

# AS5311

## Magnet Specification

### Magnetic Multipole Strip MS10-10 Pole Length 1.0mm, 10 Poles

#### 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: plastic bonded Hard Ferrite

#### 2 Dimensional Specification

Parameter	Symbol	Min	Typ	Max	Unit	Note
Strip Length	L		11		mm	Active length = 10mm
Strip Width	W		2		mm	Active width = 1.0mm
Strip Thickness	T		0.5		mm	
Thermal Expansion			49		$\times 10^{-6}/K$	Mechanical length expansion
Density			3.4		$g/cm^3$	Estimated
Delivery	Single cut pieces without adhesive					

#### 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 (10 poles @ 1.0mm, 2 border poles ~0.5mm)
Pole Length Deviation			1	1.2	% of $2 \times L_p$	Measured at $B_z=0$ , all poles within active area
Amplitude Variation				2	% of $B_{pk}$	All poles within active area
Number of Poles			10		poles	Excluding poles with $L < L_p$ at the ends of the strip
Resolution	Res		1.95		$\mu m$	AS5311 @ 10-bit incremental output
			0.488			AS5311 @ 12-bit absolute serial output
Magnetic Field Amplitude @ 0.8mm Distance	$B_{pk}$	10			mT	Vertical component of the magnetic field strength in the center of the strip at 25°C
Magnetic Field Temperature Drift	$TkB_r$		-0.2		%/K	
Active Region to strip edge	A			0.5	mm	Recommended scan path = strip center
Thermal Expansion				1E-4	1/K	Mechanical length expansion
Temperature Range	$T_{amb}$	-20	25	70	°C	

## Magnetization

The MS10-10 magnet strip is magnetized on both sides (top and bottom). Either side may be used. Note that the polarization of the magnet will change when it is rotated or flipped as the pole arrangement 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

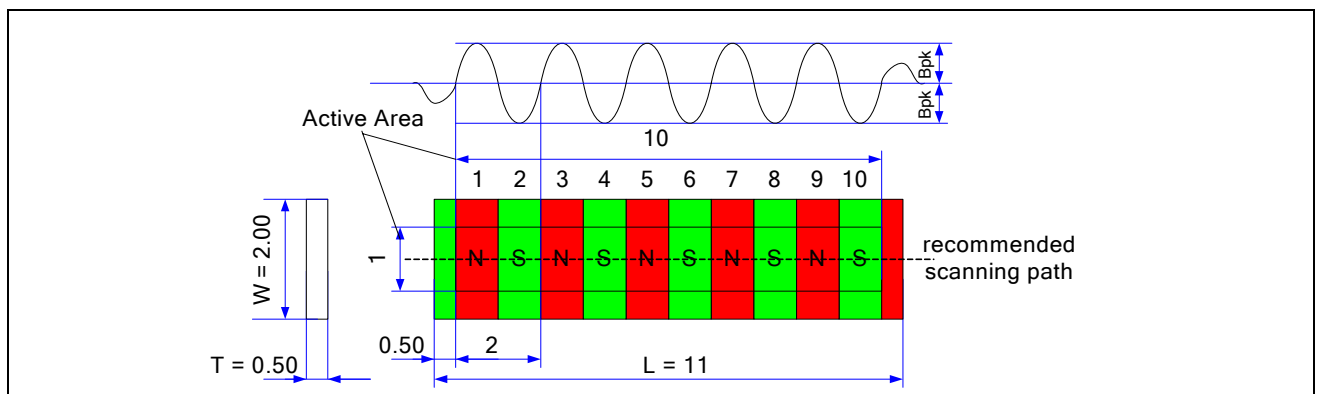
The magnet strip may be mounted directly on magnetic or non-magnetic surfaces. When magnetic surfaces are used, the strip must be mounted on top of the surface, but not immersed in a cavity, as this may weaken the magnetic field of the magnet. When mounting the magnet on a non-magnetic surface, either method is acceptable. Depending on the carrier material, there are several adhesives available to glue the strip to the surface. For general ruggedness and vibration demands, the use of two-component-adhesive (binder + hardener) or acrylic UV cured glues such as Loctite 662 have proven to be successful in most cases.

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: MS10-10 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.

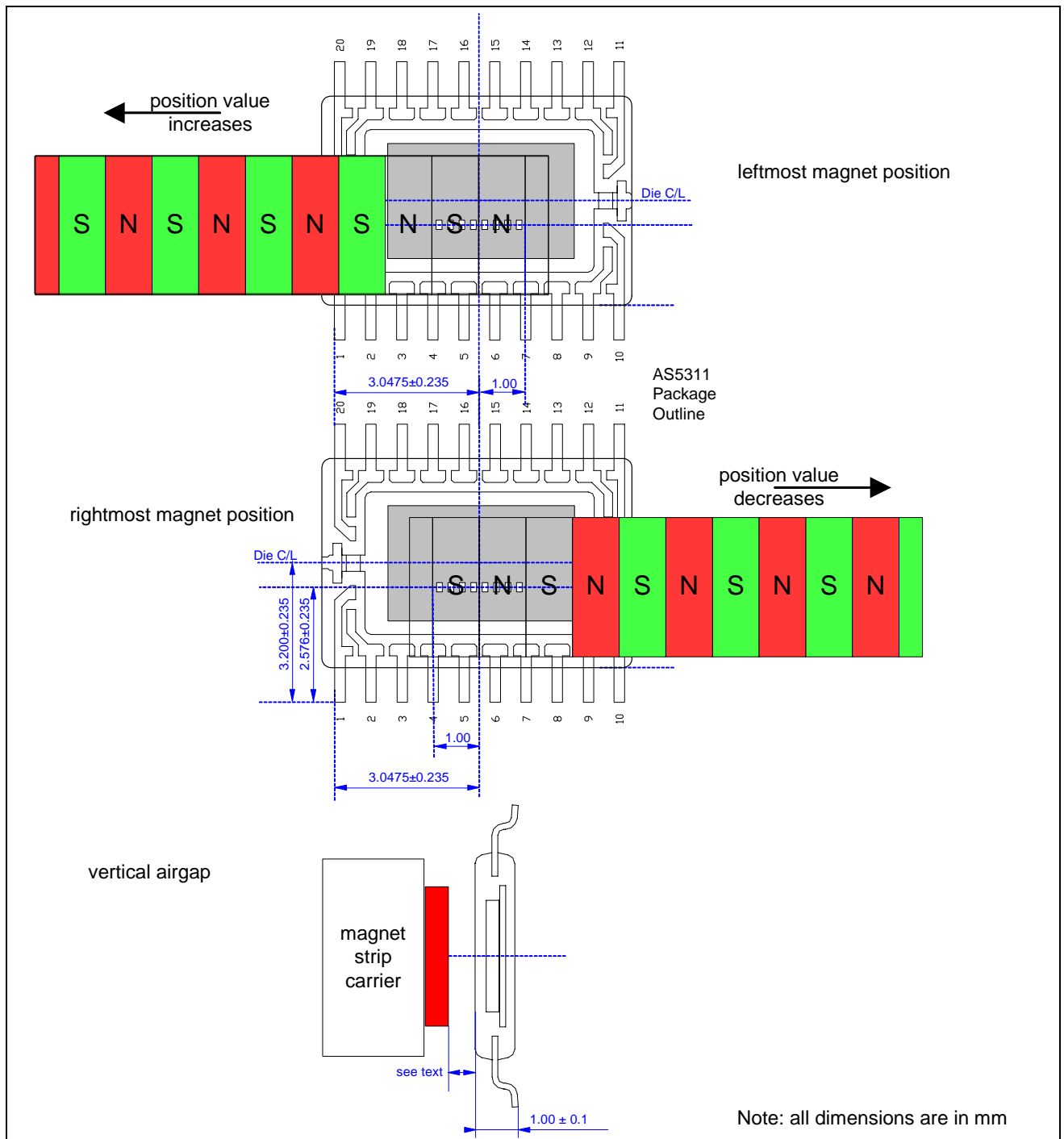
See also Figure 3 for measurement data of the MS10-10 magnetic strip.

### 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

$$\text{Stroke} = \text{Length of active area} - \text{length of Hal array} = 8.0\text{mm} - 2.0\text{mm} = \underline{6.0\text{mm}}$$

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).

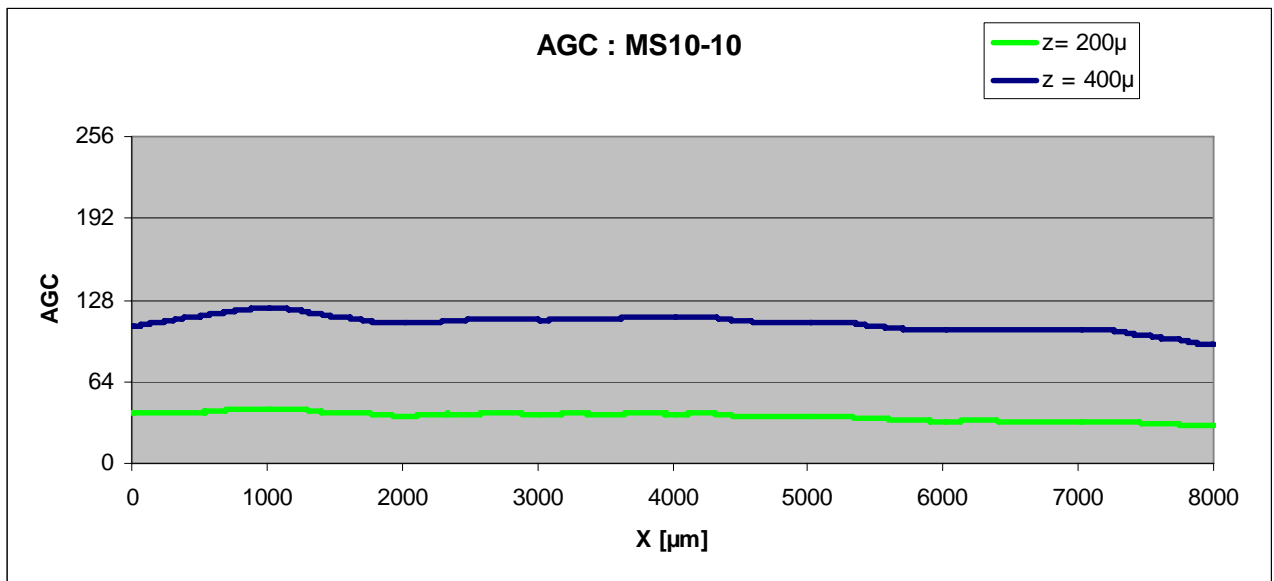
## 5 Measurement Data

Figure 3 and Figure 4 show typical test results of MS10-10 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 MS10-10 magnetic strip at two different vertical gaps between strip and IC surface: 200 $\mu\text{m}$  and 400 $\mu\text{m}$ . 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 ( $>0 \dots <255$ ).

Figure 3: AS5311 AGC values versus airgap

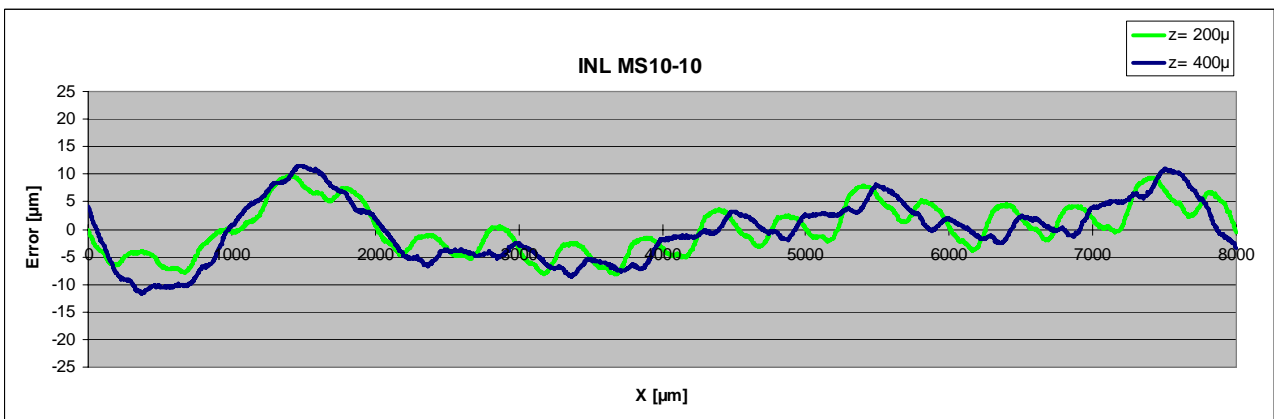


### Accuracy (non-linearity) of the MS10-10 Magnetic Strip

Figure 4 shows the accuracy of an MS10-10 sample over the full stroke range of 8mm at two different vertical gaps. The graphs show that the accuracy is virtually identical (about  $\pm 10\mu\text{m}$ ) for both 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



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