ALLEGRO microsystems

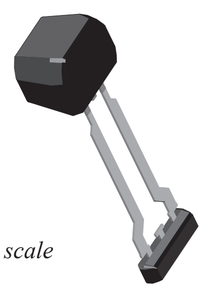
# ATS19510LSN

## Two-Wire, Differential, Vibration-Resistant Sensor IC with Speed and Direction Output

### FEATURES AND BENEFITS

- EMC compliance using integrated protection components and advanced IC design methodology
  - □ Immunity to harsh automotive transients such as switching inductive loads
- Advanced algorithm options capable of withstanding full range sudden and dynamic air gap shifts
- Two-wire, pulse-width output protocol
- Highly configurable output protocol options
- Speed and direction information of target
- Vibration tolerance
  - □ Small signal lockout for small amplitude vibration
  - □ Proprietary vibration detection algorithms for large amplitude vibration
- Air-gap-independent switchpoints
- Undervoltage lockout
- True zero-speed operation
- Wide operating voltage range
- Single chip sensing IC for high reliability
- Robust test-coverage capability with Scan Path and IDDQ measurement
- Integrated back-biasing magnet

### PACKAGE: 3-pin SIP (suffix SN)



*Not to scale*

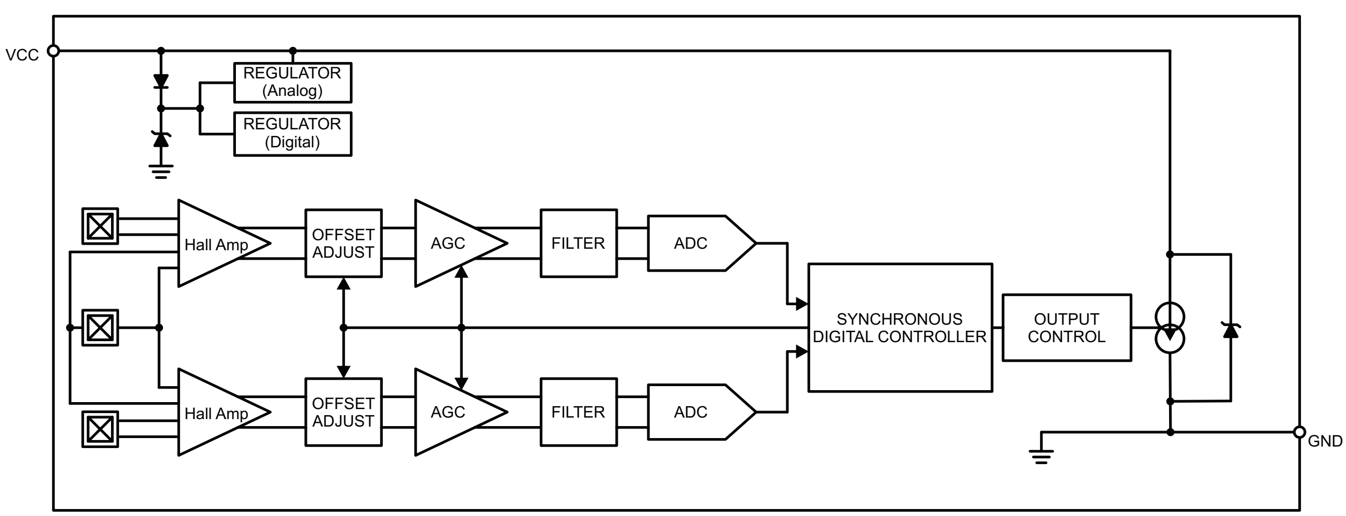
### DESCRIPTION

The ATS19510LSN integrates an advanced Hall-effect circuit IC, EMC protection components, and a rare-earth pellet combination in a single overmolded package. The optimized, user-friendly solution provides direction detection and true zero-speed digital gear-tooth sensing for challenging environments, such as automotive and industrial transmissions and a wide variety of gear-tooth-sensing applications.

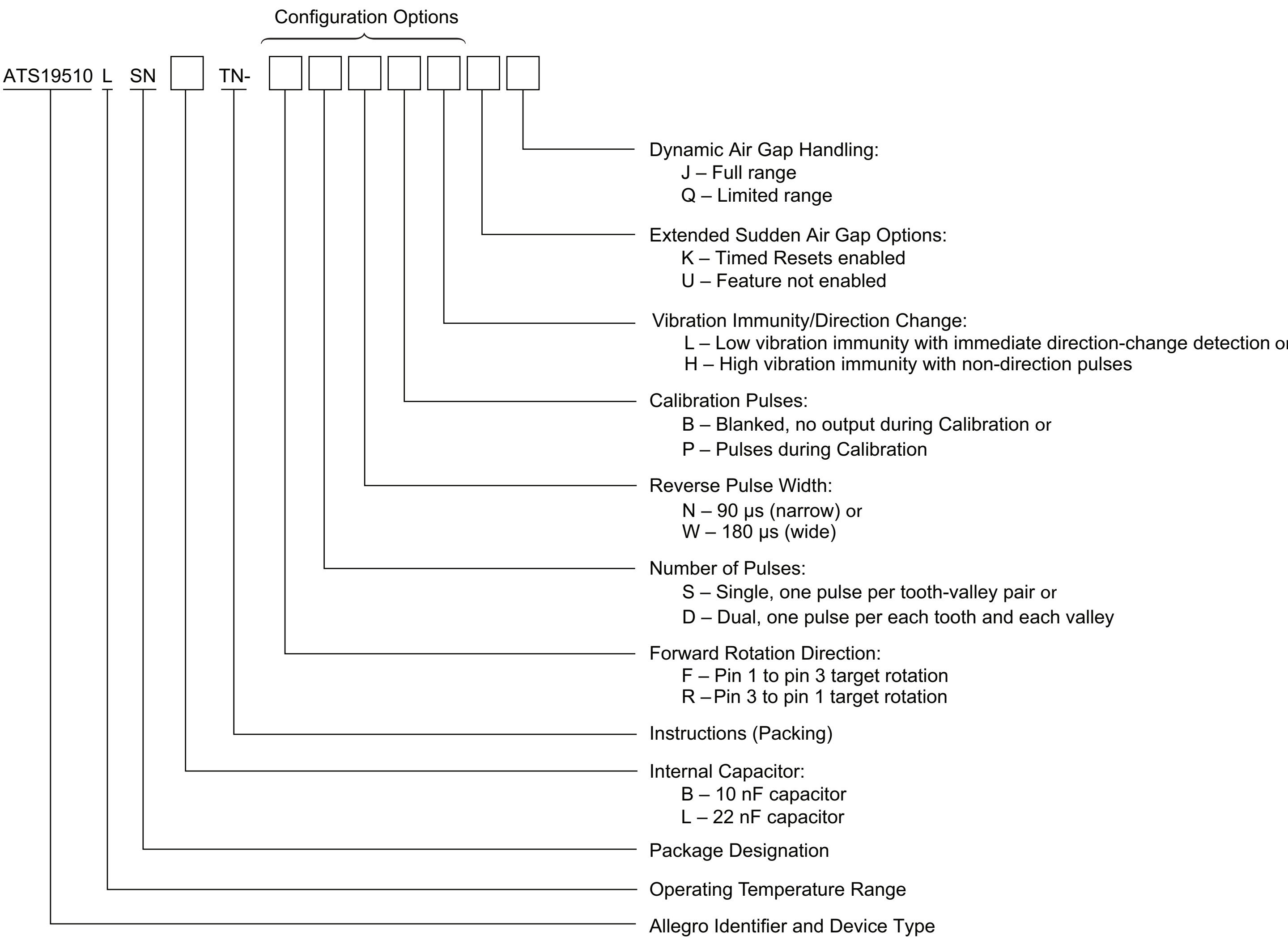
The IC's patented advanced algorithms provide EMI compliance to the harshest automotive requirements, capability to withstand full range sudden and dynamic air gap shifts, and vibration suppression.

The speed and direction of the target are communicated through a variable pulse-width output protocol. The ATS19510 is particularly adept at handling vibration without sacrificing maximum air gap capability or creating any erroneous "direction" pulses. The advanced vibration detection algorithm will systematically calibrate the sensor IC on the initial teeth of true target rotation and not on vibration, ensuring an accurate running mode signal. Advanced packaging combined with innovative algorithms make the ATS19510 an ideal solution for a wide range of speed and direction-sensing needs.

This device is available in a lead (Pb) free 3-pin SIP package with tin-plated leadframe.




**Functional Block Diagram**




For example: ATS19510LSNBTN-RSNPHKJ

Where a configuration character is unspecified, “x” will be used. For example, -xSNPLKJ applies to both Rotation Direction configuration variants.

### SELECTION GUIDE*

| Part Number | Packing |
|---|---|
| ATS19510LSNBTN-RSWPHUJ | Tape and reel, 13-in. reel, 800 pieces per reel |
| ATS19510LSNBTN-FSWPHUJ | Tape and reel, 13-in. reel, 800 pieces per reel |

* Not all combinations are available. Contact Allegro sales for availability and pricing of custom programming options.



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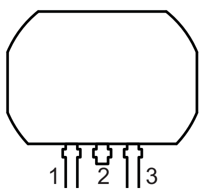
## SPECIFICATIONS

### 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 | ºC |
| Maximum Junction Temperature | $T_{J(max)}$ | | 165 | ºC |
| Storage Temperature | $T_{stg}$ | | –60 to 170 | ºC |

## PINOUT DIAGRAM AND TERMINAL LIST




**Package SN, 3-Pin SIP Pinout Diagram**

**Terminal List Table**

| Number | Name | Function |
|---|---|---|
| 1 | VCC | Supply voltage |
| 2 | VCC | Supply voltage |
| 3 | GND | Ground |

### Internal Discrete Capacitor Ratings

| Characteristic | Symbol | Notes | | Rating | Units |
|---|---|---|---|---|---|
| Nominal Capacitance | $C_{SUPPLY}$ | Connected between VCC and GND | SNB | 10000 | pF |
| | | | SNL | 22000 | pF |

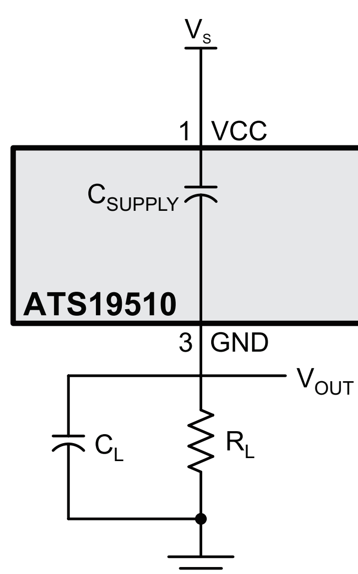



**Figure 1: Typical Application Circuit**



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**OPERATING CHARACTERISTICS:** Valid throughout full operating and temperature ranges, using Reference Target 60-0, unless otherwise noted.

<table>
<tr><th>Characteristics</th><th>Symbol</th><th colspan="2">Test Conditions</th><th>Min.</th><th>Typ. [1]</th><th>Max.</th><th>Unit</th></tr>
<tr><td colspan="8">ELECTRICAL CHARACTERISTICS</td></tr>
<tr><td>Supply Voltage [2]</td><td>$V_{CC}$</td><td colspan="2">Operating, $T_J < T_J(max)$</td><td>4</td><td>–</td><td>24</td><td>V</td></tr>
<tr><td>Undervoltage Lockout</td><td>$V_{CC(UV)}$</td><td colspan="2">$V_{CC}$ 0 → 5 V or 5 → 0 V</td><td>–</td><td>3.6</td><td>3.95</td><td>V</td></tr>
<tr><td>Reverse Supply Current [3]</td><td>$I_{RCC}$</td><td colspan="2">$V_{CC} = V_{RCC\ (MAX)}$</td><td>–</td><td>–</td><td>–10</td><td>mA</td></tr>
<tr><td>Supply Zener Clamp Voltage</td><td>$V_{ZSUPPLY}$</td><td colspan="2">$I_{CC} = I_{CC\ (HIGH)}$ + 3 mA, $T_A$ = 25°C</td><td>28</td><td>–</td><td>–</td><td>V</td></tr>
<tr><td rowspan="3">Supply Current</td><td>$I_{CC(Low)}$</td><td colspan="2">Low-current state (Running mode)</td><td>5</td><td>–</td><td>8</td><td>mA</td></tr>
<tr><td>$I_{CC(High)}$</td><td colspan="2">High-current state (Running mode)</td><td>12</td><td>–</td><td>16</td><td>mA</td></tr>
<tr><td>$I_{CC(SU)(Low)}$</td><td colspan="2">Startup current level and Power-On mode</td><td>5</td><td>–</td><td>8.5</td><td>mA</td></tr>
<tr><td>Supply Current Ratio</td><td>$I_{CC(High)} / I_{CC(Low)}$</td><td colspan="2">Measured as a ratio of high current to low current</td><td>1.9</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td colspan="8">OUTPUT STAGE [4]</td></tr>
<tr><td rowspan="2">Output Rise Time</td><td rowspan="2">$t_r$</td><td rowspan="2">ΔI/Δt from 10% to 90% $I_{CC}$ level; corresponds to measured output slew rate with $C_{SUPPLY}$</td><td>SNL package option</td><td>0</td><td>4.5</td><td>8</td><td>μs</td></tr>
<tr><td>SNB package option</td><td>0</td><td>2</td><td>4</td><td>μs</td></tr>
<tr><td rowspan="2">Output Fall Time</td><td rowspan="2">$t_r$</td><td rowspan="2">ΔI/Δt from 90% to 10% $I_{CC}$ level; corresponds to measured output slew rate with $C_{SUPPLY}$</td><td>SNL package option</td><td>0</td><td>4.5</td><td>8</td><td>μs</td></tr>
<tr><td>SNB package option</td><td>0</td><td>2</td><td>4</td><td>μs</td></tr>
<tr><td colspan="8">OUTPUT PULSE CHARACTERISTICS [4]</td></tr>
<tr><td>Pulse Width, Forward Rotation</td><td>$t_{w(FWD)}$</td><td colspan="2"></td><td>38</td><td>45</td><td>52</td><td>μs</td></tr>
<tr><td rowspan="2">Pulse Width, Reverse Rotation</td><td rowspan="2">$t_{w(REV)}$</td><td colspan="2">-xxNxxxx variant</td><td>76</td><td>90</td><td>104</td><td>μs</td></tr>
<tr><td colspan="2">-xxWxxxx variant</td><td>153</td><td>180</td><td>207</td><td>μs</td></tr>
<tr><td rowspan="2">Pulse Width, Non-Direction</td><td rowspan="2">$t_{w(ND)}$</td><td colspan="2">-xxNPxxx and -xxNxHxx variants</td><td>153</td><td>180</td><td>207</td><td>μs</td></tr>
<tr><td colspan="2">-xxWPxxx and -xxWxHxx variants</td><td>306</td><td>360</td><td>414</td><td>μs</td></tr>
</table>

[1] Typical values are at $T_A$ = 25°C and $V_{CC}$ = 12 V. Performance may vary for individual units, within the specified 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] Load circuit is $R_L$ = 100 Ω and $C_L$ = 10 pF. Pulse duration measured at threshold of ( $(I_{CC(HIGH)} + I_{CC(LOW)})$ /2)
[5] Maximum Operating Frequency is determined by satisfactory separation of output pulses: $I_{CC(LOW)}$ of $tw_{(FWD)(MIN)}$. If the customer can resolve shorter low-state durations, maximum $f_{REV}$ and $f_{ND}$ may be increased.

*Continued on the next page…*



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**OPERATING CHARACTERISTICS (continued): valid throughout full operating and temperature ranges, using Reference Target 60-0, unless otherwise noted.**

| Characteristics | Symbol | Test Conditions | Min. | Typ. [1] | Max. | Unit |
|---|---|---|---|---|---|---|
| **PERFORMANCE CHARACTERISTICS** | | | | | | |
| Operate Point | $B_{OP}$ | % of peak-to-peak $V_{PROC}$ | – | 69 | – | % |
| Release Point | $B_{RP}$ | % of peak-to-peak $V_{PROC}$ | – | 31 | – | % |
| Operating Frequency, Forward Rotation | $f_{FWD}$ | -xSxxxxx variant | 0 | – | 12 | kHz |
| | | -xDxxxxx variant | 0 | – | 6 | kHz |
| Operating Frequency, Reverse Rotation | $f_{REV}$ | -xSNxxxx variant | 0 | – | 7 | kHz |
| | | -xDNxxxx variant | 0 | – | 3.5 | kHz |
| | | -xSWxxxx variant | 0 | – | 4 | kHz |
| | | -xDWxxxx variant | 0 | – | 2 | kHz |
| Operating Frequency, Non-Direction Pulses [5] | $f_{ND}$ | -xSNxxxx variant | 0 | – | 4 | kHz |
| | | -xDNxxxx variant | 0 | – | 2 | kHz |
| | | -xSWxxxx variant | 0 | – | 2.2 | kHz |
| | | -xDWxxxx variant | 0 | – | 1.1 | kHz |
| **DAC CHARACTERISTICS** | | | | | | |
| Allowable User-Induced Offset | | Magnitude valid for both differential magnetic channels | –60 | – | 60 | G |
| **PERFORMANCE CHARACTERISTICS** | | | | | | |
| Operational Magnetic Range | $B_{IN}$ | Peak to peak differential signal; valid for each magnetic channel. | 30 | – | 1200 | G |
| Air Gap Range | | Using Allegro 60-0 reference target; tested at 1000 rpm [2] | 0.5 | – | 2.5 | mm |
| Vibration Immunity (Startup) | $Err_{VIB(SU)}$ | See Figure 2; -xxxxLxx variant | $T_{TARGET}$ | – | – | degrees |
| | | See Figure 2; -xxxxHxx variant | $T_{TARGET}$ | – | – | degrees |
| Vibration Immunity (Running Mode) | $Err_{VIB}$ | See Figure 2; -xxxxLxx variant | 0.12x $T_{TARGET}$ | – | – | degrees |
| | | See Figure 2; -xxxxHxx variant | $T_{TARGET}$ | – | – | degrees |

[1] Typical values are at $T_A$ = 25°C and $V_{CC}$ = 12 V. Performance may vary for individual units, within the specified maximum and minimum limits.
[2] Speed-related effects on maximum air gap are highly dependent upon specific target geometry. Consult with Allegro field applications engineering for aid with assessment of target geometries.

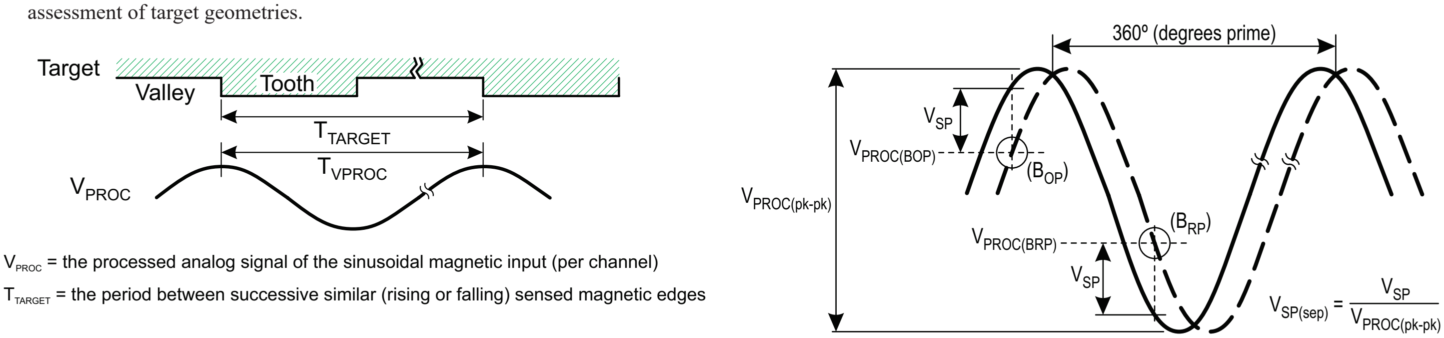


**Figure 2: Definition of $T_{TARGET}$**

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**OPERATING CHARACTERISTICS (continued): Valid throughout full operating and temperature ranges, using Reference Target 60-0, unless otherwise noted.**

| Characteristics | Symbol | Test Conditions | | Min. | Typ. [1] | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **INPUT MAGNETIC CHARACTERISTICS** | | | | | | | |
| Allowable Differential Sequential Signal Variation | $B_{SEQ(n+1)}$ / $B_{SEQ(n)}$ | Signal cycle-to-cycle variation (see Figure 3) | -xxxxxxJ variant | 0.5 | – | – | – |
| | | | -xxxxxxQ variant | 0.6 | – | – | – |
| Allowable Differential Sequential Signal Variation | $B_{SEQ(n+i)}$ / $B_{SEQ(n)}$ | Overall signal variation (see Figure 3) | -xxxxxxJ variant | 0.1 [2] | – | – | – |
| | | | -xxxxxxQ variant | 0.4 | – | – | – |
| **CALIBRATION** | | | | | | | |
| First Direction Output Pulse [3] | | Amount of target rotation (constant direction) following power-on until first electrical output pulse of either $t_{w(FWD)}$ or $t_{w(REV)}$. See Figure 2 | $B_{IN}$ > 60 $G_{PP}$<br>$B_{IN}$ ≤ 1200 $G_{PP}$ | – | 2 × $T_{TARGET}$ | < 3 × $T_{TARGET}$ | degrees |
| | | | 30 $G_{PP}$ ≤ $B_{IN}$<br>$B_{IN}$ ≤ 60 $G_{PP}$ | – | 2.5 × $T_{TARGET}$ | < 4 × $T_{TARGET}$ | degrees |
| First Direction-Pulse Output Following Direction Change | NCD | Amount of target rotation (constant direction) following event until first electrical output pulse of either $t_{w(FWD)}$ or $t_{w(REV)}$. $V_{SP(sep)}$ ≥ 35. See Figure 2 | -xxxxLxx variant | – | 1 | – | switch-point |
| | | | -xxxxHxx variant | 1 × $T_{TARGET}$ | 2 × $T_{TARGET}$ | < 3 × $T_{TARGET}$ | degrees |
| First Direction-Pulse Output Following Running Mode Vibration | | Amount of target rotation (constant direction) following event until first electrical output pulse of either $t_{w(FWD)}$ or $t_{w(REV)}$. See Figure 2 | -xxxxLxx variant | – | – | 1.25 × $T_{TARGET}$ | degrees |
| | | | -xxxxHxx variant | 1 × $T_{TARGET}$ | 2 × $T_{TARGET}$ | < 3 × $T_{TARGET}$ | degrees |
| Timer Period | | | -xxxxxKx variant | – | 0.5 | – | s |

[1] Typical values are at $T_A$ = 25°C and $V_{CC}$ = 12 V. Performance may vary for individual units, within the specified maximum and minimum limits.
[2] Small value denotes high variation capability.
[3] Power-up frequencies ≤ 200 Hz. Higher power-on frequencies may require more input magnetic cycles until output edges are achieved.

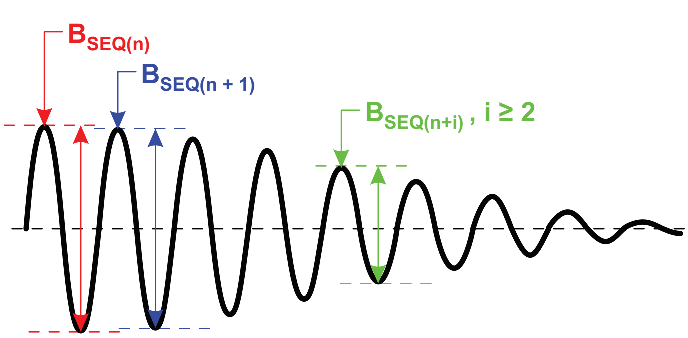


**Figure 3: Differential Signal Variation**



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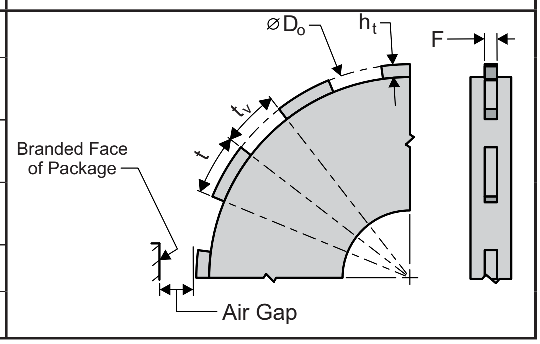
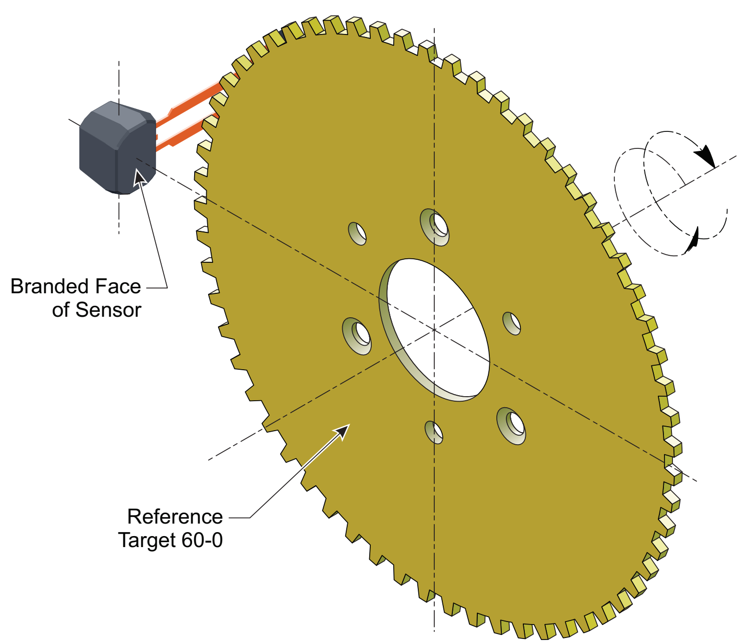
### Reference Target 60-0 (60 Tooth Target)

| 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 | |
| Circular Tooth Length | t | Length of tooth, with respect to branded face | 3 | deg. | |
| Circular Valley Width | $t_v$ | Length of valley, with respect to branded face | 3 | deg. | |
| Tooth Whole Depth | $h_t$ | | 3 | mm | |
| Material | | Low Carbon Steel | – | – | |



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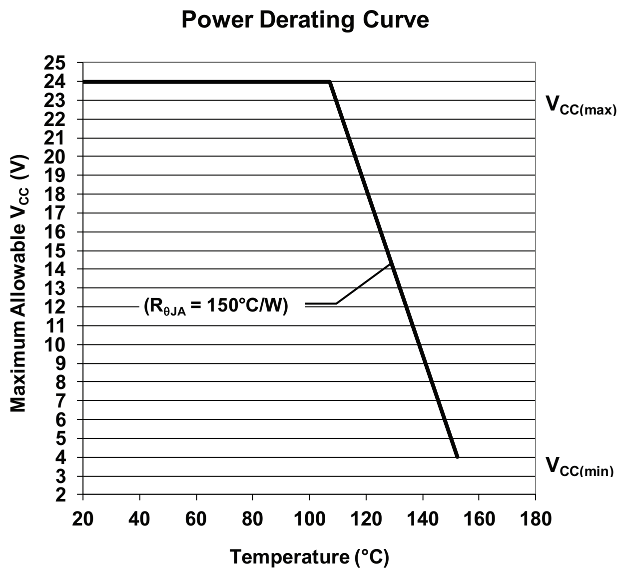
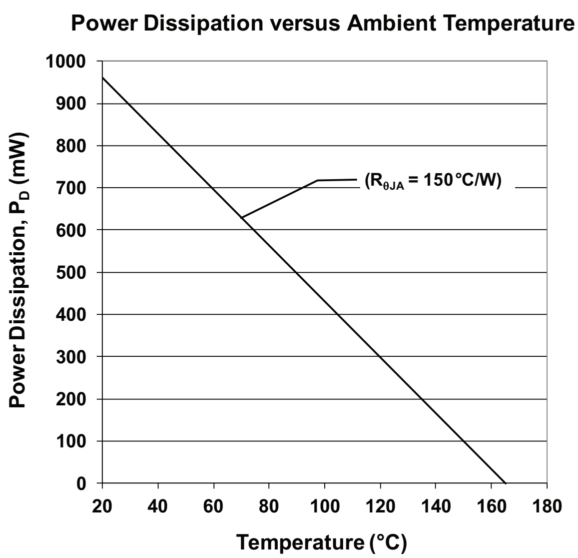
**THERMAL CHARACTERISTICS:** May require derating at maximum conditions; see Power Derating section

| Characteristic | Symbol | Test Conditions* | Value | Unit |
|---|---|---|---|---|
| Package Thermal Resistance | $R_{\theta JA}$ | Single layer PCB, with copper limited to solder pads | 150 | °C/W |

*Additional thermal information available on the Allegro website



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## FUNCTIONAL DESCRIPTION

### Sensing Technology

The sensor IC contains a single-chip Hall-effect circuit that supports a trio of Hall elements. These are used in differential pairs to provide electrical signals containing information regarding edge position and direction of target rotation. The ATS19510 is intended for use with ferromagnetic targets.

After proper power is applied to the sensor IC, it is capable of providing digital information that is representative of the magnetic features of a rotating target. The waveform diagrams in Figure 5 present the automatic translation of the target profiles, through their induced magnetic profiles, to the digital output signal of the sensor IC.

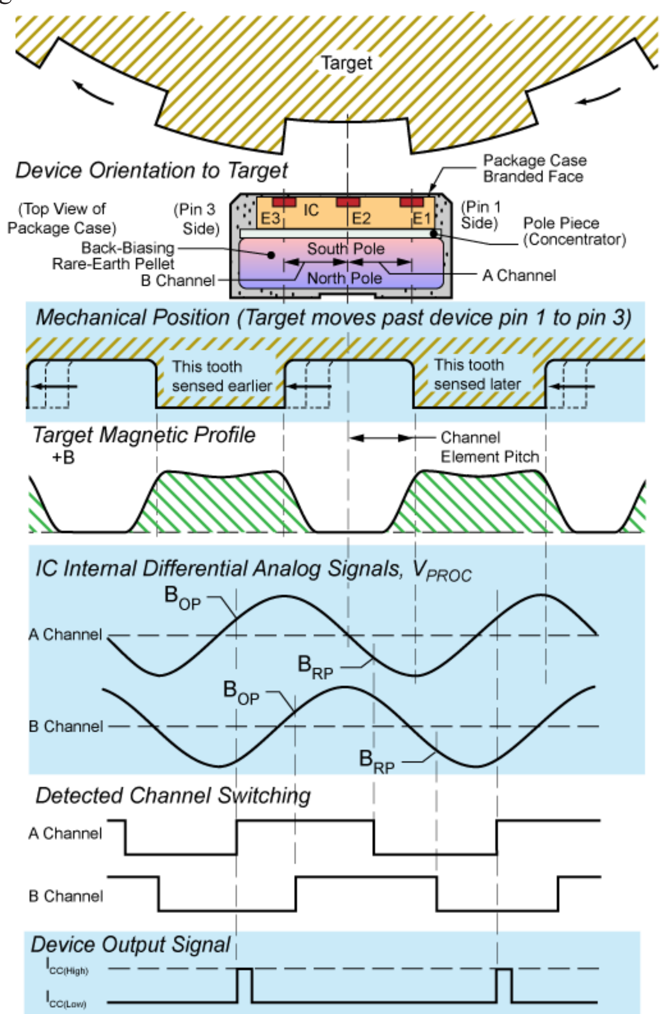


**Figure 4: Magnetic Profile**

**The magnetic profile reflects the features of the target, allowing the sensor IC to present an accurate digital output(-xSxxxxx variant shown).**

### Direction Detection

The sensor IC compares the relative phase of its two differential channels to determine which direction the target is moving. The relative switching order is used to determine the direction, which is communicated through the output protocol.

### Data Protocol Description

When a target passes in front of the device (opposite the branded face of the package case), the ATS19510 generates an output pulse for each tooth of the target. Speed information is provided by the output pulse rate, while direction of target rotation is provided by the duration of the output pulses. The sensor IC can sense target movement in both the forward and reverse directions.

#### FORWARD ROTATION

As shown in panel A in Figure 4, when the target is rotating such that a tooth near the sensor IC – of -Fxxxxxx variant – passes from pin 1 to pin 3, this is referred to as forward rotation. This direction is opposite for the -Rxxxxxx variant. Forward rotation is indicated by output pulse widths of $t_{w(FWD)}$ (45 µs typical).

#### REVERSE ROTATION

As shown in panel B in Figure 4, when the target is rotating such that a tooth passes from pin 3 to pin 1, it is referred to as reverse rotation for the -Fxxxxxx variant. Reverse rotation is indicated by output pulse widths of $t_{w(REV)}$ (90 µs typical for -xxNxxxx variant, or 180 µs typical for -xxWxxxx variant).

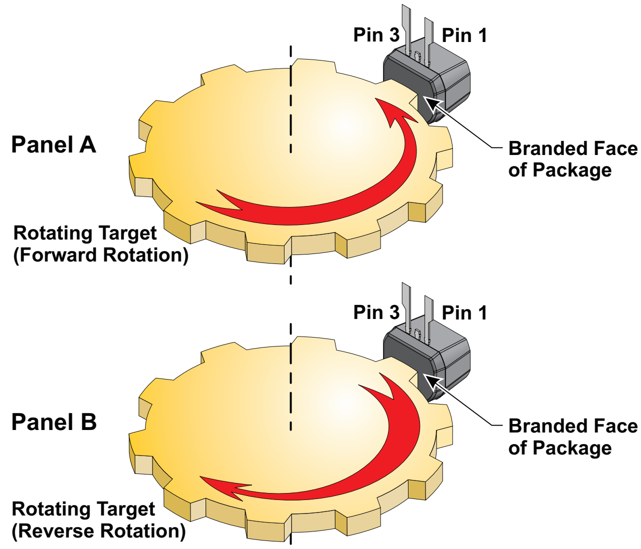


**Figure 4: Target Rotation (F Variant Shown)**



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### TIMING

As shown in Figure 6, the pulse appears at the output slightly before the sensed magnetic edge traverses the package branded face. For targets rotating from pin 3 to 1, this shift (Δfwd with R variants) results in the pulse corresponding to the valley with the sensed mechanical edge; for targets rotating from pin 1 to 3, the shift (Δrev) results in the pulse corresponding to the tooth with the sensed edge. Figure 7 shows pulse timing for F variants. The sensed mechanical edge that stimulates output pulses is kept the same for both forward and reverse rotation by using only one channel to control output switching.

## Direction Validation

For the -xxxxLxx variant, following a direction change in running mode, direction changes are immediately transmitted to the output.

For the -xxxxHxx variant, following a direction change in running mode, output pulses have a width of $t_{w(ND)}$ until direction information is validated.

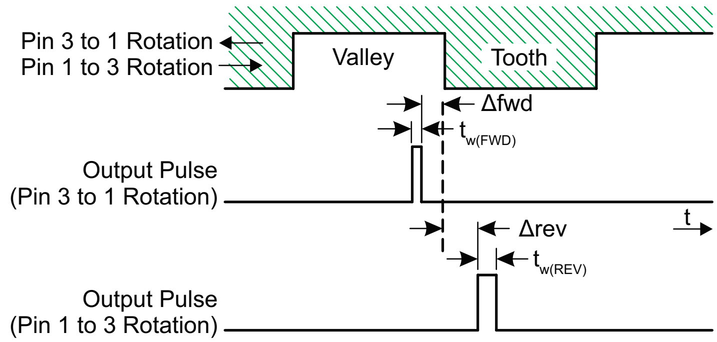


**Figure 6: Output Protocol (-RSxxxxx Variant)**

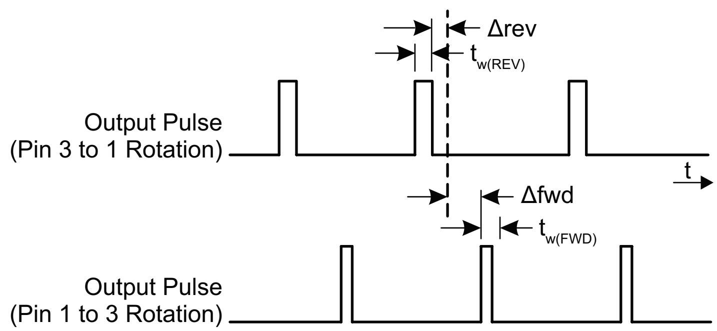


**Figure 7: Output Protocol (-FDxxxxx Variant)**

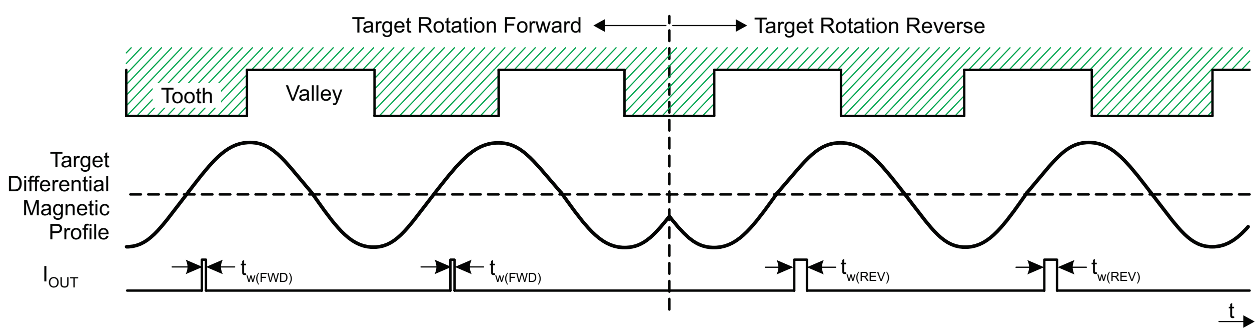


**Figure 8: Running Mode Direction Change (-FSxxLxx Variant)**

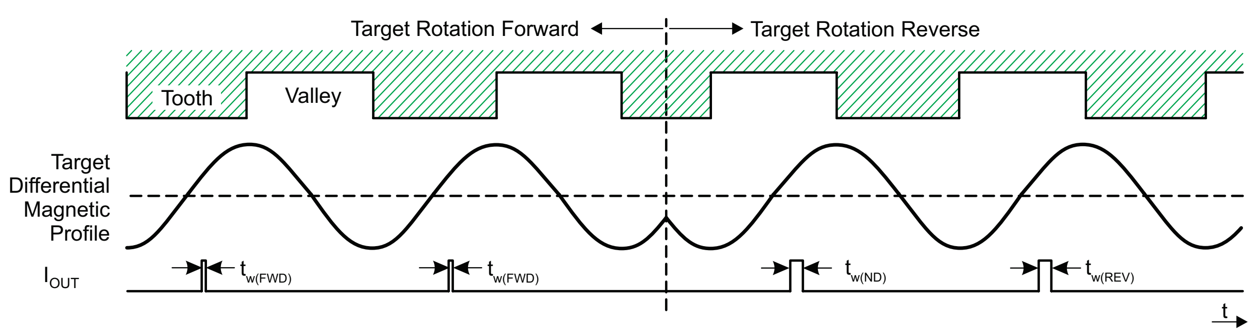


**Figure 9: Running Mode Direction Change (-FSxxHxx Variant)**



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## Startup Detection/Calibration

When power is applied to the ATS19510, the sensor IC internally detects the profile of the target. The gain and offset of the detected signals are adjusted during the calibration period, normalizing the internal signal amplitude for the air gap range of the device.

The Automatic Gain Control (AGC) feature ensures that operational characteristics are isolated from the effects of installation air gap variation.

Automatic Offset Adjustment (AOA) is circuitry that compensates for the effects of chip, magnet, and installation offsets. This circuitry works with the AGC during calibration to adjust $V_{PROC}$ in the internal A-to-D range to allow for acquisition of signal peaks. AOA and AGC function separately on the two differential signal channels.

Direction information is available after calibration is complete.

For the -xxxBxxx variant, the output becomes active at the end of calibration. Figure 10 shows where the first output edges may occur for various starting target phases.

For the -xxxPxxx variant, output pulses of $t_{w(ND)}$ are supplied during calibration.

Figure 11 shows where the first output edges may occur for various starting target phases.

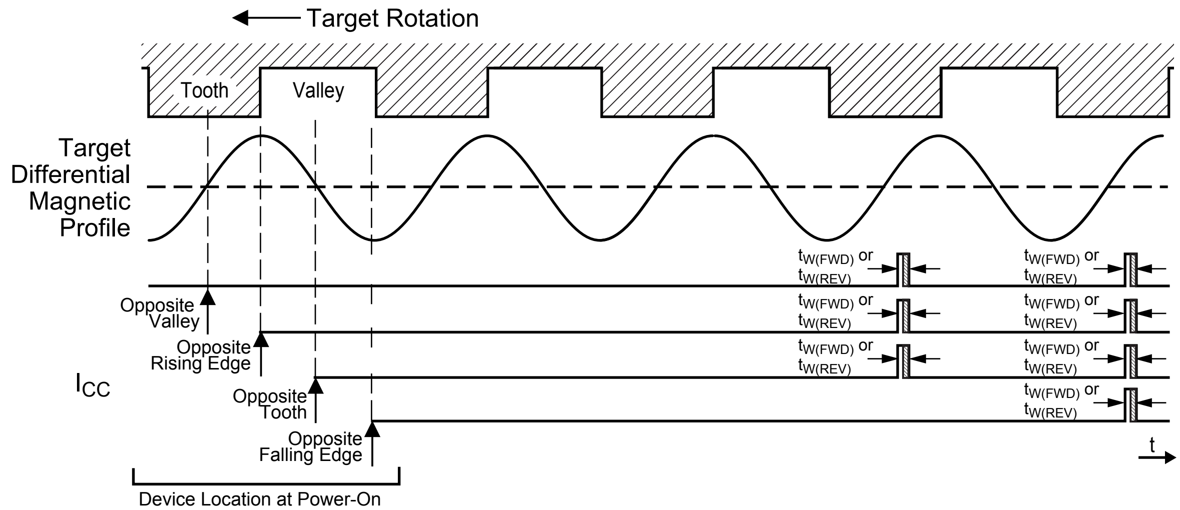


**Figure 10: Startup Position Effect on First Device Output Switching (-xxxBxxx Variant)**

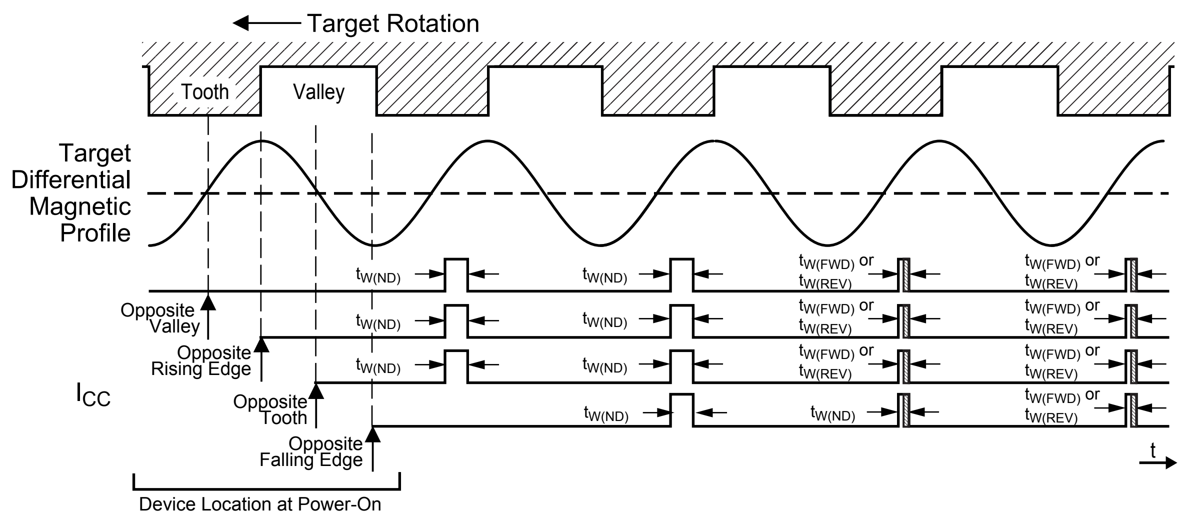


**Figure 11: Startup Position Effect on First Device Output Switching (-xxxPxxx Variant)**


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### Vibration Detection

Algorithms embedded in the IC's digital controller detect the presence of target vibration through analysis of the two magnetic input channels.

For the -xxxxLxx variant, the first direction change is immediately transmitted to the output. During any subsequent vibration, the output is blanked and no output pulses will occur for vibrations less than the specified vibration immunity. Output pulses containing the proper direction information will resume when direction information is validated on constant target rotation.

For the -xxxxHxx variant, in the presence of vibration, output pulses of $t_{w(ND)}$ may occur or no pulses may occur, depending on the amplitude and phase of the vibration. Output pulses have a width of $t_{w(ND)}$ until direction information is validated on constant target rotation.

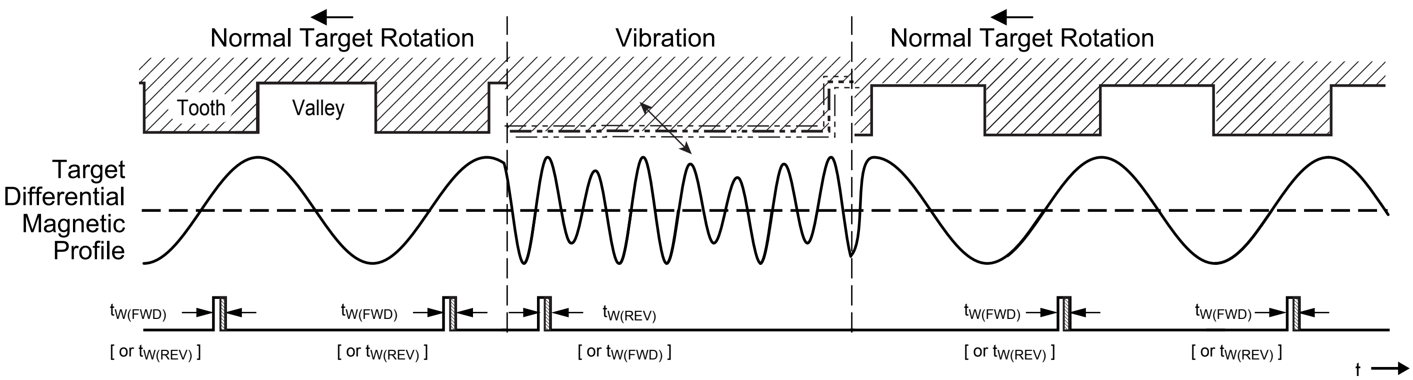


**Figure 12: Output Functionality in the Presence of Running Mode Target Vibration (-xxxxLxx Variant)**

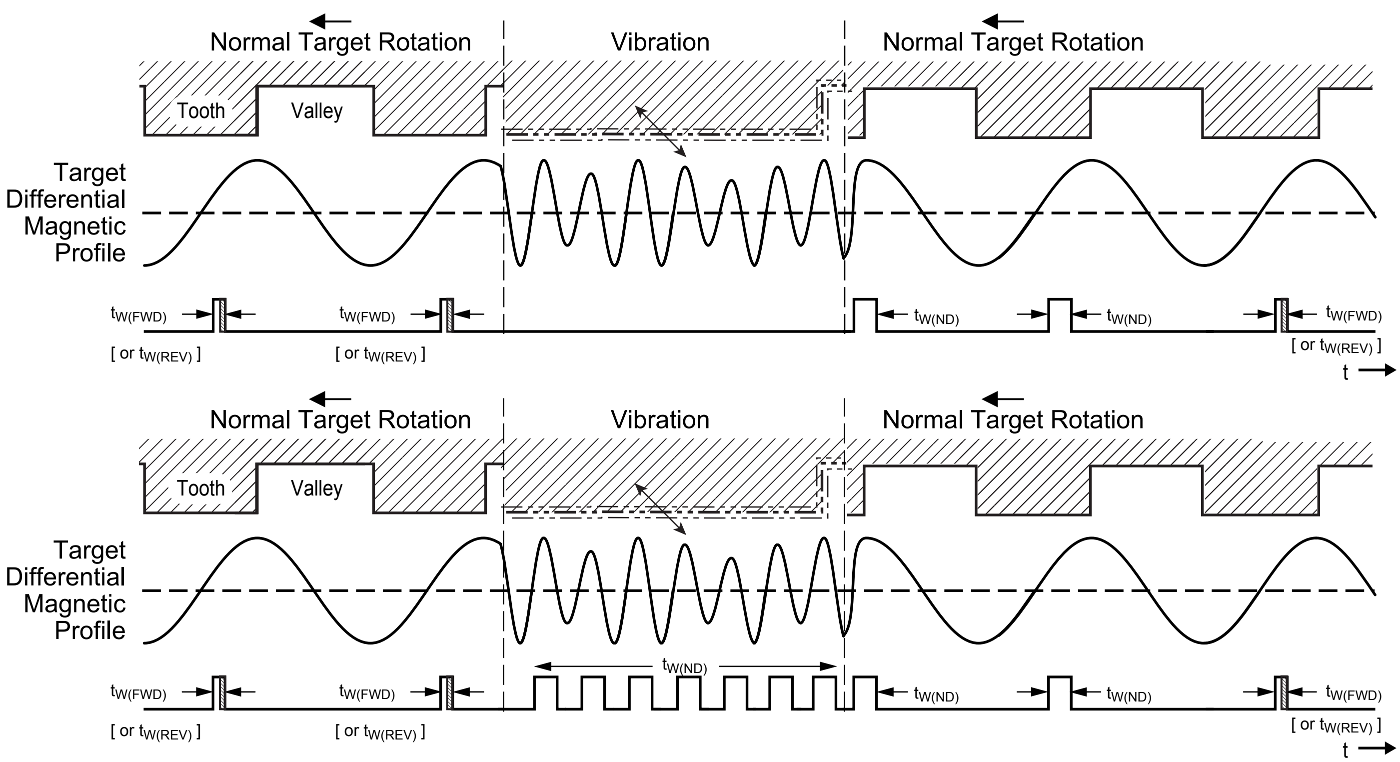


**Figure 13: Output Functionality in the Presence of Running Mode Target Vibration (-xxxxHxx Variant)**



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## POWER DERATING

The device must be operated below the maximum junction temperature of the device ($T_{J(max)}$). Under certain combinations of peak conditions, reliable operation may require derating supplied power or improving the heat dissipation properties of the application. This section presents a procedure for correlating factors affecting operating $T_J$. (Thermal data is also available on the Allegro website.)

The Package Thermal Resistance ($R_{\theta JA}$) is a figure of merit summarizing the ability of the application and the device to dissipate heat from the junction (die), through all paths to the ambient air. Its primary component is the Effective Thermal Conductivity (K) of the printed circuit board, including adjacent devices and traces. Radiation from the die through the device case ($R_{\theta JC}$) is relatively small component of $R_{\theta JA}$. Ambient air temperature ($T_A$) and air motion are significant external factors, damped by overmolding.

The effect of varying power levels (Power Dissipation, $P_D$), can be estimated. The following formulas represent the fundamental relationships used to estimate $T_J$, at $P_D$.

$$P_D = V_{IN} \times I_{IN} \quad (1)$$

$$\Delta T = P_D \times R_{\theta JA} \quad (2)$$

$$T_J = T_A + \Delta T \quad (3)$$

For example, given common conditions such as: $T_A$= 25°C, $V_{CC}$ = 12 V, $I_{CC}$ = 6 mA, and $R_{\theta JA}$ = 150°C/W, then:

$$P_D = V_{CC} \times I_{CC} = 12\ V \times 6\ mA = 72\ mW$$

$$\Delta T = P_D \times R_{\theta JA} = 72\ mW \times 150°C/W = 10.8°C$$

$$T_J = T_A + \Delta T = 25°C + 10.8°C = 35.8°C$$

A worst-case estimate, $P_{D(max)}$, represents the maximum allowable power level ($V_{CC(max)}$, $I_{CC(max)}$), without exceeding $T_{J(max)}$, at a selected $R_{\theta JA}$ and $T_A$

*Example*: Reliability for $V_{CC}$ at $T_A$=150°C, package SN, using a single-layer PCB.

Observe the worst-case ratings for the device, specifically: $R_{\theta JA}$ =150°C/W, $T_{J(max)}$ =165°C, and $I_{CC(mean)}$ = 13 mA. (Note: For variant –xxWPx, at maximum target frequency, $I_{CC(LOW)}$ = 8 mA, $I_{CC(HIGH)}$ = 16 mA, and maximum pulse widths, the result is a duty cycle of 84% and thus a worst-case mean $I_{CC}$ of 14.8 mA).

Calculate the maximum allowable power level, $P_{D(max)}$. First, invert equation 3:

$$\Delta T_{max} = T_{J(max)} - T_A = 165°C - 150°C = 15°C$$

This provides the allowable increase to $T_J$ resulting from internal power dissipation. Then, invert equation 2:

$$P_{D(max)} = \Delta T_{max} \div R_{\theta JA} = 15°C \div 150°C/W = 100\ mW$$

Finally, invert equation 1 with respect to voltage:

$$V_{CC(est)} = P_{D(max)} \div I_{CC(max)} = 100\ mW \div 14.8\ mA = 6.8\ V$$

The result indicates that, at $T_A$, the application and device can dissipate adequate amounts of heat at voltages $\leq V_{CC(est)}$.

Compare $V_{CC(est)}$ to $V_{CC(max)}$. If $V_{CC(est)} \leq V_{CC(max)}$, then reliable operation between $V_{CC(est)}$ and $V_{CC(max)}$ requires enhanced $R_{\theta JA}$. If $V_{CC(est)} \geq V_{CC(max)}$, then operation between $V_{CC(est)}$ and $V_{CC(max)}$ is reliable under these conditions.



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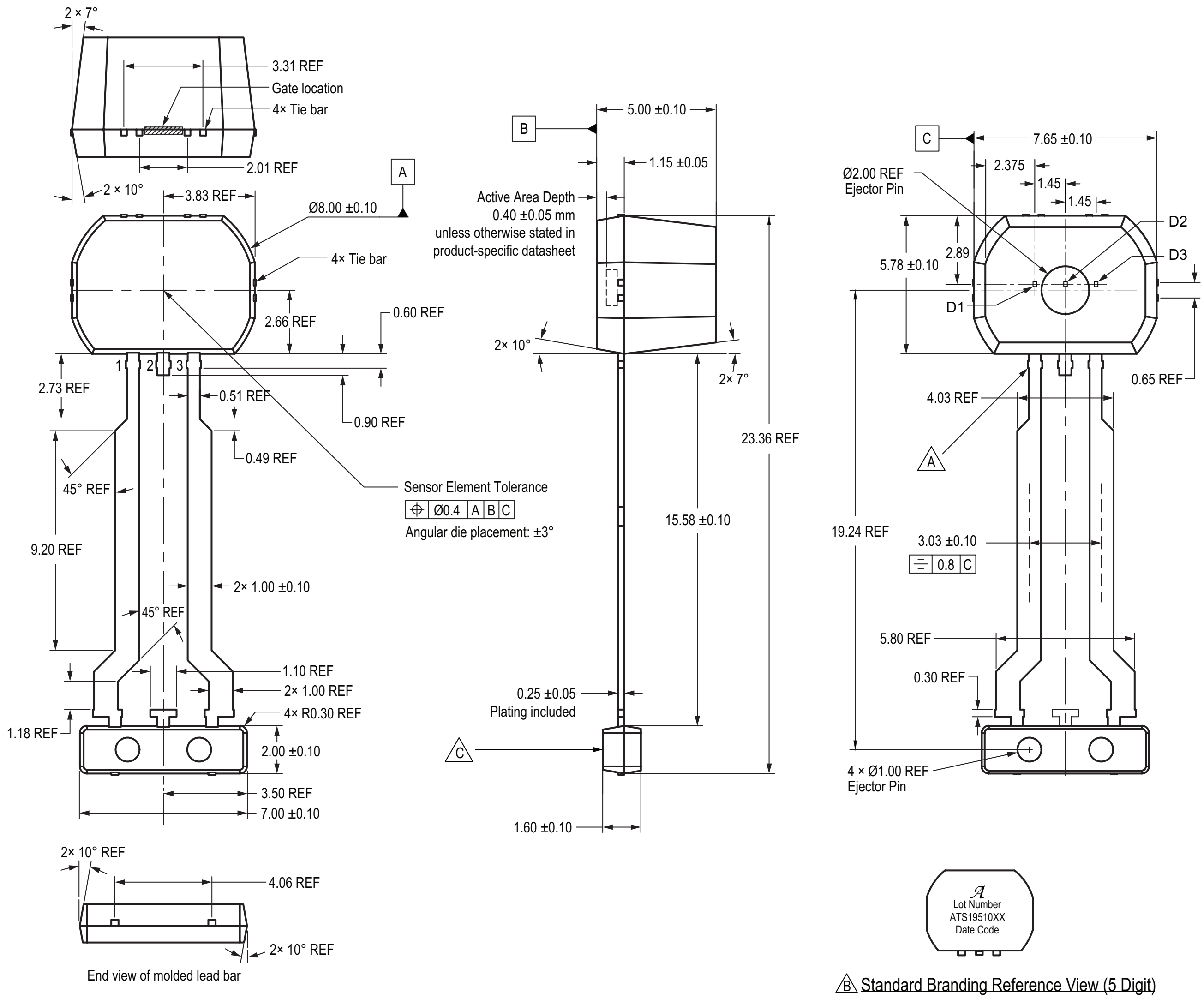
## PACKAGE OUTLINE DRAWING

### For Reference Only – Not for Tooling Use

(Reference Allegro DWG-0000429, Rev. 5)
Dimensions in millimeters – NOT TO SCALE
Dimensions exclusive of mold flash, gate burs, and dambar protrusions
Exact case and lead configuration at supplier discretion within limits shown




Lines 1, 2, 3, 4: Max. 10 characters per line

Line 1: Logo A
Line 2: Characters 5, 6, 7, 8, 9, 10, 11 of Assembly Lot Number
Line 3: Part Number:
3 character prefix (ATS),
5 digit part number (19510),
0-2 character part variant (XX).
Example: ATS19510B
Line 4: 4-digit Date Code

A Dambar removal protrusion (24×)

B Branding scale and appearance at supplier discretion

C Molded lead bar for preventing damage to leads during shipment

D Hall elements (D1, D2, D3); not to scale

**Figure 14: Package SN, 3-Pin SIP**

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**Revision History**

| Number | Date | Description |
|---|---|---|
| – | June 8, 2017 | Initial release |
| 1 | November 17, 2017 | Updated Selection Guide table (page 2);<br>Updated branding information in Package Outline Drawing (page 14) |
| 2 | October 15, 2018 | Whitespace removed from part number (page 2); minor editorial updates |
| 3 | November 1, 2019 | Minor editorial updates |
| 4 | November 8, 2021 | Updated package drawing (page 14) |





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