AK-571-4
Horn Antenna Kit
Operation Manual

REV C

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INTRODUCTION

Shown with optional preamplifiers

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Model Number	Description	Frequency Range	Antenna Factor (dB/m)
SAS-571	Double Ridge Guide Horn Antenna	700 MHz – 18 GHz	22 to 45
SAS-574	Double Ridge Guide Horn Antenna	18 GHz – 40 GHz	40 to 41.5
			Attenuation
SAC-18G-3	3 Meter High Frequency, Low-Loss Cable	Up to 18 GHz	3.5 dB @ 18 GHz
SAC-40G-1.5	1.5 Meter High Frequency, Low-Loss Cable	Up to 40 GHz	10.5 dB @ 40 GHz
TSC-571	Transit Storage Case		
ADP-213	2.9mm(f) to 2.9mm(f)		
ADP-203	SMA(m) to N(f) adapter		
OPTIONAL EQUIPMENT			
			Gain / Attenuation
PAM-0118P	High Frequency Preamplifier	20 MHz – 18 GHz	37 dB
SAC-18G-0.5	0.5 Meter High Frequency, Low-Loss Cable	Up to 18 GHz	1.5 dB @ 18 GHz
PAM-1840	High Frequency Preamplifier	18 GHz – 40 GHz	20 dB Gain
SAC-40G-0.5	0.5 Meter High Frequency, Low-Loss Cable	Up to 40 GHz	4.5 dB @ 40 GHz
TCC-510	Tripod Carrying Case		
ATU-510	Antenna Tripod, wooden		
AEH-510	Azimuth and Elevation Head		

GENERAL INFORMATION

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.

GENERAL DESCRIPTION

The AK-571-4 Horn Antenna kit is the newest member of A.H. Systems family of antenna kits. This Antenna Kit provides a convenient solution for increased frequency requirements from 700 MHz to 40 GHz. As specifications include higher test frequency requirements so does the need for an accurate antenna solution. Each antenna comes calibrated traceable to NIST

Cables and an adapter are provided to connect each antenna to either a N or SMA type connector on the receiver. Cable calibrations are supplied.

To help minimize any downtime the customer may be experiencing during testing we provide next-day, on-time delivery.

Each antenna mounts directly to the tripod azimuth and elevation head. The azimuth and elevation head allows the operator to vary the antenna azimuth (direction) and to change the antenna polarity (vertical or horizontal).

To obtain the field strength of the signal being measured, the operator must add the receiver reading in dBuV, the antenna factor in dB, and the cable attenuation in dB. This yields the field strength in dBuV/m. Calibrations for the E-field antennas are supplied at appropriate spacing (1, 3, and 10 meter) to comply with various test specification requirements.

E-FIELD ANTENNAS

SAS-571 Double Ridge Guide Horn Antenna 700MHz - 18 GHz
SAS-574 Double Ridge Guide Horn Antennas 18 GHz – 40 GHz

The SAS-574 horn antenna comes assembled and ready to use. The SAS-571 antenna mounting bracket is attached to the antenna backwards in order to fit in the carrying case. The bracket must be removed from the antenna, turned over (so that the bracket leg faces away from the antenna),

and re-attached to the antenna. (The bracket is not needed for mounting if the tripod being used has an Azimuth/Elevation Head.)

Operation: Attach the antenna to the tripod azimuth and elevation head through the hole on the antenna bottom or the hole in the mounting bracket. The ridge guides determine the antenna polarity: for horizontal polarity they should be parallel to the ground, for vertical polarity they should be perpendicular to the ground. Connect a cable between the antenna connector and the receiver. NOTE: BE SURE TO USE A CABLE RATED FOR HIGH FREQUENCY WHEN OPERATING ABOVE 5 GHz (for example, the SAC-18G-3 or SAC-40G-1.5).

TRANSIT STORAGE CASES

TSC-571 Transit Storage Case

The antenna carrying case (TSC-571) prevents damage and loss of antennas and optional preamplifiers when storing or transporting the antenna kit. The case is constructed of lightweight and durable polyethylene. Each case includes cutouts for the optional equipment listed below. Two case keys are provided with the case.

OPTIONAL EQUIPMENT

The AK-571 case comes with two additional cutouts for optional preamplifiers. In order to improve overall system sensitivity, the following equipment may be required:

- PAM-0118P with an SAC-18G-0.5
- PAM-1840 with an SAC-40G-0.5

PAM-0118P Preamplifier 20 MHz – 18 GHz

The preamplifier will increase the system sensitivity 37 dB and is recommend for the SAS-571 Double Ridge Guide Horn Antenna. An optional short length cable (SAC-18G-0.5), is required to connect the preamplifier to any 50-ohm receiver or spectrum analyzer.

SAC-18G-0.5 Low-Loss Cable up to 18 GHz

The Low-Loss, High Frequency cable is recommend for connecting the optional preamplifier to any 50-ohm receiver or spectrum analyzer. Our Low-Loss High-Frequency flexible cables are the preferred choice over standard cable types. With improved power handling, low VSWR, and high frequency capabilities, the Low-Loss cables can be made to your specified length and delivered in two days. The 1/2 meter SAC-18G-0.5 has a typical attenuation of 1.0 dB at 18GHz.

PAM-1840 Preamplifier 18 GHz – 40 GHz

The preamplifier will increase the system sensitivity 20 dB and is recommend for the SAS-574. An optional short length cable (SAC-40G-0.5), is required to interconnect the preamplifier to any 50-ohm receiver or spectrum analyzer.

SAC-40G-0.5 Low-Loss Cable up to 40 GHz

The Low-Loss, High Frequency cable is recommend for connecting the optional preamplifier to any 50-ohm receiver or spectrum analyzer. Our Low-Loss High-Frequency flexible cables are the preferred choice over standard cable types. With improved power handling, low VSWR, and high frequency capabilities, the Low-Loss cables can be made to your specified length and delivered in two days. The 1/2 meter SAC-40G-0.5 has a typical attenuation of 4.5 dB at 40GHz.

TRIPOD AND MOUNTING ADPTERS

ATU-510 Tripod

AEH-510 Azimuth and Elevation Head

The azimuth and elevation head (AEH-510) mounts to the tripod (ATU-510) top and allows the antennas to be rotated 360 degrees and tilted between horizontal and vertical polarization. The tripod and azimuth and elevation

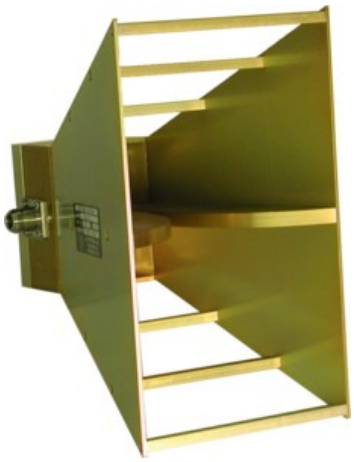
head come in their own carrying case. Each tripod leg is independently adjustable in angle and length to facilitate antenna height setting. The tripod legs have a rubber tip on one end for indoor or hard surface use, and a metal spike on the other end for outdoor soft surface (such as dirt) use.

SPECIFICATIONS

SAS-571

Antenna Specifications

Frequency Range	700 MHz – 18 GHz
Antenna Factor	22 to 44 (dB/m)
Average Gain	12 dBi
Nominal VSWR	1.5:1 (50 ohms)
Average Beamwidth	E-48 deg.,
	H-30 deg.
Max continuous power	300 W
Max Radiated Field	200 V/m
Connector	Precision N-type(f)
Mounting Base	¼-20 Thread (f)

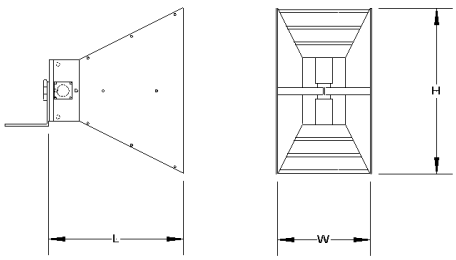


Description

The SAS-571 Double Ridge Guide Horn Antenna is a linearly polarized broadband antenna covering the frequency range of 1 GHz to 18 GHz. With High gain, low VSWR, an input power handling capability of 300 watts CW makes this horn antenna an excellent choice for both immunity and emissions testing. The SAS-571 Double Ridge Guide Horn Antenna is a must have for testing above 1 GHz. This antenna is precision machined from aluminum and may be mounted either horizontal or vertical polarization. A 1, 3 and 10 meter individual calibration is included with purchase.

Physical Specifications

Length	Width	Height	Weight
11 in. (27.9 cm)	9.62 in. (24.4 cm)	6.25 in. (15.9 cm)	4 lbs. (22 kg.)



REV C

Antenna Specifications

Frequency Range	18 GHz – 40 GHz
Antenna Factor	40.3 to 41.1 (dB/m)
Average Gain	15 to 21.2 dBi
Nominal VSWR	1.5:1 (50 ohms)
Average Beamwidth	20 to 32 deg.,
Max continuous power	10 W
Max Radiated Field	150 V/m
Connector	WRD-180 to 2.9mm (f)
Mounting Base	¼-20 Thread (f)

SAS-574

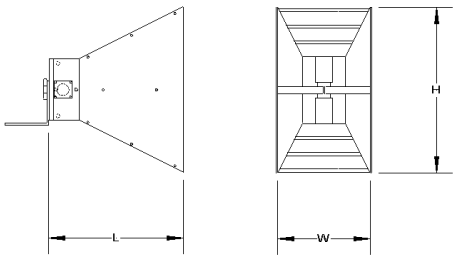
Description

The SAS-574 Double Ridge Guide Horn Antenna is a linearly polarized broadband antenna covering the frequency range of 18 GHz to 40 GHz. With High gain, low VSWR, an input power handling capability of 150 watts CW makes this horn antenna an excellent choice for both immunity and emissions testing. This antenna is precision machined from aluminum and may be mounted either horizontal or vertical polarization. A 1 meter individual calibration is include with purchase.

Physical Specifications

Length	Width	Height	Weight
3.4 in.	1.2 in.	1.6 in.	0.2 lbs.

(8.6 cm) (3 cm) (4.1 cm) (0.09 kg.)



ANTENNA FORMULAS AND 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

Common RF Related Conversion Factors

dBmW = dBμV - 107

The constant in the above equation is derived as follows. Power is related to voltage according to Ohm's law. The Log_{10} function is used for relative (dB) scales, so applying the logarythm function to Ohm's law, simplifying, and scaling by ten (for significant figures) yields:

$$P = V^2 / R$$

$$10Log_{10}[P] = 20Log_{10}[V] - 10Log_{10}[50^{\Omega}]$$

Note, the resistance of 50 used above reflects that RF systems are matched to 50^{Ω}. Since RF systems use decibels referenced from 1 mW, the corresponding voltage increase for every 1 mW power increase can be calculated with another form of Ohm's law.

$$V = (PR)^{0.5} = 0.223\ V = 223000\ \mu V$$

Given a resistance of 50Ω and a power of 1 mW

$$20Log_{10}[223000\ \mu V] = 107\ dB$$

The logarythmic form of Ohm's law shown above is provided to describe why the log of the corresponding voltage is multiplied by 20.

$dBmW/m^2 = dB\mu V/m - 115.8$

The constant in this equation is derived following similar logic. First, consider the Poynting Vector which relates the power density (W/m^2) to the electric field strength (V/m) by the following equation.

$$P=|E|^2/\eta$$

Where η is the free space characteristic impedance equal to $120\pi^{\Omega}$. Transforming this equation to decibels and using the appropriate conversion factor to convert dBW/m^2 to $dBmW/m^2$ for power density and dBV/m to $dB\mu V/m$ for the electric field, the constant becomes 115.8

$dB\mu V/m = dB\mu V + AF$

Where AF is the antenna factor of the antenna being used, provided by the antenna manufacturer or a calibration that was performed within the last year.

$V/m = 10^{\{[(dBuV/m)-120]/20\}}$

Not much to this one, just plug away!

$dB\mu A/m = dB\mu V/m - 51.5$

To derive the constant for the above equation, simply convert the characteristic impedance of free space to decibels, as shown below.

$$20Log_{10}[120\pi] = 51.5$$

$A/m = 10^{\{[(dBuA/m)-120]/20\}}$

As above, simply plug away.

$dBW/m^2 = 10Log_{10}[V/m - A/m]$

A simple relation to calculate decibel-Watts per square meter.

$dBmW/m^2 = dBW/m^2 + 30$

The derivation for the constant in the above equation comes from the decibel equivalent of the factor of 1000 used to convert W to mW and vice versa, as shown below.

$$10Log_{10}[1000] = 30$$

$dBpT = dB\mu A/m + 2.0$

In this equation, the constant 2.0 is derived as follows. The magnetic flux density, B in Teslas (T), is related to the magnetic field strength, H in A/m, by the permeability of the medium in Henry's per meter (H/m). For free space, the permeability is given as...

$$\mu_o = 4\pi \times 10^{-7} \text{ H/m}$$

Converting from T to pT and from A/m to μA/m, and taking the Log, the constant becomes...

$$240 - 120 + 20Log_{10}[4\pi \times 10^{-7}] = 2.0$$

$$dBpT = dBuV + dBpT/uV + Cable\ Loss$$

$$dBuV/m = dBpT + 49.5\ dB$$

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.

MAINTENANCE

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.

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.