Standard Gain Horn Antenna Series Operation Manual

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INTRODUCTION

The Standard Gain Horn Antennas are designed specifically for utilization in emissions and immunity testing over the frequency range of 1 to 40 GHz. Each antenna is linearly polarized and has medium gain, low VSWR, and constant antenna factor. The Standard Gain Horn performance is very precise and predictable through design parameters. Comparisons of measured versus computed antenna factor and gain have been shown to be +/- .5 dB. Therefore, the 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. Each Standard Gain Horn comes with a tripod mount that adapts to any tripod with ¼-20 male threads. Horizontal and vertical polarization is obtained by rotating the antenna on the tripod.
Each model has an approximate 15 dB Gain, also available in 10 dB or 20 dB gain.

SPECIFICATIONS

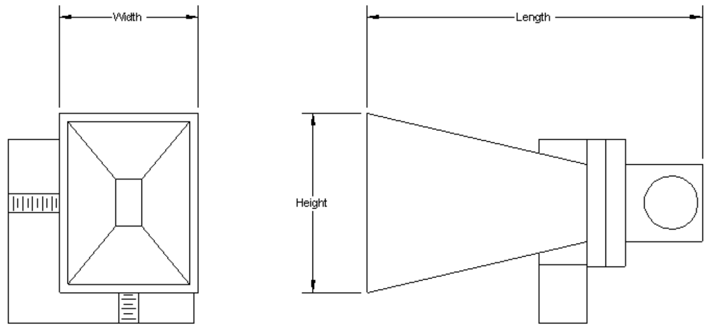


Figure 1 - (Horizontal Polarization)

Standard Gain Horn Antenna Physical Specifications

Model Number	Frequency Range	Connector Type	Length	Width	Height	Weight (lb's / Kg)
SAS-580	1.12 - 1.7 GHz	WR-650 to N (f)	34.4" 87.3cm	14.2" 36.1cm	20" 50.8cm	21lbs. 9.5kg
SAS-581	1.7 - 2.6 GHz	WR-430 to N (f)	27" 68.6cm	8.5" 21.6cm	11.8" 30cm	10.5 lbs. 4.76 kg
SAS-582	2.6 - 3.95 GHz	WR-284 to N (f)	17.9" 45.5cm	6" 15.2cm	8.1" 20.6cm	4.8 lbs. 2.17 kg
SAS-583	3.95 - 5.85 GHz	WR-187 to N (f)	12" 30.5cm	3.7" 9.4cm	5.1" 12.9cm	2.1 lbs. 0.95 kg
SAS-584	5.85 - 8.2 GHz	WR-137 to N (f)	8.6" 21.8cm	2.6" 6.6cm	3.5" 8.9cm	1.1 lbs. 0.5 kg
SAS-585	8.2 - 12.4 GHz	WR-90 to N (f)	7.2" 18.3cm	2.1" 5.3cm	2.8" 7.1cm	0.6 lbs. 0.27 kg
SAS-586	12.4 - 18 GHz	WR-62 to N (f)	4" 10.2cm	1.5" 3.8cm	1.9" 4.8cm	0.2 lbs. 0.09 kg
SAS-587	18 - 26.5 GHz	WR-42 to SMA (f)	3.4" 8.6cm	0.9" 2.3cm	1.2" 3.0cm	0.2 lbs. 0.09 kg
SAS-588	26.5 - 40 GHz	WR-28 to 2.9mm (f)	2.9" 7.4cm	0.6" 1.5cm	0.9" 2.3cm	0.1 lbs. 0.05 kg

Standard Gain Horn Antenna Electrical Specifications

			Gain (dBi)				3 dB Beamwidth	
Model Number	Frequency Range	Antenna Factor (dB/m)	Low	Mid	High	Maximum Power CW (Watts)	E-Plane	H-Plane
SAS-580	1.12 - 1.7 GHz	18.2	13.4	14.6	16.2	550	29	28
SAS-581	1.7 - 2.6 GHz	22.1	12.8	14.0	15.4	500	28	29
SAS-582	2.6 - 3.95 GHz	25.4	13.6	15.0	16.5	250	28	29
SAS-583	3.95 - 5.85 GHz	29.2	12.5	14.4	15.8	250	29	29
SAS-584	5.85 - 8.2 GHz	32.2	13.4	14.7	16.4	250	30	29
SAS-585	8.2 - 12.4 GHz	34.6	14.0	15.8	17.3	250	30	30
SAS-586	12.4 - 18 GHz	38.9	13.1	14.9	16.6	200	30	29
SAS-587	18 - 26.5 GHz	42.2	13.4	14.8	16.4	50	30	30
SAS-588	26.5 - 40 GHz	46	12.9	14.5	16.3	10	31	30

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. Therefore the output of the amplifier must be connected to an appropriate load such as an antenna, field-generating device, or receiver. 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.

INSTALLATION

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.

OPERATING INSTRUCTIONS

DESCRIPTION

The Standard Gain Horn Antennas have a wide range of applications from gain comparison to parabolic feeds due to their versatility, simplicity and good radiation performance. These waveguide horns are an ideal solution for compliance testing with their characteristic 30-degree beamwidth (which allows for optimal EUT coverage) and their flat antenna response. These lightweight horn antennas are also available with different gain and beamwidth characteristics.

OPERATION INSTRUCTIONS

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.

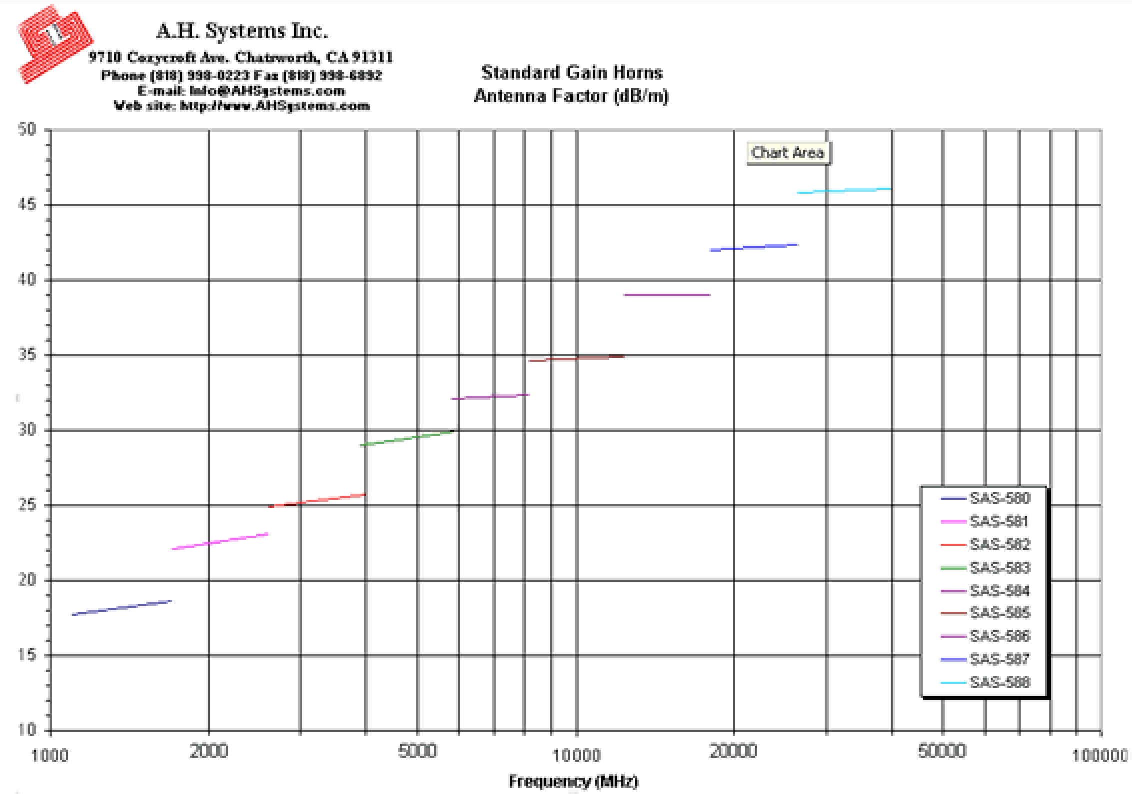
ADDITIONAL NOTES

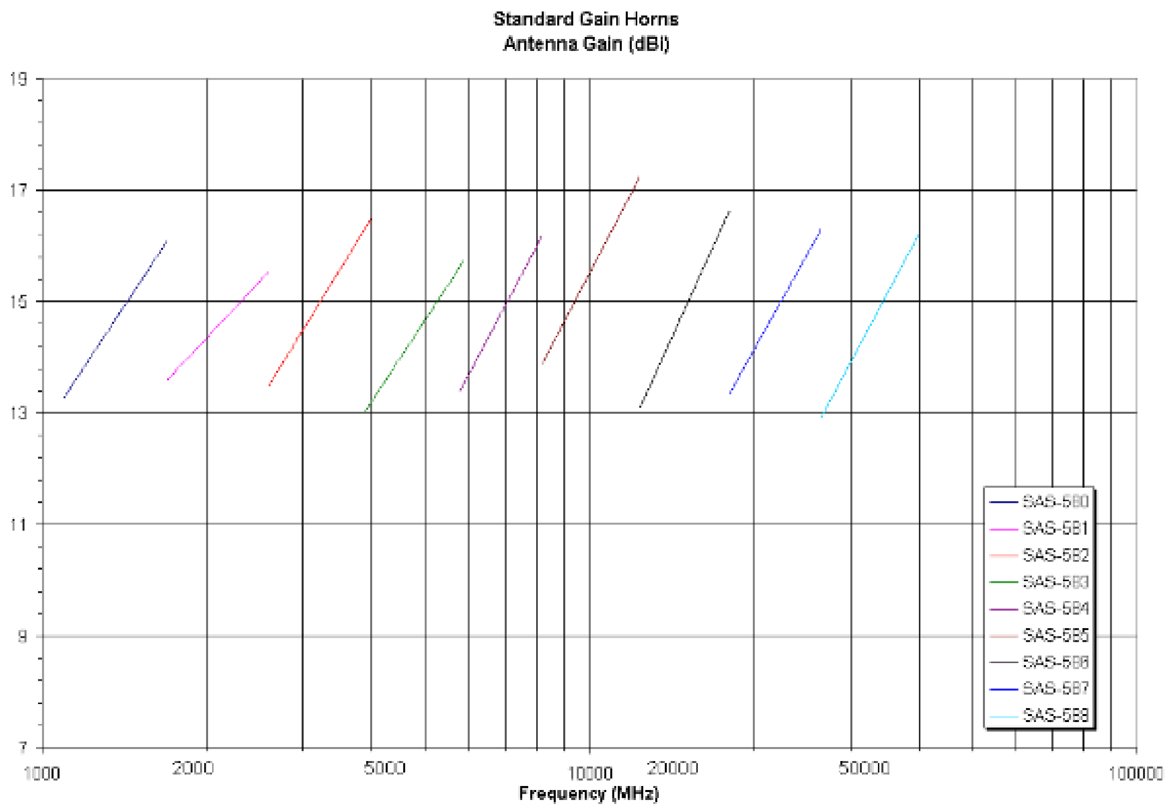
These waveguide horn antennas will respond well beyond their specified frequency ranges. The operational range of the waveguides themselves dictates the specified frequency range of the antennas.

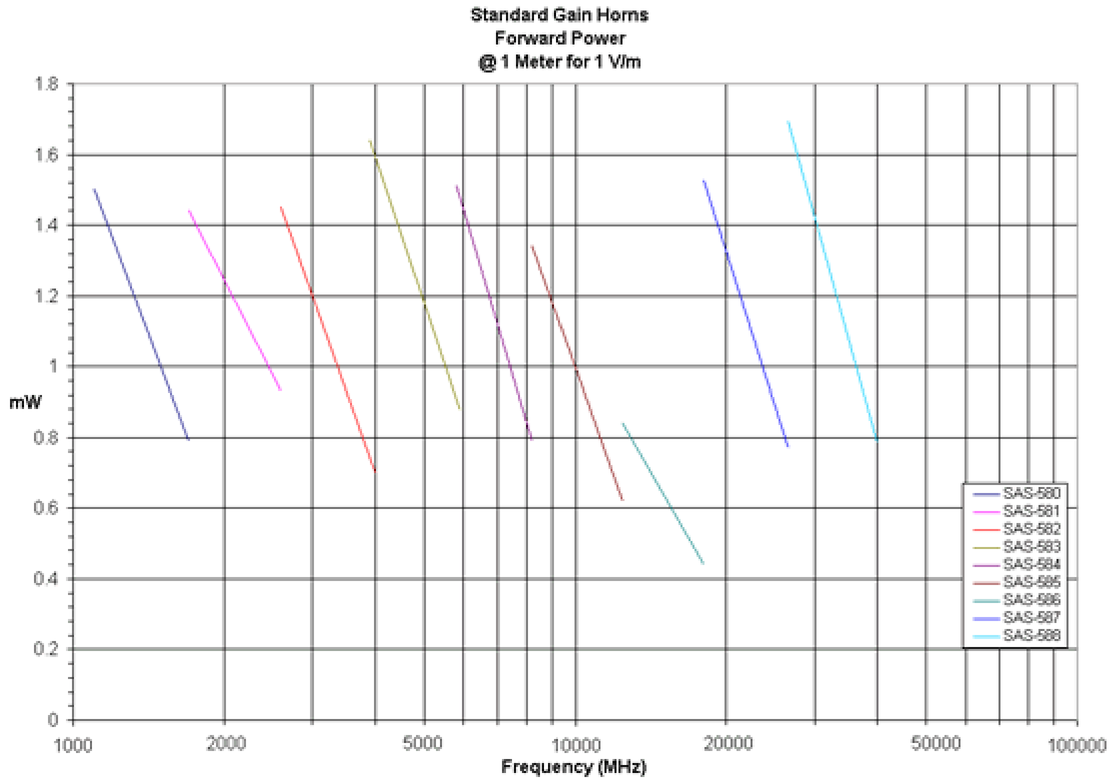
The coax-to-waveguide adapter is the only power-limiting component on the antenna and can be removed if high fields are desired.

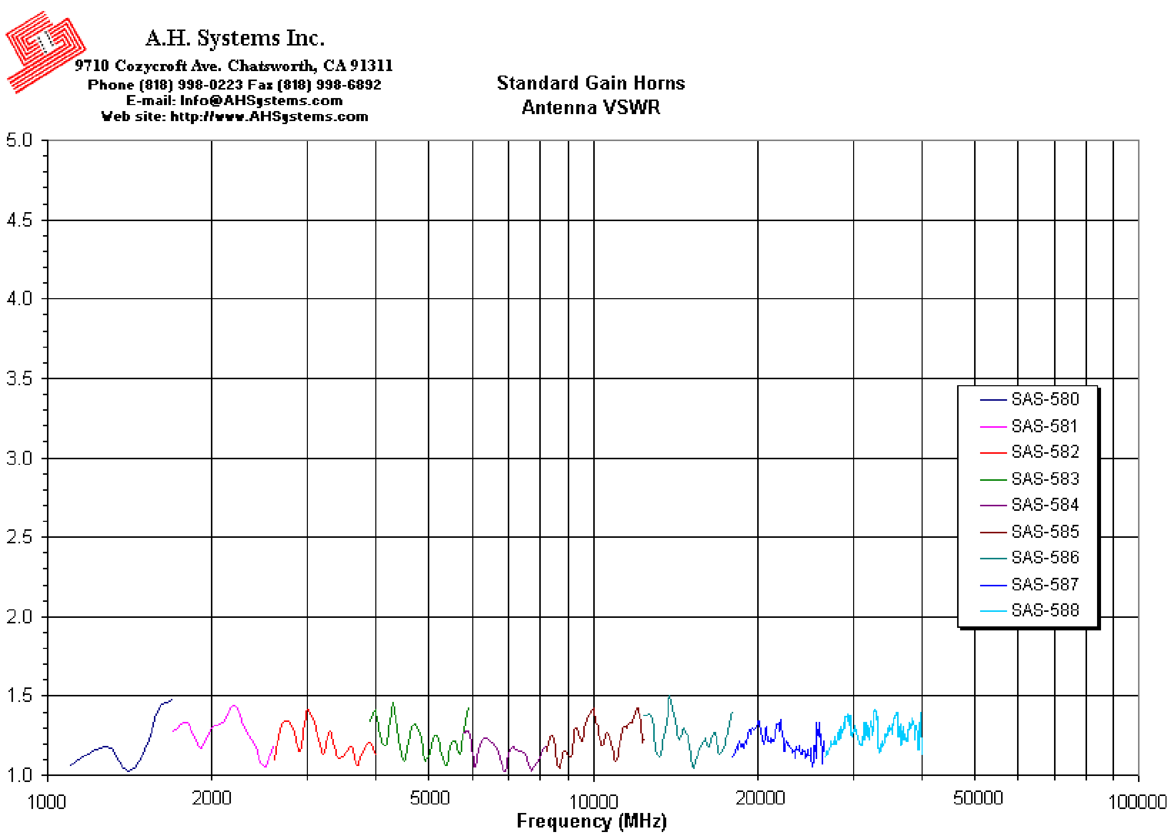
As mentioned before, the standard gain horn antenna has an approximate 15 dB gain with a 30 degree beamwidth. Other horn antennas are available with different apertures and flare angles that will increase or decrease the gain of the antenna. As the gain increases, the beamwidth will decrease. Call us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

TYPICAL DATA






Standard Gain Horns
Forward Power
@ 1 Meter for 1 V/m
mW
Frequency (MHz)
SAS-580
SAS-581
SAS-582
SAS-583
SAS-584
SAS-585
SAS-586
SAS-587
SAS-588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Standard Gain Horns
Antenna VSWR
Frequency (MHz)
SAS-580
SAS-581
SAS-582
SAS-583
SAS-584
SAS-585
SAS-586
SAS-587
SAS-588

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/m.

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

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 logarithmic 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:

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

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

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

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

dBmW/m² = dBμV/m – 115.8

The constant in this equation is derived following similar logic. First, consider the pointing vector which relates the power density (W/m²) 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/m² to dBmW/m² for power density and dBV/m to dBμV/m for the electric field, the constant becomes 115.8.

dBμV/m = dBμV + 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!

dBμA/m = dBμV/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/m² = dBW/m² + 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 Henrys 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 deriving the Log, the constant becomes:

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

$$dBpT = dB\mu V + dBpT/\mu V + \text{Cable Loss}$$

$$dB\mu V/m = dBpT + 49.5 \text{ dB}$$

MAINTENANCE

An Annual re-calibration of your standard gain horn antenna is recommended. Our staff can recalibrate almost any type or brand of antenna.

For more information about our calibration services 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.