AS5311

Magnetic Multipole Strip MS10-300
Pole Length 1.0mm, 300 Poles

Magnet Specification

1 General

This specification defines the dimensional and magnetic properties of a multipole magnetic strip for use with the AS5311 magnetic linear motion and off-axis rotary angle encoder.

Material: Strontium ferrite bonded

2 Dimensional Specification

Parameter	Symbol	Min	Typ	Max	Unit	Note
Strip Length	L		300±2		mm	Active length = 300mm
Strip Width	W		10±0.2		mm	Active width = 10mm
Strip Thickness	T		1,3±0,15		mm	1mm rubber bonded magnet on 0.3mm stainless steel strip
Thermal Expansion			17		$x10^{-6}/K$	Mechanical length expansion
Density		3.5 1.43	3.65 4.64	3.8 7.85	g/cm^3	magnetic rubber: stainless steel
Delivery	Single cut pieces without adhesive, rolls of 25m, 50m (up to 100m max.)					

3 Magnet Specification

Parameter	Symbol	Min	Typ	Max	Unit	Note
Pole Length	L_p		1.00		mm	Results in pole pair length of 2.0mm (300 poles @ 1.0mm)
Pole Length Deviation			1	1.5	% of $2*L_p$	Measured at Bz=0, all poles within active area
Amplitude Variation				±10	% of B_{pk}	All poles within active area
Number of Poles			300		poles	Excluding poles with $L<L_P$ at the ends of the strip
Resolution	Res		1.95		µm	AS5311 @ 10-bit incremental output
			0.488			AS5311 @ 12-bit absolute serial output
Magnetic Field Amplitude @ **0.8mm** Distance	B_{pk}				mT	Vertical component of the magnetic field strength in the center of the strip at 25℃
Magnetic Field Temperature Drift	TkB_r		-0.2		%/K	

Parameter	Symbol	Min	Typ	Max	Unit	Note
Cumulative error				40 20 10	µm/m	depending on accuracy grade standard A20 A10
Thermal Expansion				1E-4	1/K	Mechanical length expansion
Temperature Range	Tamb	-40	25	100	℃	scale mounted, no bending

Magnetization

The MS10-300 magnet strip is magnetized on the top side and bonded on a steel support with elastomer adhesive (bottom). Note that the polarization of the magnet will change when it is rotated as the pole arrangement is not symmetric. This will influence the position of the index pulse.

An index pulse is generated when the North and South poles are placed over the Hall array as shown in Figure *2.*

The incremental output count increases when the magnet is moving to the left, facing the chip with pin#1 at the lower left corner (see Figure *2*, top drawing). At the same time, the absolute position information increases.

Likewise, the position information decreases when the magnet is moved in the opposite direction. Note that there is no hysteresis at the absolute output. In order to get a stable 12-bit absolute reading, it may be necessary to filter the values by averaging, e.g. a moving average calculation in the external microcontroller. Averaging 4 readings results in 6dB (=50%) noise and jitter reduction. An average of 16 readings reduces the jitter by a factor of 4.

Mounting the Magnet Strip

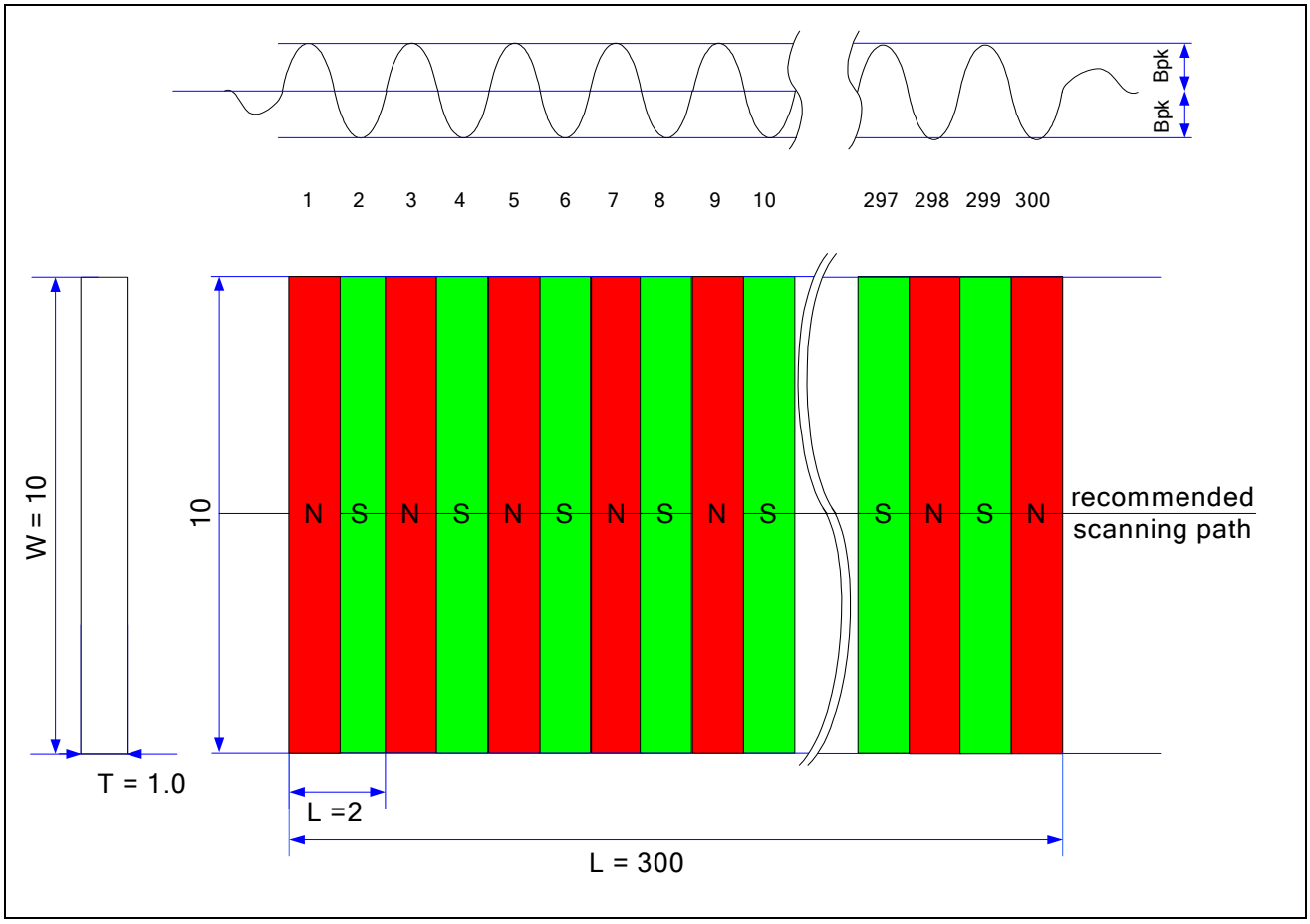
The magnet strip may be mounted directly on magnetic or non-magnetic surfaces. When magnetic surfaces are used, the strip must be mounted on top of the surface, but not immersed in a cavity, as this may weaken the magnetic field of the magnet. When mounting the magnet on a non-magnetic surface, either method is acceptable.

For more rigid demands, magnet suppliers offer customized solutions where the magnet material is directly overmolded on the carrier, e.g. a shaft, bushing, plate, etc..

Please contact your magnet supplier for more information. A list of recommended suppliers is available for download on the austriamicrosystems website

4 Magnet Dimensions

Figure 1: MS10-300 Strip Dimensions



Alignment of Magnet Strip and Sensor IC

When aligning the magnet strip to the AS5311 sensor IC, the centerline of the magnet strip should be placed exactly over the Hall array. See Figure *2* for the position of the Hall array relative to Pin #1.

Vertical Distance

The vertical distance between the magnet strip and the top of the IC package should be 0.3 +- 0.2mm. Note that the vertical distance depends on the strength of the magnet. The AS5311 automatically adjusts for fluctuating magnet strength by using an automatic gain control (AGC). There are several indicators for proper magnetic field strength available with the AS5311. The vertical distance should be set such that the magnetic field is in the “green” range. See the AS5311 datasheet for more details.

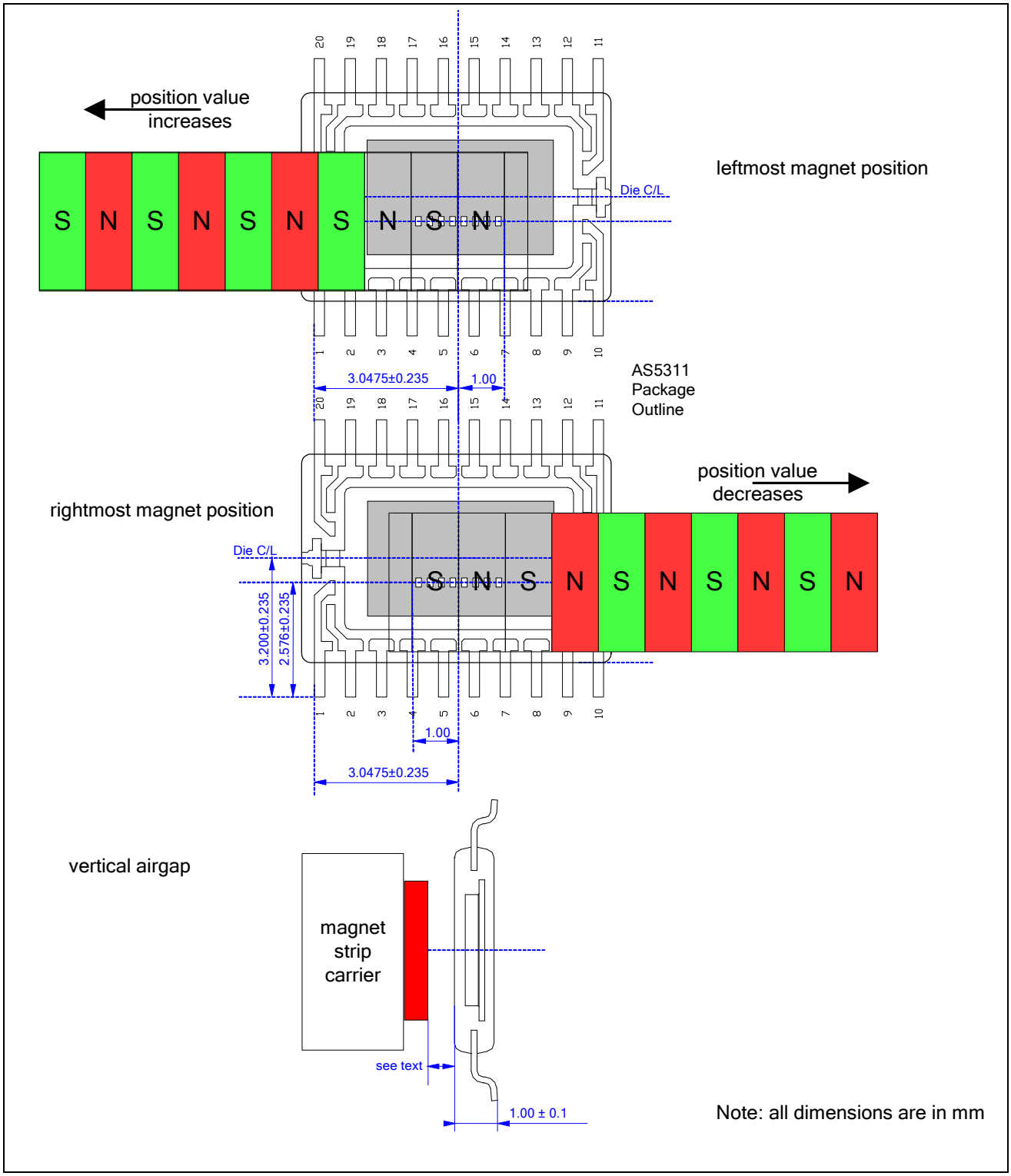
See also Figure 3 for measurement data of the MS10-300 magnetic strip.

Lateral Stroke

The lateral movement range (stroke) can cover the active area of the magnetic strip (see Figure 1) as long as all Hall sensors of the IC are covered by the magnet. The Hall array on the AS5311 has a length of 2.0mm, hence the total stroke is

Stroke = Length of active area – length of Hal array = 300mm – 2.0mm = 298mm

Figure 2: Alignment of Magnet Strip with AS5311 Sensor IC



Note that the polarization of the magnet will be reversed when it is rotated or flipped (see Magnetization for more details).

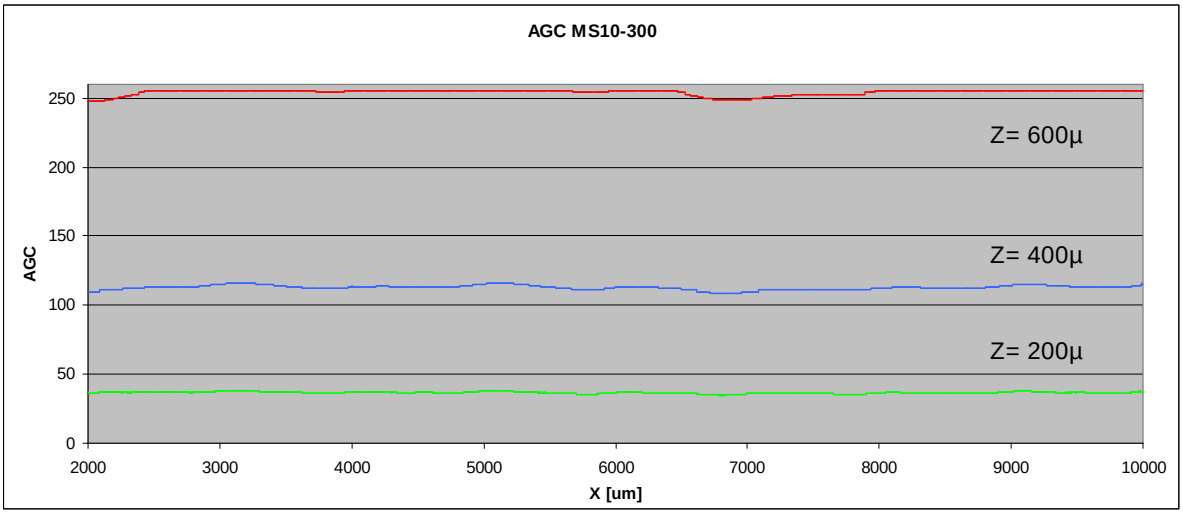
5 Measurement Data

Figure 3 and Figure 4 show typical test results of MS10-300 samples. Note that austriamicrosystems AG does not guarantee this data for all magnet samples. Please contact the magnet supplier for detailed specifications.

Automatic Gain Control

Figure 3 shows a typical measurement result using the MS10-300 magnetic strip at three different vertical gaps between strip and IC surface: 200µm, 400µm and 600µm. The AGC automatically adjusts for fluctuating magnetic field strength. Note that a stronger magnetic field (shorter airgap) results in a smaller AGC value. The vertical gap should be adjusted such that the AGC is within its regulation limits (>0….<255).

Figure 3: AS5311 AGC Values versus Airgap

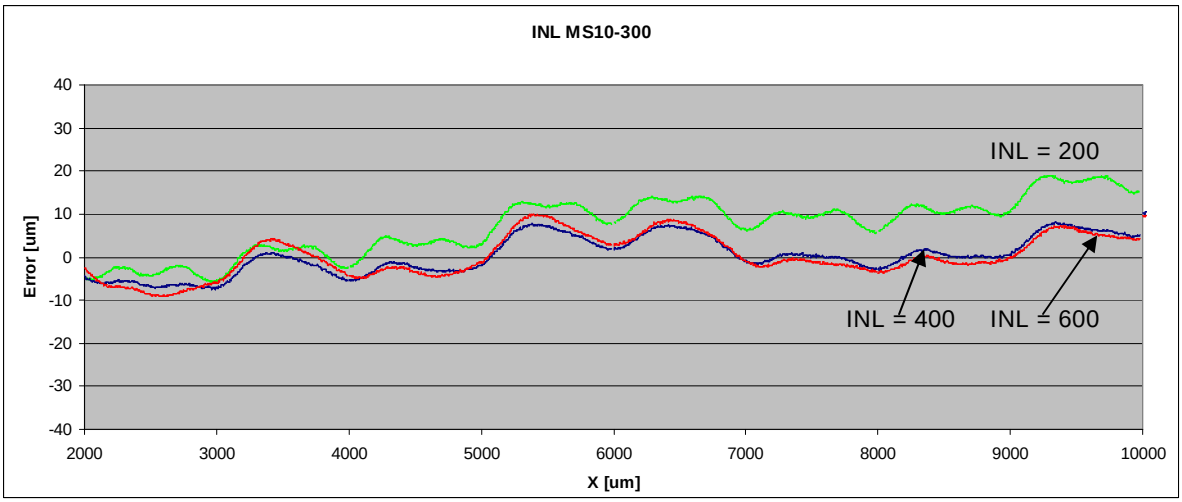


Accuracy (non-linearity) of the MS10-300 Magnetic Strip

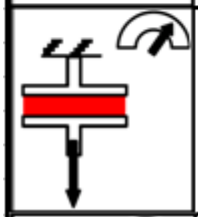
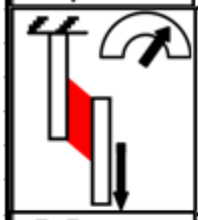
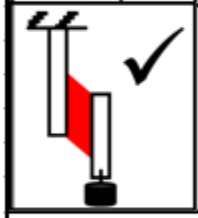
Figure 4 shows the accuracy of an MS10-300 sample over the full stroke range of 8mm at three different vertical gaps. The graphs show that the accuracy is virtually identical (about +/- 10µm) for all three airgaps due to the automatic gain control of the AS5311.

Note: the accuracy depends greatly on the length of each pole and hence from the precision of the tool used for magnetization.

Figure 4: Integral nonlinearity versus Airgap



6 Adhesive Tape Specification

Adhesive			Acrylic
Colour			Transparent
Thickness of adhesive tape			0.13 mm
Protective cap			Paper
Temperature resistance permanently short term			 150°C 260°C
	Peel Force ASTM D3330, after 72h, 300 mm/Min.; 90°; RT; Steel		131 (N/100mm)
	Tensile Strength ASTM D-897, after 72h; Steel 12.7 mm/Min.; 6.45cm²; RT		69 (N/cm²)
	Shearing Strength Dynamic ASTM D-1002, after 72h; Steel 12.7 mm/Min.; 6,45cm²; RT		55 (N/cm²)
	Shearing strength static ASTM D-3654 after 72h; Steel; > 10.000 Min.; 3.23cm²: RT	20°C 65°C 90°C 120°C 150°C 175°C	1000g 1000g 1000g 1000g 500g 500g
Length of reel			55m/165m
Roll width minimum maximum			 6 mm 1200 mm
Cutting tolerance			± 0.4mm
Inner core diameter			76.2 mm

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