SAS-551 Passive Monopole Antenna Operation Manual

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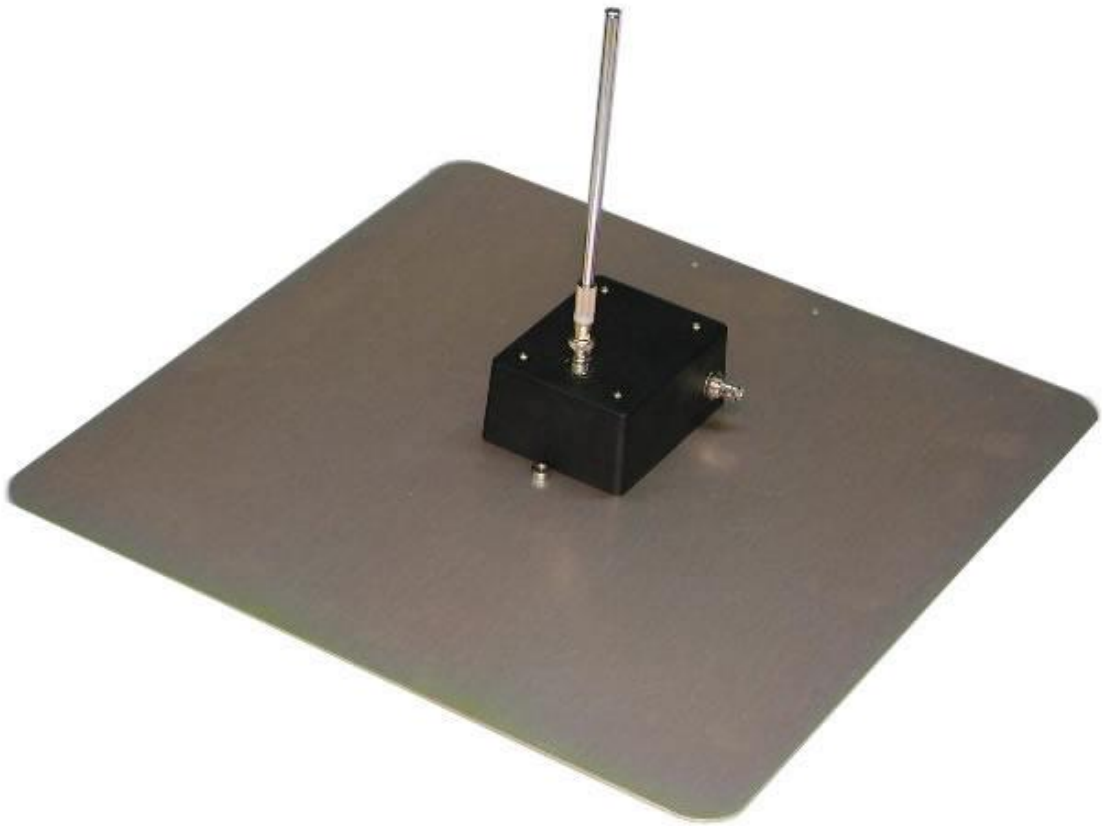


Model	Frequency Range	Part Number	Description
SAS-551	9 kHz – 40 MHz	2348	Passive Monopole Antenna

INTENDED PURPOSES

This equipment is intended for general laboratory 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 2 km

Temperature: 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.

SPECIFICATIONS

GENERAL DESCRIPTION

The A.H. Systems passive monopole antenna is a general-purpose transmitting antenna which cover the 10 KHz – 40 MHz frequency range. Each unit comes with a telescoping rod and ground plane. Review this manual and become familiar with all safety markings and instructions.

ANTENNA SPECIFICATIONS

SAS-551 Monopole Antenna specifications:

Frequency Range	9 kHz – 40 MHz
Input Connector Type	BNC(f)
Mounting Base	1/4-20 Tread(f)
Weight	3.5 lbs.
Size (W x H x D)	18" x 18" x 41" *(46 cm x 46 cm x 104 cm)*

OPERATING INSTRUCTIONS

ASSEMBLY INSTRUCTIONS

To prepare the antenna for operation, attach the telescoping rod antenna element to the top of the ground plane box.

Connect the rod antenna by pushing straight down on the female connector on top of the amplifier. Do not apply excessive sideways force, as this can cause the antenna center-pin to break.

SETUP INSTRUCTIONS

The ground plane can be mounted to any tripod with a 1/4-20 attaching stud. Extend the rod antenna to 41" (104 cm) above the ground plane. Connect the output BNC connector on the side of the antenna to the output of a 50 Ω generator or amplifier. Establish a ground connection to the ground plane if required by the test specification.

GENERAL USE INSTRUCTIONS

The SAS-551 monopole antenna is a passive antenna designed to transmit broadband electric fields. When used with the SAS-550-1B active monopole, these antennas are the ideal solution for shielding effectiveness testing. This antenna may also be used as a passive receive antenna for testing in areas with high fields.

Each antenna is individually calibrated per ANSI C63.5 (ECSM) and comes with a calibration certificate references the NIST traceable test equipment.

The calibration tables shown provide a listing of the frequency of operation and its antenna factor in dB/m. The field strength is the receiver voltage in dBμV plus the antenna factor (refer to the antenna factor calibration) plus any cable loss. When making a measurement, mount the antenna on an appropriate mast or tripod.

Caution:
It is recommended to load the monopole input with 50 ohms or use a power resistor (connected in parallel with the antenna) if the signal generator or power amplifier used to drive the antenna requires a 50 ohm match. This requirement is typical for antennas with short radiators (radiator length of λ/10 or less) and that operate below 30 MHz.

The SAS-551 antenna by itself does not represent a 50-ohm load to the signal source.

OPTIONAL EQUIPMENT

The following is a recommend accessory list for the SAS-551 Passive Monopole Antenna:

ECF-10
The ECF-10 is an equivalent capacitance fixture constructed per IEEE 291 and ARP 958. This is an indispensable tool used for gain adjustment and calibration of the active monopole antennas. The ECF-10 is used as a signal substitution source when calibrating the active monopole antennas. Refer to the calibration procedures below.

SAC-210

Standard 3 meter BNC(m) to BNC(m) RF cable made with RG-58. Optional ferrite loading and custom lengths can be made to your specifications. Other cable types available upon request.

Adapters

Need an Adapter? We stock those as well.

CALCULATIONS

EMISSIONS TESTING

Individual calibration data for the passive monopole antenna is supplied 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

CALIBRATION

Equivalent Capacitance

It is our recommendation to use a 12 pF for the ECSM fixture for an element height of 41" (1.04 meter) as per ANSI C63.5:2017 and CISPR 16-1-6:2017. Our telescoping rod with a BNC connector that is supplied with the SAS-551 has an average radius of 2.223mm. The formula for calculating the capacitance is (per ANSI C63.5:2017 and CISPR 16-1-6:2017):

$$C_a = (55.6\ h) / (\ln(h / a) - 1) * (\tan(2\ \pi\ h / \lambda)) / (2\ \pi\ h / \lambda) \qquad \textit{Eq 1}$$

where:

h = actual length of the monopole element (adjusted to 1.04m), m
a = average radius of the antenna element (6.17mm), m
λ = wavelength in meters
C_a = capacitance of the dummy load

NOTE - Other fixtures with different capacitance are available as an option.

Effective Height Calculation

The correction factor for the calibration is dependent on the effective height of the monopole. The effective height calculation is:

$$h_e = (\lambda / 2\pi) * \tan(2\ \pi\ h / \lambda) \qquad \textit{Eq. 2}$$

where:

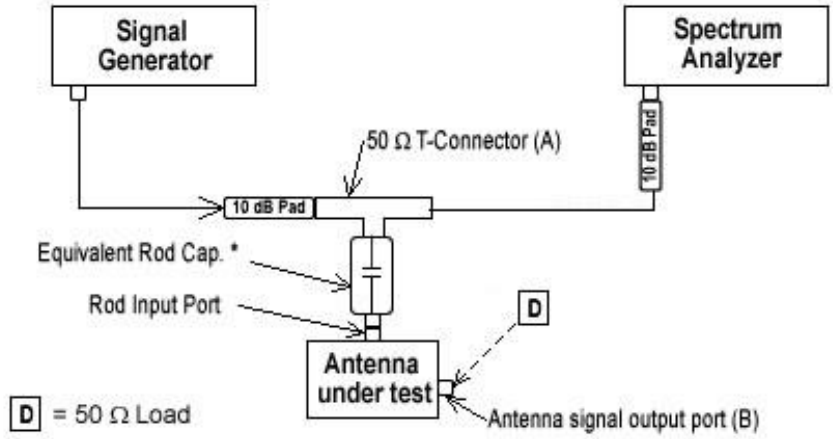
λ = wavelength in meters
h = Telescoping element height in meters

Examples:

- For a 41" (1.04 Meter) length, the effective height would be 0.52 meters (up to approximately 2 MHz) and the correction factor should be 20*Log(*0.52*) = -5.68 dB.
- For a 1 Meter length, the effective height would be 0.5 meters (up to approximately 2 MHz) and the correction factor should be 20*Log(*0.5*) = -6.02 dB.

Active Monopole Calibration

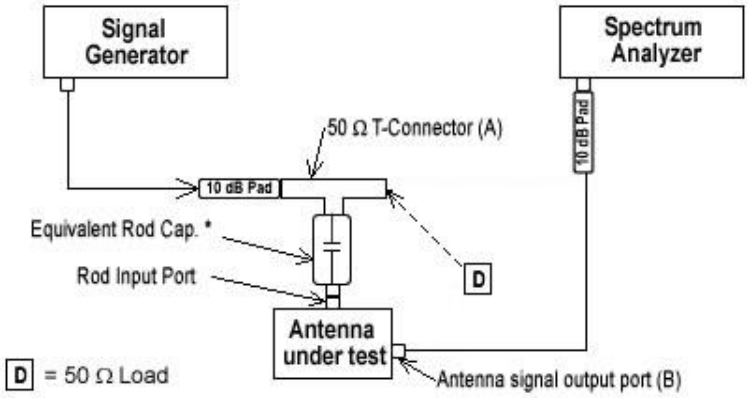
The antenna factor for the rod antenna shall be determined by measuring the signal transfer characteristics with the matching device and assuming that the antenna is a short monopole with an infinite ground plane. Set up the monopole to be calibrated and the test equipment per Figure 3. Allow all equipment to warm up for 30 minutes.



* Also referred to as a Dummy Antenna.

Figure 1

1) With the equipment connected as shown in *Figure 1*, measure the drive signal voltage V_D in dBμV at the T-connector (A).



* Also referred to as a Dummy Antenna.

Figure 2

2) Leaving the RF output of the signal generator unchanged, transfer the 50 Ω termination to the T-connector (A) and transfer the receiver input cable to the signal output port (B). Measure the output signal voltage V_L in dBμV.

3) The antenna factor (in dB) is calculated by the following equation.

$$AF(dB) = V_D - V_L - (20*Log(h_e)) \qquad Eq.3$$

NOTES – If the VSWR of the receiver or signal generator is low, pads (attenuators) may not be needed or reduced to 6dB or 3dB. The signal generator does not need to be calibrated, but it shall be stable per manufacturers recommendations. The 50 Ω termination and attenuators shall have low VSWR. The spectrum analyzer shall be calibrated and have low VSWR.

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) *$dB\mu V = dBm + 10\log(Z) + 90$*
dBμV to dBm	$dBm = dB\mu V - 107$ (50Ω) *$dBm = dB\mu V - 10\log(Z) - 90$*
dBm to dBμA	$dB\mu A = dBm - 73$ (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	$V/m = \frac{\sqrt{30 * watts * Gain_{numeric}}}{meters}$
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

To ensure reliable and repeatable long-term performance, annual re-calibration of your active monopole preamplifier by A.H. Systems' experienced technicians is recommended. Our staff can recalibrate almost any type or brand of antenna. For more information about our calibration services or to place an order for antenna calibration, visit our website at www.AHSystems.com or call (818) 998-0223.

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.