Low-Voltage Micropower Switch For Automotive and Industrial Applications

FEATURES AND BENEFITS

- 2.2 to 5.5 V operation
- AEC-Q100 qualified
- Ultra-low power consumption (micropower)
- Omnipolar and unipolar switch threshold options
- Sleep time 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
- Push-pull output
- Solid-state reliability
- Industry-standard package and pinout

APPLICATIONS

- Battery-critical applications
- Cell phones, laptops, e-locks, smoke detectors
- Medical equipment
- Doors, covers, lids, and tray position detection
- E-mobility
- Valves position detection
- Smart meters
- Home appliances
- Automotive: power closures, in-cabin applications, wiper position, gear-shift selectors, etc.

DESCRIPTION

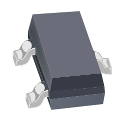
The APS11753 micropower Hall-effect switch ICs are AEC-Q100 qualified for low-voltage applications. These sensors are temperature-stable and suited for operation over extended junction temperature ranges up to 165°C. This family of Hall-effect switches provides contactless control of a push-pull output, which actuates in response to a magnetic field applied to the branded package face. Additionally, the micropower logic allows ultra-low power consumption and operation from 2.2 to 5.5 V.

These devices are equipped with chopper stabilization, which reduces the residual offset typically caused by device overmolding, temperature dependencies, and thermal stress, allowing superior high-temperature performance.

The APS11753 is offered in package type MD-3, a standard 3-pin SOT23-3 surface-mount package. The package is lead (Pb) free.

PACKAGE

Not to scale



3-pin SOT23-3
(suffix MD)

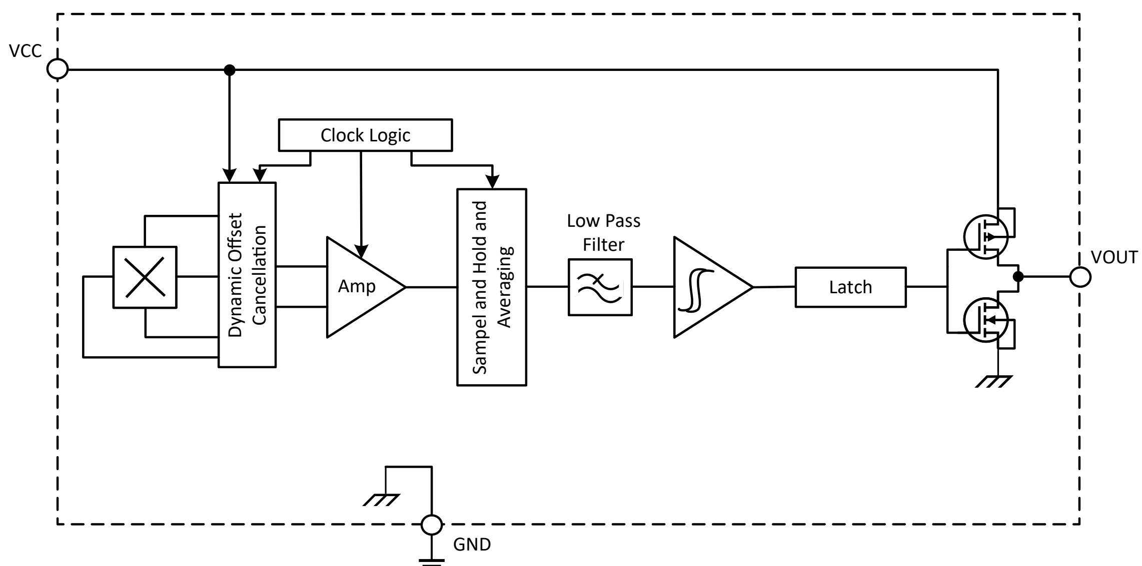


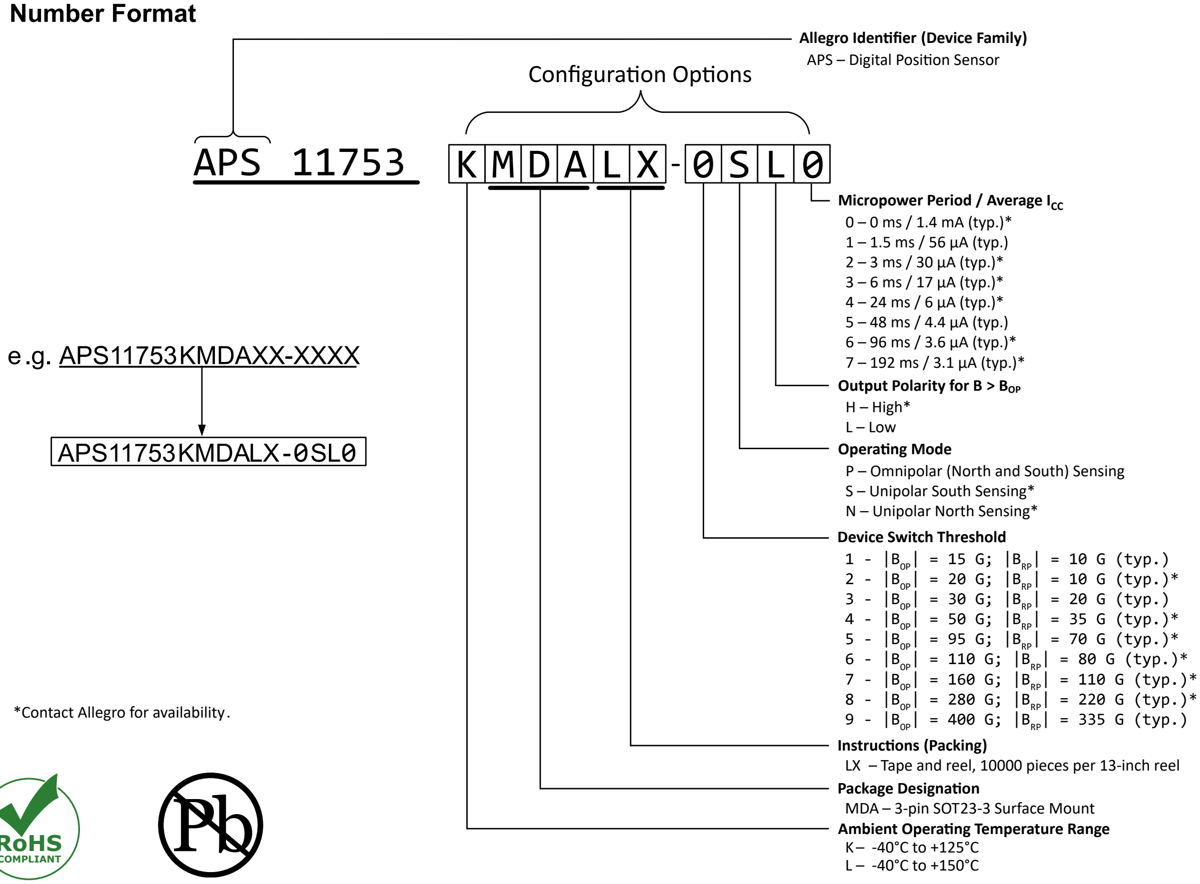
Figure 1: Functional Block Diagram

SELECTION GUIDE

Part Number [1]	Sleep Time (ms)	Average Supply Current (µA)	Typ. Switch Point Magnitude		Operating Temperature (°C)	Product Grade	Mounting	Packing [2]
			B_{OP} (G)	B_{RP} (G)				
APS11753KMDALX-3PL5	50	4.4	30	20	–40 to 125	Industrial	3-pin SOT23-3 surface mount	Tape and Reel, 10,000 pieces per 13-inch reel
APS11753KMDALX-1PL5	50	4.4	15	10				
APS11753KMDALX-9PL5	50	4.4	400	335				
APS11753KMDALX-3PL1	1.5	56	30	20				
APS11753LMDALX-3PL5	50	4.4	30	20	–40 to 150	Automotive	3-pin SOT23-3 surface mount	Tape and Reel, 10,000 pieces per 13-inch reel
APS11753LMDALX-1PL5	50	4.4	15	10				
APS11753LMDALX-9PL5	50	4.4	400	335				
APS11753LMDALX-3PL1	1.5	56	30	20				

[1] Contact Allegro MicroSystems for options not listed in the selection guide.
[2] Contact Allegro MicroSystems for additional packing options.

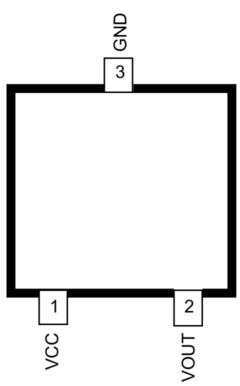
Complete Part Number Format



ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Rating	Units
Supply Voltage	V_{CC}		6	V
Reverse Supply Voltage	V_{RCC}		–0.3	V
Output Current	I_{OUT}	Source or sink	±5	mA
Operating Ambient Temperature	T_A	Range K	–40 to 150	°C
Maximum Junction Temperature	$T_{J(max)}$		165	°C
Storage Temperature	T_{stg}		–65 to 170	°C

PINOUT DIAGRAM AND TERMINAL LIST
(VIEW FROM BRANDED FACE)



3-pin SOT23-3
(suffix MD)

Terminal List

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

TYPICAL APPLICATION CIRCUIT

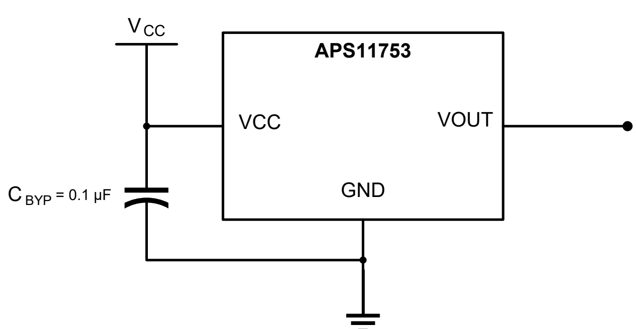


Figure 2: Typical Application Circuit

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ELECTRICAL CHARACTERISTICS [1]: 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. [2]	Max.	Unit
SUPPLY AND STARTUP						
Supply Voltage	V_{CC}	Operating, T_J < 165°C	2.2	–	5.5	V
Supply Current	$I_{CC(AVG)}$ [3]	-xxx5 option: 48 ms sleep period	–	4.4	11.5	µA
		-xxx1 option: 1.5 ms sleep period	–	56.4	251.8	µA
	$I_{CC(AWAKE)}$	Device is awake, V_{CC} = 2.2 V	–	1	1.5	mA
		Device is awake, V_{CC} = 3.5 V	–	1.4	2.3	mA
		Device is awake, V_{CC} = 5.5 V	–	2.2	3.5	mA
	$I_{CC(SLEEP)}$	Device is asleep	–	2.7	6	µA
Power-On State [4]	POS	$t < t_{PO}$, $V_{CC} \geq V_{CC(min)}$		Low		–
Power-On Time [4]	t_{PO}	$V_{CC} \geq V_{CC(min)}$	–	60	100	µs
MICROPOWER OPERATION (See Figure 6)						
Awake	t_{AWAKE}		–	–	60	µs
Sleep	t_{SLEEP}	-xxx5 option	25	48	90	ms
		-xxx1 option	0.5	1.5	2.5	ms
CHOPPER STABILIZATION AND OUTPUT CHARACTERISTICS						
Chopping Frequency	f_c		–	250	–	kHz
Output Saturation Voltage	$V_{OUT(SAT)HIGH}$	I_{OUT} = 1 mA (sink)	V_{CC} – 300	V_{CC} – 150	–	mV
	$V_{OUT(SAT)LOW}$	I_{OUT} = 1 mA (source)	–	150	300	mV
Supply Slew Rate	SR		20	–	–	V/ms

[1] Temperature performance is guaranteed by design and characterization.
[2] Typical data is at T_A = 25°C and V_{CC} = 3.5 V unless otherwise noted.
[3] I_{CC} average is calculated with the equation:

$$\frac{I_{CC(awake)} \times t_{awake} + I_{CC(sleep)} \times t_{sleep}}{t_{awake} + t_{sleep}}$$

[4] Guaranteed by device design and characterization; not tested in final production.

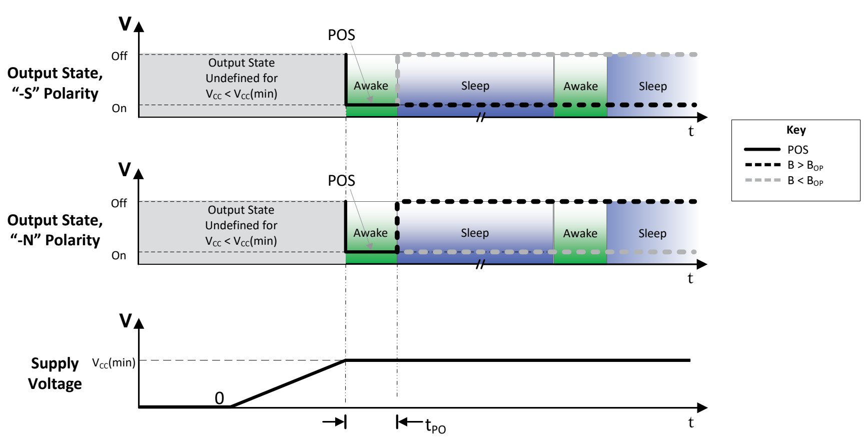

Figure 3: Device Power-on Behavior ("L" Polarity Shown)
The output remains latched in the last sampled state during the sleep time (output on or output off).

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MAGNETIC SWITCH CHARACTERISTICS [1]: 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. [2]	Max.	Unit [3]
Operate Point	B_{OP}	-1xxx Option, T_A 25°C	5	15	25	G
		-1xxx Option, T_A 150°C	8	17	33	G
		-3xxx Option	10	30	50	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
		-3xxx Option	5	20	35	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
		-3xxx Option	–	10	–	G
		-9xxx Option	30	65	110	G

[1] Temperature performance is guaranteed by design and characterization.
[2] Typical data is at T_A = 25°C and V_{CC} = 3.5 V, unless otherwise noted.
[3] Magnetic flux density, B, is indicated as a negative value for north-polarity magnetic fields, and a positive value for south-polarity magnetic fields.

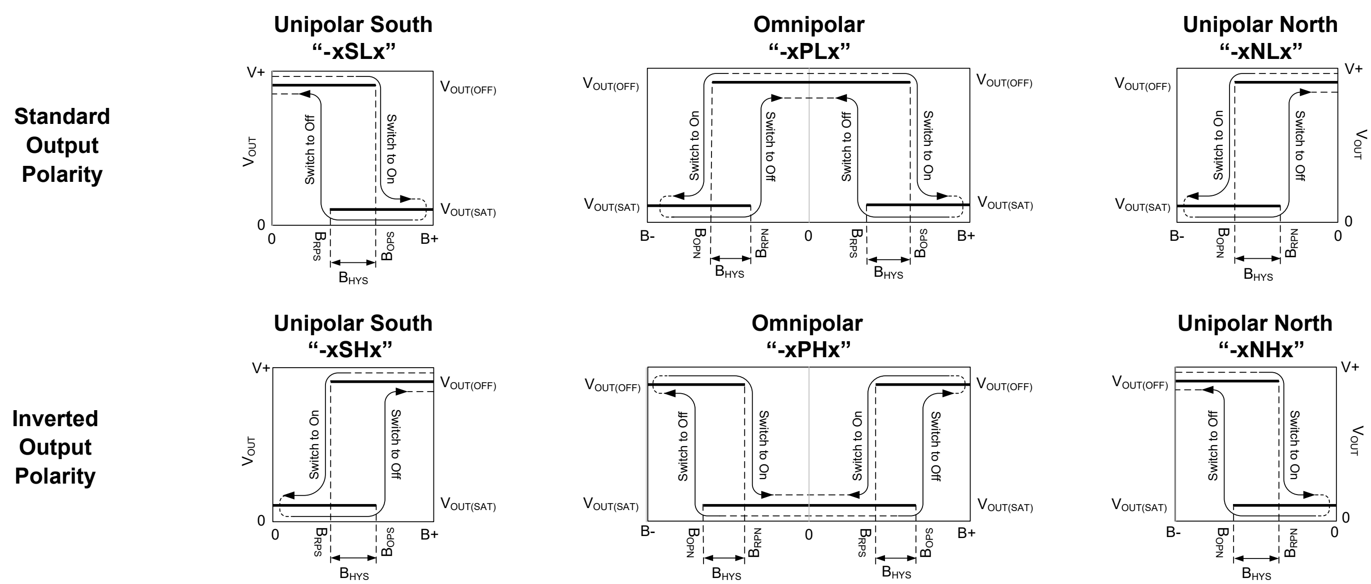

Figure 4: Hall Switch Output State vs. Magnetic Field

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

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PACKAGE THERMAL CHARACTERISTICS: Device power consumption is extremely low. On-chip power dissipation is not an issue under typical operating conditions.

Characteristic	Symbol	Test Conditions	Value	Units
Package Thermal Resistance	$R_{θJA}$	Package MD, 2-layer PCB (1S0P)	331.5	°C/W
		Package MD, 4-layer PCB (2S2P)	203.6	°C/W

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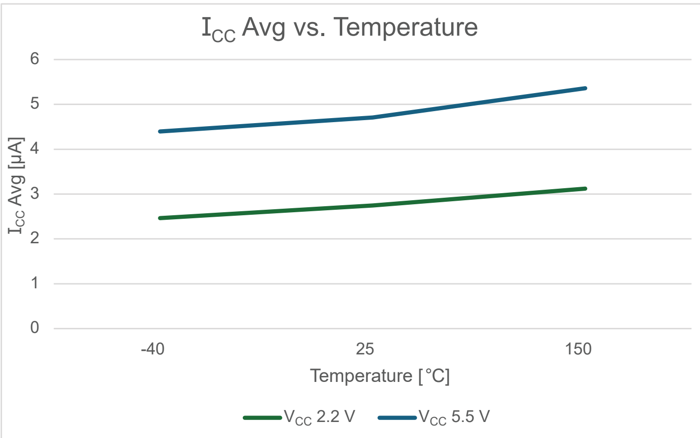
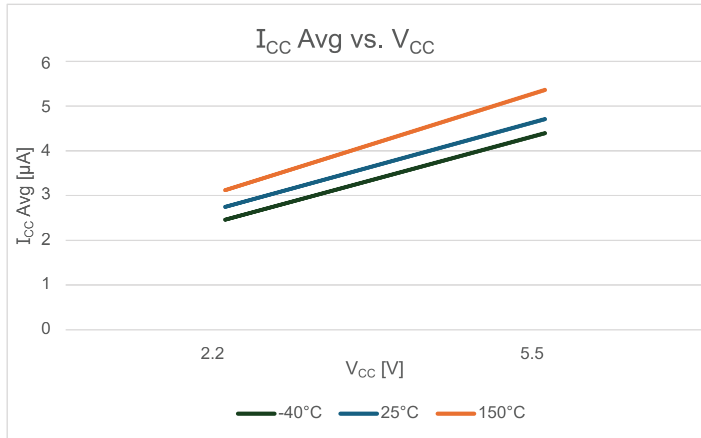
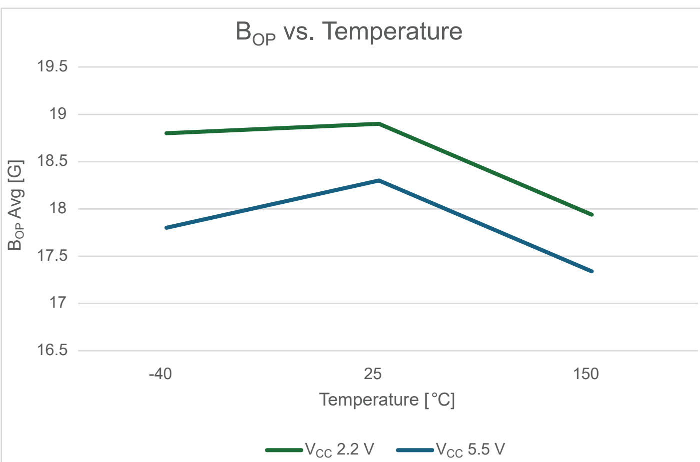
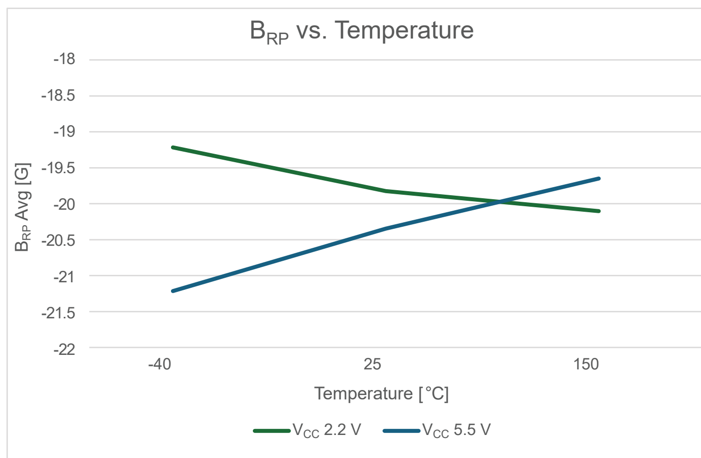
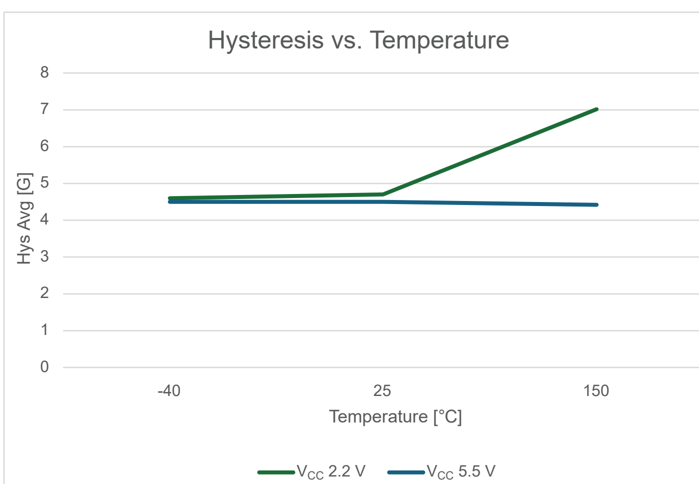
APS11753-1PL5 CHARACTERIZATION PLOTS











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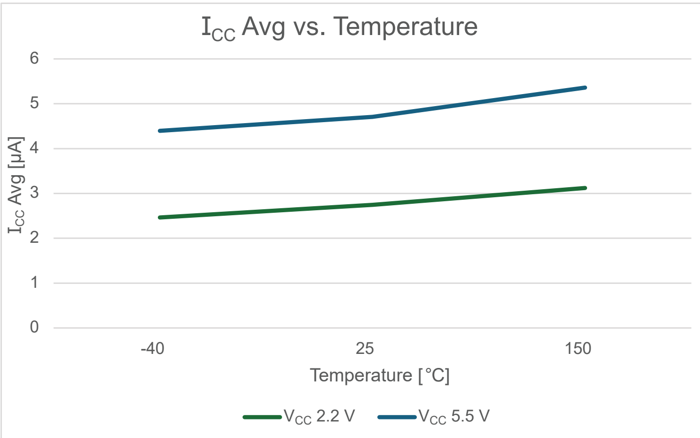
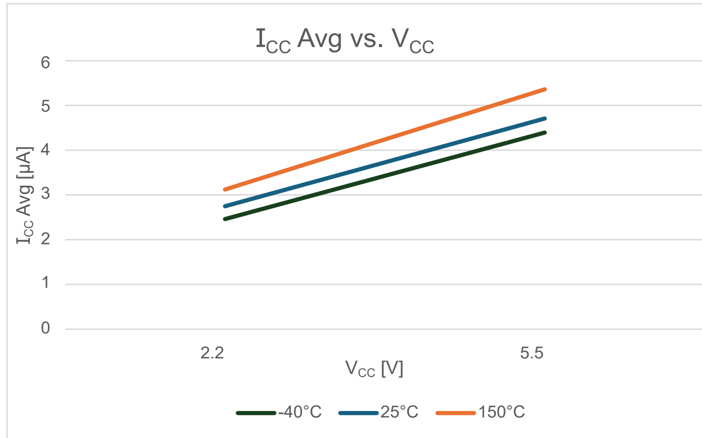
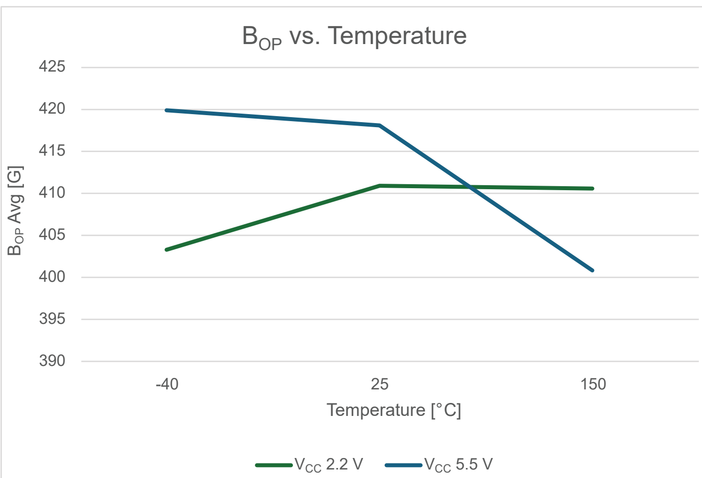
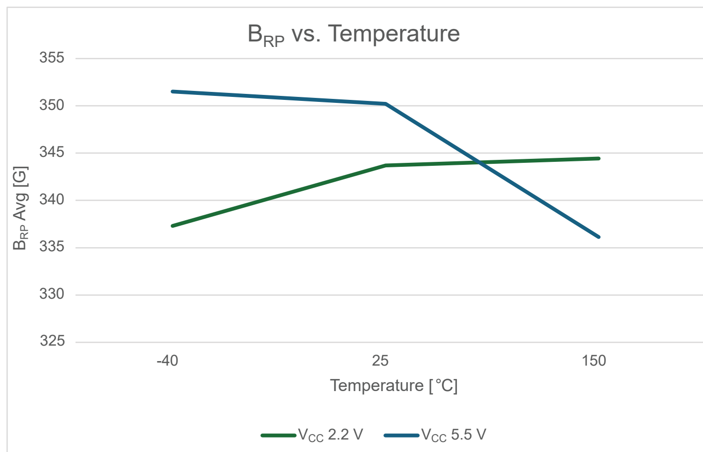
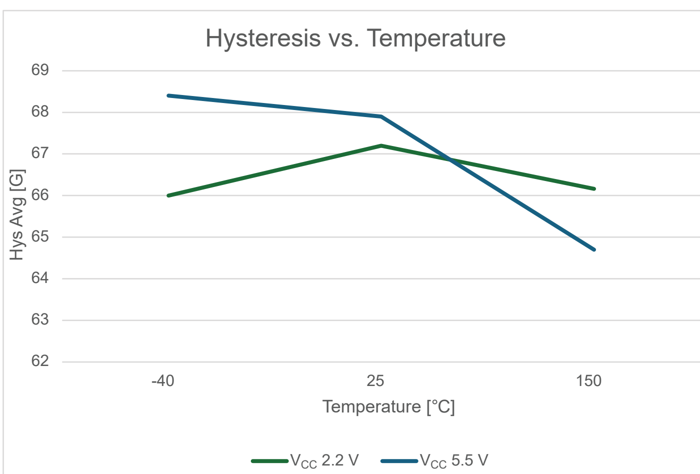
APS11753-9PL5 CHARACTERIZATION PLOTS











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FUNCTIONAL DESCRIPTION

Operation

The APS11753 is an integrated Hall-effect sensor IC with a switch output. The output is a push-pull configuration that actuates in response to a magnetic field applied to the branded package face (Figure 4). 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, panels C and F). When B_{OPS} is exceeded, the APS11753 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 see Figure 4, panels A and D). When B_{OPN} is exceeded, the APS1173 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 or a south polarity field. The APS11753 operates using the standard output polarity convention. Fields exceeding the operating points, B_{OPS} or B_{OPN}, turn the output on (low). When the magnetic field is removed or reduced to less than the release point, B_{RPN} or B_{RPS}, the device output turns off (goes high).

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.

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

Figure 5: Magnetic Sensing Orientations

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Low Average Power

The built-in micropower control periodically activates the Hall switch circuitry for a short period of time (t_{AWAKE}), and deactivates it for the remainder of the period (t_{PERIOD}). For an example of the system timing, see Figure 6. The short-duration awake state allows for sensor stabilization prior to sampling the Hall switch and latching the state on the output. The output is latched on the falling edge of the timing pulse and held in the last sampled state during the sleep period; updates to the output only occur on the falling edge of the timing pulse. The micropower control operates independently of the output driver state. At initial power-on, the APS11753 samples a t_{AWAKE} cycle before the first t_{SLEEP} cycle (see Figure 6).

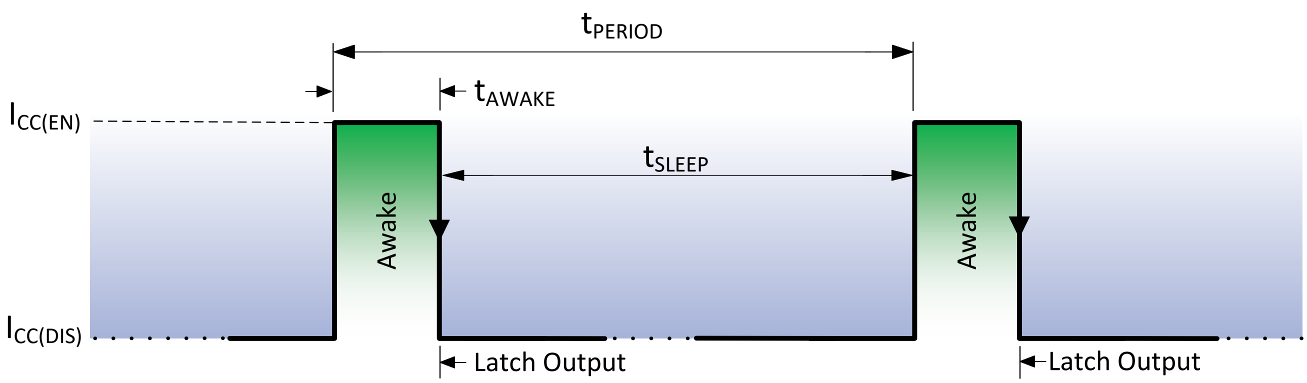

Figure 6: Micropower Operation

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 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 that is implemented as illustrated 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 Allegro chopper-stabilization technique uses a high-frequency clock.

The 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 such as the APS11753 that use this approach 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.

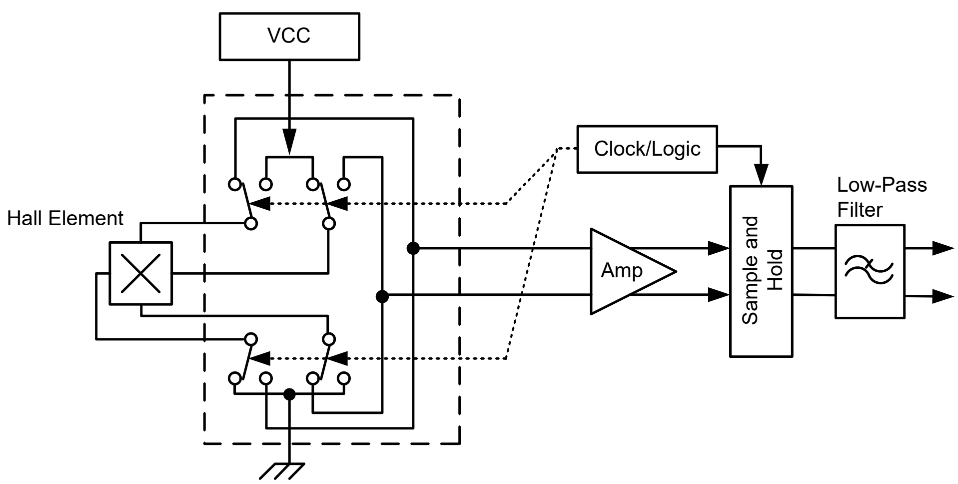

Figure 7: Model of Chopper Stabilization Circuit (Dynamic Offset Cancellation)

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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

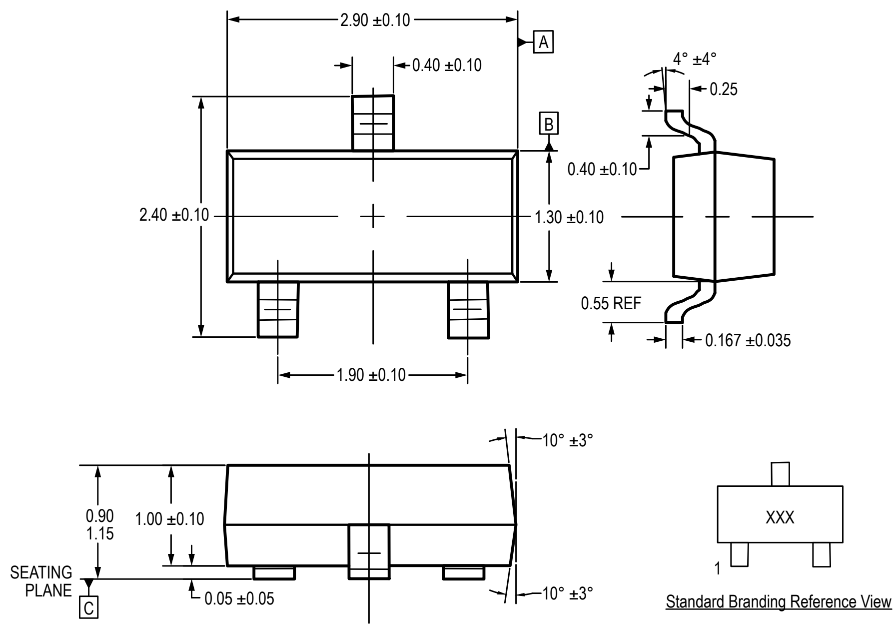

Figure 8: Package MD, 3-Pin SMD (SOT23-3)

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REVISION HISTORY

Number	Date	Description
–	September 26, 2024	Initial release
1	October 17, 2024	Updated title, features and benefits, and description (page 1), selection guide (page 2), absolute maximum ratings table (page 3), characterization plots (pages 7 to 8), and functional description (page 9).
2	October 30, 2024	Updated Magnetic Switch Characteristics table (page 5)
3	December 6, 2024	Updated -3xxx Option Operate Point typical value (page 5)
4	August 11, 2025	Added automotive variants and modified selection guide (headings, and pages 1 and 2), updated operating ambient temperature (page 3), and updated characterization plots (pages 7 and 8), and made minor editorial changes throughout.
5	November 21, 2025	Updated pinout diagram (page 3)

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