

Except for the warranty set forth above, there are no other warranties, expressed or implied, with respect to the condition of the product or it's suitability for the use intended for them by the buyer.

For prompt service, please contact our service department for a Return Material Authorization Number before shipping equipment back to us.