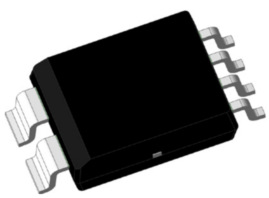
ACS37220LMZ

Current Sensor in SOICW-6 Package with Reinforced Isolation

FEATURES AND BENEFITS

- Ultra-low primary conductor resistance, 800 μΩ, for high efficiency and high-inrush current capability
- Differential Hall sensing rejects common-mode fields
- Patented integrated digital temperature compensation circuitry
- High accuracy and low offset drift over temperature and lifetime
- 150 kHz analog output for fast response time in control applications
- Non-ratiometric output
- 3.3 V and 5 V supply voltage options
- UL 62368-1 certified
  - □ 1097 V_{RMS} basic working voltage
  - □ 565 V_{RMS} reinforced working voltage
- Wide operating temperature range, –40ºC to 150ºC
- AEC-Q100 Grade 0, automotive qualified

PACKAGE: 6-pin fused-lead SOIC (suffix MZ)



Not to scale

DESCRIPTION

The ACS37220 is a fully integrated Hall-effect current sensor in a 6-pin fused-lead wide body SOIC-6 package (MZ). The small MZ package has very low internal conductor resistance, 800 μΩ, and is designed to measure currents up to 60 A. The current is sensed differentially via two Hall plates that provide common-mode field rejection and optimized performance in the presence of external magnetic fields.

This custom package supports a similar reinforced isolation rating to comparable SOICW-16 packages in just half the size.

The ACS37220 is factory-calibrated to provide high accuracy over the entire operating temperature range. It is an automotive grade 0 device capable of operating between –40°C and 150°C ambient temperatures. 5 V and 3.3 V supply voltage variants are available.

The ACS37220 is a lead (Pb) free device plated with 100% matte tin, compatible with standard lead-free printed circuit board assembly processes.

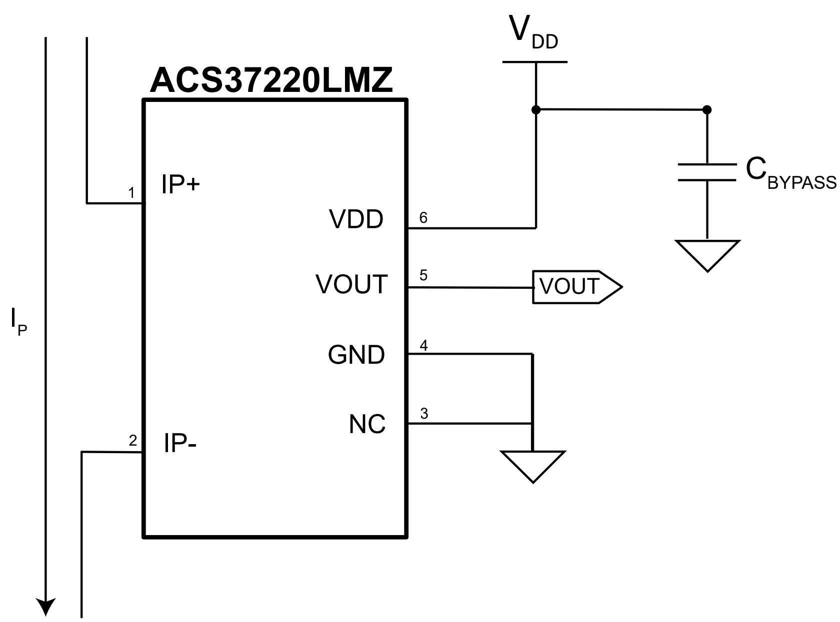


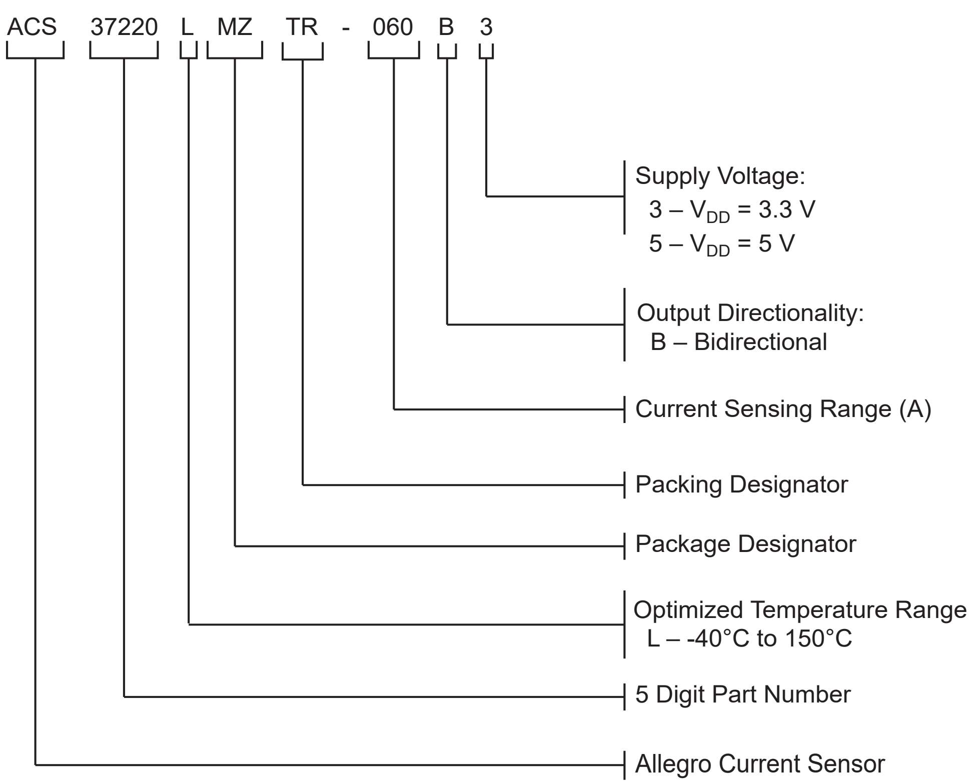
Figure 1: Typical Application Circuit

The ACS37220 outputs an analog signal at VOUT that varies linearly with the primary current, I_P, within the specified ranges.

SELECTION GUIDE

Part Number	Current Sensing Range (A)	Sensitivity (mV/A)	Supply Voltage V_{DD} (V)	Quiescent Voltage Output V_{QVO} (V)	Optimized Temperature Range T_A (°C)	Packing
ACS37220LMZTR-060B3	±60	22	3.3	1.65	–40 to 150	Tape and Reel, 3000 pieces per reel
ACS37220LMZTR-060B5		33.33	5	2.5		

NAMING SPECIFICATION



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ABSOLUTE MAXIMUM RATINGS[1]

Characteristic	Symbol	Notes	Min.	Max.	Unit
Supply Voltage	V_{DD}		–0.5	6.5	V
Forward Output Voltage	V_O	Applies to VOUT	–0.5	(V_{DD} + 0.7) < 6.5	V
Operating Ambient Temperature	T_A		–40	150	°C
Storage Temperature	T_{stg}		–65	165	°C
Maximum Junction Temperature	$T_{J(MAX)}$		–	165	°C

[1] Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

MZ PACKAGE SPECIFIC PERFORMANCE

Characteristic	Symbol	Notes	Rating	Unit
Withstand Voltage [1][2]	V_{ISO}	Agency rated for 60 seconds per UL 62368-1 (edition 3) [1][2]	5656	V_{RMS}
Working Voltage for Basic Insulation [2]	V_{WVBI}	Maximum approved working voltage for basic insulation according to UL 62368-1 (edition 3)	1550	V_{PK} or V_{DC}
			1097	V_{RMS}
Working Voltage for Reinforced Insulation [2]	V_{WVRI}	Maximum approved working voltage for reinforced insulation according to UL 62368-1 (edition 3)	800	V_{PK} or V_{DC}
			565	V_{RMS}
Surge Voltage	$V_{IMPULSE}$	Tested in air, ±5 pulses at 2/minute in compliance to IEC 61000-4-5 1.2 µs (rise) / 50 µs (width)	13000	V_{PK}
Impulse Voltage	V_{SURGE}	1.2/50µs waveform, tested in air	8000	V_{PK}
Clearance	D_{CL}	Minimum distance through air from IP leads to signal leads	8.5	mm
Creepage	D_{CR}	Minimum distance along package body from IP leads to signal leads	8.5	mm
Distance Through Insulation	DTI	Minimum internal distance through insulation	110	µm
Comparative Track Index	CTI	Material Group II	400 to 599	V

[1] Production tested for 1 second in accordance with UL 62368-1 (edition 3).
[2] Certification pending.

PACKAGE CHARACTERISTICS

Characteristic	Symbol	Notes	Min.	Typ.	Max.	Unit
Internal Conductor Resistance	R_{IC}	T_A = 25°C	–	800	–	µΩ
Internal Conductor Inductance	L_{IC}		–	4.4	–	nH
Moisture Sensitivity Level	MSL	Per IPC/JEDEC J-STD-020	–	3	–	–

THERMAL CHARACTERISTICS

Characteristic	Symbol	Notes	Value	Unit
Package Thermal Resistance (Junction to Ambient)	$R_{\theta JA}$	Mounted on the Allegro MZ+MY Current Sensor Evaluation Board (ACSEVB-MZ6-MY6)	17	°C/W
Package Thermal Metric (Junction to Top)	Ψ_{JT}		–3	°C/W

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Terminal List Table

Number	Name	Description
1	IP+	Positive terminal for current being sensed
2	IP–	Negative terminal for current being sensed
3	NC	No Connection ground for best ESD performance
4	GND	Device ground terminal
5	VOUT	Analog output signal
6	VDD	Device power supply terminal

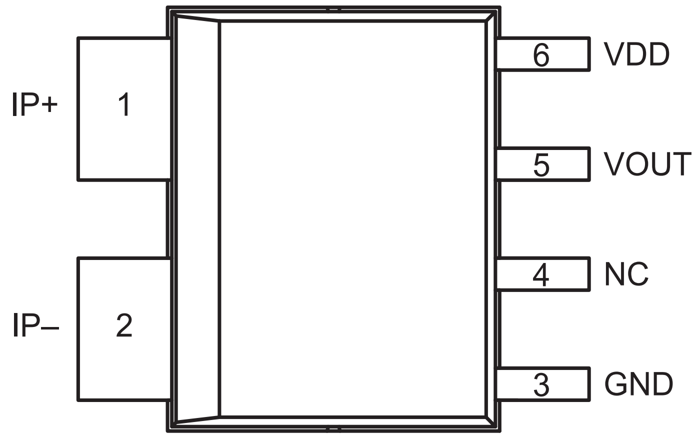

Figure 2: MZ package pinout diagram (top view)

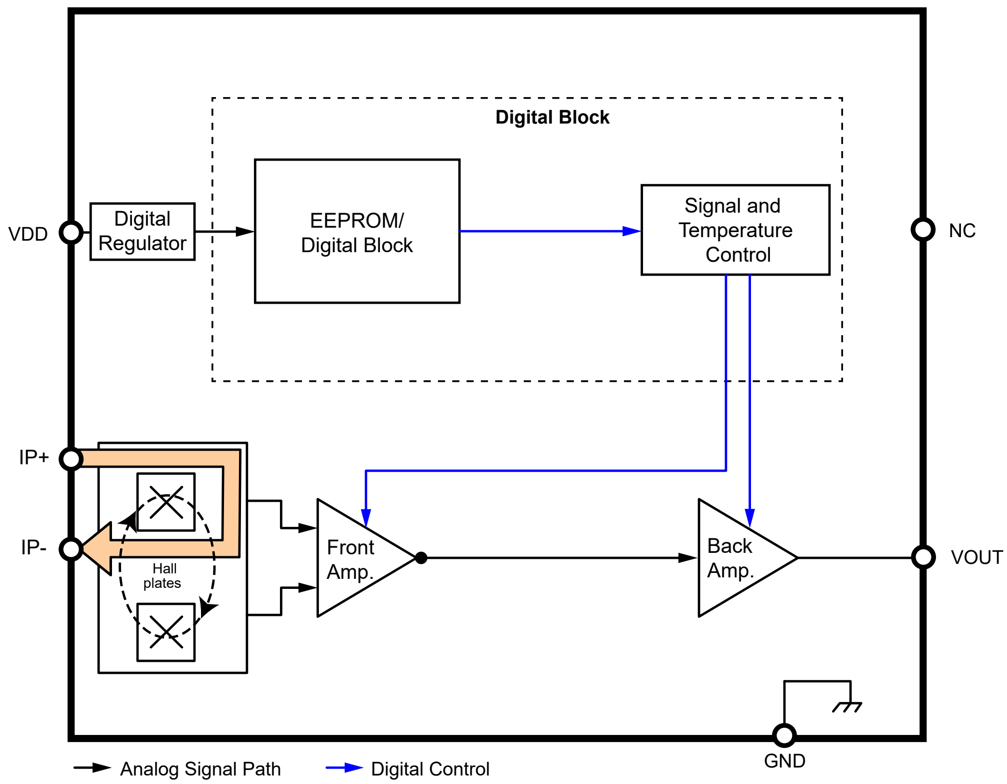

Figure 3: Functional block diagram

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COMMON ELECTRICAL CHARACTERISTICS: Valid through the full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1µF, and $V_{DD} = V_{DD(TYP)}$, unless specified otherwise. Minimum and maximum values are tested in production or validated by design and characterization.

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{DD}	5 V variant	4.5	5	5.5	V
		3.3 V variant	3.15	3.3	3.45	V
Supply Current	I_{DD}	VOUT open; T_A = –40°C	–	–	15.5	mA
Supply Bypass Capacitor	C_{BYPASS}		–	0.1	–	µF
Output Resistive Load [1]	R_{L_VOUT}		10	–	–	kΩ
Output Capacitive Load [1]	C_{L_VOUT}		–	–	4.7	nF
Power-On Reset Voltage	V_{POR}	T_A = 25°C, V_{DD} rising 1 V/ms	2.65	–	3	V
Power-On Reset Hysteresis	V_{POR_HYS}	T_A = 25°C	250	–	350	mV
Power-On Time	t_{PO}		–	80	–	µs
OUTPUT SIGNAL CHARACTERISTICS (VOUT)						
Saturation Voltage [2]	V_{SAT_H}	T_A = 25°C, $V_{DD} = V_{DD(Typ.)}$	V_{DD} – 0.3	–	–	V
	V_{SAT_L}	T_A = 25°C, $V_{DD} = V_{DD(Typ.)}$	–	–	0.3	V
Short Circuit Current	I_{SC_VOUT}	VOUT to GND	–	30	–	mA
Bandwidth	BW	Small signal –3 dB, C_L = 100 pF	–	150	–	kHz
Rise Time	t_R	C_L = 100 pF	–	2.3	–	µs
Response Time [1]	t_{RESP}	C_L = 100 pF	–	–	4	µs
Propagation Delay	t_{PD}	C_L = 100 pF	–	1.6	–	µs
Noise Density	N_D	5 V variant, C_L = 1 nF	–	550	–	µA/√Hz
		3.3 V variant, C_L = 1 nF	–	660	–	µA/√Hz
Common-Mode Field Rejection	CMFR	Input-referred error due to common-mode field	–	2	–	mA/G

[1] Validated by design and characterization.
[2] The sensor may continue to respond to current beyond the specified Current Sensing Range, I_{PR}, until the output saturates at the high or low saturation voltage; however, the linearity and performance beyond the specified Current Sensing Range are not validated.

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ACS37220LMZTR-060B3 PERFORMANCE CHARACTERISTICS: Valid through the full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{DD} = 3.3 V, unless specified otherwise. Minimum and maximum values are tested in production.

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [1]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–60	–	60	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	22	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	1.65	–	V
ERROR COMPONENTS						
Sensitivity Error	E_{SENS}	T_A = 25°C, T_A = –40°C, T_A = 150°C	–1.5	–	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A; T_A = 25°C, T_A = –40°C, T_A = 150°C	–10	–	10	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 1 nF, BW = 150 kHz	–	5.4	–	mV_{RMS}
Power Supply Offset Error	V_{OE_PS}	V_{DD} = 3.15 V, V_{DD} = 3.45 V, T_A = 25°C	–15	–	15	mV
Power Supply Sensitivity Error	E_{SENS_PS}	V_{DD} = 3.15 V, V_{DD} =3.45 V, T_A = 25°C	–1.5	–	1.5	%

[1] Validated by design and characterization.

ACS37220LMZTR-060B5 PERFORMANCE CHARACTERISTICS: Valid through the full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{DD} = 5 V, unless specified otherwise. Minimum and maximum values are tested in production.

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [1]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–60	–	60	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	33.33	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	2.5	–	V
ERROR COMPONENTS						
Sensitivity Error	E_{SENS}	T_A = 25°C, T_A = –40°C, T_A = 150°C	–1.5	–	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A; T_A = 25°C, T_A = –40°C, T_A = 150°C	–10	–	10	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 1 nF, BW = 150 kHz	–	5.4	–	mV_{RMS}
Power Supply Offset Error	V_{OE_PS}	V_{DD} = 3.15 V, V_{DD} = 3.45 V, T_A = 25°C	–15	–	15	mV
Power Supply Sensitivity Error	E_{SENS_PS}	V_{DD} = 3.15 V, V_{DD} =3.45 V, T_A = 25°C	–1.5	–	1.5	%

[1] Validated by design and characterization.

ACS37220LMZATR LIFETIME CHARACTERISTICS: Valid through the full operating temperature range, T_A = –40°C to 150°C, unless specified otherwise.

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
ERROR INCLUDING LIFETIME DRIFT						
Sensitivity Error Including Lifetime Drift [1]	E_{SENS_LT}	Based on six sigma drift of worst-case distribution observed after AEC-Q100 qualification stresses	–2.9	–	2.9	%
Quiescent Voltage Error Including Lifetime Drift [1]	V_{QVO_LT}	Based on six sigma drift of worst-case distribution observed after AEC-Q100 qualification stresses	–20	–	20	mV

[1] Validated by design and characterization.

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ACS37220 TYPICAL FREQUENCY RESPONSE

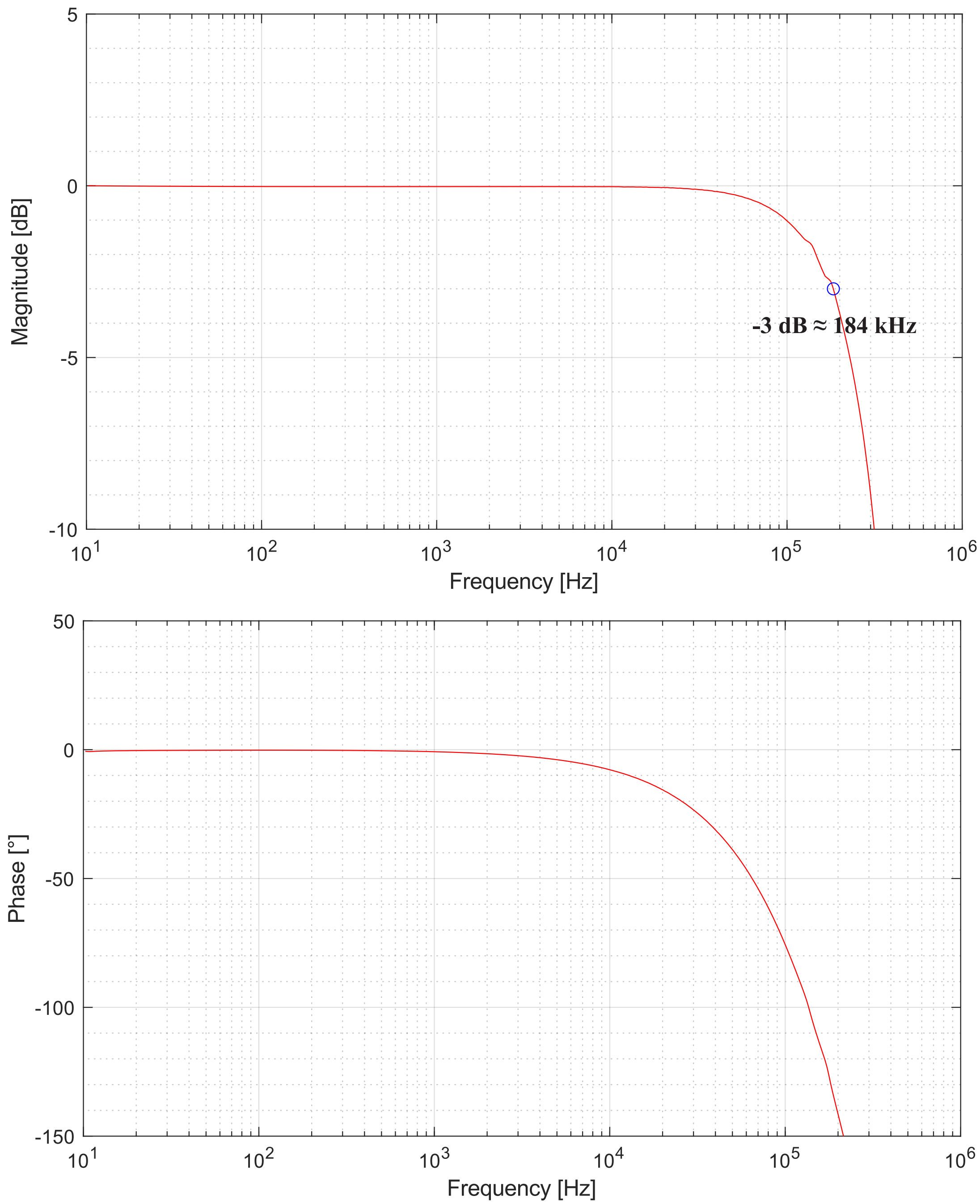

Figure 4: ACS37220 Typical Frequency Response

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RESPONSE CHARACTERISTICS DEFINITIONS AND PERFORMANCE DATA

Response Time (t_{RESP})

The time interval between a) when the sensed input current reaches 90% of its full-scale value, and b) when the sensor output, V_{OUT}, reaches 90% of its full-scale output value.

Propagation Delay (t_{PD})

The time interval between a) when the sensed input current reaches 20% of its full-scale value, and b) when the sensor output, V_{OUT}, reaches 20% of its full-scale output value.

Rise Time (t_R)

The time interval between a) when the sensor output, V_{OUT}, reaches 10% of its full-scale value, and b) when the sensor output, V_{OUT}, reaches 90% of its full-scale value.

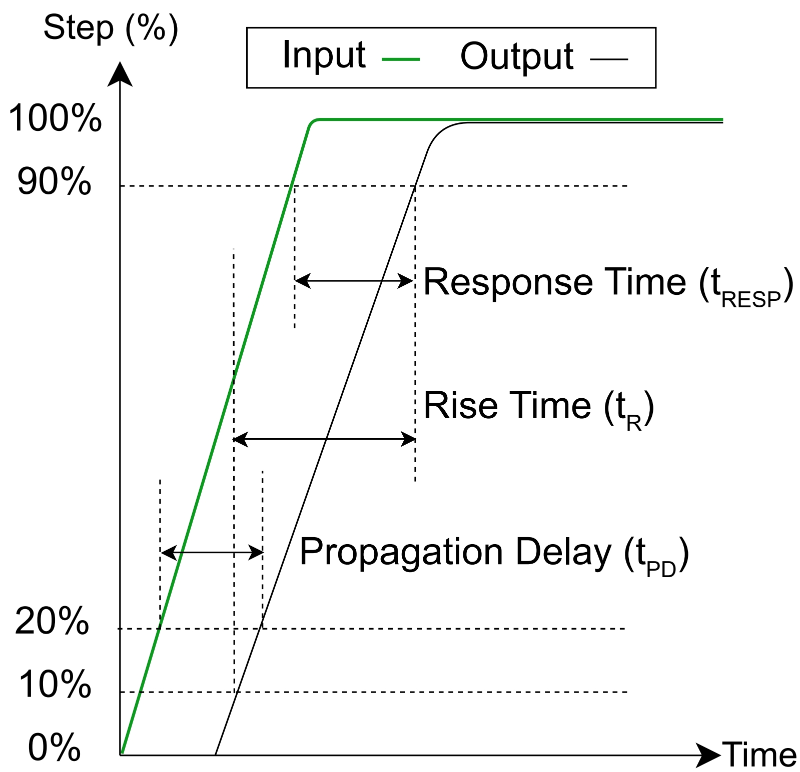

Figure 5: Step Response characteristics

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FUNCTIONAL DESCRIPTION OF POWER ON/OFF OPERATION

Introduction

The graphs in this section show the behavior of V_{OUT} as V_{DD} reaches or falls below the required power-on voltage. Figure 6 and Figure 7 use the same labeling convention for different voltage thresholds. References in brackets "[ ]" are valid for each of these graphs.

POWER-ON OPERATION

As V_{DD} ramps up, the VOUT pin is in a high-impedance (high-Z) state until V_{DD} reaches and passes V_{POR} [1]. Once V_{DD} has passed V_{POR} [1], V_{OUT} enters normal operation and starts responding to applied current, I_P.

POWER-OFF OPERATION

As V_{DD} drops below $V_{POR} – V_{POR\_HYS}$ the outputs enters a high-Z state. The hysteresis on the power-on voltage prevents noise on the supply line from causing V_{OUT} to repeatedly enter and exit the high-Z state around the V_{POR} level.

NOTE: Because the device is entering a high-Z state and not driving the output, the time it takes the output to reach a steady state depends on the external circuitry.

Voltage Thresholds

POWER-ON RESET RELEASE VOLTAGE (V_{POR})

If V_{DD} falls below $V_{POR} – V_{POR\_HYS}$ [2] while the sensor is in operation, the digital circuitry turns off and the output re-enters a high-Z state. After V_{DD} recovers and exceeds V_{POR} [1], the output enters normal operation after a delay of t_{PO}.

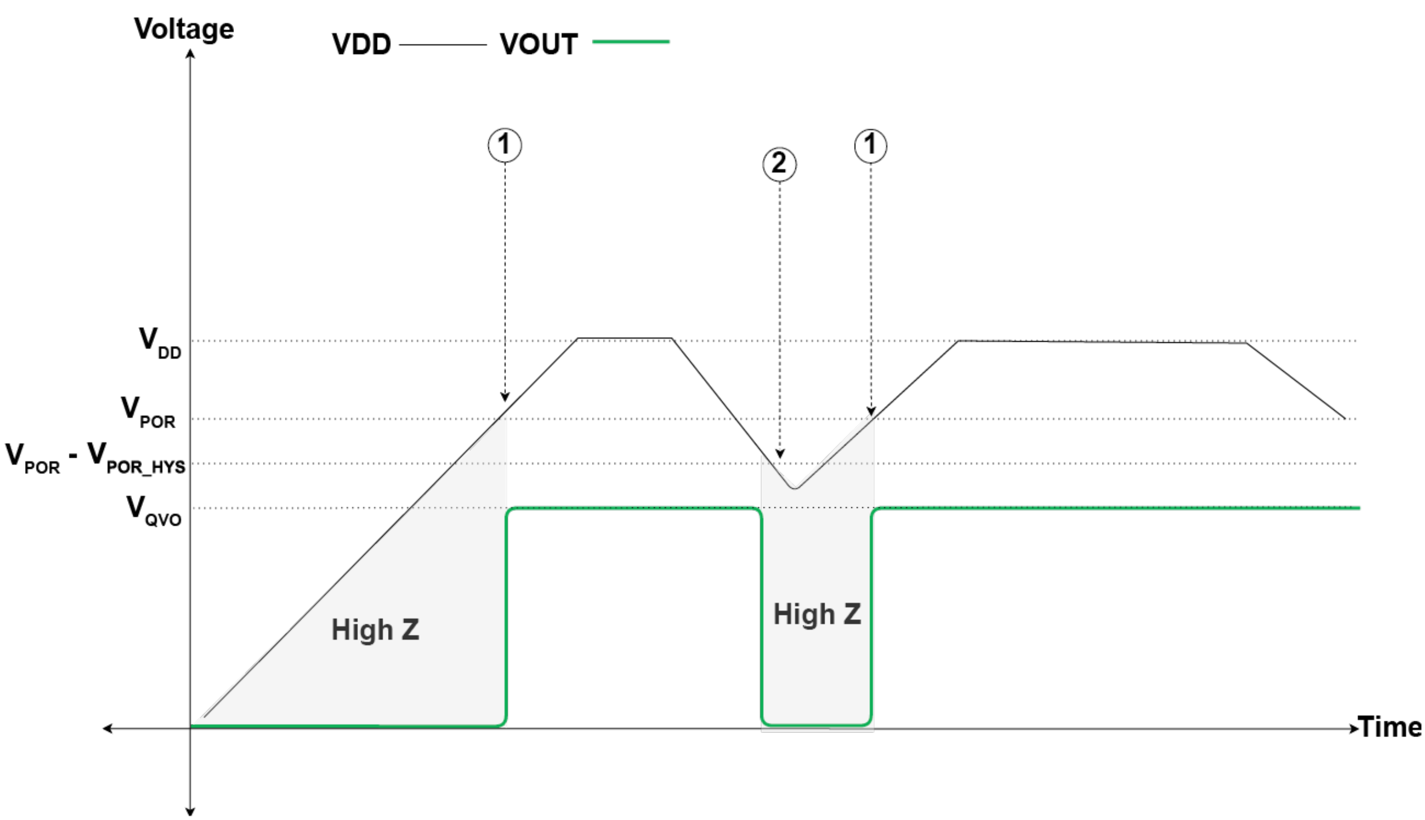

Figure 6: Power-On And Power-Off operation

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Timing Thresholds

POWER-ON DELAY (t_{PO})

When the supply voltage reaches V_{POR} [1], the device requires a finite time to power its internal components before the outputs are released from the high-impedance state and start responding to the measured current, I_P. Power-On Time, t_{PO}, is defined as the time it takes for the output voltage to settle within ±10% of its steady-state value under an applied current, I_P , which can be seen as the time from [1] to [A] in Figure 6.

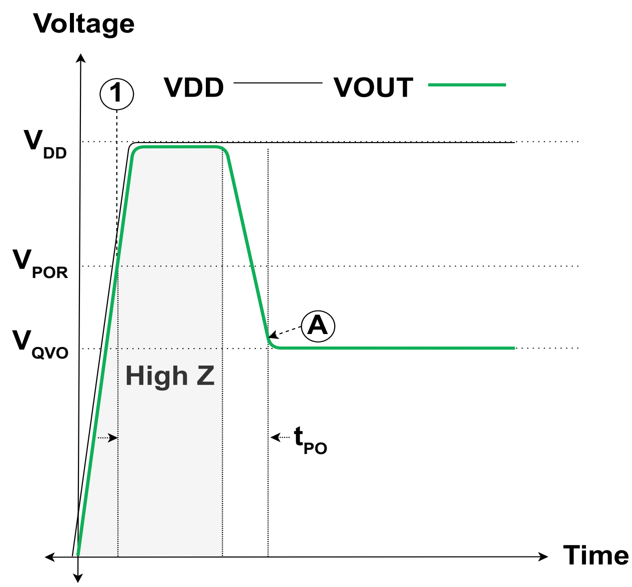

Figure 7: Power-On Delay, t_{PO}

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DEFINITIONS OF OPERATING AND PERFORMANCE CHARACTERISTICS

Quiescent Voltage Output (V_{QVO})

Quiescent Voltage Output, V_{QVO}, is defined as the voltage on the output, V_{OUT}, when no current is applied, $I_P = 0$.

$$V_{QVO} = V_{OUT\_@0A}\ [mV]$$

Quiescent Voltage Output Error (V_{QVO_E})

Quiescent Voltage Output Error, V_{QVO_E}, is defined as the deviation of V_{QVO} from the nominal target value in production testing.

$$V_{QVO\_E} = V_{QVO\_MEASURED} - V_{QVO\_IDEAL}\ [mV]$$

Quiescent Voltage Output Temperature Drift (V_{QVO_T})

Quiescent Voltage Output Temperature Drift, V_{QVO_T}, is defined as the expected deviation of V_{QVO} from its value at T_A= 25°C over the temperature range T_A= –40 to 150°C, based on observed three-sigma temperature drifts.

$$V_{QVO\_T} = V_{QVO_{@}-40\ to\ 150°C} - V_{QVO\_@25°C}\ [mV]$$

Power Supply Offset Error (V_{OE_PS})

Power Supply Offset Error, V_{OE_PS}, is defined as the change in V_{QVO} due to variations in the power supply voltage at a specific temperature. The Power Supply Offset Error is defined as the change in offset measured between the nominal supply voltage (V_{DD}) and V_{DD} ±E%, where E is the difference between V_{DD} and $V_{DD(MAX)}$ in percent. The error is expressed in mV to indicate how much the offset deviates from its ideal value due to changes in the supply voltage.

$$V_{OE\_PS} = V_{QVO_{@VDD} \pm E\%, T_A} - V_{QVO_{@VDD}, T_A}\ [mV]$$

Sensitivity (Sens)

Sensitivity, or Sens, is defined as the ratio of the V_{OUT} swing and the current through the primary conductor, I_P. The current causes a voltage change on V_{OUT} away from V_{QVO} until V_{SAT}. The magnitude and direction of the output voltage is proportional to the magnitude and direction of the current, I_P. The proportional relationship between output voltage and current is Sensitivity, defined as:

$$Sens = \frac{V_{OUT\_IP1} - V_{OUT\_IP2}}{I_{P1} - I_{P2}}\ [mV/A]$$

where I_{P1} and I_{P2} are two different currents, and $V_{OUT}(I_{P1})$ and $V_{OUT}(I_{P2})$ are the respective output voltages, at VOUT, at those currents.

Sensitivity Error (E_{SENS})

Sensitivity Error, E_{SENS}, is the deviation of Sensitivity from the nominal sensitivity target value in production testing.

$$E_{SENS} = \frac{SENS_{MEASURED} - SENS_{IDEAL}}{SENS_{IDEAL}}\ x\ 100\ [\%]$$

Sensitivity Temperature Drift (E_{SENS_T})

Sensitivity Temperature Drift, E_{SENS_T}, is defined as the expected deviation of Sens from its value at T_A= 25°C over the temperature range T_A= –40 to 150°C, based on observed three-sigma temperature drifts.

$$E_{SENS\_T} = \frac{SENS_{@-40\ to\ 150°C} - SENS_{@25°C}}{SENS_{@25°C}}\ x\ 100\ [\%]$$

Power Supply Sensitivity Error (E_{SENS_PS})

Power Supply Sensitivity Error, E_{SENS_PS}, is a measure of the change in sensitivity due to variations in the power supply voltage at a specific temperature. The Power Supply Sensitivity Error is defined as the percentage change in sensitivity measured between the nominal supply voltage (V_{DD}) and V_{DD} ±E%, where E is the difference between V_{DD} and $V_{DD(MAX)}$ in percent. The error is expressed as a percentage to indicate how much the sensitivity deviates from its ideal value due to changes in the supply voltage.

$$E_{SENS\_PS} = \frac{SEN_{@VDD \pm E\%, T_A} - SENS_{@VDD, T_A}}{SENS_{@VDD, T_A}}\ x\ 100\ [\%]$$

Output Saturation Voltage (V_{SAT_H} and V_{SAT_L})

Output Saturation Voltage, V_{SAT}, is defined as the minimum and maximum voltages the VOUT output budder can drive. V_{SAT_H} is the highest voltage the output can reach, while V_{SAT_L} is the lowest. In other states, the VOUT pin may be pulled outside of V_{SAT_L} and V_{SAT_H}. Note that changing the sensitivity does not change the V_{SAT} points.

Lifetime Drift (E_{SENS_LT} and V_{QVO_LT})

Lifetime drift characteristics are based on a statistical combination of production distributions and six-sigma drift in the worst-case distribution observed during AEC-Q100 qualification stresses.

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PACKAGE OUTLINE DRAWING

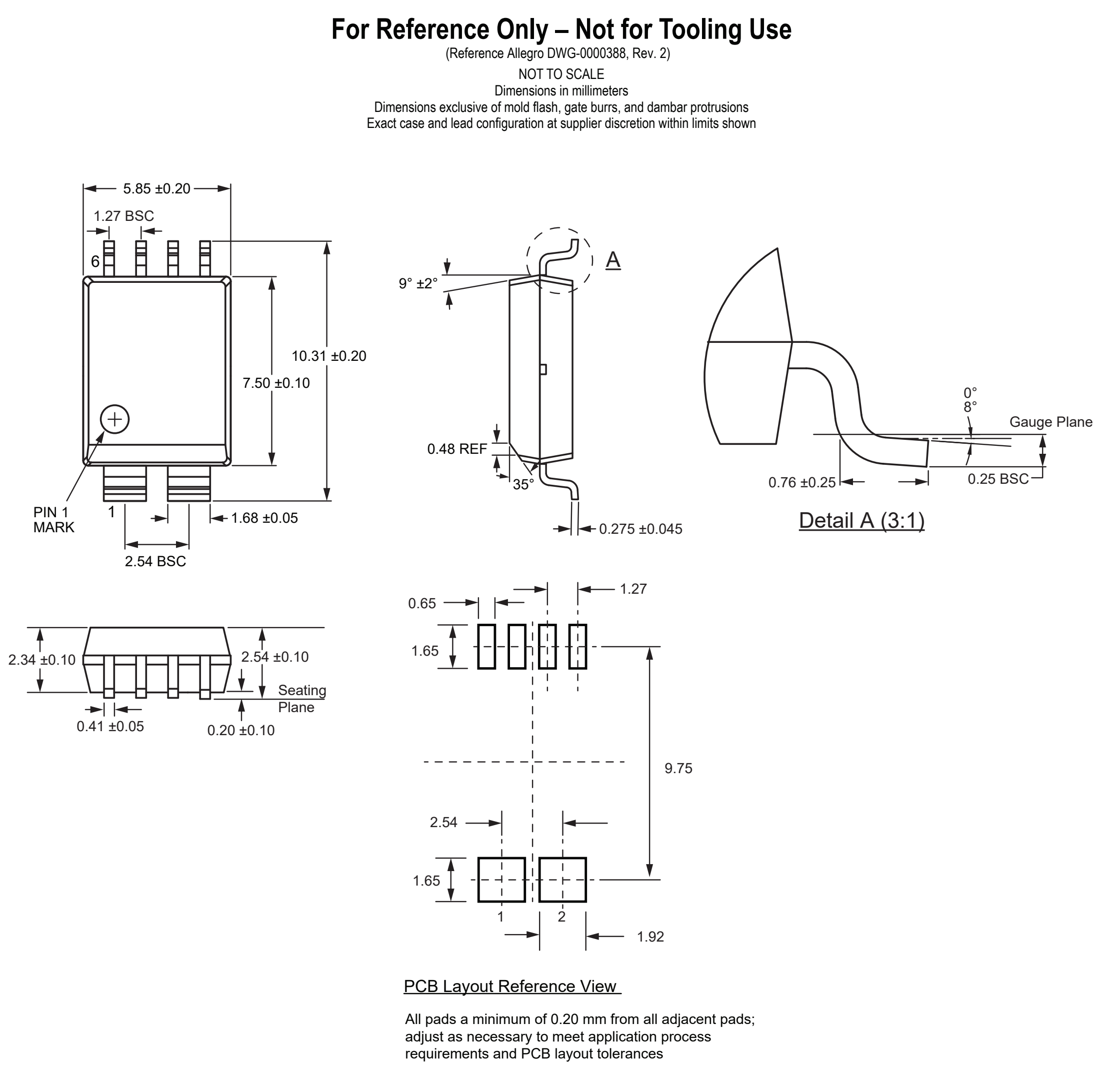

Figure 8: 6-Pin fused-lead SOIC (suffix MZ)

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Revision History

Number	Date	Description
–	October 28, 2024	Initial release
1	May 30, 2025	Updated selection guide (page 2), performance characteristics tables (page 6)
2	June 27, 2025	Updated pinout diagram (page 4)

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