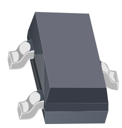
High-Voltage Switch for Automotive and Industrial Applications

FEATURES AND BENEFITS

- 2.7 to 26 V operation
- AEC-Q100 qualified
- Omnipolar and unipolar switch threshold options
- High and low sensitivity magnetic switch-point options
- Choice of output polarity
- Chopper stabilization
  - Low switch-point drift over temperature
  - Insensitive to physical stress
- Open-drain output
- Solid-state reliability
- Industry-standard package and pinout
- Low jitter

PACKAGE

3-pin SOT23-3
(suffix MD)



Not to scale

DESCRIPTION

The APS11203 high-voltage Hall-effect switch integrated circuits (ICs) are AEC-Q100 qualified for automotive applications. These sensors are temperature-stable and suited for operation over extended junction temperature ranges up to 165°C. This family of Hall-effect switches provides contactless control of an open-drain output that actuates in response to a magnetic field applied to the branded package face. The device responds to a north and/or south polarity depending on device configuration.

These devices apply the chopper-stabilization technique, which reduces the residual offset typically caused by device overmolding, temperature dependencies, and thermal stress. This feature allows superior high-temperature performance.

The APS11203 is offered in Allegro package type MD-3, a standard 3-pin small-outline transistor (SOT23-3) surface-mount device (SMD) package. The package is lead (Pb) free.

APPLICATIONS

- Automotive: power closures, seatbelt buckles, break switch, headlight position, hood latch position, throttle and valve position, mirror position, etc.
- Industrial: smart meters, home appliances, position detection, e-mobility, etc.

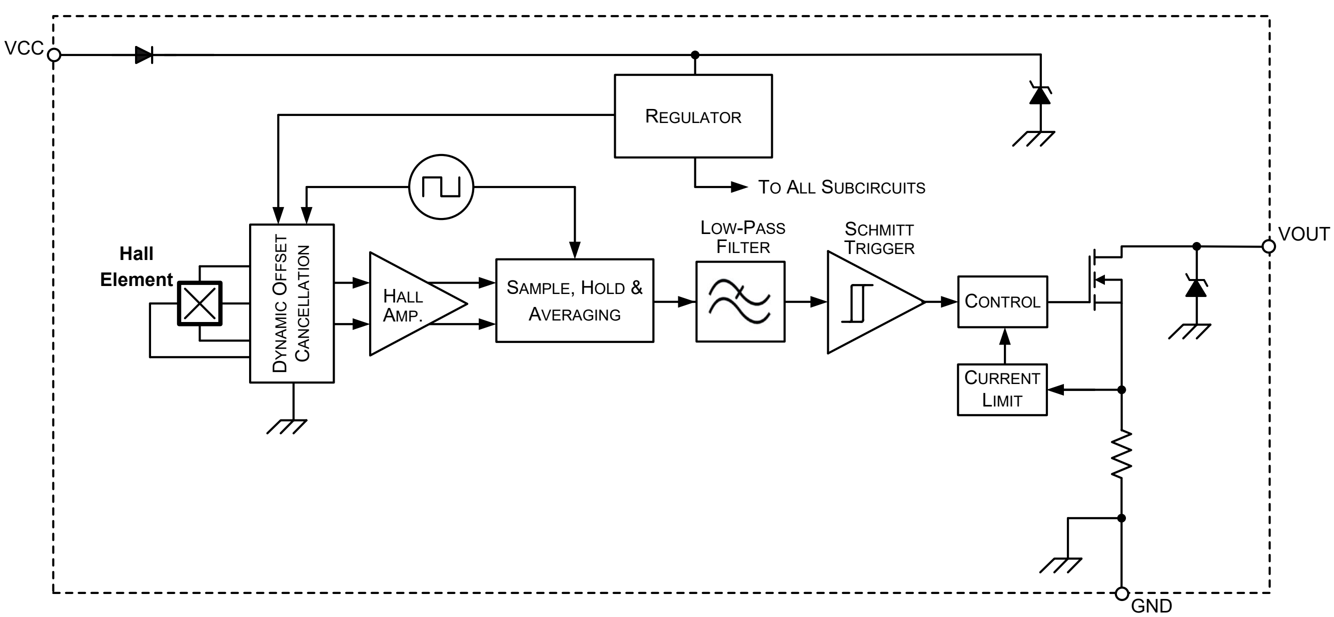


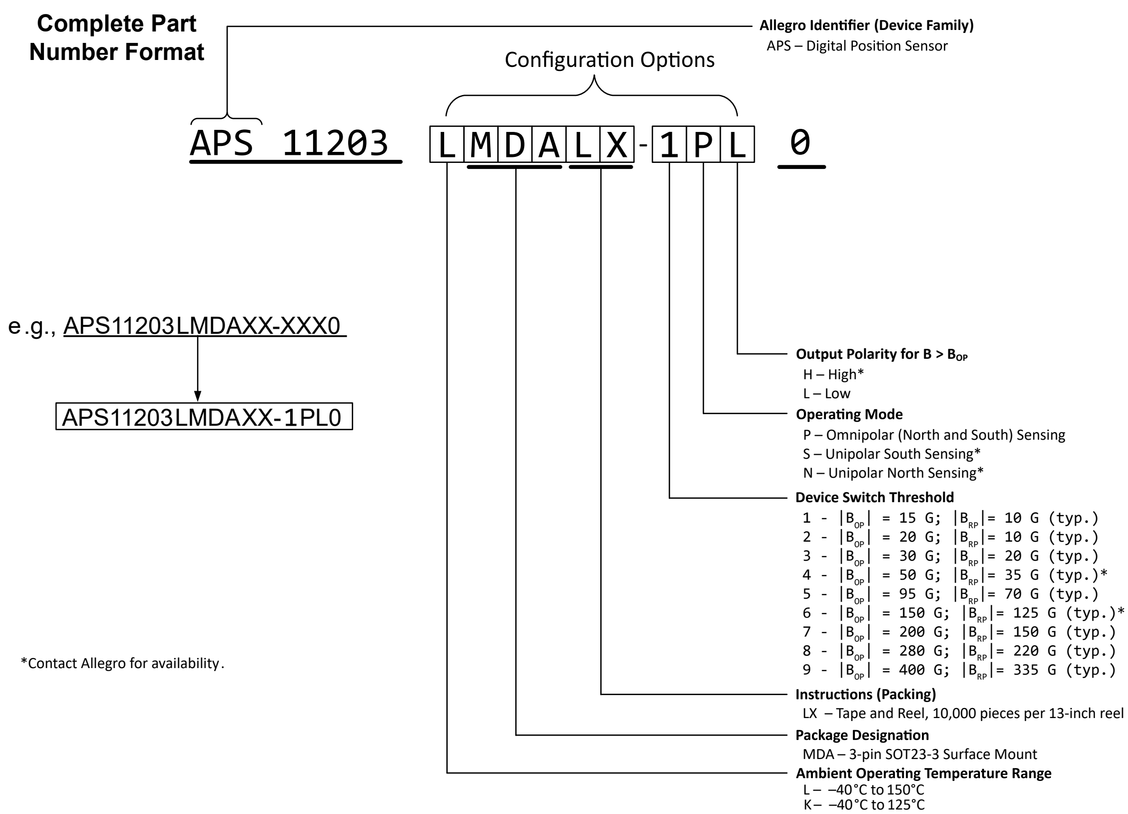
Figure 1: Functional Block Diagram

SPECIFICATIONS

SELECTION GUIDE

Part Number [1]	Typ. Switch Point Magnitude		Operating Temperature (°C)	Header	Packing [2]
	B_{OP} (G)	B_{RP} (G)			
APS11203LMDALX-1PL0	15	10	–40 to 150	3-pin SOT23-3 surface mount	Tape and reel, 10,000 pieces per 13-inch reel
APS11203LMDALX-3SL0	30	20			
APS11203LMDALX-5SL0	95	70			
APS11203LMDALX-7PL0	200	150			
APS11203LMDALX-8PL0	280	225			
APS11203LMDALX-9PL0	400	335			
APS11203KMDALX-1PL0	15	10	–40 to 125	3-pin SOT23-3 surface mount	Tape and reel, 10,000 pieces per 13-inch reel
APS11203KMDALX-3SL0	30	20			
APS11203KMDALX-5SL0	95	70			
APS11203KMDALX-7PL0	200	150			
APS11203KMDALX-8PL0	280	225			
APS11203KMDALX-9PL0	400	335			

[1] For options not listed in the selection guide, contact Allegro MicroSystems.
[2] For additional packing options, contact Allegro MicroSystems



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ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Rating	Units
Supply Voltage	V_{CC}		28	V
Reverse Supply Voltage	V_{RCC}		–18	V
Output Off Voltage	V_{OUT}		30	V
Output Current	I_{OUT}	Sink	30	mA
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

THERMAL CHARACTERISTICS: May require derating at maximum conditions; see the Characteristic Performance section.

Characteristic	Symbol	Test Conditions	Value	Units
Package Thermal Resistance	$R_{\theta JA}$	Package MD, 2-layer PCB (1S0P)	309.2	°C/W
		Package MD, 4-layer PCB (2S2P)	197.9	°C/W

[1] Additional thermal information is available on the Allegro website.

ESD CHARACTERISTICS: Device power consumption is extremely low. Under typical operating conditions, on-chip power dissipation is not an issue.

Characteristic	Symbol	Test Conditions	Value	Units
HBM			7	kV
CDM			1	kV

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PINOUT DIAGRAM AND TERMINAL LIST

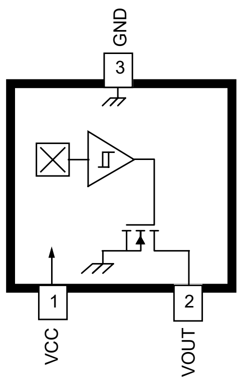

Figure 2: Package MD, 3-Pin SMD (SOT23-3) (View From Branded Face)

Terminal List Table

Number	Name	Function
1	VCC	Connection from power supply to chip
2	VOUT	Output from circuit
3	GND	Terminal for ground connection

TYPICAL APPLICATION CIRCUIT

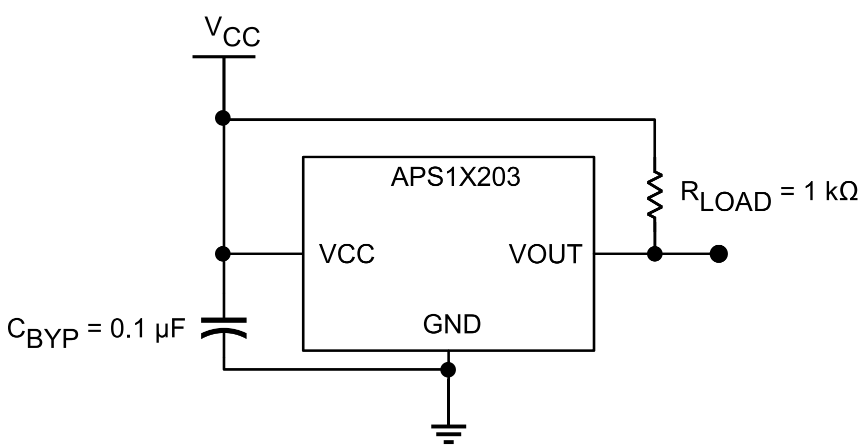

Figure 3: Typical Application Circuit

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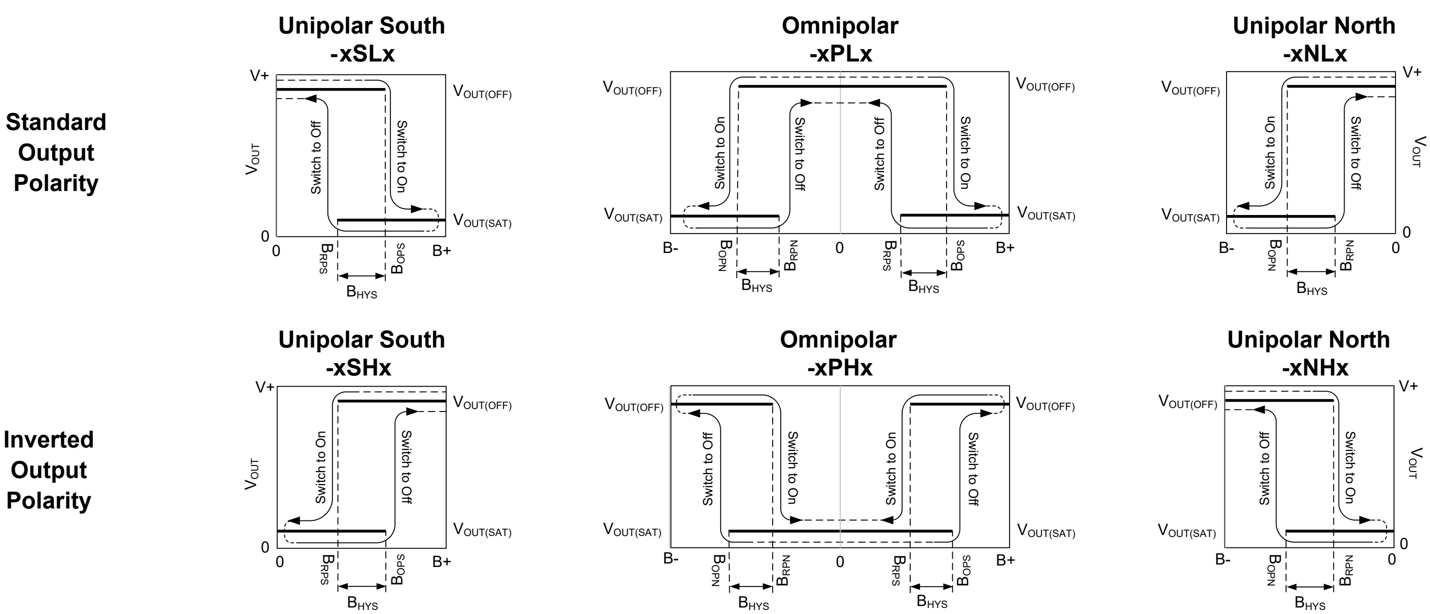
ELECTRICAL CHARACTERISTICS: Valid over full operating voltage and ambient temperature ranges for $T_J < T_{J(max)}$ and C_{BYP} = 0.1 µF, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Unit
SUPPLY AND STARTUP						
Supply Voltage	V_{CC}	Operating, T_J < 165°C	2.7	–	26	V
Supply Current	I_{CC}		–	–	3	mA
Power-On Time [2]	t_{PO}	V_{CC} > 2.7 V $B < B_{RP(min)} – 0.25 × B_{RP(max)}$, $B > B_{OP(max)} + 0.25 × B_{OP(max)}$	–	–	25	µs
Power-On State [2]	POS	$t < t_{PO}$, $V_{CC} ≥ V_{CC(min)}$		Low		–
Reverse Battery Current	I_{RCC}	V_{RCC}= –18 V	–	–	–5	mA
CHOPPER STABILIZATION AND OUTPUT CHARACTERISTICS						
Chopping Frequency [2]	f_c		–	500	–	kHz
Propagation Delay [2]		V_{CC} = 5 V Square-wave field with $B > B_{OP}$ + 30 G	–	5	10	µs
Jitter [2]		60 poles ring magnet at 922 rpm B = ±230 G; 1σ value	–	320	–	ns
Output Rise Time [2]		R_L = 820 Ω, C_L = 20 pF	–	–	2	µs
Output Fall Time [2]		R_L = 820 Ω, C_L = 20 pF	–	–	2	µs
Output Saturation Voltage	$V_{OUT(SAT)}$	I_{OUT} = 10 mA (sink)	–	–	500	mV
Output Short-Circuit Current Limit	I_{OM}		30	–	60	mA
Output Leakage Current	I_{OUTOFF}	V_{OUT} = 26 V, output state = high	–	–	10	µA

[1] Typical data is at T_A = 25°C and V_{CC} = 12 V unless otherwise noted.
[2] Not tested in final production. Guaranteed by device characterization and design.



B- indicates increasing north polarity magnetic field strength, and B+ indicates increasing south polarity magnetic field strength.

Figure 4: Hall Switch Output State vs. Magnetic Field

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MAGNETIC SWITCH CHARACTERISTICS: Valid over full operating voltage and ambient temperature ranges for $T_J < T_{J(max)}$ and C_{BYP} = 0.1 µF, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Operate Point	B_{OP}	-1xxx option, T_A = 25°C	5	15	25	G
		-1xxx option, T_A = 150°C	8	17	33	G
		-2xxx option	5	20	35	G
		-3xxx option	10	30	50	G
		-5xxx option	50	95	135	G
		-7xxx option	150	200	250	G
		-8xxx option	200	280	360	G
		-9xxx option	280	400	520	G
Release Point	B_{RP}	-1xxx option, T_A = 25°C	1	10	20	G
		-1xxx option, T_A = 150°C	1	11	24	G
		-2xxx option	–5	10	25	G
		-3xxx option	5	20	35	G
		-5xxx option	40	70	110	G
		-7xxx option	110	150	190	G
		-8xxx option	150	220	290	G
		-9xxx option	235	335	435	G
Hysteresis	B_{HYS}	-1xxx option, T_A = 25°C	–	5	–	G
		-1xxx option, T_A = 150°C	–	6	–	G
		-2xxx option	–	10	–	G
		-3xxx option	–	10	–	G
		-5xxx option	10	25	42	G
		-7xxx option	15	50	85	G
		-8xxx option	10	60	100	G
		-9xxx option	30	65	110	G

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CHARACTERISTIC PERFORMANCE

Power Derating Curve

$T_{J(MAX)}$ = 165 °C; I_{CC} = $I_{CC(MAX)}$; I_{OUT} = 0 mA (Output Off)

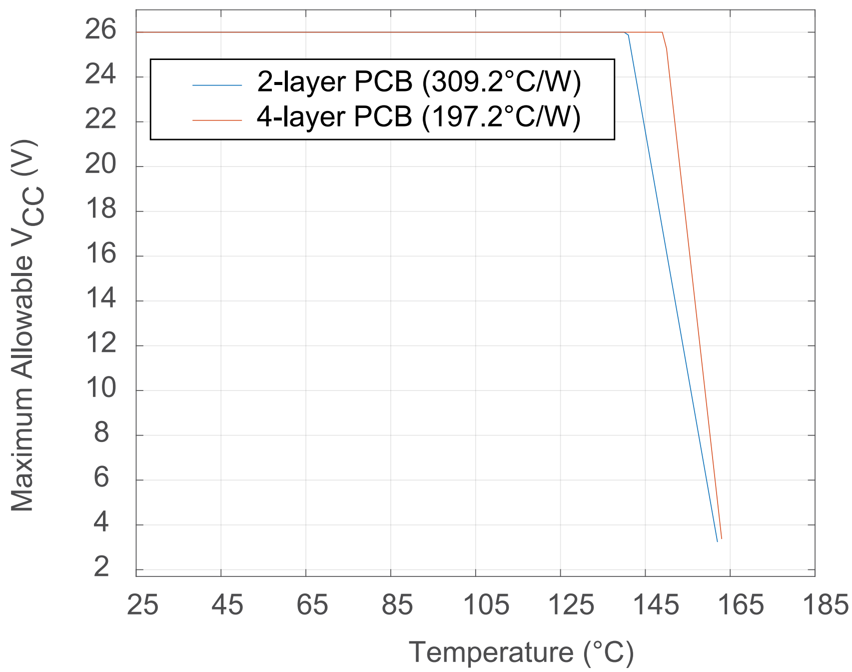

Figure 5: Power Derating

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FUNCTIONAL DESCRIPTION

Operation

The APS11203 is an integrated Hall-effect sensor IC with a switch output. The output is an open-drain configuration that actuates in response to a magnetic field applied to the branded package face (see Figure 6). The devices are offered in a package with a 3-pin surface-mount configuration. For a complete list of available options, see the Selection Guide.

Unipolar South Pole: The unipolar output of these devices is actuated when a south-polarity magnetic field perpendicular to the Hall element exceeds the operate-point threshold, B_{OPS} (see Figure 4). When B_{OPS} is exceeded, the APS11203 output turns on (goes low). When the magnetic field is removed or reduced to less than the release point, B_{RPS}, the device outputs return to their original state.

Unipolar North Pole: The unipolar output of these devices is actuated when a north-polarity magnetic field perpendicular to the Hall element exceeds the operate-point threshold, B_{OPN} (see Figure 4). When B_{OPN} is exceeded, the APS11203 output turns on (goes low). When the magnetic field is removed or reduced to less than the release point, B_{RPN}, the device outputs return to their original state.

Omnipolar: The omnipolar operation of these devices allows actuation with either a north-polarity or a south-polarity field. The APS11203 operates using the standard output-polarity convention.

Fields in excess of the operating points, B_{OPS} or B_{OPN}, turn the output to the on state (low). When the magnetic field is removed or reduced to less than the release point, B_{RPN} or B_{RPS}, the device output turns on (goes low). When the field is removed or reduced to less than the release-point threshold, B_{RPS} or B_{RPN}, the output switches to the on state (low) (see Figure 4).

The difference in the magnetic operate and release points is the hysteresis, B_{HYS}, of the device. This built-in hysteresis allows clean switching of the output, even in the presence of external mechanical vibration and electrical noise.

If a device power-on occurs in the hysteresis range (less than B_{OP} and greater than B_{RP}), the output state is $V_{OUT(OFF)}$. In this case, the correct state is attained after the first excursion beyond B_{OP} or B_{RP}.

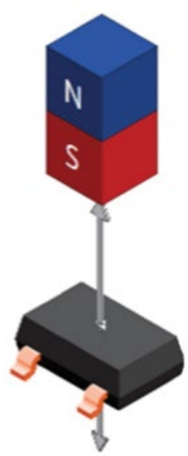

Figure 6: Magnetic-Sensing Orientations

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CHOPPER STABILIZATION

A limiting factor for switch-point accuracy when using Hall-effect technology is the small-signal voltage developed across the Hall plate. This voltage is proportionally small relative to the offset that can be produced at the output of the Hall sensor. This makes it difficult to process the signal and maintain an accurate, reliable output over the specified temperature and voltage range. Chopper stabilization is a proven approach used to minimize the Hall offset.

The Allegro technique, dynamic quadrature offset cancellation, removes key sources of the output drift induced by temperature and package stress. This offset-reduction technique is based on a signal modulation-demodulation process implemented as shown in Figure 7.

The undesired offset signal is separated from the magnetically induced signal in the frequency domain through modulation. The subsequent demodulation acts as a modulation process for the offset, causing the magnetically induced signal to recover its original spectrum at baseband while the DC offset becomes a high frequency signal. Then, using a low-pass filter, the signal passes while the modulated DC offset is suppressed. The innovative Allegro chopper-stabilization technique uses a high-frequency clock.

High-frequency operation allows a greater sampling rate that produces higher accuracy, reduced jitter, and faster signal processing. Additionally, filtering is more effective and results in a lower-noise analog signal at the sensor output. Devices that use this approach, such as the APS11203, have an extremely stable quiescent Hall output voltage, are immune to thermal stress, and have precise recoverability after temperature cycling. This technique is made possible through the use of a BiCMOS process that allows the use of low-offset and low-noise amplifiers in combination with high-density logic and sample-and-hold circuits.

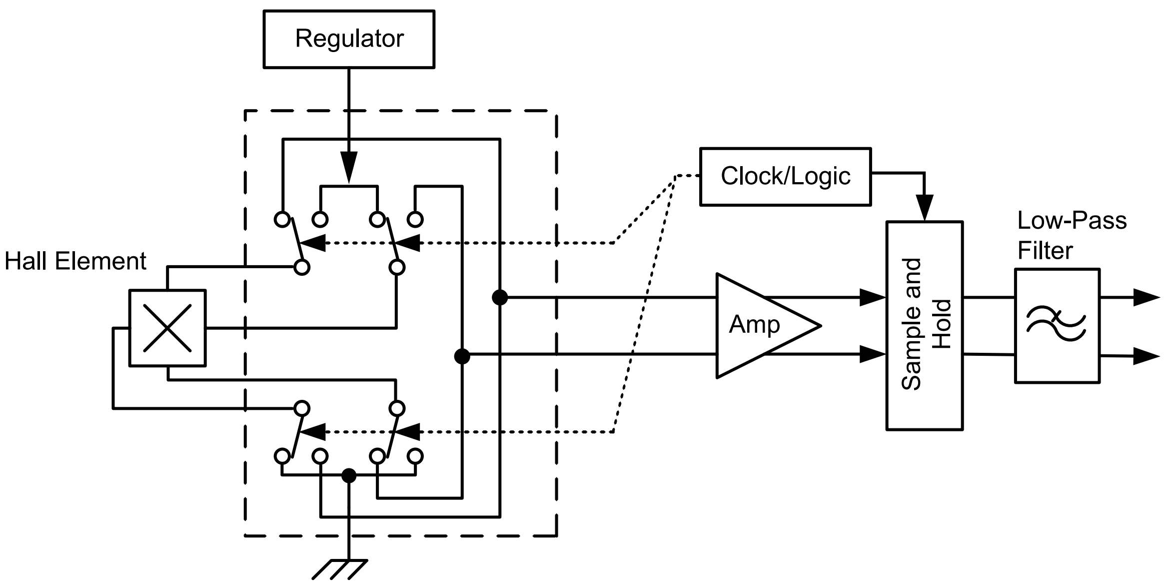

Figure 7: Model of Chopper Stabilization Circuit (Dynamic Offset Cancellation)

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PACKAGE OUTLINE DRAWING

For Reference Only – Not for Tooling Use

(Reference Allegro DWG-0000930)
NOT TO SCALE
Dimensions in millimeters
Dimensions exclusive of mold flash, gate burrs, and dambar protrusions
Exact case and lead configuration at supplier discretion within limits shown

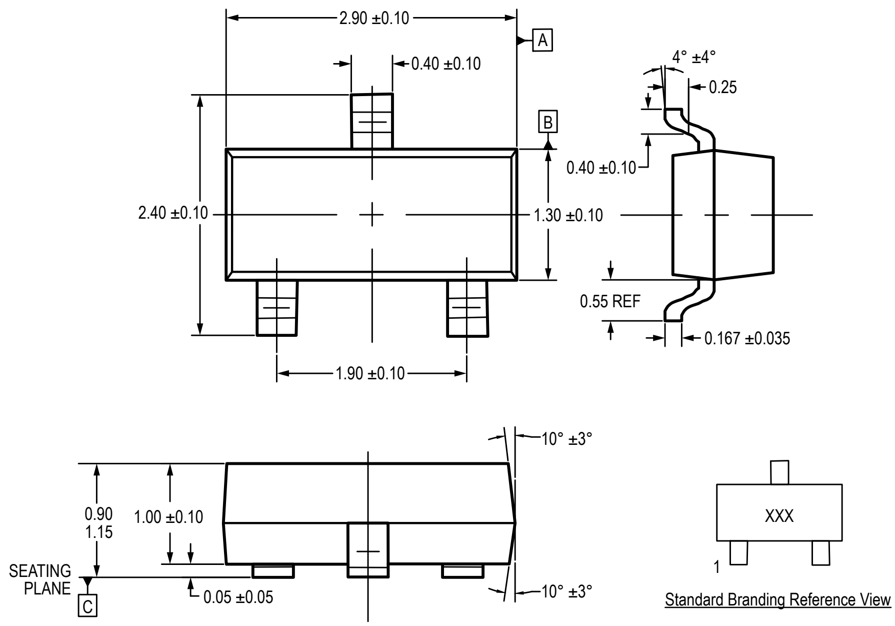

Figure 8: Package MD, 3-Pin SMD (SOT23-3)

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REVISION HISTORY

Number	Date	Description
–	May 27, 2025	Initial release
1	June 25, 2025	Modified selection guide table (page 2)
2	July 11, 2025	Modified jitter characteristic (page 5)
3	July 15, 2025	Removed banner for web release (all pages)

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