SAS-585
Standard Gain Horn
Operation Manual

REV A

TABLE OF CONTENTS

INTRODUCTION

Shown with azimuth and elevation head

The SAS-585 Standard Gain Horn Antenna is designed specifically for utilization in emissions and immunity testing over the frequency range of 8.2 GHz to 12.4 GHz. This X-band horn antenna is linearly polarized and has medium gain, low VSWR, and a constant antenna factor. The antenna performance is very precise and predictable through design parameters and comparisons of measured versus computed antenna factors and gain have been shown to be +/- 0.5 dB. Therefore, this horn antenna is considered to be a standard reference, similar to that of a resonant dipole below 1 GHz. The coax-to-waveguide adapter is the only power-limiting component on the antenna and can be removed if high fields are desired.

GENERAL DESCRIPTION

The SAS-585 Standard Gain Horn Antenna mounts directly to the tripod azimuth and elevation head (AEH-510) at the bottom of the antenna. Horizontal and vertical polarization is obtained by rotating the antenna on the tripod. The azimuth and elevation head also allows the operator to vary the antenna azimuth (left right direction) and elevation (up, down direction) and makes it easy to change the antenna polarity (horizontal or vertical).

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 1 meter.

INTENDED PURPOSES

The standard gain horn antenna is intended for general laboratory use in a wide variety of industrial and scientific applications. It has been 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.

OPTIONAL EQUIPMENT

The following is a recommend accessory list for the SAS-585 Standard Gain Horn Antenna:

CONNECTING ACCESSORIES:

PAM-0118

This preamplifier has a broad frequency range and high gain, designed to match the double ridge guide horn antenna. An ideal solution for improving overall system sensitivity.

SAC-18G-3

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

MOUNTING ACCESSORIES:

AEH-510

Azimuth and elevation head is used to assist the test engineer in orientating the horn antenna towards the device under test.

ATU-510

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.

ATU-514

This collapsible tripod is built with all non-metallic materials that will not influence your antenna measurements. The ATU-514 is a no-nonsense antenna tripod that offers up to 50lbs. (22.6Kg) load capacity and has telescoping legs with an adjustable center mast to achieve heights up to 2 meters.

OPERATING INSTRUCTIONS

ASSEMBLY INSTRUCTIONS

There is no assembly required, the SAS-585 Horn antenna is supplied with an attached waveguide to coax adapter and tripod mount.

MOUNTING INSTRUCTIONS

The antenna should be firmly mounted to a tripod with a 1/4-20 male stud. Horizontal polarization can be determined by the orientation of the RF connector. If the connector is parallel (or horizontal) to the ground, then the antenna is in the horizontal polarization. If the antenna is perpendicular to the ground the antenna is in the vertical polarization.

The cable connecting the Horn antenna to the receiver must have 50Ω characteristic impedance and matching cable connectors. The cable must be well shielded since any leakage will cause erroneous readings. For emissions testing, an optional preamplifier is recommended to help increase system sensitivity.

The SAS-585 horn antenna has a beamwidth of approximately 30 degrees and it should be pointed or aimed in the direction that the received signal is coming from. Refer to our antenna beamwidth coverage tool on our website (https://www.ahsystems.com/EMC-formulas-equations/Antenna-beamwidth-coverage-calculation.php). The measurement reference point is at the aperture of the antenna for all distances.

OPERATING INSTRUCTIONS

Once the antenna is mounted to a mast or tripod, connect a N-type coaxial cable from the horn antenna to a receiver or RF generator. The cable should be matched to 50 ohms, and it is recommended to use a high-frequency low-loss cable (i.e., SAC-18G-3 Low Loss cable). For certain applications where an increased dynamic range is required, an optional preamplifier (PAM-0118P) may be used to increase the total system sensitivity.

CAUTION: Even though the horn antenna does not have any ESD concerns, touching the horn antenna while connected to a sensitive preamplifier may cause damage to that device.

The antenna factor is used to convert the receiver reading to field intensity. In measuring the field intensity with the standard gain horn antenna, add the antenna factor to the receiver reading (dBuV). The antenna factor supplied with each antenna is individually calibrated at 1 Meter using the three-antenna technique per ARP-958. The 1-meter measurement point is measured from the aperture of the antenna.

ADDITIONAL NOTES

These waveguide horn antennas will respond well beyond their specified frequency ranges. The operational range of the waveguides themselves dictates the specified frequency range of the antennas.

The coax-to-waveguide adapter is the only power-limiting component on the antenna and can be removed if high fields are desired.

As mentioned before, the standard gain horn antenna has an approximate 15 dB gain with a 30-degree beamwidth. Other horn antennas are available with different apertures and flare angles that will increase or decrease the gain of the antenna. As the gain increases, the beamwidth will decrease. Call us with your specification and discuss your needs with one of our design engineers.

SPECIFICATIONS

The SAS-585 Horn Antenna specifications:

ELECTRICAL

Frequency Range ..... 8.2 GHz – 12.4 GHz
Antenna Factor ..... 34.6 dB/m
Average Gain ..... 15.6 dBi
Maximum Continuous Power ..... 250 Watts
Maximum Radiated Field: ..... 500 V/m
Average Beamwidth (E-Field) ..... 30°
Average Beamwidth (H-Field) ..... 30°
Impedance (nominal) ..... 50 Ω
Average VSWR ..... 1.3:1 (1.5:1 max)
Connector: ..... WR-90 to N-type (female)

MECHANICAL

Length ..... 7.2” (18.3cm)
Width ..... 2.1” (5.3cm)
Height ..... 2.8” (7.1cm)
Weight ..... 0.6 lbs. *(0.27 Kg)*

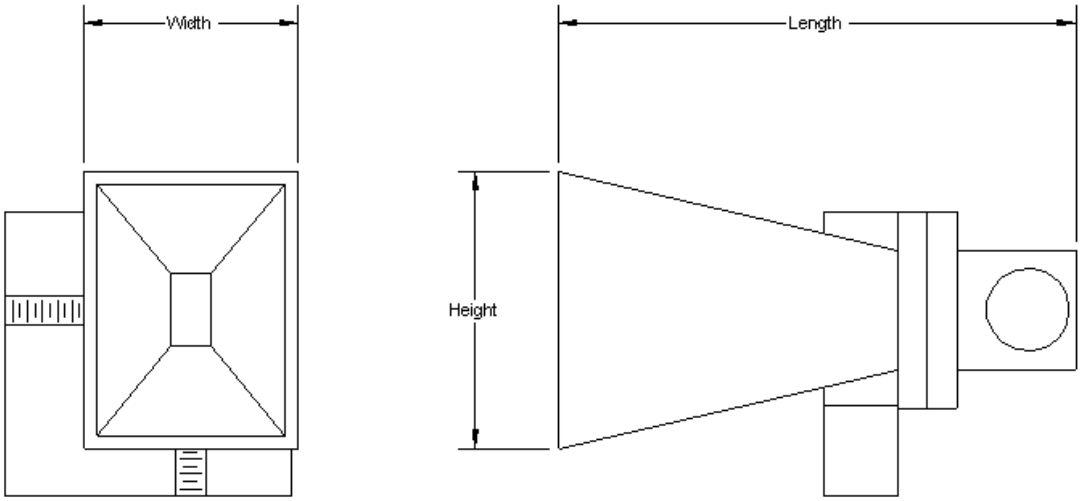
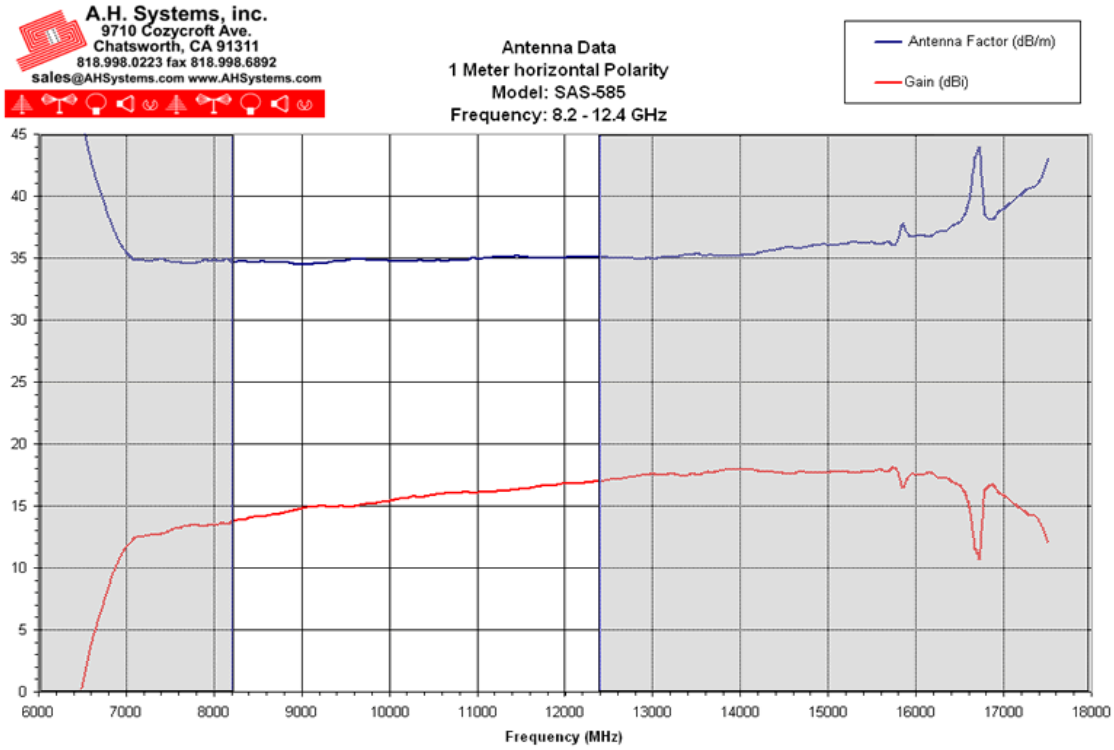
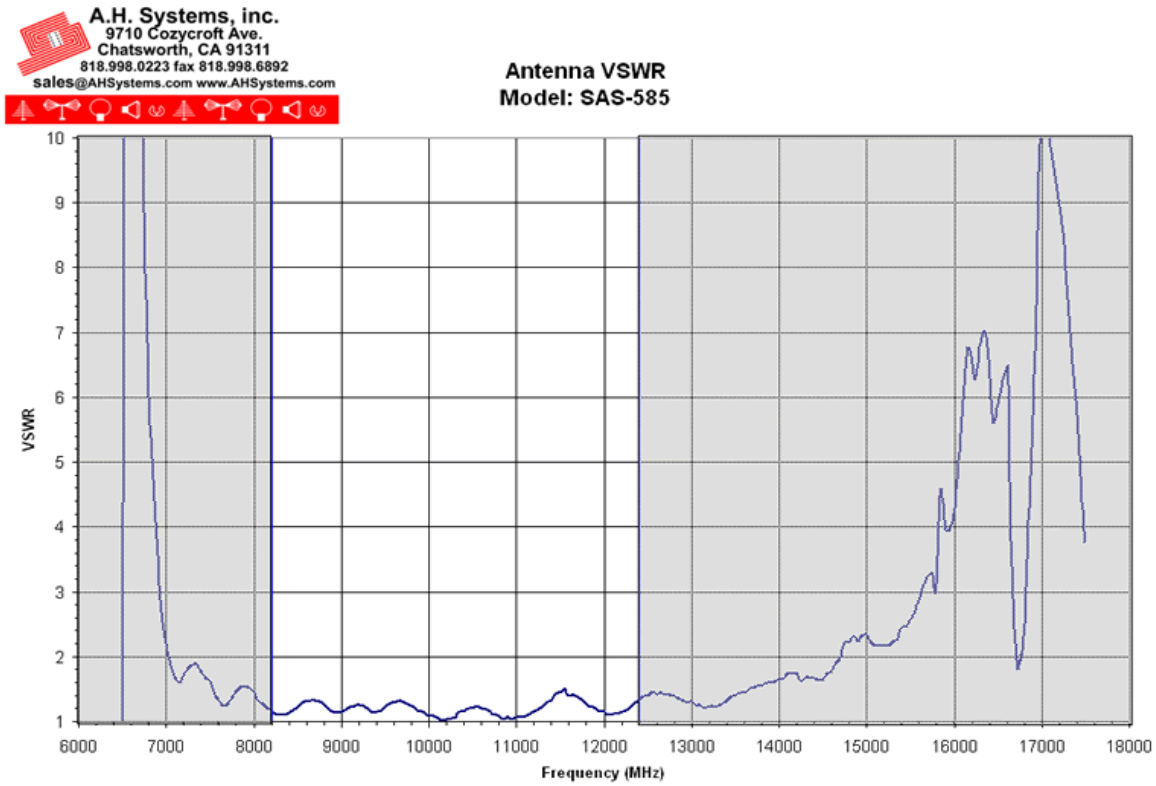


Figure 1 – SAS-585 (Horizontal Polarization)

TYPICAL DATA





CALCULATIONS

EMISSIONS TESTING

Individual calibration data for the SAS-585 horn antenna is supplied at a 1-meter separation distance. For emissions measurements, add the 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 (typically 1 meter), 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) *$dB\mu V = dBm + 10\log(Z) + 90$*
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	$V/m = \sqrt{\frac{30 * watts * Gain_{numeric}}{meters}}$
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 loose or missing hardware
- Check for corrosion near the 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.

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.