

TARGET PITCH OPTIMIZATION FOR ATS604-G2

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INTRODUCTION

The ATS604-G2 is a two-wire, back-biased, wheel speed and direction sensor IC with an AK protocol and orientation independent mounting. This IC can be used with a variety of different target geometries, and target dimensions may be tailored to achieve optimal required performance. In this application note, simulation data is used to determine the target pitch to optimize maximum air gap and output event location accuracy. Pitch is defined as distance between corresponding points on adjacent target features. For targets with equal teeth and valleys, as is considered in the application note, target pitch is the width of tooth plus the width of the valley, as shown in Figure 1.

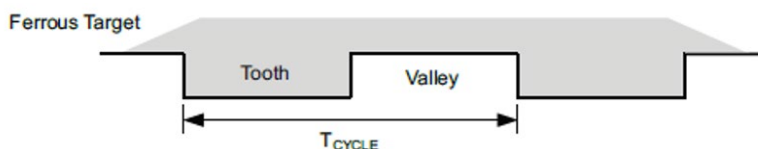


Figure 1: Target Pitch

TRENDS IN OUTPUT BEHAVIOR VS TARGET PITCH

Generally, if the target pitch is increased, amplitude of the differential magnetic signal detected by the IC increases. This directly results in increase of maximum operating air gap. However, if the target pitch is increased beyond a certain size, the differential signal shape starts to distort from a perfect sinusoidal signal to a signal with flat regions. If these flat regions are close to the switch point of the sensor, the position of output pulses may be affected causing accuracy to be reduced. Figure 2 shows this effect of increasing target pitch on amplitude and signal shape.

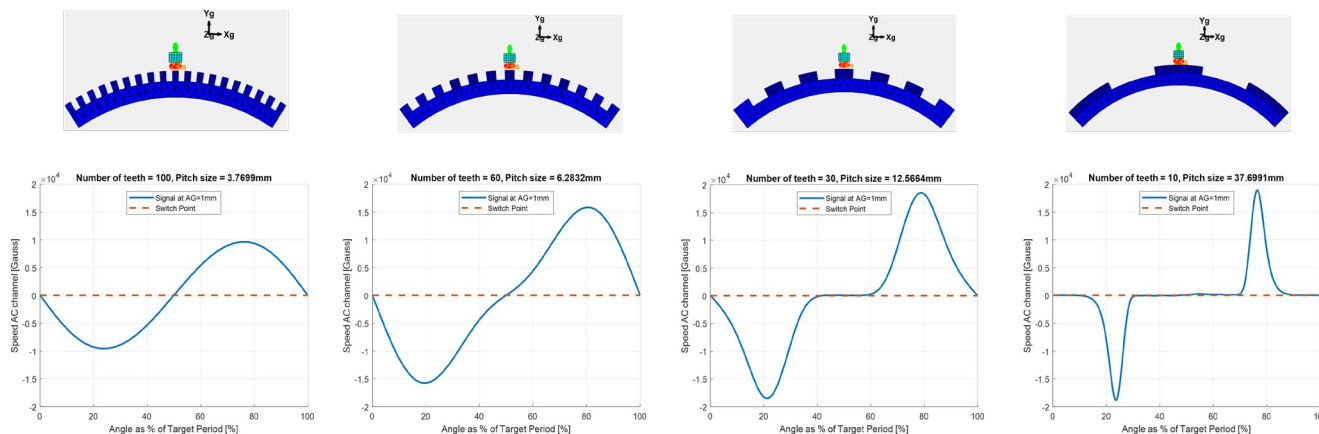


Figure 2: Effect of Increasing Target Pitch on Amplitude and Signal Shape

With this reduced switching accuracy due to large pitch, output pulses may no longer appear to be equidistant. Figure 3 shows oscilloscope captures of ATS604-G2 output from an ideal target versus output from a large pitch target.

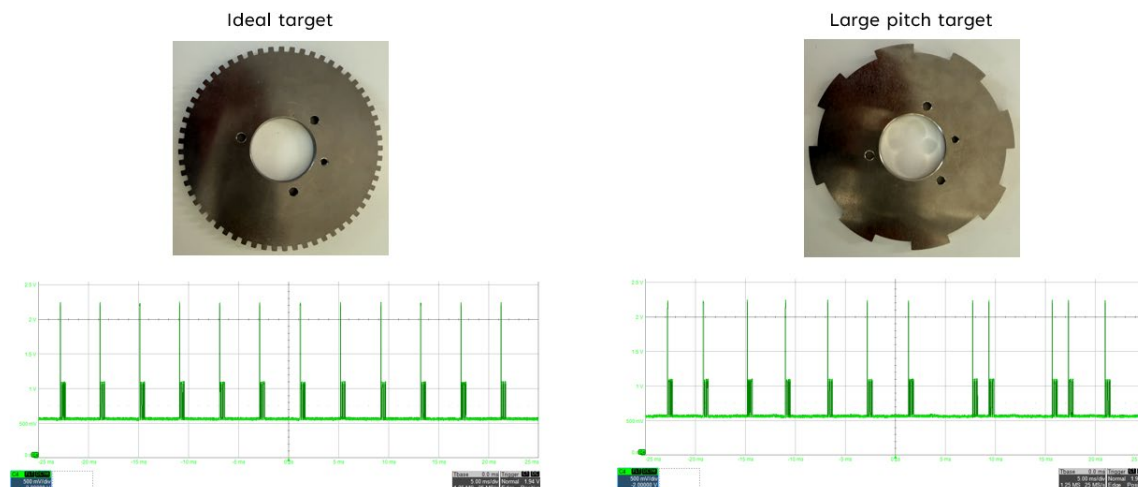


Figure 3: Output Signal Captured for Targets with Regular (left) and Large (right) Pitch Size.

As shown, the output on the large pitch target shows non-equidistant pulses. Therefore, if the target pitch increases beyond a certain limit, there is a trade off between max air gap and switching accuracy. This application note analyzes simulation data for targets with different pitch sizes to quantify the behavior over pitch size.

CALCULATING SIZE OF FLAT SIGNAL REGION

To measure the size of the flat region, the differential signal is normalized from 0 to 100% and angle is normalized as a percentage of target period such that 0% to 100% is one period. The signal crossings at +2.5% and -2.5% from the 50% switch point are identified and the normalized angle between these crossings is taken as a measure of the flat region. Figure 4 shows a graphical representation of the measure of the flat region.

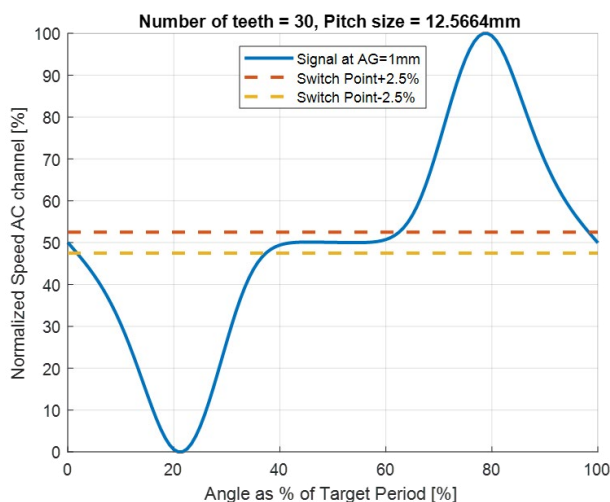


Figure 4: Measure of the Flat Region in the Differential Speed Signal

SIMULATION RESULTS

Simulations were performed on targets with different pitch sizes. The maximum operating air gap and size of flat signal region

was calculated for each pitch size. The results for air gaps exceeding the max operating air gap were excluded from the analysis. These results are shown in Figure 5.

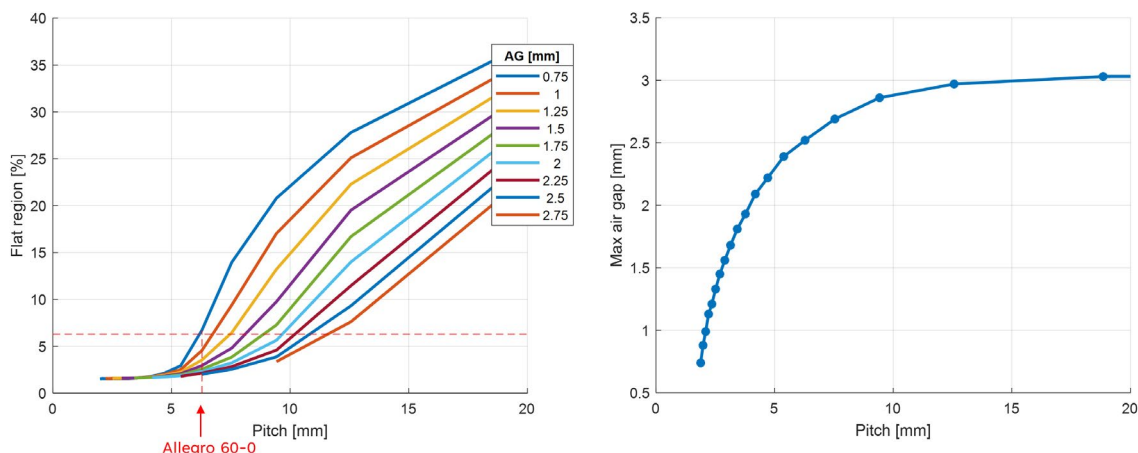


Figure 5: Plots for Size of the Flat Region versus Pitch Size (Left) and for Maximum Operating Air Gap versus Pitch Size (Right)

The simulation results show that as the pitch size increases, the max air gap increases. Simultaneously, the flat region in the magnetic differential signal increases. If the pitch size is too small, the signal does not have large flat regions around the switch point but the operating air gap is also significantly reduced. The Allegro 60-0 target was used as a reference. The pitch of the Allegro 60-0 target is 6.2832 mm and corresponding worst-case flat region for this pitch size is 6.726%. Since performance on the Allegro 60-0 reference target is verified and specified in the datasheet, target pitch sizes with a flat region smaller than 6.726% fall into the recommended pitch range. The graph in Figure 6 summarizes these results. Pitch sizes and air gaps below the red line are recommended to be used. The color represents the width of the flat signal region. Brighter colors represent larger flat regions. The black area represents the configurations where the max air gap is exceeded so they should not be used. The red line provides a recommendation for selection of pitch size and air gap. Any configuration below the red line falls into the recommended configuration range. Note that the results of simulations should be used for trends and not absolute information, especially in regards to production.

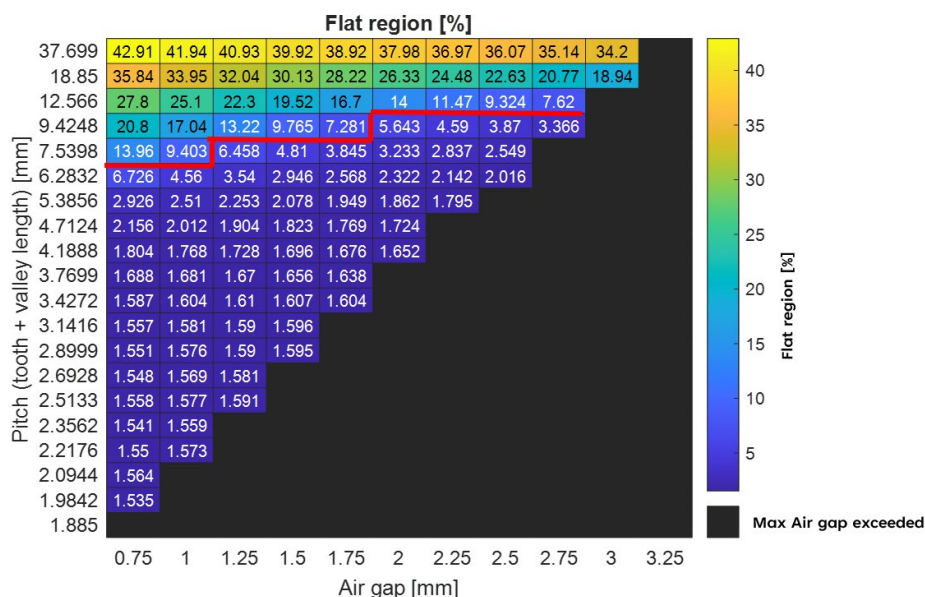


Figure 6: Visual Summary of the Simulation Results

CONCLUSION

This application note describes the trends in ATS604-G2 output behavior versus target pitch, presents simulation results and analyzes effect of target pitch size on maximum air gap and output event location accuracy. Based on the analysis recommendations are made for the best pitch sizes and air gap ranges to be used. It should be noted that these are recommendations and not IC specifications, therefore targets outside the recommended ranges may also meet application requirements depending on the application requirements.

APPENDIX

Table 1: Reference Target 60-0

Characteristics	Symbol	Test Conditions	Typ.	Units	Symbol Key
Outside Diameter	D_o	Outside diameter of target	120	mm	
Face Width	F	Breadth of tooth, with respect to branded face	6	mm	
Angular Tooth Thickness	t	Length of tooth, with respect to branded face	3	degrees	
Angular Valley Thickness	t_v	Length of valley, with respect to branded face	3	degrees	
Tooth Whole Depth	h_t		3	mm	
Material		Low Carbon Steel	—	—	

Revision History

Number	Date	Description	Responsibility
–	January 20, 2026	Initial release	Syed Bilal Ali

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