

## 400 kHz, High Accuracy Current Sensor with Pin-Selectable Gains and Adjustable Overcurrent Fast Fault in SOICW-16 Package

### FEATURES AND BENEFITS

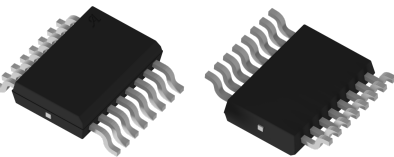
- Low internal primary conductor resistance (0.27 mΩ) for better power efficiency and low heat dissipation
- High operating bandwidth and response time to enable reliable current measurements in applications where fast control loops are used or high-speed currents are monitored
  - 400 kHz bandwidth
  - 1.1 μs typical response time
- High accuracy current measurements
  - ±1.5 % maximum sensitivity error over temperature
  - ±10 mV maximum offset voltage over temperature
  - Non-ratiometric operation with V<sub>REF</sub> output
  - Differential sensing for high immunity to external magnetic fields
  - No magnetic hysteresis
- Adjustable fast overcurrent fault
  - 1 μs typical response time
  - Pin adjustable threshold
- Externally configurable gain settings using two logic pins
  - Four adjustable gain levels for increased design flexibility

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### PACKAGE:

16-pin SOICW  
(suffix MC)

*Not to scale*



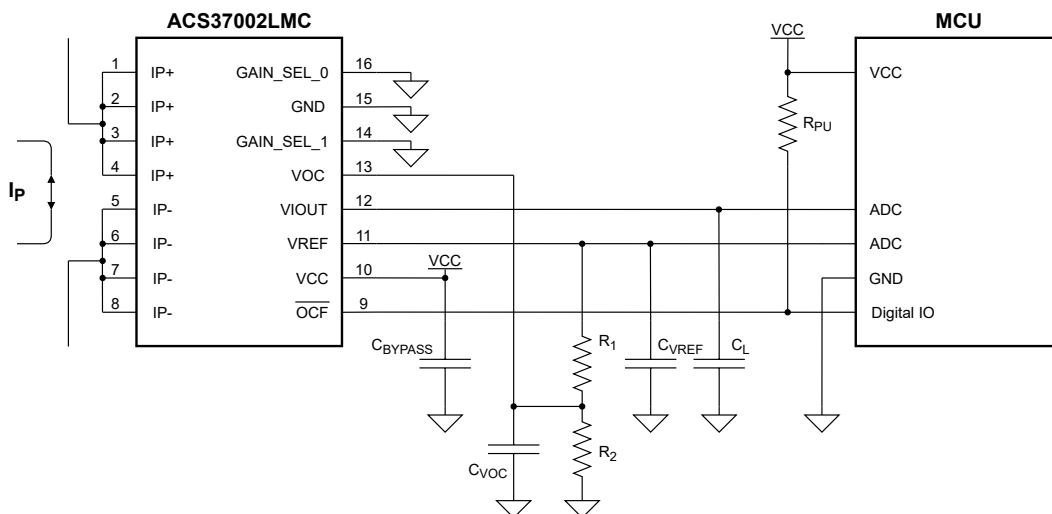
### DESCRIPTION

The ACS37002LMC is a fully integrated Hall-effect current sensor in an SOICW-16 package that is factory-trimmed to provide high accuracy over the entire operating range without the need for customer programming. The current is sensed differentially by two Hall plates that subtract out interfering external common-mode magnetic fields.

The package construction provides high isolation by magnetically coupling the field generated by the current in the conductor to the monolithic Hall sensor IC which has no physical connection to the integrated current conductor. The MC package is optimized for high isolation with withstand voltage, 5 kV<sub>RMS</sub>, and 0.27 mΩ conductor resistance, ideal for low power dissipation constraints.

The ACS37002LMC has functional features that are externally configurable and robust without the need for programming. Two logic gain selection pins can be used to configure the device to one of four defined sensitivities and corresponding current ranges. A fast overcurrent fault output provides short-circuit detection for system protection with a fault threshold that is proportional to the current range and can be set with an analog input. The reference pin provides a stable voltage that corresponds to the 0 A output voltage. This reference voltage allows for differential measurements as well as a device-referred voltage to set the overcurrent fault threshold.

Devices are RoHS compliant and lead (Pb) free with 100% matte-tin-plated leadframes.



**Figure 1: Typical Bidirectional Application Showing 00 Gain Select Configuration.**  
For more application circuits, refer to the Application and Theory section.

# ACS37002LMC

## 400 kHz, High Accuracy Current Sensor with Pin-Selectable Gains and Adjustable Overcurrent Fast Fault in SOICW-16 Package

### FEATURES AND BENEFITS (continued)

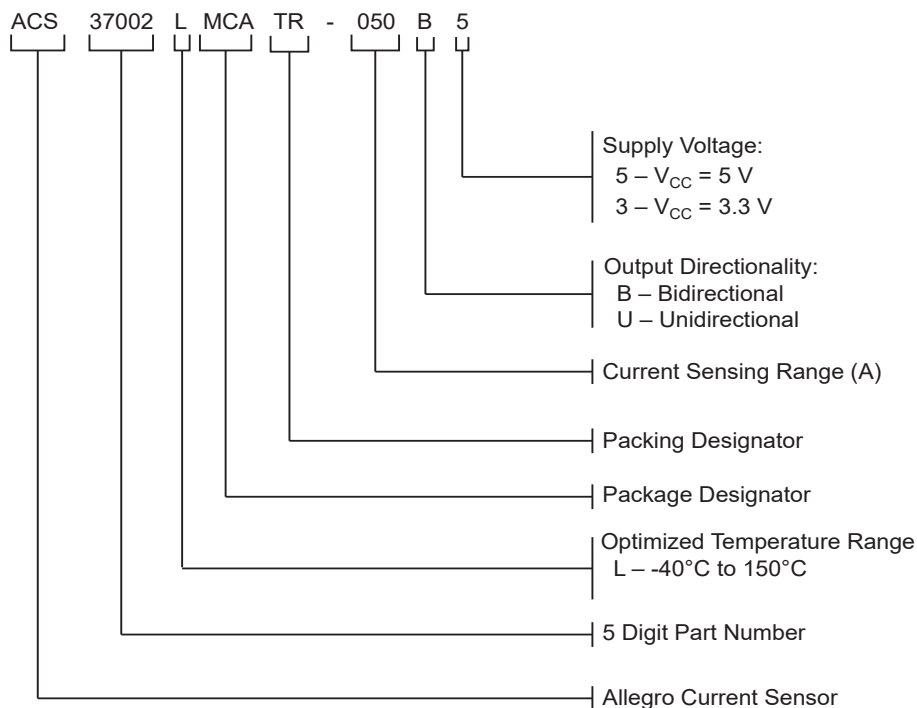
- Enabling measurement ranges from 33 to 180 A in both unidirectional and bidirectional modes
- UL60950-1 (ed. 2) and UL 62368 (ed. 1) certification, highly isolated compact SOICW-16 surface mount package (MC)
  - 5 kV<sub>RMS</sub> rated isolation voltage
  - 1144 V<sub>RMS</sub> / 1618 V<sub>DC</sub> basic isolation voltages
  - 572 V<sub>RMS</sub> / 809 V<sub>DC</sub> reinforced isolation voltages
- Wide operating temperature, -40°C to 150°C
- AEC-Q100 qualified



### SELECTION GUIDE

Part Number	Current Sensing Range, I <sub>PR</sub> (A)	Sensitivity [1] (mV/A)	Nominal V <sub>CC</sub> (V)	Optimized Temp. Range T <sub>A</sub> (°C)	Packing
ACS37002LMCATR-050B5	±33.3, ±40, ±50, ±66.7	60, 50, 40, 30	5	-40 to 150	1000 pieces per 13-inch reel
ACS37002LMCATR-066B5	±66.7, ±80, ±100, ±133.3	30, 25, 20, 15			
ACS37002LMCATR-090B5	±90, ±108, ±135, ±180	22.2, 18.5, 14.8, 11.1			
ACS37002LMCATR-050U5	33.3, 40, 50, 66.7	120, 100, 80, 60			
ACS37002LMCATR-050B3	±33.3, ±40, ±50, ±66.7	39.6, 33, 26.4, 19.8	3.3		
ACS37002LMCATR-066B3	±66.7, ±80, ±100, ±133.3	19.8, 16.5, 13.2, 9.9			
ACS37002LMCATR-090B3	±90, ±108, ±135, ±180	14.7, 12.2, 9.8, 7.3			

[1] Refer to the part specific performance characteristics sections for Gain\_Sel configuration.



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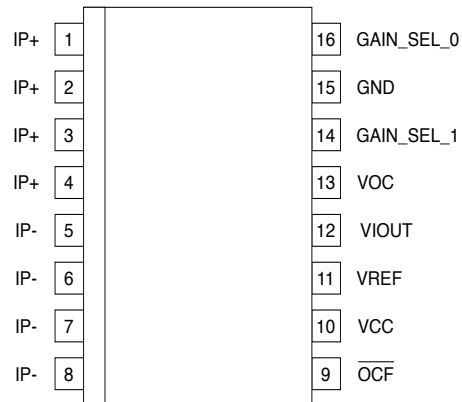
### ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Rating	Unit
Forward Supply Voltage	$V_{CC}$		6.5	V
Reverse Supply Voltage	$V_{RCC}$		-0.5	V
Forward Output Voltage	$V_{OUT}$	Applies to $V_{IOUT}$ , $V_{OCF}$ , and $V_{REF}$	$(V_{CC} + 0.7) \leq 6.5$	V
Reverse Output Voltage	$V_{ROUT}$	Applies to $V_{IOUT}$ , $V_{OCF}$ , and $V_{REF}$	-0.5	V
Forward Input Voltage	$V_{IN}$	Applies to GAIN_SEL_0, GAIN_SEL_1, and VOC	$(V_{CC} + 0.7) \leq 6.5$	V
Reverse Input Voltage	$V_{RIN}$	Applies to GAIN_SEL_0, GAIN_SEL_1, and VOC	-0.5	V
Operating Ambient Temperature	$T_A$		-40 to 150	°C
Storage Temperature	$T_{stg}$		-65 to 165	°C
Maximum Junction Temperature	$T_{J(max)}$		165	°C

### ISOLATION AND PACKAGE CHARACTERISTICS

Characteristic	Symbol	Notes	Rating	Unit
Dielectric Strength Test Voltage	$V_{ISO}$	Agency type-tested for 60 seconds per UL 60950-1 (edition 2) and 62368-1 (edition 1). Production tested at 3125 $V_{RMS}$ for 1 second in accordance with UL 60950-1 (edition 2) and 62368-1 (edition 1).	5000	$V_{RMS}$
Working Voltage for Basic Isolation	$V_{WVBI}$	Maximum approved working voltage for basic (single) isolation according to UL 60950-1 (edition 2) and 62368-1 (edition 1)	1618	$V_{PK}$ or $V_{DC}$
			1144	$V_{RMS}$
Working Voltage for Reinforced Isolation	$V_{WVRI}$	Maximum approved working voltage for reinforced isolation according to UL 60950-1 (edition 2) and 62368-1 (edition 1)	809	$V_{PK}$ or $V_{DC}$
			572	$V_{RMS}$
Clearance	$D_{cl}$	Minimum distance through air from IP leads to signal leads	8.2	mm
Creepage	$D_{cr}$	Minimum distance along package body from IP leads to signal leads	8.2	mm
Distance Through Insulation	DTI	Minimum internal distance through insulation	70	$\mu m$
Comparative Track Index	CTI	Material Group II	400 to 599	V
Moisture Sensitivity Level	MSL	Per IPC/JEDEC J-STD-020	3	-

### PINOUT DIAGRAM AND TERMINAL LIST TABLE



**Figure 2: MC Pinout Diagram**

#### Terminal List Table

Number	Name	Description
1, 2, 3, 4	IP+	Terminals for current being sensed; fused internally
5, 6, 7, 8	IP-	Terminals for current being sensed; fused internally
9	$\overline{\text{OCF}}$	Overcurrent fault, open-drain
10	VCC	Device power supply terminal
11	VREF	Zero current voltage reference
12	VIOUT	Analog output representing the current flowing through $I_p$
13	VOC	Overcurrent fault operation point input
14	GAIN_SEL_1	Gain selection bit 1
15	GND	Device ground terminal
16	GAIN_SEL_0	Gain selection bit 0

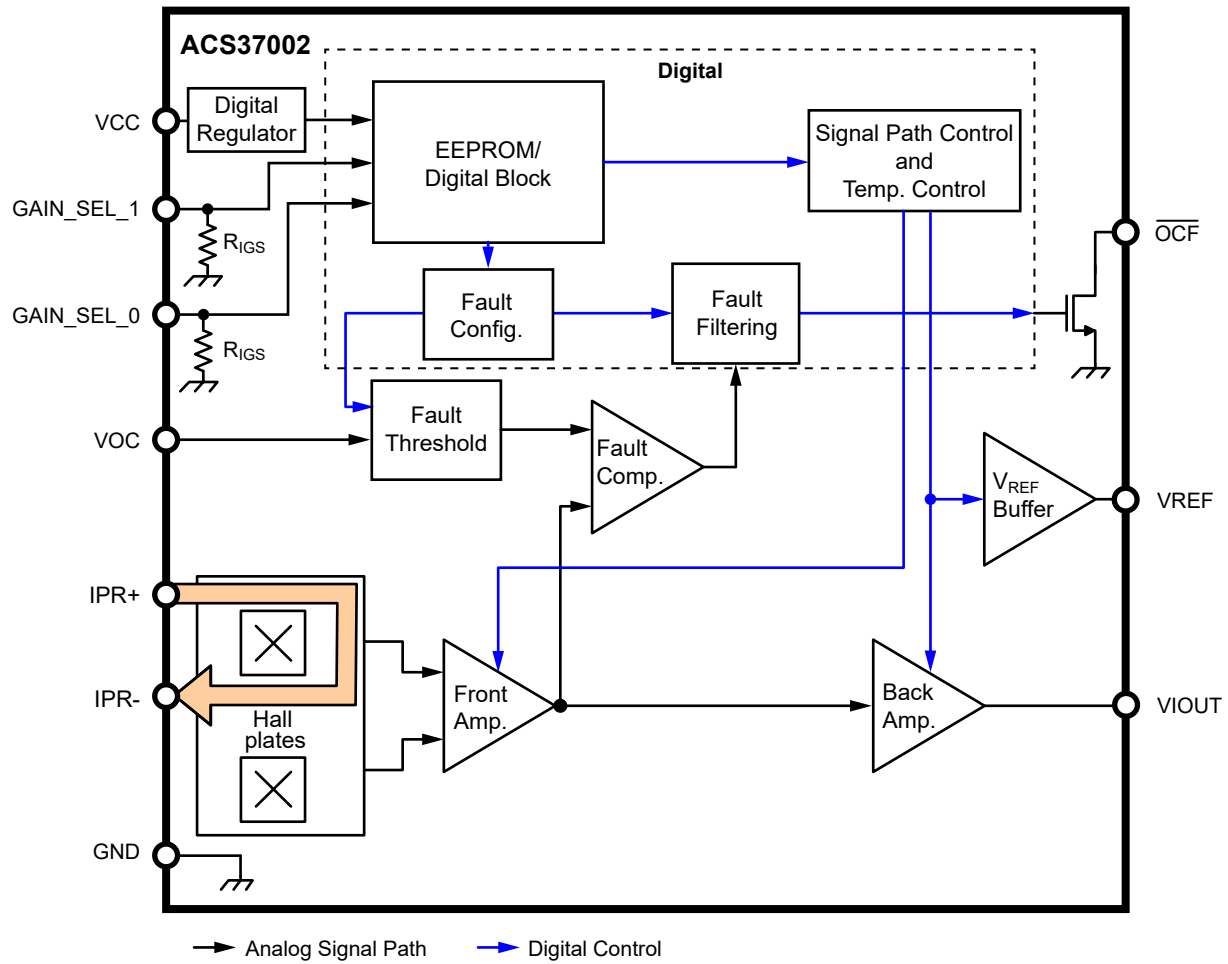


Figure 3: Functional Block Diagram

**COMMON ELECTRICAL CHARACTERISTICS:** Valid through full operating temperature range,  $T_A = -40^\circ\text{C}$  to  $150^\circ\text{C}$ ,  $C_{\text{BYPASS}} = 0.1 \mu\text{F}$ , and  $V_{\text{CC}} = 5 \text{ V}$  or  $3.3 \text{ V}$ , unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage	$V_{\text{CC}}$	5 V devices only	4.5	5	5.5	V
		3.3 V devices only	3.15	3.3	3.6	V
Supply Current	$I_{\text{CC}}$	No load on VIOOUT or VREF; $V_{\text{CC}} = 5 \text{ V}$	–	13	18	mA
		No load on VIOOUT or VREF; $V_{\text{CC}} = 3.3 \text{ V}$	–	12	15	mA
Supply Bypass Capacitor	$C_{\text{BYPASS}}$	VCC to GND recommended	0.1	–	–	$\mu\text{F}$
Output Resistive Load	$R_{\text{L}}$	VIOOUT to GND, VIOOUT to VCC	10	–	–	k $\Omega$
Output Capacitive Load	$C_{\text{L}}$	VIOOUT to GND	–	1	6	nF
Reference Resistive Load	$R_{\text{VREF}}$	VREF to GND (recommended to supply VOC); VREF to VCC	10	62.7	–	k $\Omega$
Reference Capacitive Load	$C_{\text{VREF}}$	VREF to GND	–	–	6	nF
Fault Pull-Up Resistance	$R_{\text{PU}}$		4.7	–	500	k $\Omega$
Primary Conductor Resistance	$R_{\text{IP}}$	$T_A = 25^\circ\text{C}$	–	0.27	–	m $\Omega$
Primary Conductor Inductance	$L_{\text{IP}}$	$T_A = 25^\circ\text{C}$	–	4.45	–	nH
Output Buffer Resistance	$R_{\text{OUT}}$	Internal output buffer resistance on VIOOUT and VREF	–	4	–	$\Omega$
Power-On Reset Voltage	$V_{\text{POR(H)}}$	$V_{\text{CC}}$ rising [1]	2.6	2.9	3.1	V
	$V_{\text{POR(L)}}$	$V_{\text{CC}}$ falling [1]	2.2	2.5	2.8	V
POR Hysteresis	$V_{\text{POR(HYS)}}$		250	–	–	mV
Power-On Time	$t_{\text{POD}}$	Time from $V_{\text{CC}}$ rising $\geq V_{\text{POR(H)}}$ after a POR event until power-on; VREF, OCF, VIOOUT	100	–	–	$\mu\text{s}$
Overvoltage Detection (OVD) Threshold	$V_{\text{OVD(H)}}$	$V_{\text{CC}}$ rising [1]	6.1	6.4	6.8	V
	$V_{\text{OVD(L)}}$	$V_{\text{CC}}$ falling [1]	5.6	5.8	6.1	V
Overvoltage Detection Hysteresis	$V_{\text{OVD(HYS)}}$		–	660	–	mV
OVD Delay Time	$t_{\text{dOVD(E)}}$	Time from $V_{\text{CC}}$ rising $\geq V_{\text{OVD(EN)}}$ until OVD asserts	60	82	120	$\mu\text{s}$
	$t_{\text{dOVD(D)}}$	Time from $V_{\text{CC}}$ falling $\leq V_{\text{OVD(DIS)}}$ until OVD clears	–	7	–	$\mu\text{s}$

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**COMMON PERFORMANCE CHARACTERISTICS (VIOUT):** Valid through full operating temperature range,  $T_A = -40^\circ\text{C}$  to  $150^\circ\text{C}$ ,  $C_{\text{BYPASS}} = 0.1 \mu\text{F}$ , and  $V_{\text{CC}} = 5 \text{ V}$  or  $3.3 \text{ V}$ , unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>OUTPUT SIGNAL CHARACTERISTICS (<math>V_{\text{IOUT}}</math>)</b>						
Saturation Voltage	$V_{\text{SAT(H)}}$	$R_L = 10 \text{ k}\Omega$ to GND	$V_{\text{CC}} - 0.25$	–	–	V
	$V_{\text{SAT(L)}}$	$R_L = 10 \text{ k}\Omega$ to $V_{\text{CC}}$	–	–	0.15	V
Output Operating Range	$V_{\text{OOR}}$	5 V linear operating range	0.5	–	4.5	V
		3.3 V linear operating range	0.3	–	3.0	V
Output Current Limit	$I_{\text{OUT(src)}}$	$V_{\text{IOUT}}$ shorted to GND	–	25	–	mA
	$I_{\text{OUT(snk)}}$	$V_{\text{IOUT}}$ shorted to $V_{\text{CC}}$	–	25	–	mA
Internal Bandwidth	BW	Small signal –3 dB, $C_L = 5.7 \text{ nF}$	–	400	–	kHz
Rise Time	$t_r$	$T_A = 25^\circ\text{C}$ , $C_L = 5.7 \text{ nF}$ , 10%-90% of 1 V output swing	–	0.7	2.5	$\mu\text{s}$
Response Time	$t_{\text{RESPONSE}}$	$T_A = 25^\circ\text{C}$ , $C_L = 5.7 \text{ nF}$ , 90% input to 90% of 1 V output swing	–	1.1	2.5	$\mu\text{s}$
Propagation Delay	$t_{\text{PD}}$	$T_A = 25^\circ\text{C}$ , $C_L = 5.7 \text{ nF}$ , 20% input to 20% of 1 V output swing	–	0.7	2	$\mu\text{s}$
Noise Density	$I_{\text{ND}}$	Input-referenced noise density; $T_A = 25^\circ\text{C}$ , $C_L = 5.7 \text{ nF}$ ; $V_{\text{CC}} = 5 \text{ V}$	–	350	–	$\mu\text{A}/\sqrt{\text{Hz}}$
		Input-referenced noise density; $T_A = 25^\circ\text{C}$ , $C_L = 5.7 \text{ nF}$ ; $V_{\text{CC}} = 3.3 \text{ V}$	–	450	–	$\mu\text{A}/\sqrt{\text{Hz}}$
Noise	$I_{\text{N}}$	Input-referenced noise at 400 kHz; $T_A = 25^\circ\text{C}$ , $C_L = 5.7 \text{ nF}$ ; $V_{\text{CC}} = 5 \text{ V}$	–	277	–	$\text{mA}_{\text{RMS}}$
		Input-referenced noise at 400 kHz; $T_A = 25^\circ\text{C}$ , $C_L = 5.7 \text{ nF}$ ; $V_{\text{CC}} = 3.3 \text{ V}$	–	357	–	$\text{mA}_{\text{RMS}}$
Nonlinearity	$E_{\text{LIN}}$		–	$\pm 0.75$	–	%
Power Supply Offset Error	$V_{\text{OE(PS)}}$	Bidirectional; $V_{\text{CC}} @ V_{\text{CC(MIN)}}$ or $V_{\text{CC(MAX)}}$	–10	$\pm 1$	10	mV
		Unidirectional; $V_{\text{CC}} @ V_{\text{CC(MIN)}}$ or $V_{\text{CC(MAX)}}$	–18	$\pm 1$	18	mV
Power Supply Sensitivity Error	$E_{\text{SENS(PS)}}$	$V_{\text{CC}} @ V_{\text{CC(MIN)}}$ or $V_{\text{CC(MAX)}}$	–1.5	$\pm 0.3$	1.5	%
Power Supply Rejection Ratio Offset	$\text{PSRR}_O$	DC to 1 kHz, 100 mV pk-pk ripple around $V_{\text{CC}} = V_{\text{CC(typ)}}$ , $I_P = 0 \text{ A}$ , change in $V_{\text{OE}}$	–	–40	–	dB
		1 to 100 kHz, 100 mV pk-pk ripple around $V_{\text{CC}} = V_{\text{CC(typ)}}$ , $I_P = 0 \text{ A}$ , change in $V_{\text{OE}}$	–	–30	–	dB
Power Supply Rejection Ratio Sens	$\text{PSRR}_S$	DC to 1 kHz, 100 mV pk-pk ripple around $V_{\text{CC}} = V_{\text{CC(typ)}}$ , $I_P = I_{\text{PR(MAX)}}$ , change in Sens	–	–15	–	dB
		1 to 100 kHz, 100 mV pk-pk ripple around $V_{\text{CC}} = V_{\text{CC(typ)}}$ , $I_P = I_{\text{PR(MAX)}}$ , change in Sens	–	–6	–	dB
Common-Mode Field Rejection	CMFR	Input-referred error due to common-mode field	–	4	–	$\text{mA/G}$

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**COMMON PERFORMANCE CHARACTERISTICS (VREF, FAULT, GAIN\_SEL):** Valid through full operating temperature range,  $T_A = -40^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ ,  $C_{\text{BYPASS}} = 0.1 \mu\text{F}$ , and  $V_{\text{CC}} = 5 \text{ V}$  or  $3.3 \text{ V}$ , unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>REFERENCE OUTPUT CHARACTERISTICS (VREF)</b>						
Zero Current Reference Voltage	$V_{\text{REF}}$	Bidirectional; $V_{\text{CC}} = 5 \text{ V}$	2.49	2.5	2.51	V
		Bidirectional; $V_{\text{CC}} = 3.3 \text{ V}$	1.64	1.65	1.66	V
		Unidirectional; $V_{\text{CC}} = 5 \text{ V}$	0.49	0.5	0.51	V
Reference Source Current Limit	$I_{\text{REF}(\text{src})}$	Maximum current $V_{\text{REF}}$ can passively source	–	25	–	mA
	$I_{\text{REF}(\text{snk})}$	Maximum current $V_{\text{REF}}$ can passively sink	–	–25	–	mA
<b>OVERCURRENT FAULT CHARACTERISTICS (OCF)</b>						
OCF On Voltage	$V_{\text{FAULT-ON}}$	$R_{\text{PU}} = 4.7 \text{ k}\Omega$ , under fault condition	–	0.07	0.4	V
OCF Sink Current [3]	$I_{\text{OCF}(\text{snk})}$	No Fault	–	100	–	nA
		Fault Asserted	0.01	–	1.1	mA
VOC Operating Voltage Range	$V_{\text{VOC}}$	$V_{\text{CC}} = 5 \text{ V}$	0.5	–	2	V
		$V_{\text{CC}} = 3.3 \text{ V}$	0.33	–	1.32	V
Fault Error	$E_{\text{OCF}}$		–10	$\pm 3$	10	% $I_{\text{OCF-OP}}$
OCF Hysteresis	$I_{\text{OCF}(\text{HYS})}$	$V_{\text{CC}} = 5 \text{ V}$	–	6	–	%FS
		$V_{\text{CC}} = 3.3 \text{ V}$	–	9	–	%FS
OCF Response Time [3]	$t_{\text{OCF}}$	Time from $I_{\text{OCF-OP}}$ with a $1.2 \times I_{\text{OCF-OP}}$ until fault asserts	–	1	1.5	$\mu\text{s}$
OCF Reaction Time [3]	$t_{\text{OCF-R}}$	Time from $I_{\text{OCF-OP}} - I_{\text{OCF}(\text{HYS})}$ until fault releases	–	0.75	1	$\mu\text{s}$
OCF Mask [2][3]	$t_{\text{OCF-MASK}}$	Time $I_{\text{OCF-OP}}$ must be present after $t_{\text{OCF-R}}$ for fault assertion	0	0	3	$\mu\text{s}$
OCF Hold Time [2][3]	$t_{\text{OCF-HOLD}}$	Minimum duration of FAULT assertion	0	0	5	ms
<b>GAIN SELECTION PIN CHARACTERISTICS (GAIN_SEL_0, GAIN_SEL_1)</b>						
Gain Select Internal Resistor	$R_{\text{GSint}}$		–	1	–	$\text{M}\Omega$
GAIN_SEL Logic Input Voltage	$V_{\text{H}(\text{SEL})}$	$V_{\text{CC}} = 5 \text{ V}$	3.75	–	–	V
		$V_{\text{CC}} = 3.3 \text{ V}$	2.5	–	–	V
	$V_{\text{L}(\text{SEL})}$	$V_{\text{CC}} = 5 \text{ V}$	–	–	0.5	V
		$V_{\text{CC}} = 3.3 \text{ V}$	–	–	0.4	V
Leakage Current [3]	$I_{\text{SEL}(\text{snk})}$		–	–	10	$\mu\text{A}$

[1]  $V_{\text{CC}}$  rate +1 V/ms, for best accuracy.

[2] Typical value is factory default.

[3] Guaranteed by design and bench validated.

### ACS37002LMCATR-050B5

ACS37002LMCATR-050B5 Gain\_Sel Pin Performance Key

				Selection Identifier
Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Sens (mV/A)	Max I <sub>P</sub> (A)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	40	50
	0	1	50	40
	1	0	60	33.3
	1	1	30	66.7

**ACS37002LMCATR-050B5 PERFORMANCE CHARACTERISTICS:** Valid through full operating temperature range, T<sub>A</sub> = -40°C to 150°C, C<sub>BYPASS</sub> = 0.1 μF, and V<sub>CC</sub> = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
<b>NOMINAL PERFORMANCE</b>						
Current Sensing Range	I <sub>PR</sub>	Gain Sel 00	-50	-	50	A
		Gain Sel 01	-40	-	40	A
		Gain Sel 10	-33.3	-	33.3	A
		Gain Sel 11	-66.7	-	66.7	A
Sensitivity	Sens	Gain Sel 00; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	40	-	mV/A
		Gain Sel 01; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	50	-	mV/A
		Gain Sel 10; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	60	-	mV/A
		Gain Sel 11; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	30	-	mV/A
Overcurrent Fault Operating Range	I <sub>OCF-OR</sub>	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	V <sub>IOUT(Q)</sub>	Bidirectional; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C	-	2.5	-	V
<b>TOTAL ERROR (V<sub>IOUT(ACTUAL)</sub> - (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub> + V<sub>REF</sub>)) / (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub>) × 100 AND TOTAL ERROR COMPONENTS</b>						
Total Error	E <sub>TOT</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.75	±1.2	1.75	%
Sensitivity Error	E <sub>SENS</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.5	±1.1	1.5	%
Zero Current Reference Error	V <sub>RE</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
Offset Error	V <sub>OE</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-8	-1 ±3	8	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-8	-1 ±4	8	mV
QVO Error	V <sub>QE</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-2 ±4	10	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-2 ±6	10	mV
<b>TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]</b>						
Total Error Including Lifetime Drift	E <sub>TOT_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4.2	-0.8 ±2.4	4.2	%
Sensitivity Error Including Lifetime Drift	E <sub>SENS_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4	-1.3 ±1.7	4	%
Zero Current Reference Error Including Lifetime Drift	V <sub>RE_LTD</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±4	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±5	10	mV
Offset Error Including Lifetime Drift	V <sub>OE_LTD</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±6	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-1 ±6	12	mV
QVO Error Including Lifetime Drift	V <sub>QE_LTD</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-12	-2 ±5	12	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-2 ±6	12	mV

[1] Typical values are the mean ±3 sigma of production distributions. These are formatted as mean ±3 sigma.

[2] Typical values are the mean ±3 sigma statistical combination of production and AEC-Q100 individual drift distributions. These are formatted as mean ±3 sigma.

[3] Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification.

### ACS37002LMCATR-066B5

ACS37002LMCATR-066B5 Gain\_Sel Pin Performance Key

				Selection Identifier	
Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Sens (mV/A)	Max I <sub>P</sub> (A)	
Type	Digital Input	Digital Input	Calculation	Bidirectional	
Selection Combination	0	0	30	66.7	
	0	1	25	80	
	1	0	20	100	
	1	1	15	133.3	

**ACS37002LMABTR-066B5 PERFORMANCE CHARACTERISTICS:** Valid through full operating temperature range, T<sub>A</sub> = -40°C to 150°C, C<sub>BYPASS</sub> = 0.1 μF, and V<sub>CC</sub> = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
<b>NOMINAL PERFORMANCE</b>						
Current Sensing Range	I <sub>PR</sub>	Gain Sel 00	-66.7	-	66.7	A
		Gain Sel 01	-80	-	80	A
		Gain Sel 10	-100	-	100	A
		Gain Sel 11	-133.3	-	133.3	A
Sensitivity	Sens	Gain Sel 00; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	30	-	mV/A
		Gain Sel 01; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	25	-	mV/A
		Gain Sel 10; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	20	-	mV/A
		Gain Sel 11; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	15	-	mV/A
Overcurrent Fault Operating Range	I <sub>OCF-OR</sub>	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	V <sub>IOUT(Q)</sub>	Bidirectional; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C	-	2.5	-	V
<b>TOTAL ERROR (V<sub>IOUT(ACTUAL)</sub> - (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub> + V<sub>REF</sub>)) / (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub>) × 100 AND TOTAL ERROR COMPONENTS</b>						
Total Error	E <sub>TOT</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.75	±1.2	1.75	%
Sensitivity Error	E <sub>SENS</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.5	±1.1	1.5	%
Zero Current Reference Error	V <sub>RE</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
Offset Error	V <sub>OE</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-8	-1 ±3	8	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-8	-1 ±4	8	mV
QVO Error	V <sub>QE</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-2 ±4	10	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-2 ±6	10	mV
<b>TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2,3]</b>						
Total Error Including Lifetime Drift	E <sub>TOT_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4.2	-0.8 ±2.4	4.2	%
Sensitivity Error Including Lifetime Drift	E <sub>SENS_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4	-1.3 ±1.7	4	%
Zero Current Reference Error Including Lifetime Drift	V <sub>RE_LTD</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±4	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±5	10	mV
Offset Error Including Lifetime Drift	V <sub>OE_LTD</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±6	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-1 ±6	12	mV
QVO Error Including Lifetime Drift	V <sub>QE_LTD</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-12	-2 ±5	12	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-2 ±6	12	mV

[1] Typical values are the mean ±3 sigma of production distributions. These are formatted as mean ±3 sigma.

[2] Typical values are the mean ±3 sigma statistical combination of production and AEC-Q100 individual drift distributions. These are formatted as mean ±3 sigma.

[3] Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification.

# ACS37002LMC

## 400 kHz, High Accuracy Current Sensor with Pin-Selectable Gains and Adjustable Overcurrent Fast Fault in SOICW-16 Package

### ACS37002LMCATR-090B5

ACS37002LMCATR-090B5 Gain\_Sel Pin Performance Key

				Selection Identifier
Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Sens (mV/A)	Max I <sub>P</sub> (A)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	22.2	90
	0	1	18.5	108
	1	0	14.8	135
	1	1	11.1	180

**ACS37002LMCATR-090B5 PERFORMANCE CHARACTERISTICS:** Valid through full operating temperature range, T<sub>A</sub> = -40°C to 150°C, C<sub>BYPASS</sub> = 0.1 μF, and V<sub>CC</sub> = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
<b>NOMINAL PERFORMANCE</b>						
Current Sensing Range	I <sub>PR</sub>	Gain Sel 00	-90	-	90	A
		Gain Sel 01	-108	-	108	A
		Gain Sel 10	-135	-	135	A
		Gain Sel 11	-180	-	180	A
Sensitivity	Sens	Gain Sel 00; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	22.2	-	mV/A
		Gain Sel 01; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	18.5	-	mV/A
		Gain Sel 10; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	14.8	-	mV/A
		Gain Sel 11; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	11.1	-	mV/A
Overcurrent Fault Operating Range	I <sub>OCF-OR</sub>	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	V <sub>IOUT(Q)</sub>	Bidirectional; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C	-	2.5	-	V
<b>TOTAL ERROR (V<sub>IOUT(ACTUAL)</sub> - (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub> + V<sub>REF</sub>)) / (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub>) × 100 AND TOTAL ERROR COMPONENTS</b>						
Total Error	E <sub>TOT</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.75	±1.2	1.75	%
Sensitivity Error	E <sub>SENS</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.5	±1.1	1.5	%
Zero Current Reference Error	V <sub>RE</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
Offset Error	V <sub>OE</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-8	-1 ±3	8	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-8	-1 ±4	8	mV
QVO Error	V <sub>QE</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-2 ±4	10	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-2 ±6	10	mV
<b>TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2,3]</b>						
Total Error Including Lifetime Drift	E <sub>TOT_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4.2	-0.8 ±2.4	4.2	%
Sensitivity Error Including Lifetime Drift	E <sub>SENS_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4	-1.3 ±1.7	4	%
Zero Current Reference Error Including Lifetime Drift	V <sub>RE_LTD</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±4	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±5	10	mV
Offset Error Including Lifetime Drift	V <sub>OE_LTD</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±6	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-1 ±6	12	mV
QVO Error Including Lifetime Drift	V <sub>QE_LTD</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-12	-2 ±5	12	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-2 ±6	12	mV

[1] Typical values are the mean ±3 sigma of production distributions. These are formatted as mean ±3 sigma.

[2] Typical values are the mean ±3 sigma statistical combination of production and AEC-Q100 individual drift distributions. These are formatted as mean ±3 sigma.

[3] Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification.

### ACS37002LMCATR-050U5

ACS37002LMCATR-050U5 Gain\_Sel Pin Performance Key

				Selection Identifier
Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Sens (mV/A)	Max I <sub>P</sub> (A)
Type	Digital Input	Digital Input	Calculation	Unidirectional
Selection Combination	0	0	80	50
	0	1	100	40
	1	0	120	33.3
	1	1	60	66.7

**ACS37002LMCATR-050U5 PERFORMANCE CHARACTERISTICS:** Valid through full operating temperature range, T<sub>A</sub> = -40°C to 150°C, C<sub>BYPASS</sub> = 0.1 μF, and V<sub>CC</sub> = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
<b>NOMINAL PERFORMANCE</b>						
Current Sensing Range	I <sub>PR</sub>	Gain Sel 00	0	–	50	A
		Gain Sel 01	0	–	40	A
		Gain Sel 10	0	–	33.3	A
		Gain Sel 11	0	–	66.7	A
Sensitivity	Sens	Gain Sel 00; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	–	80	–	mV/A
		Gain Sel 01; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	–	100	–	mV/A
		Gain Sel 10; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	–	120	–	mV/A
		Gain Sel 11; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	–	60	–	mV/A
Overcurrent Fault Operating Range	I <sub>OCF-OR</sub>	Typ. = factory-programmed default, FS = Full-Scale	25	50	100	%FS
Zero Current Output Voltage	V <sub>IOUT(Q)</sub>	Unidirectional; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C	–	0.5	–	V
<b>TOTAL ERROR (V<sub>IOUT(ACTUAL)</sub> – (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub> + V<sub>REF</sub>)) / (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub>) × 100 AND TOTAL ERROR COMPONENTS</b>						
Total Error	E <sub>TOT</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	–1.75	±1.2	1.75	%
Sensitivity Error	E <sub>SENS</sub>	I <sub>P</sub> = I <sub>PR(max)</sub> ; T <sub>A</sub> = 25°C to 150°C or –40°C to 25°C	–1.5	±1.1	1.5	%
Zero Current Reference Error	V <sub>RE</sub>	V <sub>REFactual</sub> – V <sub>REFideal</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	–10	–1 ±3	10	mV
		V <sub>REFactual</sub> – V <sub>REFideal</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = –40°C to 25°C	–10	–1 ±4	10	mV
Offset Error	V <sub>OE</sub>	V <sub>IOUT(Q)</sub> – V <sub>REF</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	–8	–1 ±3	8	mV
		V <sub>IOUT(Q)</sub> – V <sub>REF</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = –40°C to 25°C	–8	–1 ±4	8	mV
QVO Error	V <sub>QE</sub>	V <sub>IOUT(Q)</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	–10	–2 ±4	10	mV
		V <sub>IOUT(Q)</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = –40°C to 25°C	–10	–2 ±6	10	mV
<b>TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2,3]</b>						
Total Error Including Lifetime Drift	E <sub>TOT_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	–4.2	–0.8 ±2.4	4.2	%
Sensitivity Error Including Lifetime Drift	E <sub>SENS_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	–4	–1.3 ±1.7	4	%
Zero Current Reference Error Including Lifetime Drift	V <sub>RE_LTD</sub>	V <sub>REFactual</sub> – V <sub>REFideal</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	–10	–1 ±4	10	mV
		V <sub>REFactual</sub> – V <sub>REFideal</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = –40°C to 25°C	–10	–1 ±5	10	mV
Offset Error Including Lifetime Drift	V <sub>OE_LTD</sub>	V <sub>IOUT(Q)</sub> – V <sub>REF</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	–10	–1 ±6	10	mV
		V <sub>IOUT(Q)</sub> – V <sub>REF</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = –40°C to 25°C	–12	–1 ±6	12	mV
QVO Error Including Lifetime Drift	V <sub>QE_LTD</sub>	V <sub>IOUT(Q)</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	–12	–2 ±5	12	mV
		V <sub>IOUT(Q)</sub> ; I <sub>P</sub> = 0 A, T <sub>A</sub> = –40°C to 25°C	–12	–2 ±6	12	mV

[1] Typical values are the mean ±3 sigma of production distributions. These are formatted as mean ±3 sigma.

[2] Typical values are the mean ±3 sigma statistical combination of production and AEC-Q100 individual drift distributions. These are formatted as mean ±3 sigma.

[3] Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification.

### ACS37002LMCATR-050B3

ACS37002LMCATR-050B3 Gain\_Sel Pin Performance Key

				Selection Identifier
Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Sens (mV/A)	Max I <sub>P</sub> (A)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	26.4	50
	0	1	33	40
	1	0	39.6	33.3
	1	1	19.8	66.7

**ACS37002LMABTR-050B3 PERFORMANCE CHARACTERISTICS:** Valid through full operating temperature range, T<sub>A</sub> = -40°C to 150°C, C<sub>BYPASS</sub> = 0.1 μF, and V<sub>CC</sub> = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
<b>NOMINAL PERFORMANCE</b>						
Current Sensing Range	I <sub>PR</sub>	Gain Sel 00	-50	-	50	A
		Gain Sel 01	-40	-	40	A
		Gain Sel 10	-33.3	-	33.3	A
		Gain Sel 11	-66.7	-	66.7	A
Sensitivity	Sens	Gain Sel 00; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	26.4	-	mV/A
		Gain Sel 01; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	33	-	mV/A
		Gain Sel 10; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	39.6	-	mV/A
		Gain Sel 11; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	19.8	-	mV/A
Overcurrent Fault Operating Range	I <sub>OCF-OR</sub>	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	V <sub>IOUT(Q)</sub>	Bidirectional; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C	-	1.65	-	V
<b>TOTAL ERROR (V<sub>IOUT(ACTUAL)</sub> - (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub> + V<sub>REF</sub>)) / (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub>) × 100 AND TOTAL ERROR COMPONENTS</b>						
Total Error	E <sub>TOT</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.75	±1.2	1.75	%
Sensitivity Error	E <sub>SENS</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.5	±1.1	1.5	%
Zero Current Reference Error	V <sub>RE</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
Offset Error	V <sub>OE</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
QVO Error	V <sub>QE</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-2 ±4	10	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-2 ±6	10	mV
<b>TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2,3]</b>						
Total Error Including Lifetime Drift	E <sub>TOT_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4.2	-0.8 ±2.4	4.2	%
Sensitivity Error Including Lifetime Drift	E <sub>SENS_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4	-1.3 ±1.7	4	%
Zero Current Reference Error Including Lifetime Drift	V <sub>RE_LTD</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±4	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±5	10	mV
Offset Error Including Lifetime Drift	V <sub>OE_LTD</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±6	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-1 ±6	12	mV
QVO Error Including Lifetime Drift	V <sub>QE_LTD</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-12	-2 ±5	12	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-2 ±6	12	mV

[1] Typical values are the mean ±3 sigma of production distributions. These are formatted as mean ±3 sigma.

[2] Typical values are the mean ±3 sigma statistical combination of production and AEC-Q100 individual drift distributions. These are formatted as mean ±3 sigma.

[3] Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification.

### ACS37002LMCATR-066B3

ACS37002LMCATR-066B3 Gain\_Sel Pin Performance Key

				Selection Identifier
Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Sens (mV/A)	Max I <sub>P</sub> (A)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	19.8	66.7
	0	1	16.5	80
	1	0	13.2	100
	1	1	9.9	133.3

**ACS37002LMABTR-066B3 PERFORMANCE CHARACTERISTICS:** Valid through full operating temperature range, T<sub>A</sub> = -40°C to 150°C, C<sub>BYPASS</sub> = 0.1 μF, and V<sub>CC</sub> = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
<b>NOMINAL PERFORMANCE</b>						
Current Sensing Range	I <sub>PR</sub>	Gain Sel 00	-66.7	-	66.7	A
		Gain Sel 01	-80	-	80	A
		Gain Sel 10	-100	-	100	A
		Gain Sel 11	-133.3	-	133.3	A
Sensitivity	Sens	Gain Sel 00; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	19.8	-	mV/A
		Gain Sel 01; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	16.5	-	mV/A
		Gain Sel 10; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	13.2	-	mV/A
		Gain Sel 11; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	9.9	-	mV/A
Overcurrent Fault Operating Range	I <sub>OCF-OR</sub>	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	V <sub>IOUT(Q)</sub>	Bidirectional; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C	-	1.65	-	V
<b>TOTAL ERROR (V<sub>IOUT(ACTUAL)</sub> - (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub> + V<sub>REF</sub>)) / (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub>) × 100 AND TOTAL ERROR COMPONENTS</b>						
Total Error	E <sub>TOT</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.75	±1.2	1.75	%
Sensitivity Error	E <sub>SENS</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.5	±1.1	1.5	%
Zero Current Reference Error	V <sub>RE</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
Offset Error	V <sub>OE</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
QVO Error	V <sub>QE</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-2 ±4	10	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-2 ±6	10	mV
<b>TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2,3]</b>						
Total Error Including Lifetime Drift	E <sub>TOT_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4.2	-0.8 ±2.4	4.2	%
Sensitivity Error Including Lifetime Drift	E <sub>SENS_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4	-1.3 ±1.7	4	%
Zero Current Reference Error Including Lifetime Drift	V <sub>RE_LTD</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±4	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±5	10	mV
Offset Error Including Lifetime Drift	V <sub>OE_LTD</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±6	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-1 ±6	12	mV
QVO Error Including Lifetime Drift	V <sub>QE_LTD</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-12	-2 ±5	12	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-2 ±6	12	mV

[1] Typical values are the mean ±3 sigma of production distributions. These are formatted as mean ±3 sigma.

[2] Typical values are the mean ±3 sigma statistical combination of production and AEC-Q100 individual drift distributions. These are formatted as mean ±3 sigma.

[3] Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification.

## ACS37002LMCATR-090B3

ACS37002LMCATR-090B3 Gain\_Sel Pin Performance Key

				Selection Identifier
Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Sens (mV/A)	Max I <sub>P</sub> (A)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	14.7	90
	0	1	12.2	108
	1	0	9.8	135
	1	1	7.3	180

**ACS37002LMABTR-090B3 PERFORMANCE CHARACTERISTICS:** Valid through full operating temperature range, T<sub>A</sub> = -40°C to 150°C, C<sub>BYPASS</sub> = 0.1 μF, and V<sub>CC</sub> = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
<b>NOMINAL PERFORMANCE</b>						
Current Sensing Range	I <sub>PR</sub>	Gain Sel 00	-90	-	90	A
		Gain Sel 01	-108	-	108	A
		Gain Sel 10	-135	-	135	A
		Gain Sel 11	-180	-	180	A
Sensitivity	Sens	Gain Sel 00; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	14.7	-	mV/A
		Gain Sel 01; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	12.2	-	mV/A
		Gain Sel 10; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	9.8	-	mV/A
		Gain Sel 11; I <sub>PR(min)</sub> < I <sub>P</sub> < I <sub>PR(max)</sub>	-	7.3	-	mV/A
Overcurrent Fault Operating Range	I <sub>OCF-OR</sub>	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	V <sub>IOUT(Q)</sub>	Bidirectional; I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C	-	1.65	-	V
<b>TOTAL ERROR (V<sub>IOUT(ACTUAL)</sub> - (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub> + V<sub>REF</sub>)) / (Sens<sub>(IDEAL)</sub> × I<sub>PR</sub>) × 100 AND TOTAL ERROR COMPONENTS</b>						
Total Error	E <sub>TOT</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.75	±1.2	1.75	%
Sensitivity Error	E <sub>SENS</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-1.5	±1.1	1.5	%
Zero Current Reference Error	V <sub>RE</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
Offset Error	V <sub>OE</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±3	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±4	10	mV
QVO Error	V <sub>QE</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-2 ±4	10	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-2 ±6	10	mV
<b>TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2,3]</b>						
Total Error Including Lifetime Drift	E <sub>TOT_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4.2	-0.8 ±2.4	4.2	%
Sensitivity Error Including Lifetime Drift	E <sub>SENS_LTD</sub>	I <sub>P</sub> = I <sub>PR(max)</sub>	-4	-1.3 ±1.7	4	%
Zero Current Reference Error Including Lifetime Drift	V <sub>RE_LTD</sub>	V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±4	10	mV
		V <sub>REFactual</sub> - V <sub>REFideal</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-10	-1 ±5	10	mV
Offset Error Including Lifetime Drift	V <sub>OE_LTD</sub>	V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-10	-1 ±6	10	mV
		V <sub>IOUT(Q)</sub> - V <sub>REF</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-1 ±6	12	mV
QVO Error Including Lifetime Drift	V <sub>QE_LTD</sub>	V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = 25°C to 150°C	-12	-2 ±5	12	mV
		V <sub>IOUT(Q)</sub> , I <sub>P</sub> = 0 A, T <sub>A</sub> = -40°C to 25°C	-12	-2 ±6	12	mV

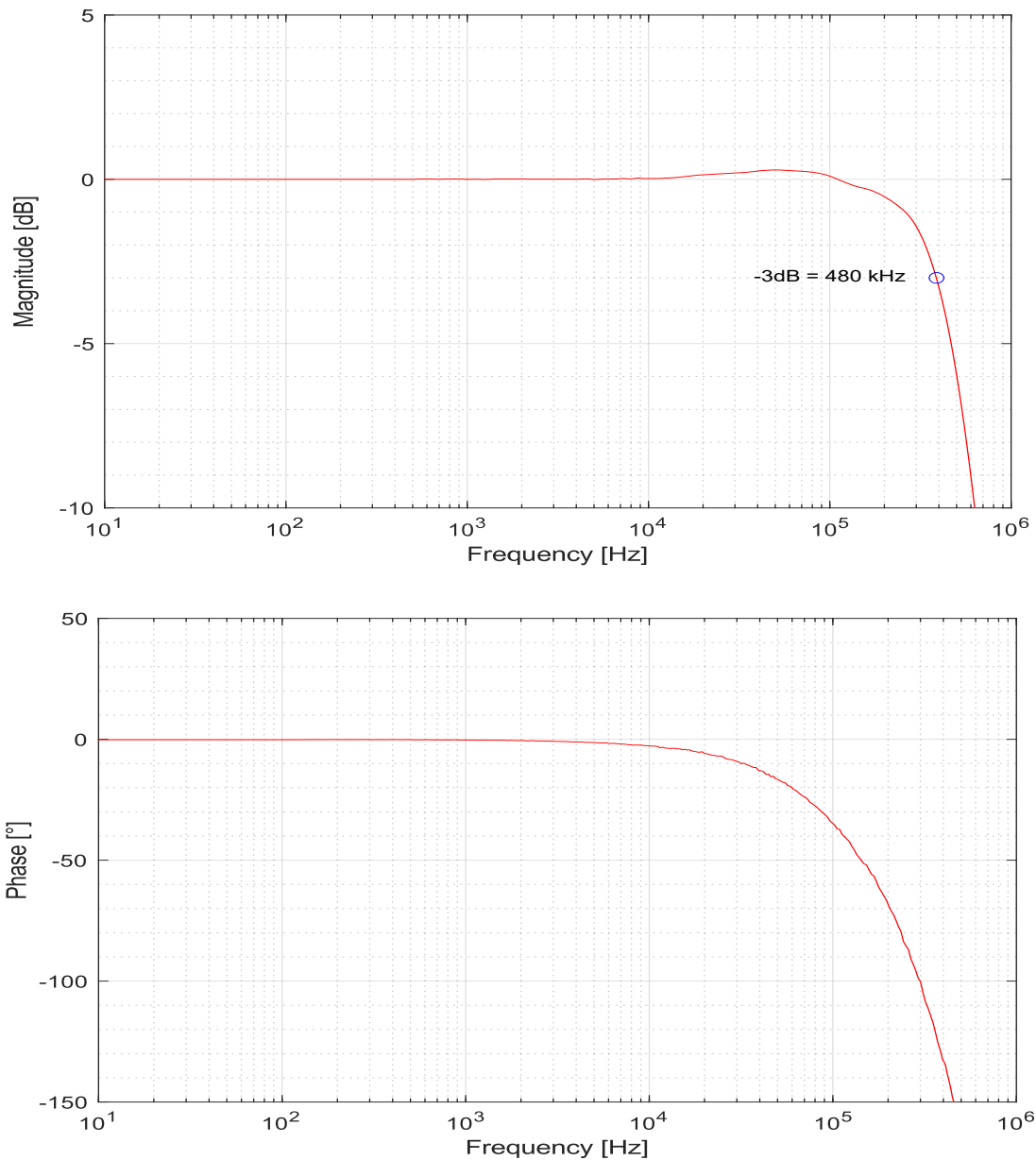
[1] Typical values are the mean ±3 sigma of production distributions. These are formatted as mean ±3 sigma.

[2] Typical values are the mean ±3 sigma statistical combination of production and AEC-Q100 individual drift distributions. These are formatted as mean ±3 sigma.

[3] Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification.



### CHARACTERISTIC PERFORMANCE ACS37002LMC TYPICAL FREQUENCY RESPONSE



For information regarding bandwidth characterization methods used for the ACS37002, see the “Characterizing System Bandwidth” application note (<https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/an-effective-method-for-characterizing-system-bandwidth-an296169>) on the Allegro website.

## FUNCTIONAL DESCRIPTION

### Power-On Reset Operation

The descriptions in this section use the listed test conditions and assume a temperature of 25°C. The provided graphs in this section show  $V_{IOUT}$  moving with  $V_{CC}$ . The voltage of  $V_{IOUT}$  during a high-impedance state will be most consistent with a known load ( $R_L, C_L$ ).

#### POWER-ON

As  $V_{CC}$  ramps up,  $V_{IOUT}$  and  $V_{REF}$  pins are high impedance until  $V_{CC}$  reaches and passes  $V_{POR(H)}$ .

#### POWER-OFF

As  $V_{CC}$  drops below  $V_{POR(L)}$ , the outputs will enter a high-impedance state.

Note: Since the device is entering a high-impedance state, and not driving the output, the time it takes the output to reach a steady state will depend on the external circuitry used.

#### POWER-ON RESET (POR)

If  $V_{CC}$  falls below  $V_{POR(L)}$  while in operation, the device will enter a POR event and reset,  $V_{IOUT}$  and  $V_{REF}$  will switch to high-impedance state.

#### POWER-ON DELAY ( $T_{POD}$ )

When the supply is ramped to  $V_{POR(H)}$ , the device will require a finite time to power its internal components before the outputs are released from high impedance and can respond to an input magnetic field [A]. Power-On Time,  $t_{POD}$ , is defined as the time it takes for the output voltage to settle within  $\pm 10\%$  of its steady-state value under an applied magnetic field. After this delay, the output will quickly approach  $V_{IOUT(IP)} = \text{Sens} \times I_P + V_{REF}$ .

### Overvoltage Detection (OVD)

To ensure that the device's output is reporting accurately, the device contains an overvoltage detection flag. This flag on  $V_{IOUT}$  can be used to alert the system when the supply voltage for the device is outside of the operational range.

#### OVERVOLTAGE DETECTION VOLTAGE THRESHOLDS ( $V_{OVD(H/L)}$ )

When  $V_{CC}$  raises above  $V_{OVD(H)}$ , the  $V_{IOUT}$  pin output will go high impedance and  $V_{IOUT}$  will be pulled to either  $V_{CC}$  or  $GND$ , depending if  $R_L$  is in a pull-up or pull-down configuration.

#### OVERVOLTAGE DETECTION HYSTERESIS ( $V_{OVD(HYS)}$ )

There is hysteresis between enable and disable thresholds to reduce nuisance flagging and clears.

#### OVERVOLTAGE ENABLE AND DISABLE TIME ( $T_{OVD(E/D)}$ )

The enable time for OVD,  $t_{OVD(E)}$ , is the time from  $V_{OVD(H)}$  to OVD flag [B]. The OVD enable flag has a counter to reduce transients faster than 64  $\mu s$  from triggering nuisance flags.

The disable time for OVD,  $t_{OVD(D)}$ , is the time from  $V_{OVD(L)}$  to the OVD clear to normal operation [C]. The disable time for OVD does not have a counter to release the output and resume reporting.

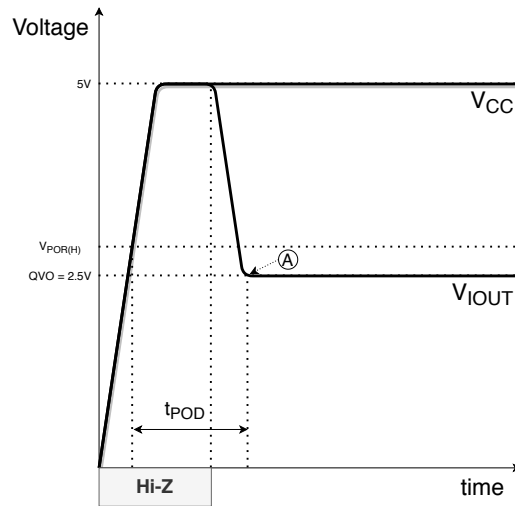


Figure 4: t<sub>POD</sub> behavior with R<sub>L</sub> = Pull-Up

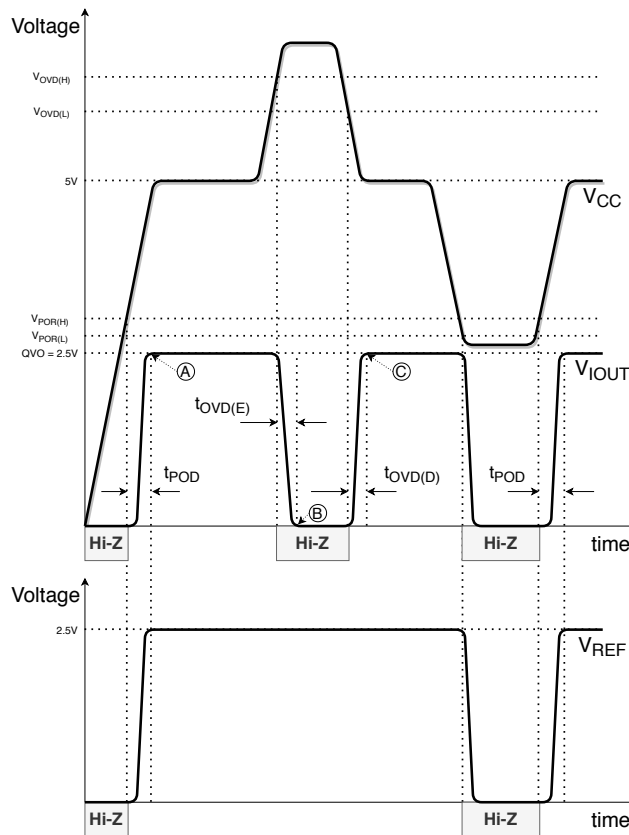


Figure 5: t<sub>POD</sub> and t<sub>OVD(E/D)</sub> with R<sub>L</sub> = Pull-Down

### Absolute Maximum Ratings

These are the maximum application or environmental conditions that the device can be subjected before damage may occur.

#### FORWARD AND REVERSE SUPPLY VOLTAGE

These are the largest voltage magnitudes that can be supplied to  $V_{CC}$  from GND during programming or transient switching. This voltage should not be used as a DC voltage bias for an extended time.

#### FORWARD AND REVERSE OUTPUT VOLTAGE

The Forward Output Voltage,  $V_{IOUT}$ , should be no greater than  $V_{CC} + 0.5$  up to 6.5 V. This is the greatest voltage that the output can be biased with from GND during programming or transient switching. The Reverse Output Voltage,  $V_{RIOUT}$ , should not drop below  $-0.5$  V during programming or transient switching. These voltages should not be used as a DC voltage bias for an extended time.

#### FORWARD AND REVERSE INPUT VOLTAGE

The Forward Input Voltage,  $V_{OI}$ , should be no greater than  $V_{CC} + 0.5$  V, up to 6.5 V. This is the greatest voltage that the input can be applied during programming or transient switching. The Reverse Input Voltage,  $V_{ROI}$ , should not drop below  $-0.5$  V during programming or transient switching.

### OUTPUT SOURCE AND SINK CURRENT

This is the maximum current that  $V_{IOUT}$  can passively sink or source before damage may occur.

#### AMBIENT TEMPERATURE ( $T_A$ )

This is the ambient temperature of the device. The Operating Ambient Temperature Range is the ambient temperature range in which the Common Electricals and Common Performance Characteristics limits are valid.

### DEFINITIONS OF OPERATING AND PERFORMANCE CHARACTERISTICS

#### Zero Current Voltage Output ( $V_{IOUT(Q)}$ , QVO)

Zero Current Voltage Output or  $V_{IOUT(Q)}$  (also called QVO) is defined as the voltage on the output,  $V_{IOUT}$ , when 0 A are applied through  $I_p$ .

#### QVO Temperature Drift ( $V_{QE}$ )

QVO Temperature Drift, or  $V_{QE}$ , is defined as the drift of QVO from room to hot or room to cold (25°C to 150°C or 25°C to -40°C respectively). To improve over temperature performance the temperature drift is compensated with Allegro's factory trim to remain within the limits across temperature.

#### Reference Voltage ( $V_{REF}$ )

There is a Voltage Reference Output, ( $V_{REF}$ ) on the ACS37002LMC. This output reports the zero-current voltage for the output channel  $V_{IOUT}$  allowing for differential measurement and a device referred supply for the VOC pin.

#### Reference Voltage Temperature Drift ( $V_{RE}$ )

Reference Voltage Temperature Drift, or  $V_{RE}$ , is defined as the drift of  $V_{REF}$  from room to hot or room to cold (25°C to 150°C or 25°C to -40°C respectively).

#### Offset Voltage ( $V_{OE}$ )

Offset Voltage, or  $V_{OE}$ , is defined as the difference between QVO and  $V_{REF}$  (see Figure 6).  $V_{OE}$  includes the drift of QVO minus  $V_{REF}$  from room to hot or room to cold (25°C to 150°C or 25°C to -40°C respectively).

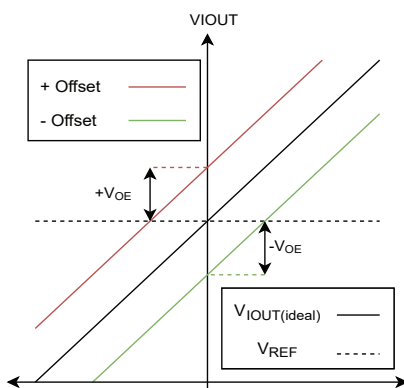


Figure 6: Offset ( $V_{OE}$ ) Between  $V_{IOUT}$  and  $V_{REF}$

#### Output Saturation Voltage ( $V_{SAT(HIGH/LOW)}$ )

Output Saturation Voltage, or  $V_{SAT}$ , is defined as the voltage that  $V_{IOUT}$  does not pass as a result to an increasing magnitude of current.  $V_{SAT(HIGH)}$  is the highest voltage the output can drive to while,  $V_{SAT(LOW)}$  is the lowest. This can be seen in Figure 7. Note that changing the sensitivity does not change the  $V_{SAT}$  points.

#### OUTPUT VOLTAGE OPERATING RANGE ( $V_{OOR}$ )

The Output Voltage Operating Range, or  $V_{OOR}$ , is the functional range for linear performance of  $V_{IOUT}$  and its related datasheet parameters. This can be seen in Figure 7. The  $V_{OOR}$  is the output region that the performance accuracy parameters are valid. It is possible for the output to report beyond these voltages until  $V_{SAT}$ . The output performance is demonstrated in Figure 7 through and beyond the  $V_{OOR}$ .

Voltage Output Operating Range for $V_{CC}$ and Output Modes, $V_{OOR}(V_{CC}, Mode)$		
$V_{CC}$ (V)	Bidirectional	Unidirectional
3.3	$\pm 1.32$	+2.64
5	$\pm 2$	+4

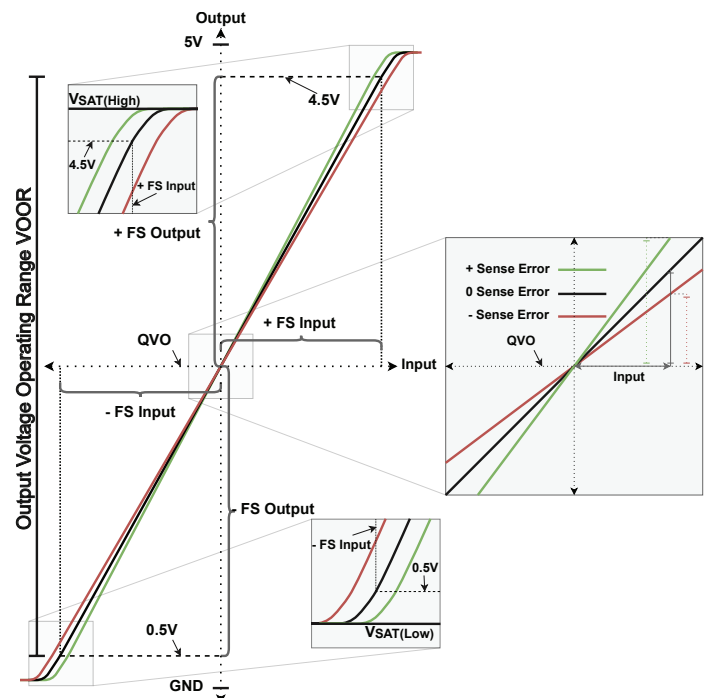


Figure 7:  $V_{OOR}$ ,  $V_{SAT}$  and SENS with Full Scale

## Sensitivity (Sens)

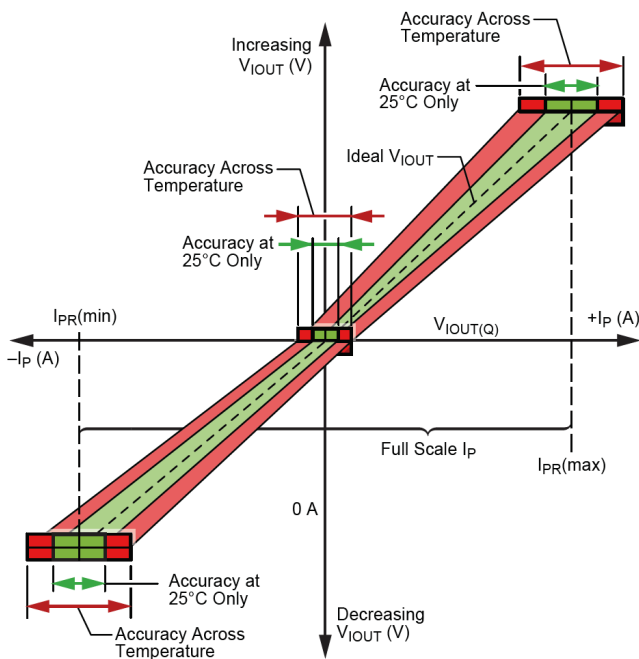
Sensitivity, or Sens, is the ratio of the output swing versus the applied current through the primary conductor,  $I_P$ . This current causes a voltage deviation away from QVO on the  $V_{IOUT}$  output until  $V_{SAT}$ . The magnitude and direction of the output voltage swing is proportional to the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

$$Sens = \frac{V_{IOUT(IP1)} - V_{IOUT(IP2)}}{I_{P1} - I_{P2}}$$

where  $I_{P1}$  and  $I_{P2}$  are two different currents, and  $V_{IOUT(IP1)}$  and  $V_{IOUT(IP2)}$  are the voltages of the device at the applied currents.  $V_{IOUT(IP1)}$  or  $V_{IOUT(IP2)}$  can be QVO with zero current.

## Sensitivity Error ( $E_{sens}$ )

Sensitivity Temperature Drift, or  $E_{sens}$ , is the drift of Sens from room to hot or room to cold (25°C to 150°C or 25°C to -40°C, respectively). No trimming/programming is needed as temperature drift is compensated with Allegro's factory trim to remain within the datasheet limits across temperature.



**Figure 8: Output Accuracy Pocket for Room and Across Temperature**

## Gain Selection Pins

The ACS37002LMC features external gain selection pins that configures the device sensitivity. The gain select logic is latched based on the pin voltage at startup. Either pin may be shorted directly to VCC or GND, which is logic 1 or 0 respectively. Both pins include an internal 1 MΩ pull-down resistor to GND. Externally floating pins will be interpreted as logic 0; if both pins are floating, the device will be in the 00 configuration. Specific gain select performance can be found in the selection Performance Characteristics table. To change the gain of the device, refer to Figure 18 in the Application and Theory section.

## Full Scale (FS)

Full Scale, or FS, is a method to relate an input and/or output to the max input and/or output of the device. For example, 50%FS of a 50 A sensor is 25 A, or 50% of its maximum input current. The 50% input of 25 A will cause the output to move 50%, or 50%FS. FS is used to interchangeably refer to input and output deviations when discussing input steps, fault trip thresholds and relating input to output performance.  $FS_{INPUT}$  is the input bias that results in  $FS_{OUTPUT}$  and these two are directly related by the device actual sensitivity. Both FS can be seen in Figure 7, labeled as positive or negative FS input and FS output. The equation for input referred FS for a 5 V bidirectional device is:

$$FS = V_{OOR(5V,Bi)} / Sens_{Actual} = \pm 2V / Sens_{Actual}$$

Note: that a percentage change in  $FS_{INPUT}$  is equivalent to a resultant percentage change of  $FS_{OUTPUT}$  and visa versa.

## Nonlinearity ( $E_{LIN}$ )

As the amount of field applied to the part changes, the sensitivity of the device can also change slightly. This is referred to as linearity error or  $E_{LIN}$  (see Figure 9). Consider two currents,  $I_{P1}$  (1/2 FS) and  $I_{P2}$  (FS). Ideally, the sensitivity of the device is the same for both fields. Linearity Error is calculated as the percent change in sensitivity from one field to another. Error is calculated separately for positive ( $E_{LIN(+)}$ ) and negative ( $E_{LIN(-)}$ ) currents, and the percent errors are defined as:

$$E_{LIN(\pm)} = \left( 1 - \frac{Sens_{IP2\pm}}{Sens_{IP1\pm}} \right) \times 100\%$$

where:

$$Sens_{IPX+} = (V_{IOUT(IPX+)} - V_{REF}) / I_{PX+}$$

and

$$Sens_{IPX-} = (V_{IOUT(IPX-)} - V_{REF}) / I_{PX-}$$

$I_{PX+}$  and  $I_{PX-}$  are positive and negative currents through  $I_P$ , such that  $|I_{P2+}| = 2 \times |I_{P1+}|$  and  $|I_{P2-}| = 2 \times |I_{P1-}|$ .  $E_{LIN} = \max(E_{LIN(+)}, E_{LIN(-)})$ .

### Total Output Error ( $E_{TOT}$ )

The Total Output Error is the current measurement error from the sensor IC as a percentage of the actual applied current. This is equivalent to the difference between the ideal output voltage and the actual output voltage, divided by the ideal sensitivity, relative to the current applied to the device, or simplified to:

$$E_{TOT} = \frac{V_{IOUT(ACTUAL)} - (Sens_{(IDEAL)} \times I_{PR} + V_{REF})}{(Sens_{(IDEAL)} \times I_{PR})} \times 100$$

Total Output Error incorporates all sources of error and is a function of current. At relatively high currents, Total Output Error will be mostly due to sensitivity error, and at relatively low inputs, Total Output Error will be mostly due to Offset Voltage ( $V_{OE}$ ). At  $I = 0$  A, Total Output Error approaches infinity due to the offset. An example of total error at FS can be seen in Figure 99.

Note: Total Output Error goes to infinity as the amount of applied field approaches 0 A.

### Power Supply Offset Error ( $V_{PS}$ )

Power Supply Offset Error,  $V_{PS}$ , is defined at the offset error in mV between  $V_{CC}$  and  $V_{CC} \pm 10\% V_{CC}$ .

### Offset Power Supply Rejection Ratio ( $PSRR_O$ )

The Offset Power Supply Rejection Ratio,  $PSRR_O$ , is defined as  $20 \times \log$  of the ratio of the change of QVO in volts over a  $\pm 100$  mV variable AC  $V_{CC}$  centered at 5 V, reported as dB in a specified frequency range. This is an AC version of the  $V_{PS}$  parameter. The equation is shown below:

$$PSRR_O = 20 \log \left( \frac{\Delta QVO}{\Delta V_{CC}} \right)$$

### Power Supply Sensitivity Error ( $E_{PS}$ )

Power Supply Sensitivity Error, or  $E_{PS}$ , is defined as the percent sensitivity error measured between  $V_{CC}$  and  $V_{CC} \pm 10\%$ .

### Sensitivity Power Supply Rejection Ratio ( $PSRR_S$ )

The Sensitivity Power Supply Rejection Ratio,  $PSRR_S$ , is defined as  $20 \times \log$  of the ratio of the % change in sensitivity over the % change in  $V_{CC}$  ( $\pm 100$  mV variable AC  $V_{CC}$  centered at 5 V), reported as dB in a specified frequency range. This is the AC version of the  $E_{PS}$  parameter. The equation is shown below:

$$PSRR_S = 20 \log \left( \frac{\Delta \% SENS}{\Delta \% V_{CC}} \right)$$

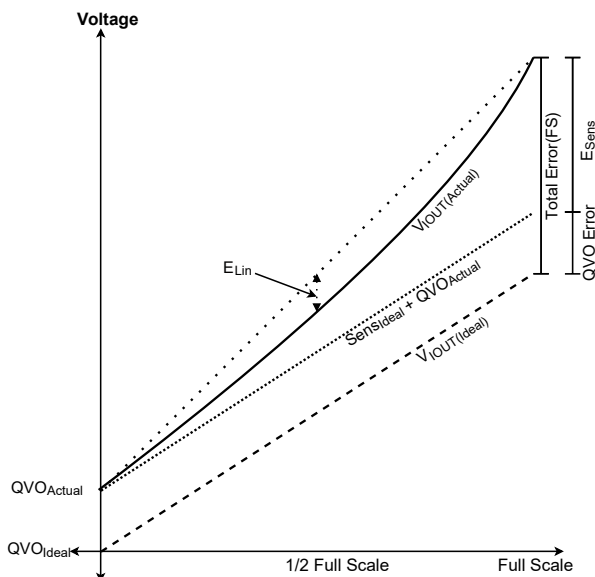


Figure 9: Accuracy Error

## FAULT BEHAVIOR

### Overcurrent Fault (OCF)

As the output swings, the Overcurrent Fault pin will trigger with an active low flag if the sensed current exceeds its comparator threshold. This is internally compared with either the factory-programmed thresholds or via the VOC voltage when  $V_{VOC} > 0.1$  V. This flag trips symmetrically for the positive and negative OCF operating point.

The implementation for the OCF circuitry is accurate over temperature and does not require further temperature compensation as it is dependent on the Sens and  $V_{OFF}$  parameters that are factory-trimmed flat over temperature.

### OVERCURRENT FAULT OPERATING RANGE/POINT ( $I_{OCF-OR}$ , $I_{OCF-OP}$ )

Overcurrent Fault Operating Range is the functional range that the OCF thresholds can be set in terms of percentage of full-scale output swing. The Overcurrent Fault Operating Point is the specific point at which the OCF trigger will occur and is set by either  $V_{VOC}$  or the factory default setting. The  $I_{OCF-OP}$  can be seen in Figure 10 as [9] along with the FAULT pin functionality.

### OVERCURRENT FAULT HYSTERESIS ( $I_{OCF(HYS)}$ )

Overcurrent Fault Hysteresis or  $I_{OCF(HYS)}$  is defined as the magnitude of percent FS that must drop before a fault assertion will be cleared. This can be seen as the separation between the voltages [9] to [10] in Figure 10. Note the MASK and HOLD functionality are independent of each other. The ACS37002LMC comes standard with an  $OCF_{HYS}$  of 120 mV (on the output) or 6%FS for a 5 V device and 9%FS for a 3.3 V device.

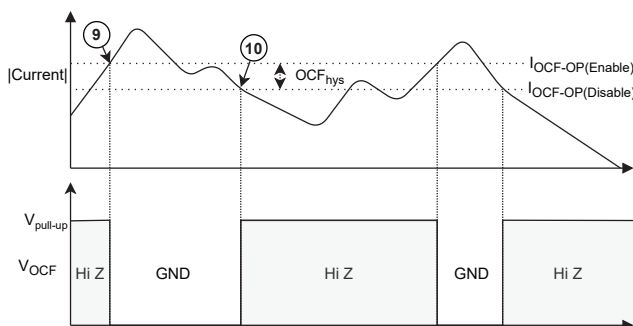


Figure 10: Fault Thresholds and OCF Pin Functionality

### VOLTAGE OVERCURRENT PIN (VOC)

The fault trip points can be set using the VOC pin as the direct analog input for the fault trip point. The VOC pin voltage can be set using resistor dividers from  $V_{REF}$  on bidirectional devices. The fault performance is valid when  $V_{VOC}$  is within the VOC Operating Voltage Range or  $<0.1$  V. The device will respond to voltage outside of the defined valid performance region with varied results. For a 5 V bidirectional device, setting the VOC pin to 0.5 V selects the minimum trip point,  $I_{FAULT(min)}$ , and setting the pin to 2 V selects the maximum trip point,  $I_{FAULT(max)}$  as defined by selection performance tables. All voltages between 0.5 to 2 V for 5 V option and 0.33 to 1.321 V for 3.3 V option can linearly select a trip point between the minimum and maximum levels, as shown in Figure 11. When  $V_{OC} < 0.1$  V, the internal EEPROM fault level will be used.

The resulting equation for the fault is:

$$OCF_{\%FS} [\%] = \frac{V_{OC(VCC)} [V]}{V_{OC(VCC)100\%} [V]} \times 100 [\%]$$

$$I_{OCF} [A] = OCF_{\%FS} [\%] \times I_{PR} [A]$$

Table 1:  $V_{OC(VCC)}$  thresholds and corresponding percentage of the Full-Scale Output for Bidirectional and Unidirectional operational modes

$V_{OC(3.3V)}$ (V)	$V_{OC(5V)}$ (V)	Fault Operation Point %FS	
		Bidirectional	Unidirectional
<0.1		100% (factory default)	50% (factory default)
0.330	0.5	50%	25%
0.466	0.75	75%	37.5%
0.661	1	100%	50%
0.826	1.25	125%	62.5%
0.991	1.5	150%	75%
1.156	1.75	175%	85%
1.321	2	200%	100%

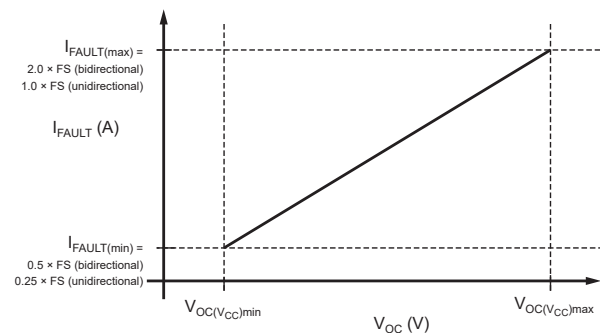


Figure 11: VOC Functional Range



## OVERCURRENT FAULT ERROR ( $E_{OCF}$ )

Fault Error or  $E_{OCF}$  is the error between the  $I_{OCF-OP(actual)}$  and  $I_{OCF-OP(ideal)}$ .

## OVERCURRENT FAULT RESPONSE TIME ( $t_{OCF}$ )

Overcurrent Response Time or  $t_{OCF}$  is defined as the time from the input reaches the operating point [9] (seen in Figure 12) until the OCF pin falls below  $V_{FAULT-ON}$  [G]. If the OCF Mask is disabled, then  $t_{OCF}$  is equal to  $t_{OCF-R}$  seen as the time from [9] until [F].

## OVERCURRENT FAULT REACTION TIME ( $t_{OCF-R}$ )

Overcurrent Reaction Time or  $t_{OCF-R}$  is defined as the time from the current input rising above  $I_{OCF-OP}$  at point [9] in Figure 12 until the OCF pin reaches  $V_{OCF-ON}$  at point [F] with the OCF mask disabled. This is the time required for the device to recognize and clear the fault, seen as the time between [10] until [I].

## OVERCURRENT FAULT MASK TIME ( $t_{OCF-MASK}$ )

Overcurrent Fault Mask Time or  $t_{OCF-MASK}$  is defined as the additional amount of time the OCF must be present beyond the  $t_{OCF-R}$  time (seen in Figure 12 [F] until [G]). This is to reduce nuisance tripping of the FAULT pin. If an OCF occurs, but does not persist beyond  $t_{OCF-R} + t_{OCF-MASK}$ , it is not reported by the device (seen in Figure 13). This prevents short transient spikes from causing erroneous OCF flagging. Factory default setting is  $t_{OCF-MASK} = 0 \mu s$ .

## OVERCURRENT FAULT HOLD TIME ( $t_{OCF-HOLD}$ )

Overcurrent Fault Hold Time or  $t_{OCF-HOLD}$  is defined as the minimum time OCF flag will be asserted after a sufficient OCF event. After the hold time has been reached, the OCF will release if the OCF condition has ended (seen in Figure 12 [G] until [J]) or persist if the OCF condition is still present (seen in Figure 14 [G] until [J]). Factory default is 0 ms.

## OVERCURRENT FAULT PERSIST

The ACS37002LMC has a fault persist option that will maintain the OCF flag if a flag occurred until a POR event.

## OCF DISABLE

The ACS37002LMC has the ability to disable overcurrent fault functionality; when this is disabled, the OCF pin will remain in high impedance.

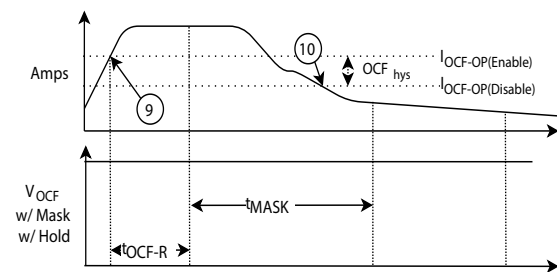


Figure 13: Fault Condition Clearing Before Mask Time Is Reached

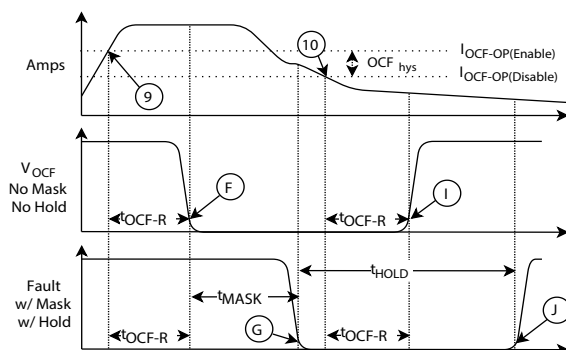


Figure 12: General Fault Timing.  
Note: the MASK and HOLD functionality are independent of each other

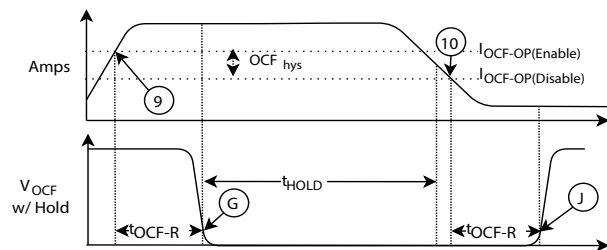


Figure 14: Fault Hold with Clear Fault After Hold Time

## DYNAMIC RESPONSE PARAMETERS

The descriptions in this section use the listed test conditions and assume a temperature of 25°C. The step applied is a input step that corresponds to 1 V deviation on the output, unless otherwise stated.

### Propagation Time ( $t_{PD}$ )

The time interval between a) when the sensed current reaches 10% of its stable value, and b) when the sensor output reaches 10% of its stable value for a step input. See Figure 15.

### Rise Time ( $t_r$ )

The time interval between a) when the sensor reaches 10% of its stable value, and b) when it reaches 90% of the stable value for a step input. See Figure 15.

### Response Time ( $t_{RESPONSE}$ )

The time interval between a) when the sensed current reaches 90% of its stable value, and b) when the sensor output reaches 90% of its stable value. See Figure 15.

### Temperature Compensation

To help compensate for the effects temperature has on performance, the ACS37002LMC has an integrated internal temperature sensor. This sensor and compensation algorithms help to standardize device performance over the full range of optimized temperatures. This allows for room temperature system calibration and validation of end-of-line modules.

### Temperature Compensation Update Rate

There is an 8 ms update time that is required to maintain a valid temperature compensated output; that is, temperature compensations are calculated and applied every 8 ms.

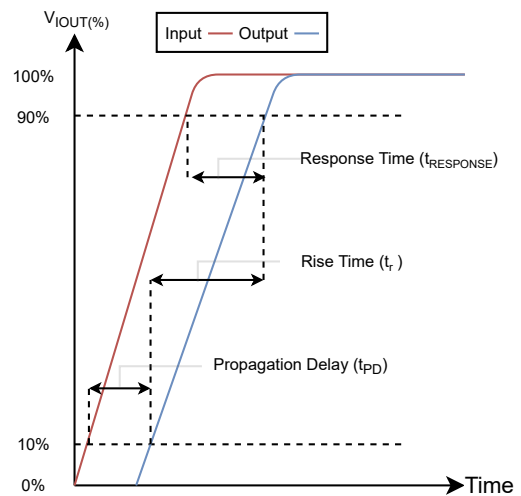
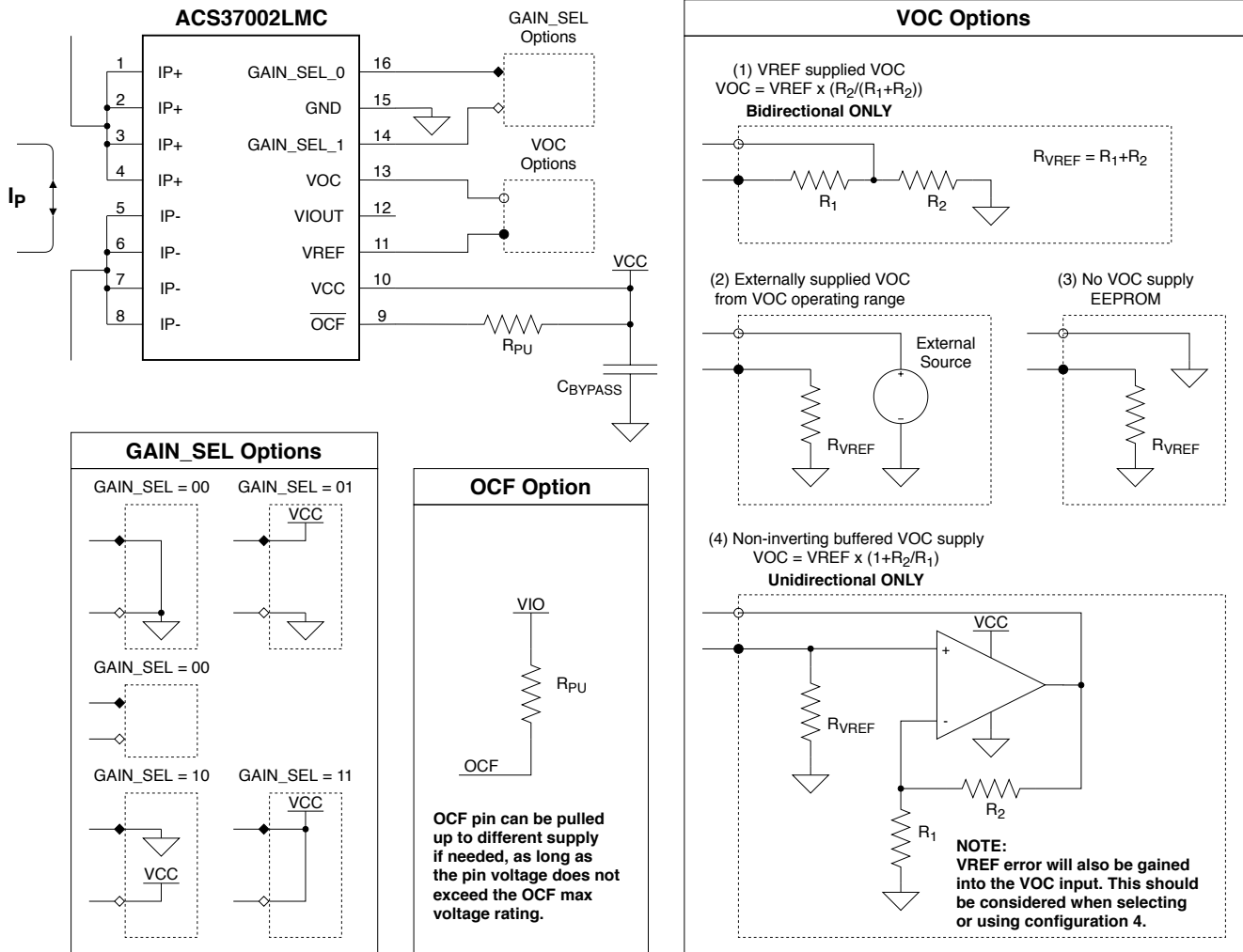


Figure 15: Dynamic Response Parameters

### APPLICATION AND THEORY

#### Application Circuits



**Figure 16: Applications Circuits for GAIN\_SEL, VOC, and FAULT pin**

These configurations are simplified to the network required for functionality.

Bypass and load capacitors are recommended for best performance.

Theory and Functionality – VOC and OCF

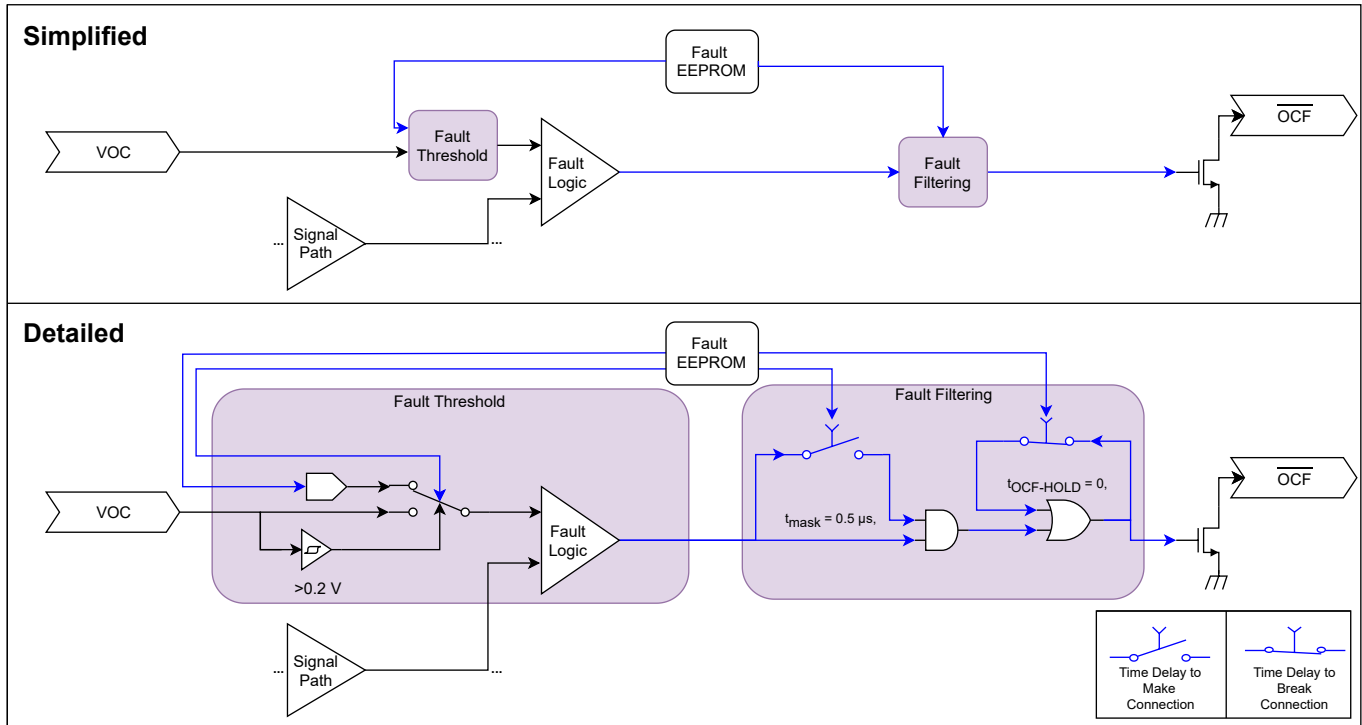


Figure 17: OCF Signal Path Simplified and Detailed Blocks of Functionality

VOC DRIVEN BY NON-INVERTING BUFFERED VREF

If the VOC pin is being driven by a non-inverted buffered  $V_{REF}$ , it is important to consider that any error from the  $V_{REF}$  pin will be gained as well. For instance, if  $V_{REF}$  error is +10 mV and the gain = 4 for the non-inverting operational amplifier, then the VOC pin will be 40 mV from the expected target. For unidirectional devices, OCF would be subjected to an additional 4% error due to the error propagation from  $V_{REF}$  through the gain stage.

POWER SUPPLY DECOUPLING CAPACITOR AND OUTPUT CAPACITIVE LOADS

The higher the capacitive load on the outputs ( $V_{REF}$ ,  $V_{IOUT}$ ), the larger the decoupling capacitor should be on the power supply ( $V_{CC}$ ) to maintain performance.

$C_{LOAD}$	$C_{BYPASS}$
0 nF	100 nF
1 nF	>100 nF
3 nF	>1 μF
6 nF	>10 μF

### Dynamically Change Gain in a System

The ACS37002LMC has GAIN\_SEL pins that are used to change the gain of the device on startup. If a more dynamic gain is desired, then reduce  $V_{CC}$  below  $V_{POR(L)}$  and restart the device by returning  $V_{CC}$  to the nominal voltage with the new desired GAIN\_SEL configuration. The GAIN\_SEL pin voltage

must be greater than the desired configuration voltage ( $V_{H(SEL)}$  or  $V_{L(SEL)}$ ) at or before  $V_{CC} > V_{POR(H)}$  in order to successfully change the device gain. The GAIN\_SEL pin voltage is latched at startup, and any changes to the pin voltages after the device's  $V_{IOUT}$  comes out of high impedance will not affect gain. The cycle time to complete this operation is up to  $2 \times t_{POD}$ .

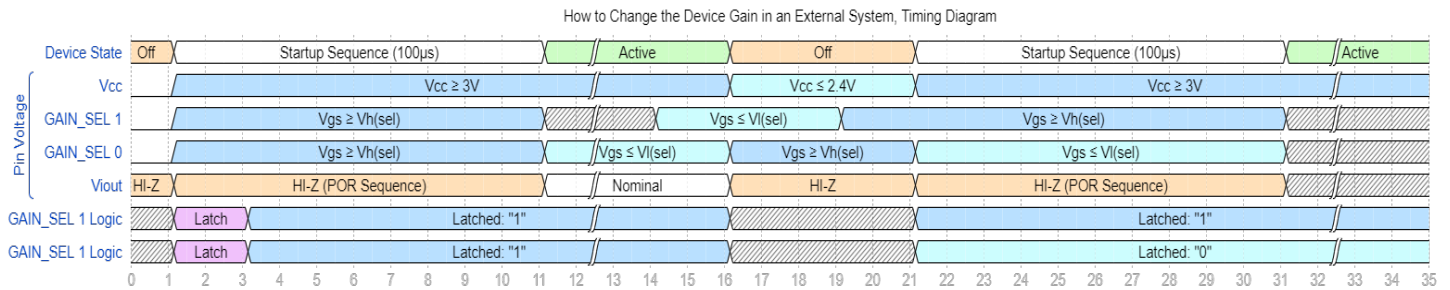


Figure 18: GAIN\_SEL Dynamic Gain Changing Timing Diagram

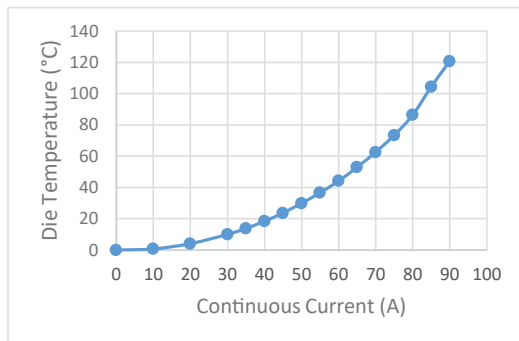
## APPLICATION INFORMATION

### Thermal Rise vs. Primary Current

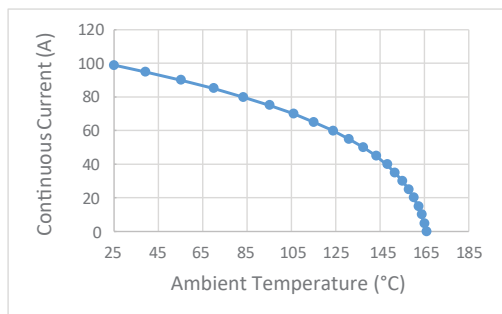
Self-heating due to the flow of current should be considered during the design of any current sensing system. The sensor, printed circuit board (PCB), and contacts to the PCB will generate heat as current moves through the system.

The thermal response is highly dependent on PCB layout, copper thickness, cooling techniques, and the profile of the injected current. The current profile includes peak current, current “on-time”, and duty cycle. While the data presented in this section was collected with direct current (DC), these numbers may be used to approximate thermal response for both AC signals and current pulses.

The plot in Figure 19 shows the measured rise in steady-state die temperature of the ACS37002LMC versus continuous current at an ambient temperature,  $T_A$ , of 25 °C. The thermal offset curves may be directly applied to other values of  $T_A$ . Conversely, Figure 20 shows the maximum continuous current at a given  $T_A$ . Surges beyond the maximum current listed in Figure 20 are allowed given the maximum junction temperature,  $T_{J(MAX)}$  (165°C), is not exceeded.



**Figure 19: Self-heating in the MC package due to current flow**

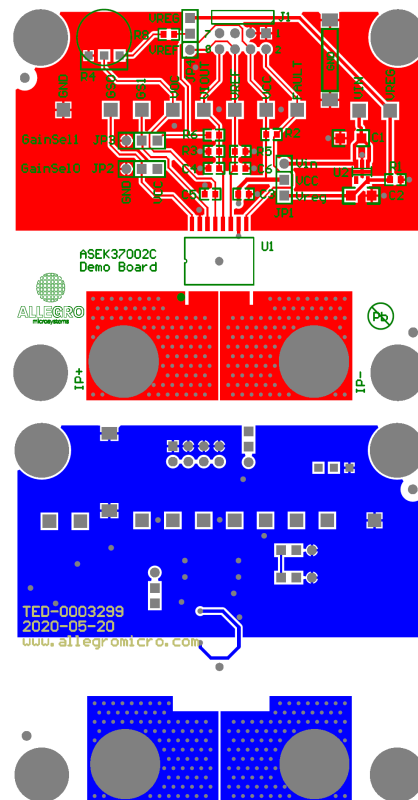


**Figure 20: Maximum continuous current at a given  $T_A$**

The thermal capacity of the ACS37002LMC should be verified by the end user. The maximum junction temperature,  $T_{J(MAX)}$ , should not be exceeded. Further information on this application testing is available in the [DC and Transient Current Capability](#) application note on the Allegro website.

### ASEK37002MC Evaluation Board Layout

Thermal data shown in Figure 19 and Figure 20 was collected using the ASEK37002MC Evaluation Board (TED-0003299). This board includes 750 mm<sup>2</sup> of 4 oz. (0.1388 mm) copper connected to pins 1 through 4, and to pins 5 through 8, with thermal vias connecting the layers. Top and bottom layers of the PCB are shown below in Figure 21.



**Figure 21: Top and bottom layers for ASEK37002MC evaluation board**

Gerber files for the ASEK37002MC evaluation board are available for download from the Allegro website. See the technical documents section of the ACS37002LMC device [webpage](#).

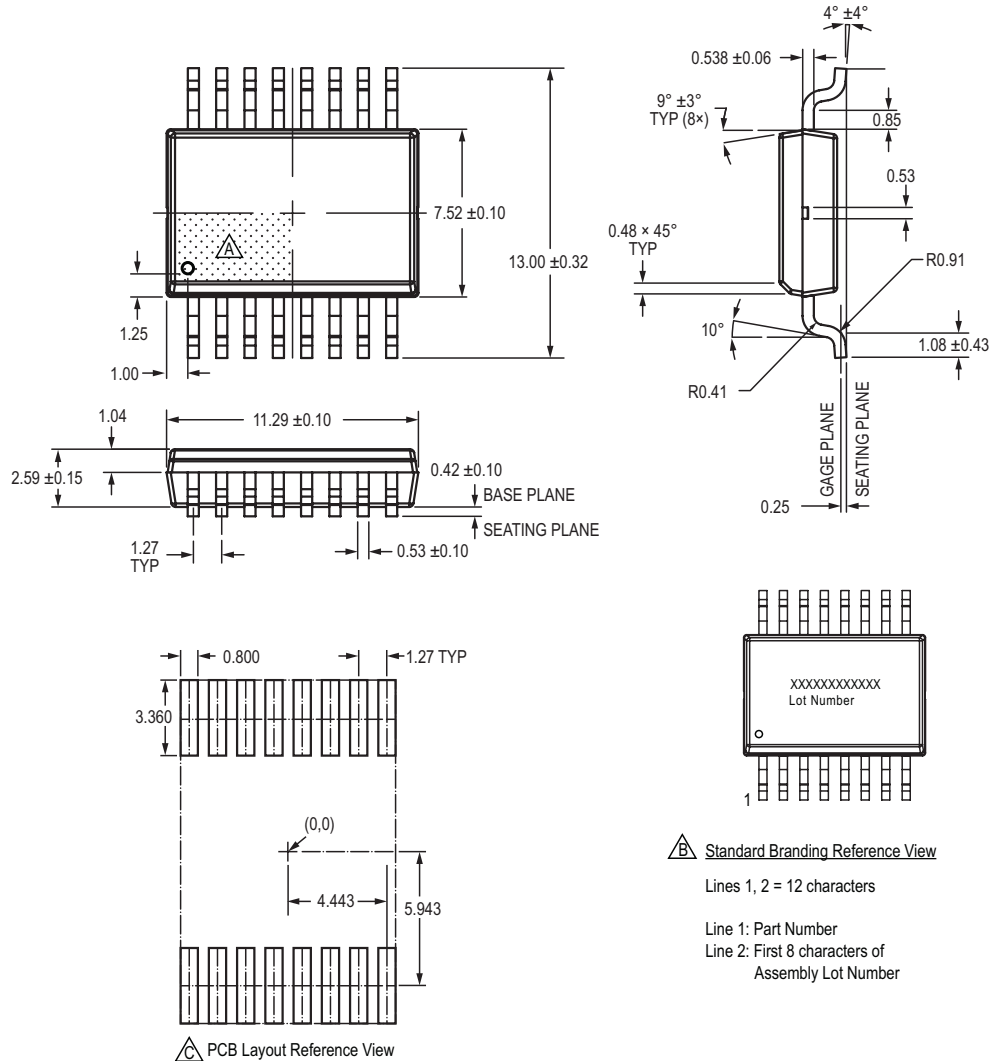
## PACKAGE OUTLINE DRAWING

For Reference Only; Not for Tooling Use

(reference DWG-0000714, Rev. 2)

Dimensions in millimeters

Dimensions exclusive of mold flash, gate burrs, and dambar protrusions  
Exact case and lead configuration at supplier discretion within limits shown



- Terminal #1 mark area
- Branding scale and appearance at supplier discretion
- Reference land pattern layout; all pads a minimum of 0.20 mm from all adjacent pads; adjust as necessary to meet application process requirements and PCB layout tolerances; when mounting on a multilayer PCB, thermal vias at the exposed thermal pad land can improve thermal dissipation (reference EIA/JEDEC Standard JESD51-5)

Figure 22: Package MC, 16-Pin SOICW

**Revision History**

Number	Date	Description
–	December 14, 2020	Initial release
1	December 7, 2021	Added RoHs compliance note (page 1); updated Figure 1 caption (page 1); updated naming convention (page 2); removed RoHS and Pb free symbols (page 2); added MSL rating to the Isolation and Package Characteristics table (page 4); added Output Buffer Resistance to the Common Electrical Characteristics table (page 7); added Typical Frequency Response (page 15); updated Figure 12, Figure 13, Figure 14 (page 23); updated Figure 17 (page 26); added Thermal Application Section (page 28); minor editorial updates (all pages)
2	January 11, 2022	Updated package drawing (page 29)
3	August 29, 2023	Added ACS37002LMCATR-066B3 and ACS37002LMCATR-090B3 part variants (all pages); removed footnote 2 from Selection Guide (page 2)

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