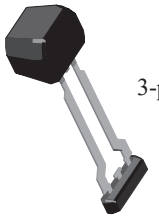
ATS19480

Large Air Gap, GMR Transmission Speed Sensor IC for Gear Tooth Sensing

FEATURES AND BENEFITS

- Fully integrated solution has GMR IC, protection capacitor, and back-bias magnet in a single in-line overmolded package
- Innovative GMR technology provides large operational air gap sensing on ferromagnetic targets
- Advanced algorithms for flexible design-in and system compensation, automatically adapts to extreme mechanical changes (air gap) and thermal drifts
- Measures differentially to reject common-mode stray magnetic fields
- Orientation compatible with Hall-effect technology
- Integrated ASIL diagnostics and certified safety design process (optional fault reporting)

PACKAGE:



3-pin SIP (suffix SN)

Not to scale

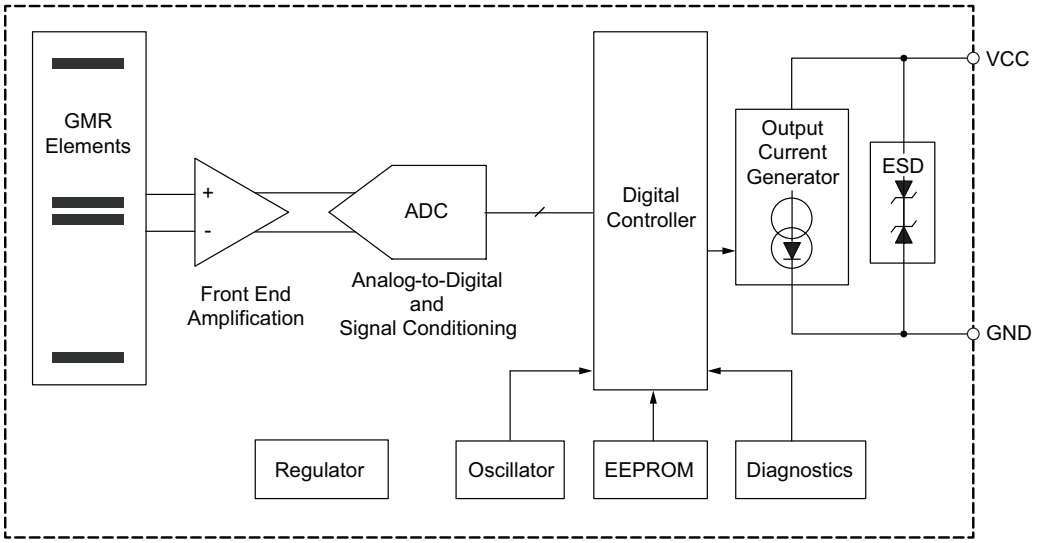
DESCRIPTION

The ATS19480 is a giant magnetoresistance (GMR) integrated circuit (IC) that provides a user-friendly two-wire solution for applications where speed information is required using ferromagnetic gear tooth targets. The fully integrated package includes the GMR IC, a protection capacitor for EMC robustness, and a back-bias magnet in a single in-line package.

The GMR-based IC is designed for use with ferromagnetic gear tooth targets and is orientation-compatible with Hall-effect technology. The fully integrated solution senses at large operating air gaps and over a large air gap range. State-of-the-art GMR technology on a monolithic IC with industry-leading signal processing provides accurate speed information in response to low-level differential magnetic signals. The differential sensing offers inherent rejection of interfering common-mode magnetic fields.

Integrated diagnostics are used to detect an IC failure that would impact output protocol accuracy, providing coverage compatible with ASIL B (assessment pending). Built-in EEPROM scratch memory offers traceability of the device throughout the IC's product lifecycle. ASIL reporting can be enabled or disabled as a product offering depending on the applications' needs.

The ATS19480 is provided in a lead (Pb) free 3-pin SIP package with tin leadframe plating. The SN package includes a GMR IC, a magnet, and capacitor integrated into a single overmold, with an additional molded lead-stabilizing bar for robust shipping and ease of assembly.



Functional Block Diagram

SELECTION GUIDE

Part Number	Packing	Fault Detection Mode
ATS19480LSNBTN-A	Tape and reel, 13-in. reel, 800 pieces per reel	Enabled
ATS19480LSNBTN	Tape and reel, 13-in. reel, 800 pieces per reel	Disabled

ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Rating	Units
Supply Voltage	V_{CC}	Refer to Power Derating section	28	V
Reverse Supply Voltage	V_{RCC}		–18	V
Operating Ambient Temperature	T_A	Range L	–40 to 150	°C
Maximum Junction Temperature	$T_{J(max)}$		165	°C
Storage Temperature	T_{stg}		–65 to 170	°C
Externally Applied Magnetic Flux Density	B	In any direction	500	G

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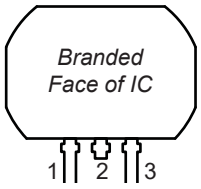
PINOUT DIAGRAM AND LIST



Package SN, 3-Pin SIP Pinout Diagram

Pinout List

Number	Name	Function
1	VCC	Supply Voltage
2	VCC	Supply Voltage
3	GND	Ground

Internal Components

Characteristic	Symbol	Notes	Rating	Units
Nominal Capacitance	C_{SUPPLY}	Connected between VCC and GND; refer to Figure 1	10	nF

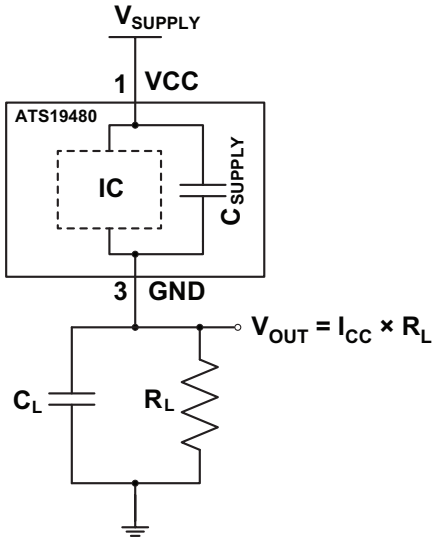


Figure 1: Typical Application Circuit

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OPERATING CHARACTERISTICS: Valid throughout full operating and temperature ranges, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Unit
ELECTRICAL SUPPLY CHARACTERISTICS						
Supply Voltage [2]	V_{CC}	Voltage across pin 1 and pin 3; does not include voltage across R_L	4	–	24	V
Undervoltage Lockout	$V_{CC(UV)}$		–	–	3.95	V
Reverse Supply Current [3]	I_{RCC}	V_{CC} = –18 V	–10	–	–	mA
Supply Current	$I_{CC(LOW)}$	Low-current state	5.9	–	8	mA
	$I_{CC(HIGH)}$	High-current state	12	–	16	mA
Supply Current Ratio	$I_{CC(HIGH)}$ / $I_{CC(LOW)}$	Ratio of high current to low current (isothermal)	1.9	–	–	–
ASIL Safety Current	I_{FAULT}	V_{CC} ≤ 14 V, -A (ASIL) variant	1.5	–	3.9	mA
ELECTRICAL PROTECTION CHARACTERISTICS						
Supply Zener Clamp Voltage	$V_{Zsupply}$	I_{CC} = 19 mA	28	–	–	V
Reverse Supply Zener Clamp Voltage	$V_{RZSUPPLY}$	I_{CC} = –3 mA	–	–	–18	V
POWER-ON STATE CHARACTERISTICS						
Power-On State	POS	V_{CC} > $V_{CC(min)}$		$I_{CC(LOW)}$		–
Power-On Time	t_{PO}	Time from V_{CC} > $V_{CC(min)}$, until device has entered Calibration mode	–	–	1	ms
OUTPUT CHARACTERISTICS						
Output Rise Time	t_r	Voltage measured at pin 3 (see Typical Application Circuit), R_L = 100 Ω, C_L = 10 pF, measured between 10% and 90% of signal	0	2	4	µs
Output Fall Time	t_r	Voltage measured at pin 3 (see Typical Application Circuit), R_L = 100 Ω, C_L = 10 pF, measured between 10% and 90% of signal	0	2	4	µs
Pulse Width, Fault	$t_{w(FAULT)}$	R_L = 100 Ω, C_L = 10 pF, pulse duration measured at threshold of ($I_{CC(LOW)}$ + I_{FAULT}) / 2 ; -A (ASIL) variant	4	–	8	ms
Operating Frequency	f_{OP}		0	–	12	kHz
Operational Air Gap Range [4]	AG	Using Reference Target 60-0, tested at 1000 rpm	1.5	–	4.5	mm
Extended Air Gap Range	AG_{EXT}	Using Reference Target 60-0. Output duty cycle may be degraded.	0.5	–	1.5	mm
Total Air Gap Variation During Operation		Momentary interruptions in output sequence permitted; operation within AG range	–4	–	4	mm
Operate Point	B_{OP}	Percentage of IC processed magnetic signals; see Figure 3	–	70	–	%
Release Point	B_{RP}	Percentage of IC processed magnetic signals; see Figure 3	–	30	–	%

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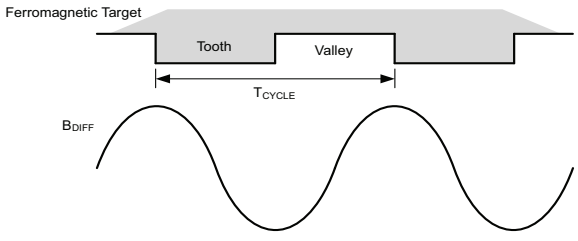
OPERATING CHARACTERISTICS (continued): Valid throughout full operating and temperature ranges, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Unit
PERFORMANCE CHARACTERISTICS						
Initial Calibration	T_{CAL}	Amount of target rotation (constant direction) after t_{PO} during which output duty cycle not guaranteed; see Figure 2	–	1	2	T_{CYCLE}
First Output Edge		Amount of target rotation (constant direction) following t_{PO} until first electrical output transition; see Figure 2	–	–	1.5	T_{CYCLE}
Tooth-to-Tooth Variation		Using Reference Target 60-0 [5]	–	0.25	–	mm
Output Duty Cycle Tolerance [6]	ΔD	Using Reference Target 60-0 at any static air gap within AG. Limits applied to maximum and minimum measurement for one full revolution of the target, around a mean value established by average value of the IC population at the given AG.	–10	–	10	%
Jitter [7]		1σ value; using Reference Target 60-0 at static 2.5 mm air gap and 1000 rpm; see Characteristic Plots	–	0.004	–	degrees
THERMAL CHARACTERISTICS						
Package Thermal Resistance [8]	$R_{\theta JA}$	Single-layer PCB with copper limited to solder pads	–	150	–	°C/W

[1] Typical values are at V_{CC} = 5 V and T_A = 25°C, unless otherwise specified. Performance may vary for individual units, within the maximum and minimum limits.
[2] Maximum voltage must be adjusted for power dissipation and junction temperature; see Power Derating section.
[3] Negative current is defined as conventional current coming out of (sourced from) the specified device terminal.
[4] Operating air gap is dependent on the available magnetic field. The available field is target geometry and material dependent and should be independently characterized.
[5] To determine IC's tolerance to air gap variations on other targets, the complete magnetic system must be analyzed. Due to the nature of the GMR system, contact Allegro for assistance in assessing other targets for use with ATS19480.
[6] Limit applied pertains to full-scale of 0 to 100%, not as a percentage of measured duty cycle.
[7] Jitter is measured on a selected output edge of one target feature, sampled at least 1000 times.
[8] Additional thermal information is available on the Allegro website.



T_{CYCLE} = Target Cycle; the amount of rotation that moves one tooth and valley across the sensor.

B_{DIFF} = The differential magnetic flux density sensed by the sensor.

Figure 2: Definition of T_{CYCLE}

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