microsystems

ACS37002

400 kHz, High Accuracy Current Sensor

with Pin-Selectable Gains and Adjustable Overcurrent Fast Fault in SOICW-16 Package

FEATURES AND BENEFITS

- High operating bandwidth for fast control loops or where high-speed currents are monitored
  - □ 400 kHz bandwidth
  - □ 2 µs typical response time
- High accuracy
  - □ As low as 1% maximum sensitivity error over temperature (K series)
  - □ 6 mV maximum offset voltage over temperature
  - □ Non-ratiometric operation with V_{REF} output
  - □ Low noise LA package
    - 124 mV_{RMS} for 3.3 V supply
    - 160 mV_{RMS} for 5 V supply
  - □ Differential sensing for high immunity to external magnetic fields
  - □ No magnetic hysteresis
- Adjustable fast overcurrent alert
  - □ 1 µs typical response time
  - □ Pin adjustable threshold
- Externally configurable gain settings using two logic pins

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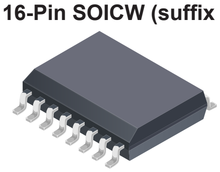
PACKAGE: 16-Pin SOICW (suffix MA/LA)



Not to scale

DESCRIPTION

The ACS37002 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 MA package is optimized for higher isolation with withstand voltage, 4.8 kV_{RMS}, and 0.85 mΩ conductor resistance. The LA package is optimized for lower noise with 3.6 kV_{RMS} withstand voltage and 1 mΩ conductor resistance.

The fast overcurrent alert fault output has a user-configurable threshold by an analog input, providing short-circuit detection and enhanced system protection. The sensor also has four user-selectable gain options with two logic inputs without the need for extra components. This reduces the need to stock inventory of individual devices with different gain. The analog output with V_{REF} pin is for use in noisy supply environments.

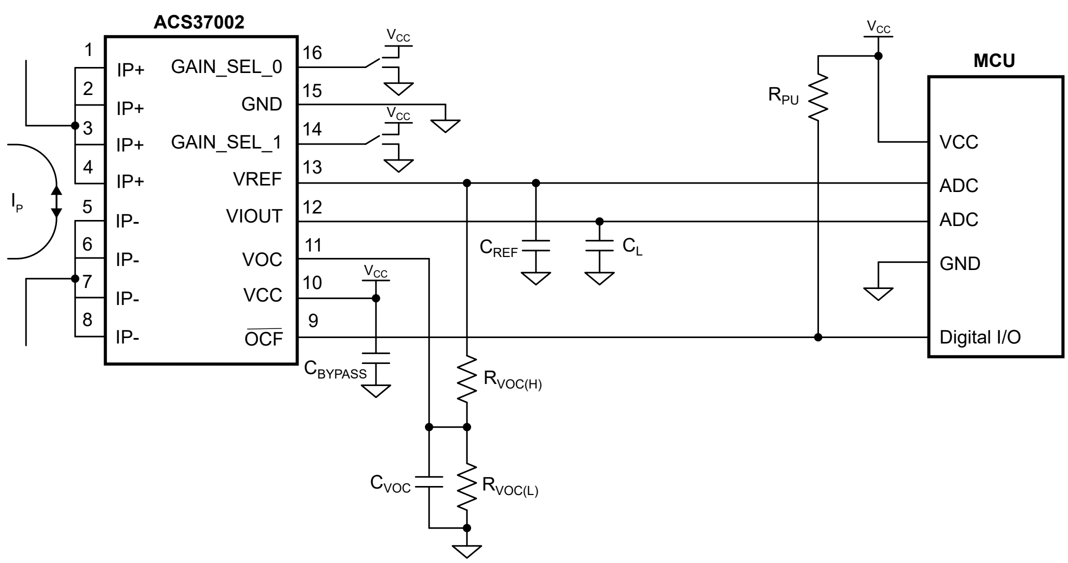


Figure 1: Typical Bidirectional Application.
For more application circuits, refer to the application circuit section.

FEATURES AND BENEFITS (continued)

  - □ 4 adjustable gain levels for increased design flexibility
  - □ Enabling measurement ranges from 10 to 133 A in both unidirectional and bidirectional modes
- Low internal primary conductor resistance 0.85 mΩ (MA) and 1 mΩ (LA) for better power efficiency
- UL-certified to 60950 standard, highly isolated compact SOICW-16 surface mount package (MA)
  - □ 4.8 kV_{RMS} rated isolation voltage
  - □ 1047 V_{RMS} / 1480 V_{DC} basic isolation voltages
  - □ 517 V_{RMS} / 730 V_{DC} reinforced isolation voltages
- Wide operating temperature, –40°C to 150°C
- Commercial qualified

SELECTION GUIDE

Part Number	Current Sensing Range, I_{PR} (A)	Sensitivity [1] Sens (mV/A)	Nominal V_{CC} (V)	Optimized Temp. Range T_A (°C)	Packing [2]
MA Package, 16-Pin SOICW					
ACS37002LMABTR-050B5	±33, ±40, ±50, ±66	60, 50, 40, 30	5	–40 to 150 [3]	1000 pieces per 13-inch reel
ACS37002LMABTR-066B5	±66, ±80 ±100, ±133	30, 25, 20, 15			
ACS37002LMABTR-050U5	33, 40, 50, 66	120, 100, 80, 60			
ACS37002LMABTR-066U5	66, 80, 100, 133	60, 50, 40, 30			
ACS37002LMABTR-050B3	±33, ±40, ±50, ±66	39.6, 33, 26.4, 19.8	3.3		
ACS37002LMABTR-066B3	±66, ±80, ±100, ±133	19.8, 16.5, 13.2, 9.9			
ACS37002LMABTR-050U3	33, 40, 50, 66	79.2, 66, 52.8, 39.6			
ACS37002LMABTR-066U3	66, 80, 100, 133	39.6, 33, 26.4, 19.8			
ACS37002KMABTR-050B5	±33, ±40, ±50, ±66	60, 50, 40, 30	5	–40 to 125 [4]	
ACS37002KMABTR-050B3	±33, ±40, ±50, ±66	39.6, 33, 26.4, 19.8	3.3		
LA Package [3], 16-Pin SOICW					
ACS37002LLAATR-015B5	±10, ±12, ±15, ±20	200,166.6,133.3,100	5	–40 to 150	1000 pieces per 13-inch reel
ACS37002LLAATR-025B5	±25, ±30, ±37.5, ±50	80, 66.6, 53.3, 40			
ACS37002LLAATR-015B3	±10, ±12, ±15, ±20	132, 110, 88, 66	3.3		
ACS37002LLAATR-025U3	+25, +30, +37.5, +50	105.6, 88, 70.4, 52.8			

[1] Refer to the part specific performance characteristics sections for Gain_Sel configuration.
[2] Contact Allegro for additional options.
[3] Advanced information. LA package and LMA variation is not yet released.
[4] The device performance is optimized from –40°C to 125°C; however, the device can still operate to an ambient temperature of 150°C. The device shares the same qualifications as the L temperature devices unless otherwise stated.

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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) ≤ 6.5	V
Reverse Output Voltage	V_{ROUT}	Applies to V_{IOUT}, V_{OCF}, and V_{REF}	–0.5	V
Forward Input Voltage	V_{OI}	Applies to GAIN_SEL0, GAIN_SEL1, and VOC	(V_{CC} + 0.7) ≤ 6.5	V
Reverse Input Voltage	V_{RI}	Applies to GAIN_SEL0, GAIN_SEL1, 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 CHARACTERISTICS

Characteristic	Symbol	Notes	Rating	Unit
Surge Voltage	V_{SURGE}	1.2/50 µs to IEC 61000-4-5	10	kV
Surge Current [1]	I_{SURGE}	8/20 µs to IEC 61000-4-5	13	kA
Comparative Track Index	CTI	Material Group II	400 to 599	V

MA PACKAGE SPECIFIC PERFORMANCE

Distance Through Insulation	DTI	Minimum internal distance through insulation	90	µm
Dielectric Strength Test Voltage	V_{ISO}	Agency type-tested for 60 seconds per UL 60950-1 (edition 2). Production tested at 3000 V_{RMS} for 1 second in accordance with UL 60950-1.	4800	V_{RMS}
Working Voltage for Basic Isolation [1]	V_{WVBI}	Maximum approved working voltage for basic (single) isolation according to UL 60950-1 (edition 2)	1480	V_{PK} or V_{DC}
			1047	V_{RMS}
Working Voltage for Reinforced Isolation [1]	V_{WVRI}	Maximum approved working voltage for reinforced isolation according to UL 60950-1 (edition 2)	730	V_{PK} or V_{DC}
			517	V_{RMS}
Clearance [1]	D_{cl}	Minimum distance through air from IP leads to signal leads	7.5	mm
Creepage [1]	D_{cr}	Minimum distance along package body from IP leads to signal leads	7.9	mm

LA PACKAGE SPECIFIC PERFORMANCE

Distance Through Insulation	DTI	Minimum internal distance through insulation	45	µm
Dielectric Strength Test Voltage	V_{ISO}	Agency type-tested for 60 seconds per UL 60950-1 (edition 2). Production tested at 3000 V_{RMS} for 1 second in accordance with UL 60950-1.	3600	V_{RMS}
Working Voltage for Basic Isolation [1]	V_{WVBI}	Maximum approved working voltage for basic (single) isolation according to UL 60950-1 (edition 2)	870	V_{PK} or V_{DC}
			616	V_{RMS}
Clearance [1]	D_{cl}	Minimum distance through air from IP leads to signal leads	7.5	mm
Creepage [1]	D_{cr}	Minimum distance along package body from IP leads to signal leads	7.5	mm

[1] Certification pending.

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PINOUT DIAGRAM AND TERMINAL LIST TABLE

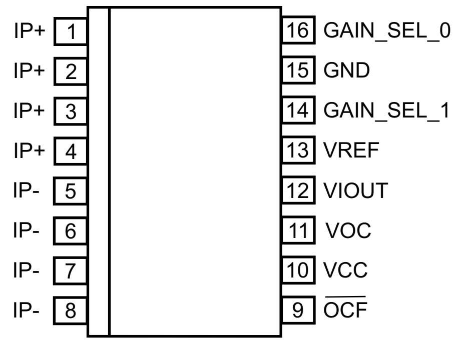

Figure 2: MA/LA Pinout Diagram

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	VOC	Overcurrent fault operation point input
12	VIOUT	Analog output representing the current flowing through I_P
13	VREF	Zero current voltage reference
14	GAIN_SEL_1	Gain selection bit 1
15	GND	Device ground terminal
16	GAIN_SEL_0	Gain selection bit 0

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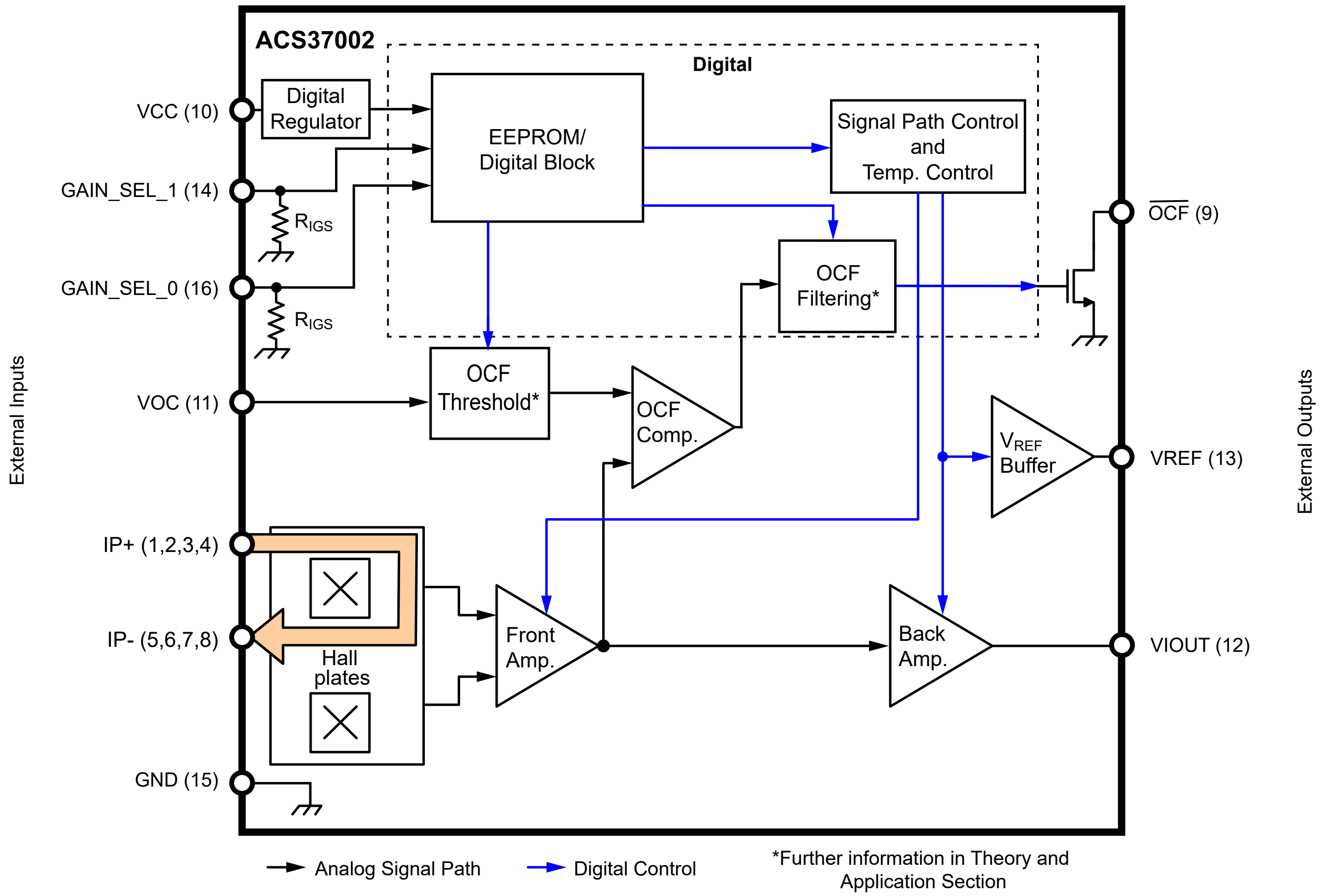

Figure 3: Functional Block Diagram

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COMMON ELECTRICAL CHARACTERISTICS: Valid through full operating temperature range, T_A = – 40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V or 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC}	5 V devices only	4.5	5	5.5	V
		3.3 V devices only	3	3.3	3.6	V
Supply Current	I_{CC}	No load on VIOUT or VREF; V_{CC} = 5 V	–	13	18	mA
		No load on VIOUT or VREF; V_{CC} = 3.3 V	–	12	15	mA
Supply Bypass Capacitor	C_{BYPASS}	VCC to GND recommended	–	0.1	–	µF
Output Resistive Load	R_L	VIOUT to GND, VIOUT to VCC	10	–	–	kΩ
Output Capacitive Load	C_L	VIOUT to GND	–	1	6	nF
Reference Resistive Load	R_{VREF}	VREF to GND (recommended for VOC supply); VREF to VCC	10	62.7	–	kΩ
Reference Capacitive Load	C_{VREF}	VREF to GND	–	–	6	nF
Fault Pull-Up Resistance	R_{PU}		4.7	–	500	kΩ
VOC Capacitive Load	C_{VOC}	VOC to GND	–	–	1	nF
Primary Conductor Resistance	R_{IP}	T_A = 25°C	–	0.85	–	mΩ
Primary Conductor Inductance	L_{IP}		–	4.2	–	nH
Power-On Reset Voltage	$V_{POR(H)}$	T_A = 25°C, V_{CC} rising [1]	2.6	2.9	3.2	V
	$V_{POR(L)}$	T_A = 25°C, V_{CC} falling [1]	2.2	2.5	2.8	V
POR Hysteresis	$V_{POR(HYS)}$		250	–	–	mV
Power-On Time	t_{POD}	Time from V_{CC} rising ≥ $V_{UVD(DIS)}$ after a POR event until power-on; VREF, OCF, VIOUT	–	100	–	µs
Undervoltage Detection (UVD) Threshold [2]	$V_{UVD(L)}$	T_A = 25°C, V_{CC} falling [1]	3.8	–	4.3	V
	$V_{UVD(H)}$	T_A = 25°C, V_{CC} rising [1]	4	–	4.5	V
UVD Hysteresis [2]	$V_{UVD(HYS)}$		–	250	–	mV
UVD Delay Time [2]	$t_{dUVD(E)}$	Time from V_{CC} falling ≤ $V_{UVD(EN)}$ until UVD asserts	35	64	120	µs
	$t_{dUVD(D)}$	Time from V_{CC} rising ≥ $V_{UVD(DIS)}$ until UVD clears	–	7	–	µs
Overvoltage Detection (OVD) Threshold	$V_{OVD(H)}$	T_A = 25°C, V_{CC} rising [1]	6.1	6.3	6.8	V
	$V_{OVD(L)}$	T_A = 25°C, V_{CC} falling [1]	5.6	5.8	6.1	V
Overvoltage Detection Hysteresis	$V_{OVD(HYS)}$		–	660	–	V
OVD Delay Time	$t_{dOVD(E)}$	Time from V_{CC} rising ≥ $V_{OVD(EN)}$ until OVD asserts	35	90	120	µs
	$t_{dOVD(D)}$	Time from V_{CC} falling ≤ $V_{OVD(DIS)}$ until OVD clears	–	7	–	µs

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COMMON PERFORMANCE CHARACTERISTICS (VIOUT): Valid through full operating temperature range, T_A = – 40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V or 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions		Min.	Typ.	Max.	Units
OUTPUT SIGNAL CHARACTERISTICS (V_{IOUT})							
Saturation Voltage	$V_{SAT(H)}$	R_L = 10 kΩ to GND		V_{CC} – 0.25	–	–	V
	$V_{SAT(L)}$	R_L = 10 kΩ to V_{CC}		–	–	0.15	V
Output Operating Range	V_{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	$I_{OUT(src)}$	V_{IOUT} shorted to GND		–	25	–	mA
	$I_{OUT(snk)}$	V_{IOUT} shorted to V_{CC}		–	25	–	mA
Output Drive	I_{OUT}			4.8	–	–	mA
Internal Bandwidth	BW	Small signal –3 dB, C_L = 5.7 nF		–	400	–	kHz
Rise Time	t_R	T_A = 25°C, C_L = 5.7 nF, 10%-90% of 1 V output swing		–	1	2.5	µs
Response Time	$t_{RESPONSE}$	T_A = 25°C, C_L = 5.7 nF, 90% input to 90% of 1 V output swing		–	2	2.5	µs
Propagation Delay	t_{pd}	T_A = 25°C, C_L = 5.7 nF, 20% input to 20% of 1 V output swing		–	1	2	µs
Noise Density	I_{ND}	Input-referenced noise density; T_A = 25°C, C_L = 5.7 nF; V_{CC} = 5 V	MA Package	–	350	–	µA/√Hz
			LA Package	–	155	–	µA/√Hz
		Input-referenced noise density; T_A = 25°C, C_L = 5.7 nF; V_{CC} = 3.3 V	MA Package	–	450	–	µA/√Hz
			LA Package	–	155	–	µA/√Hz
Noise	I_N	Input-referenced noise at 400 kHz; T_A = 25°C, C_L = 5.7 nF; V_{CC} = 5 V	MA Package	–	277	–	mA_{RMS}
			LA Package	–	124	–	mA_{RMS}
		Input-referenced noise at 400 kHz; T_A = 25°C, C_L = 5.7 nF; V_{CC} = 3.3 V	MA Package	–	357	–	mA_{RMS}
			LA Package	–	160	–	mA_{RMS}
Nonlinearity	E_{LIN}			–	±0.75	–	%
Power Supply Rejection Ratio Offset	$PSSR_{(O)}$	DC to 1 kHz, 100 mV pk-pk ripple around V_{CC} = 5 V, I_P = 0 A, change in V_{OE}		–	–40	–	dB
		1 to 100 kHz, 100 mV pk-pk ripple around V_{CC} = 5 V, I_P = 0 A, change in V_{OE}		–	–30	–	dB
Power Supply Rejection Ratio Sens	$PSSR_{(S)}$	DC to 1 kHz, 100 mV pk-pk ripple around V_{CC} = 5 V, I_P = $I_{PR(MAX)}$, change in Sens		–	–15	–	dB
		1 to 100 kHz, 100 mV pk-pk ripple around V_{CC} = 5 V, I_P = $I_{PR(MAX)}$, change in Sens		–	–6	–	dB
Power Supply Offset Error	$V_{OE(PS)}$	V_{CC} @ $V_{CC(MIN)}$ or $V_{CC(MAX)}$		–10	–	10	mV
Power Supply Sensitivity Error	$E_{SENS(PS)}$	V_{CC} @ $V_{CC(MIN)}$ or $V_{CC(MAX)}$		–1.5	–	1.5	%
Common-Mode Field Rejection	CMFR	Input-referred error due to common-mode field		–	4	–	mA/G

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COMMON PERFORMANCE CHARACTERISTICS (VREF, FAULT, GAIN_SEL): Valid through full operating temperature range, T_A = – 40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V or 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
REFERENCE OUTPUT CHARACTERISTICS (VREF)						
Zero Current Reference Voltage	$V_{REF(BI)}$	Bidirectional; V_{CC} = 5 V	2.49	2.5	2.51	V
		Bidirectional; V_{CC} = 3.3 V	1.64	1.65	1.66	V
	$V_{REF(UNI)}$	Unidirectional; V_{CC} = 5 V	0.49	0.5	0.51	V
		Unidirectional; V_{CC} = 3.3 V	0.32	0.33	0.34	V
Reference Source Current Limit	$I_{REF(SRC)}$	Maximum current V_{REF} can passively source	–	25	–	mA
	$I_{REF(SNK)}$	Maximum current V_{REF} can passively sink	–	–25	–	mA
Reference Slew Rate	SR_{REF}	C_{VREF} = 0 nF, R_{VREF} = 0 Ω	0.8	–	–	V/µs
OVERCURRENT FAULT CHARACTERISTICS (OCF)						
OCF On Voltage	$V_{FAULT-ON}$	R_{PU} = 4.7 kΩ, under fault condition	–	0.07	0.4	V
OCF Sink Current	$I_{OCF(SNK)}$	No Fault	–	100	–	nA
		Fault Assertion	0.01	–	1.1	mA
VOC Operating Voltage Range	V_{VOC}		0.2	–	2	V
Fault Error	E_{OCF}		–10	±3	10	$\%I_{OCF-OP}$
OCF Hysteresis	$I_{OCF(HYS)}$	V_{CC} = 5 V	–	6	–	%FS
		V_{CC} = 3.3 V	–	9	–	%FS
OCF Reaction Time	t_{OCF-R}	Time from I_{OCF-OP}, with a 1.2 × I_{OCF-OP} until fault asserts	–	1	1.5	µs
OCF Mask	$t_{OCF-MASK}$	Time I_{OCF-OP} must be present after t_{OCF-R} for fault assertion [3]	0	0.5	3	µs
OCF Response Time	t_{OCF}	$t_{OCF-MASK}$ = 0.5µs	–	1.5	2	µs
OCF Hold Time	$t_{OCF-HOLD}$	Minimum duration of FAULT assertion [3]	0	0	5	ms
GAIN SELECTION PIN CHARACTERISTICS (GAIN_SEL0, GAIN_SEL1)						
Gain Select Internal Resistor	R_{GSint}		–	1	–	MΩ
GAIN_SEL Logic Input Voltage	$V_{H(SEL)}$	V_{CC} = 5 V	3.75	–	–	V
		V_{CC} = 3.3 V	2.25	–	–	V
	$V_{L(SEL)}$		–	–	0.5	V
Leakage Current	$I_{SEL(SNK)}$		–	–	±10	µA

[1] V_{CC} rate +1 V/ms, for best accuracy.
[2] Only enabled on 5V devices.
[3] Typical value is factory default;

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ACS37002LMA-050B5 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (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

Selection Identifier

ACS37002LMA-050B5 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	40	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	50	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	60	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	30	–	mV/A
Overcurrent Fault Operating Range	I_{OCF-OR}	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	2.5	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
[2] Lifetime drift characteristics are based on the commercial qualification results from zero hours reads. Cannot be guaranteed. Drift is a function of customer application conditions. Contact Allegro MicroSystems for further information.

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ACS37002LMA-066B5 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
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

ACS37002LMA-066B5 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	30	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	25	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	20	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	15	–	mV/A
Overcurrent Fault Operating Range	I_{OCF-OR}	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	2.5	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
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ACS37002LMA-050U5 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	80	50
	0	1	100	40
	1	0	120	33.3
	1	1	60	66.7

ACS37002LMA-050U5 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	80	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	100	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	120	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	60	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	25	50	100	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Unidirectional; I_P = 0 A, T_A = 25°C	–	0.5	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
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ACS37002LMA-066U5 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	60	66.7 (Selection Identifier)
	0	1	50	80
	1	0	40	100
	1	1	30	133.3

ACS37002LMA-066U5 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	Gain Sel 00	0	–	66.7	A
		Gain Sel 01	0	–	80	A
		Gain Sel 10	0	–	100	A
		Gain Sel 11	0	–	133.3	A
Sensitivity	Sens	Gain Sel 00; $I_{PR(min)} < I_P < I_{PR(max)}$	–	60	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	50	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	40	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	30	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	25	50	100	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Unidirectional; I_P = 0 A, T_A = 25°C	–	0.5	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$		–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification
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ACS37002LMA-050B3 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
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

ACS37002LMA-050B3 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	26.4	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	33	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	39.6	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	19.8	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	1.65	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

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ACS37002LMA-066B3 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
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

ACS37002LMA-066B3 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	19.8	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	16.5	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	13.2	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	9.9	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	1.65	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
[2] Lifetime drift characteristics are based on the commercial qualification results from zero hours reads. Cannot be guaranteed. Drift is a function of customer application conditions. Contact Allegro MicroSystems for further information.

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ACS37002LMA-050U3 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	52.8	50
	0	1	66	40
	1	0	79.2	33.3
	1	1	39.6	66.7

ACS37002LMA-050U3 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	52.8	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	66	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	79.2	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	39.6	–	mV/A
Overcurrent Fault Operating Range	I_{OCF-OR}	Typ. = factory-programmed default, FS = Full-Scale	25	50	100	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Unidirectional; I_P = 0 A, T_A = 25°C	–	0.33	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
[2] Lifetime drift characteristics are based on the commercial qualification results from zero hours reads. Cannot be guaranteed. Drift is a function of customer application conditions. Contact Allegro MicroSystems for further information.

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ACS37002LMA-066U3 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A)
				Selection Identifier
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	39.6	66.7
	0	1	33	80
	1	0	26.4	100
	1	1	19.8	133.3

ACS37002LMA-066U3 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	Gain Sel 00	0	–	66.7	A
		Gain Sel 01	0	–	80	A
		Gain Sel 10	0	–	100	A
		Gain Sel 11	0	–	133.3	A
Sensitivity	Sens	Gain Sel 00; $I_{PR(min)} < I_P < I_{PR(max)}$	–	39.6	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	33	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	26.4	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	19.8	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	25	50	100	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Unidirectional; I_P = 0 A, T_A = 25°C	–	0.33	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
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ACS37002KMA-050B5 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
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

ACS37002KMA-050B5 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 125°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	40	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	50	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	60	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	30	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	2.5	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±0.9	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 125°C	–1	±0.8	1	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1	±0.75	1	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = 25°C to 125°C	–10	±4	10	mV
		$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = 25°C to 125°C	–8	±4	8	mV
		$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 125°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 125°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = 25°C to 125°C	–	–4 ±6	–	mV
		$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = 25°C to 125°C	–	±7	–	mV
		$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 125°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
[2] Lifetime drift characteristics are based on the commercial qualification results from zero hours reads. Cannot be guaranteed. Drift is a function of customer application conditions. Contact Allegro MicroSystems for further information.

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ACS37002KMA-050B3 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A)
Type	**Digital Input**	**Digital Input**	**Calculation**	**Bidirectional**
Selection Combination	0	0	26.4	50 (Selection Identifier)
	0	1	33	40
	1	0	39.6	33.3
	1	1	19.8	66.7

ACS37002KMA-050B3 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 125°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	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; $I_{PR(min)} < I_P < I_{PR(max)}$	–	26.4	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	33	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	39.6	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	19.8	–	mV/A
Overcurrent Fault Operating Range	I_{OCF-OR}	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	1.65	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±0.9	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 125°C	–1	±0.8	1	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1	±0.75	1	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 125°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 125°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 125°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV
TOTAL ERROR AND TOTAL ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2]						
Total Error Including Lifetime Drift	E_{TOT_LTD}	$I_P = I_{PR(max)}$	–	–2.7 ±0.8	–	%
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = I_{PR(max)}$, T_A = 25°C to 125°C	–	–1 ±1.2	–	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–	–2.7 ±0.8	–	%
Zero Current Reference Error Including Lifetime Drift	V_{RE_LTD}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 125°C	–	–4 ±6	–	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–	±8	–	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 125°C	–	±7	–	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–	±6	–	mV
QVO Error Including Lifetime Drift	V_{QE_LTD}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 125°C	–	–5 ±7	–	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–	±9	–	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.
[2] Lifetime drift characteristics are based on the commercial qualification results from zero hours reads. Cannot be guaranteed. Drift is a function of customer application conditions. Contact Allegro MicroSystems for further information.

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ACS37002LLA-015B5 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) [Selection Identifier]
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	133.3	15
	0	1	166.6	12
	1	0	200	10
	1	1	100	20

ACS37002LLA-015B5 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	Gain Sel 00	–15	–	15	A
		Gain Sel 01	–12	–	12	A
		Gain Sel 10	–10	–	10	A
		Gain Sel 11	–20	–	20	A
Sensitivity	Sens	Gain Sel 00; $I_{PR(min)} < I_P < I_{PR(max)}$	–	133.3	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	166.6	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	200	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	100	–	mV/A
Overcurrent Fault Operating Range	I_{OCF-OR}	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	2.5	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.

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ACS37002LLA-025B5 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Selection Identifier Max IP (A)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	80	25
	0	1	66.6	30
	1	0	53.3	37.5
	1	1	40	50

ACS37002LLA-025B5 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	Gain Sel 00	–25	–	25	A
		Gain Sel 01	–30	–	30	A
		Gain Sel 10	–37.5	–	37.5	A
		Gain Sel 11	–50	–	50	A
Sensitivity	Sens	Gain Sel 00; $I_{PR(min)} < I_P < I_{PR(max)}$	–	80	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	66.6	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	53.3	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	40	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	2.5	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} – V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} – V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.

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ACS37002LLA-015B3 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	88	15
	0	1	110	12
	1	0	132	10
	1	1	66	20

ACS37002LLA-015B3 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	Gain Sel 00	–15	–	15	A
		Gain Sel 01	–12	–	12	A
		Gain Sel 10	–10	–	10	A
		Gain Sel 11	–20	–	20	A
Sensitivity	Sens	Gain Sel 00; $I_{PR(min)} < I_P < I_{PR(max)}$	–	88	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	110	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	132	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	66	–	mV/A
Overcurrent Fault Operating Range	I_{OCF-OR}	Typ. = factory-programmed default, FS = Full-Scale	50	100	200	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Bidirectional; I_P = 0 A, T_A = 25°C	–	1.65	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$) × 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.

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ACS37002LLA-025U3 Gain_Sel Pin Performance Key

Parameter (Units)	Gain_Sel_1 (Boolean)	Gain_Sel_0 (Boolean)	Gain (mV/A)	Max IP (A) (Selection Identifier)
Type	Digital Input	Digital Input	Calculation	Bidirectional
Selection Combination	0	0	105.6	25
	0	1	88	30
	1	0	70.4	37.5
	1	1	52.8	50

ACS37002LLA-025U3 PERFORMANCE CHARACTERISTICS: Valid through full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ. [1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range	I_{PR}	Gain Sel 00	0	–	25	A
		Gain Sel 01	0	–	30	A
		Gain Sel 10	0	–	37.5	A
		Gain Sel 11	0	–	50	A
Sensitivity	Sens	Gain Sel 00; $I_{PR(min)} < I_P < I_{PR(max)}$	–	105.6	–	mV/A
		Gain Sel 01; $I_{PR(min)} < I_P < I_{PR(max)}$	–	88	–	mV/A
		Gain Sel 10; $I_{PR(min)} < I_P < I_{PR(max)}$	–	70.4	–	mV/A
		Gain Sel 11; $I_{PR(min)} < I_P < I_{PR(max)}$	–	52.8	–	mV/A
Overcurrent Fault Operating Range	$I_{OCF\text{-}OR}$	Typ. = factory-programmed default, FS = Full-Scale	25	50	100	%FS
Zero Current Output Voltage	$V_{IOUT(Q)}$	Unidirectional; I_P = 0 A, T_A = 25°C	–	0.33	–	V
TOTAL ERROR ($V_{IOUT(ACTUAL)}$ – ($Sens_{(IDEAL)} \times I_{PR} + V_{REF}$)) / ($Sens_{(IDEAL)} \times I_{PR}$)× 100 AND TOTAL ERROR COMPONENTS						
Total Error	E_{TOT}	$I_P = I_{PR(max)}$	–1.75	±1.4	1.75	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(max)}$, T_A = 25°C to 150°C	–1.5	±1.3	1.5	%
		$I_P = I_{PR(max)}$, T_A = –40°C to 25°C	–1.5	±1.2	1.5	%
Zero Current Reference Error	V_{RE}	$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±4	10	mV
		$V_{REFactual} - V_{REFideal}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±5	10	mV
Offset Error	V_{OE}	$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		$V_{IOUT(Q)} - V_{REF}$, I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
QVO Error	V_{QE}	$V_{IOUT(Q)}$, I_P = 0 A, T_A = 25°C to 150°C	–10	±6	10	mV
		$V_{IOUT(Q)}$, I_P = 0 A, T_A = –40°C to 25°C	–10	±7	10	mV

[1] Typicals are based on worse case mean ±3 sigma values during production or production and qualification.

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FUNCTIONAL DESCRIPTION

Power-On Reset Operation

POWER-ON

As V_{CC} ramps up, the ACS37002 V_{IOUT} and V_{REF} pins are high impedance until V_{CC} reaches and passes $V_{UVD(H)}$ [2] (or $V_{POR(H)}$ [1] if UVD is disabled). Once V_{CC} passes [2], the device takes some time without V_{CC} dropping below $V_{POR(L)}$ [8] before the device enters normal operation.

POWER-OFF

As V_{CC} drops below $V_{POR(L)}$ [8], the outputs will enter a high-impedance state. If UVD is enabled, before the device powers off, it will force V_{IOUT} to GND if $V_{CC} < V_{UVD(L)}$ [6] until $V_{POR(L)}$ [8] (seen in Figure 4 and Figure 6) is reached, at which point V_{IOUT} and V_{REF} will go high Z. If UVD is disabled, then V_{REF} and V_{IOUT} will continue to report until V_{CC} is less than $V_{POR(L)}$ [8] (seen in Figure 7), at which point they will go high Z.

Note: Since the device is entering a high Z state, and not forcing the output, the time it takes the output to settle will depend on the external circuitry used.

POWER-ON TIMING

The descriptions in this section assume: temperature = 25°C, with the labeled test conditions. 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_{LOAD},C_{LOAD}).

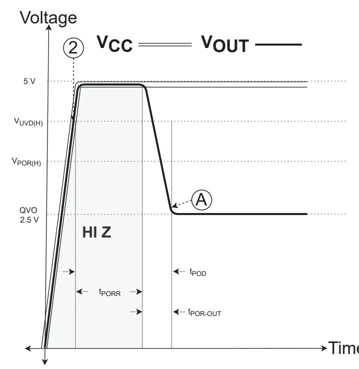

Figure 5: t_{POD} behavior UVD disabled, RL = Pull-Up

POWER-ON RESET (POR)

If V_{CC} falls below $V_{POR(L)}$ [8] while in operation, the output will re-enter a high-impedance state. After V_{CC} recovers and exceeds $V_{UVD(H)}$ [2], the output will begin reporting again after the delay of t_{POD}.

POWER-ON DELAY (T_{POD})

When the supply is ramped to $V_{UVD(H)}$ (seen in Figure 5 as [2]), the device will require a finite time to power its internal components before the outputs are released from high Z and can respond to an input magnetic field. Power-On Time, t_{POD}, is defined as the time it takes for the output voltage to settle within ±10% of its steady-state value under an applied magnetic field, which can be seen the time from [2] to [A]. After this delay, the output will quickly approach $V_{IOUT(Gauss)}$ = Sens × Amps + V_{REF}.

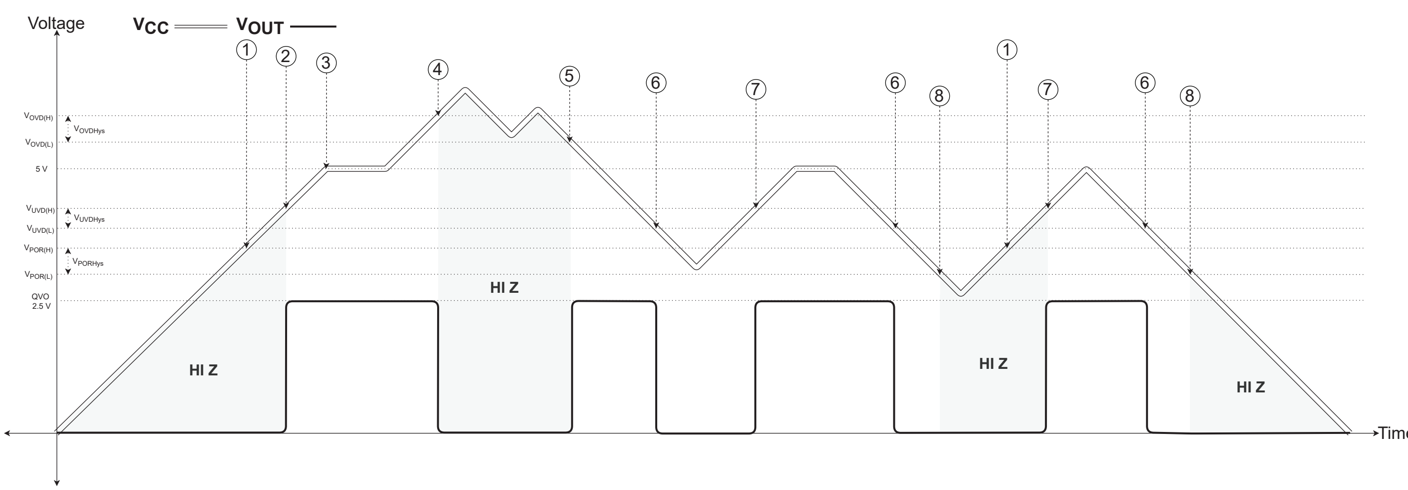

Figure 4: Power States Thresholds with V_{IOUT} Behavior for a 5 V Device, R_L = Pull-Down, UVD Enabled

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Overvoltage and Undervoltage Detection

To ensure that the device's output can be trusted, the device contains an overvoltage and an undervoltage detection flag. This will use V_{IOUT} to alert the system when the supply voltage is outside of the operational ranges.

UNDERVOLTAGE DETECTION VOLTAGE THRESHOLDS ($V_{UVD(H/L)}$)

The ACS37002 comes factory-programmed with UVD enabled. It is important to note that when powering up the device for the first time after a POR event, V_{IOUT} and V_{REF} will remain high Z until V_{CC} is raised above $V_{UVD(H)}$ (seen in Figure 6 as [2]), at which point the VIOUT and VREF pins will begin to operate. If UVD is disabled or it is a 3.3 V device, V_{IOUT} and V_{REF} will begin report after V_{CC} raises above $V_{POR(H)}$ (seen in Figure 7 as [1]) under the same conditions.

If V_{CC} drops below $V_{UVD(L)}$ [6] after normal operation, V_{IOUT} will go to GND regardless of R_{LOAD} configuration. The VIOUT pin will stay at GND until V_{CC} raises above $V_{UVD(H)}$ [7] or V_{CC} falls below $V_{POR(L)}$ [8]. If V_{CC} rises above $V_{UVD(H)}$ [7] after a UVD event, the outputs will resume operation. If V_{CC} drops below $V_{POR(L)}$ [8], the device will enter a POR event and reset; V_{IOUT} and V_{REF} will switch to high Z if this occurs.

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

When V_{CC} raises above $V_{OVD(H)}$ (seen in Figure 6 as [4]), the output of the V_{REF} and V_{IOUT} pin will go high Z, V_{REF} be pulled to GND, and V_{IOUT} will be pulled to either VCC or GND, depending if R_{Load} is in a pull-up or pull-down configuration.

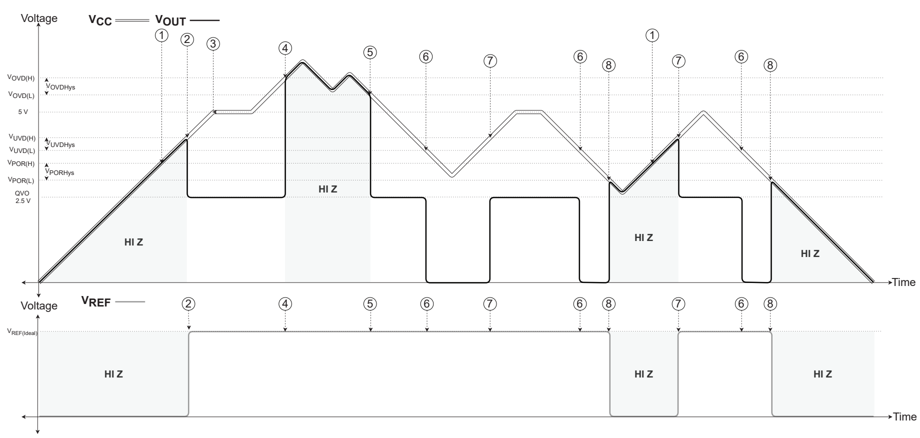

Figure 6: Power States Thresholds with V_{IOUT} and V_{REF} Behavior, 5 V Device, R_L = Pull-Up, UVD Enabled

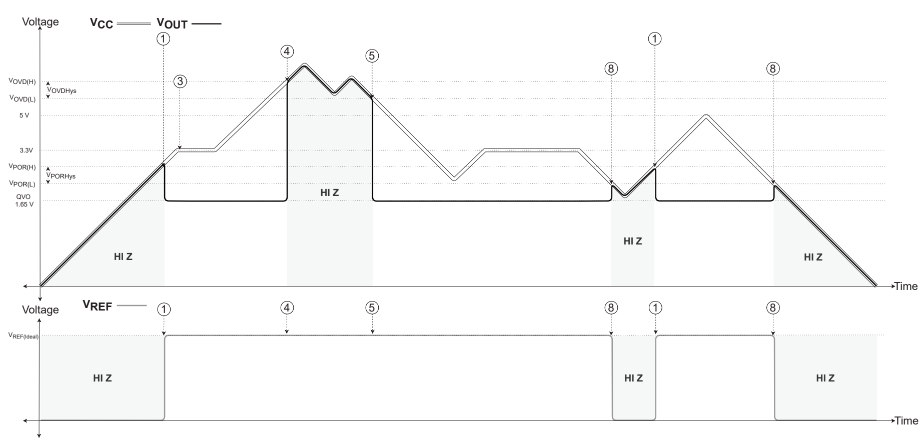

Figure 7: Power States Thresholds with V_{IOUT} and V_{REF} Behavior, 3.3 V Device, R_L = Pull-Up, UVD Disabled

OVERVOLTAGE/UNDERVOLTAGE DETECTION HYSTERESIS (V_{OVDHYS}, V_{UVDHYS})

To prevent toggling, there is hysteresis between enable and disable thresholds to reducing nuisance flagging and clears. There is about 1 V and 0.4 V of hysteresis for Overvoltage and Undervoltage respectively. These can be seen represented in Figure 6 between the relevant thresholds.

OVERVOLTAGE AND UNDERVOLTAGE ENABLE AND DISABLE TIME ($T_{OVD(E/D)}$, $T_{UVD(E/D)}$)

The enable time for OVD, $t_{OVD(E)}$, is the time from $V_{OVD(H)}$ [4] to OVD flag [B] in Figure 8. The UVD enable time, $t_{UVD(E)}$, is the time from $V_{UVD(L)}$ [6] to the UVD flag [D], also in Figure 8. The enable flag for both OVD and UVD has a counter to reduce transients faster than 64 µs from triggering nuisance flags.

If V_{CC} ramps from $>V_{UVD(L)}$ [6] to $<V_{POR(L)}$ [8] (both seen in Figure 8) faster than $t_{UVD(E)}$, then the device will not have time to report a UVD event before power off occurs.

The disable time for OVD, $t_{OVD(D)}$, is the time from $V_{OVD(L)}$ [5] to the OVD clear to normal operation [C] in Figure 8. The UVD disable time, $t_{UVD(D)}$, is the time from $V_{UVD(H)}$ [7] to the UVD flag clear to nominal operation [E], also seen in Figure 8. The disable time does not have a counter for either UVD or UVD to release the output and resume reporting as soon as possible.

SUPPLY ZENER CLAMP VOLTAGES

If the voltage applied to the device continues to increase past overvoltage detection to extreme levels, there is a point when the Zener diodes will turn on (V_Z). These internal diodes are in place to protect the device from short high voltage or ESD events and should NOT be used as a feature to reduce the voltage on a line.

Continued exposure to voltages higher than normal operating voltage $V_{CC(typical)}$ can weaken or even damage the Zener diodes and potentially lead to damage of the part.

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

This is the greatest voltage that can be supplied to V_{CC} from GND during programing 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 or V_{FOUT} rating should be read as a voltage of 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 or V_{ROUT} 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 REFERENCE/FAULT VOLTAGE

The Forward Reference/Fault Voltage or V_{F-RF} rating should be read as a voltage of 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 or V_{R-RF} 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.

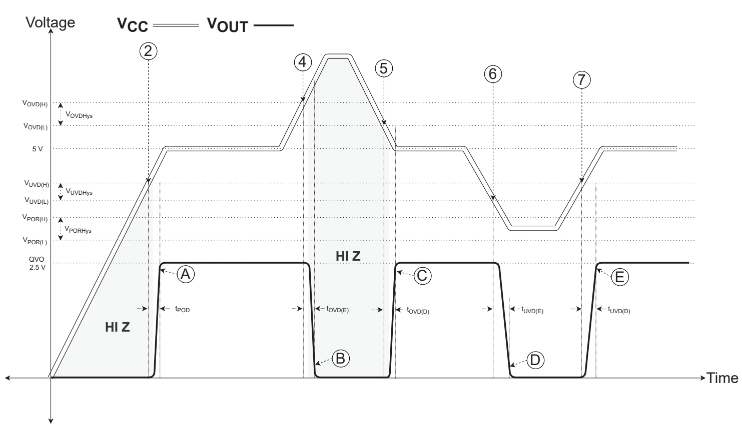

Figure 8: t_{POD}, $t_{OVD(E/D)}$, and $t_{UVD(E/D)}$ with R_L = Pull-Up

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DEFINITIONS OF OPERATING AND PERFORMANCE CHARACTERISTICS

OUTPUT SOURCE AND SINK CURRENT

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

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 zero amps are applied.

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 125/150°C or 25°C to –40°C respectively). 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 pin (VREF) on the ACS37002. This allows the user to know the zero-current voltage for the output channel V_{IOUT}. This allows for differential measurement and allows for 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 125/150°C or 25°C to –40°C respectively).

Offset Voltage (V_{OE})

Offset Voltage or V_{OE} is defined as QVO-V_{REF} and is demonstrated in Figure 9**.** This includes the drift of QVO-V_{REF} from room to hot or room to cold (25°C to 125/150°C or 25°C to –40°C respectively).

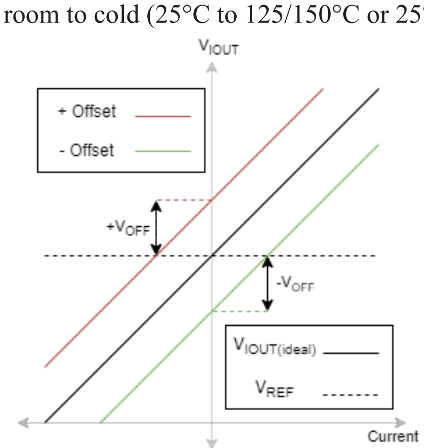

Figure 9: Offset (V_{OFF}) Between V_{IOUT} and V_{REF}

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

Output Saturation Voltage or V_{SAT} is defined as the voltage that output no longer changes when the magnitude of the magnetic field is increased. $V_{SAT(HIGH)}$ is the highest voltage the output can drive to while, $V_{SAT(LOW)}$ is the lowest. This can be seen in Figure 10. 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 10. The output is centered at QVO and will remain within datasheet limits across the V_{OOR}. It is possible for the output to report beyond these voltages until V_{SAT}, but certain parameters may not meet datasheet limits. The output performance is demonstrated in Figure 9 through and beyond the V_{OOR}.

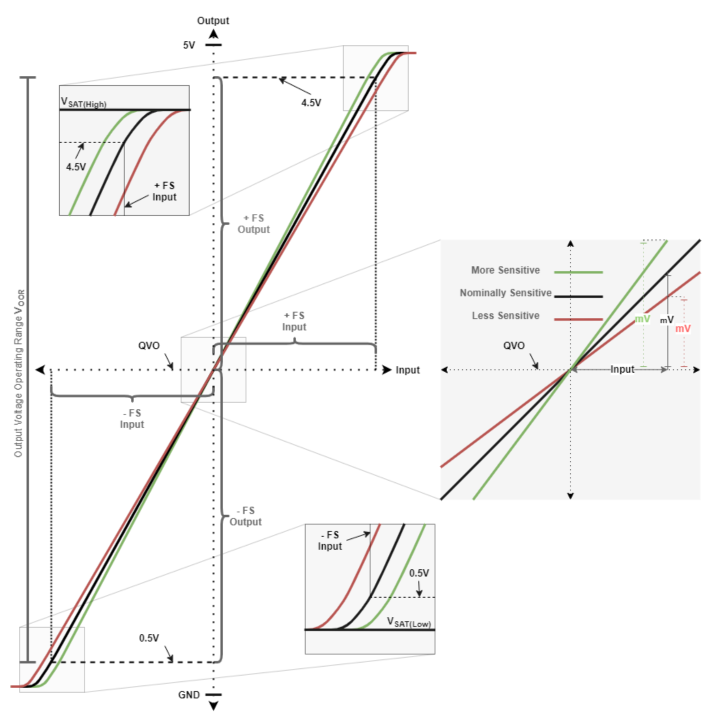

Figure 10: V_{OOR}, V_{SAT} and SENS with Full Scale

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Sensitivity (Sens)

The definition of Sensitivity or Sens is the ratio of the output swing versus current through the IP pins. This current moves the output voltage away from its QVO and towards the supply voltage rails. The magnitude and direction of the output voltage swing is proportional by Sens to the magnitude and direction of the applied current.

$$Sens = \frac{V_{OUT(I1)} - V_{OUT(I2)}}{I_1 - I_2}$$

where I_1 and I_2 are two different currents, and where $V_{IOUT(I1)}$ and $V_{IOUT(I2)}$ are the voltages of the device with the applied currents. V_{IOUT}, I_1, or I_2 can be QVO with zero current.

Sensitivity Error (E_{sens})

Sensitivity Temperature Drift or E_{sens} is defined as the drift of Sens from room to hot or room to cold (25°C to 125°C or 25°C to –40°C respectively). No trimming/programming is needed because temperature drift is compensated with Allegro's factory trim to remain within the datasheet limits across temperature.

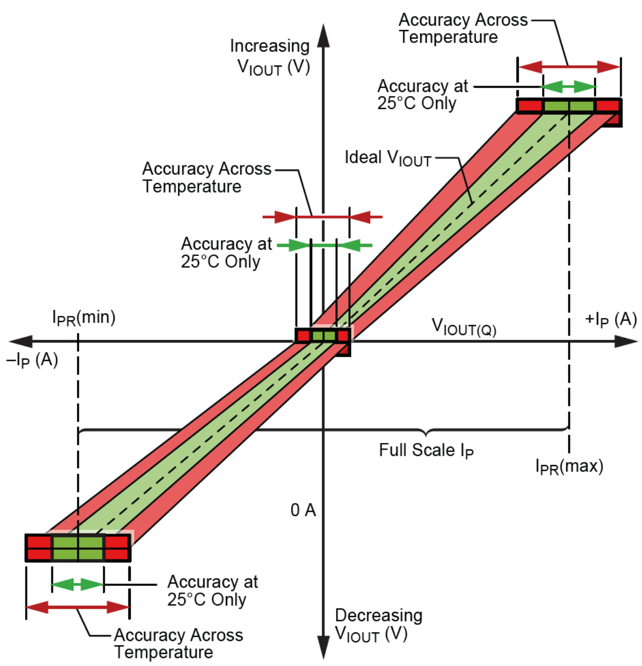

Figure 11: Output Accuracy Pocket for Room and Across Temperature

Gain Selection Pins

The ACS37002 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 (logic 1 or 0). Both pins include an internal 1 MΩ pull-down to GND. 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 22 in the application and theory section.

Full Scale (FS)

Full Scale or FS is defined as the range that relates the devices actual sensitivity, V_{OOR} and V_{REF}. This value is used for reference of the devices functional operation range and when discussing a fault trip level. 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 10, labeled as positive or negative FS input and FS output. The equation for input referred FS for a 5 V bidirectional device is:

$$FS = \pm 2\ V/Sens_{Actual}$$

Note that a percentage change in FS_{INPUT} is equivalent to 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} and an exaggerated example can be seen in Figure 12. Consider two currents, I_1(1/2 FS) and I_2(FS). Ideally, the sensitivity of the device is the same for both fields everything else equal. 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:

$$E_{LIN(\pm)} = \left(1 - \frac{Sens_{I2\pm}}{Sens_{I1\pm}}\right) * 100\%$$

where:

$$Sens_{Ix+} = (V_{IOUTIx+} - V_{REF}) / I_{x+}$$

and

$$Sens_{Ix-} = (V_{IOUTIx-} - V_{REF}) / I_{x-}$$

Ix are positive and negative currents through I_P, such that $|I_{+2}| = 2 \times |I_{+1}|$ and $|I_{-2}| = 2 \times |I_{-1}|$.$E_{LIN} = \max(E_{LIN(+)}, E_{LIN(-)})$

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Total Output Error (E_{TOT})

The difference between the current measurement from the sensor IC and the actual current I, relative to the actual 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 field applied to the device:

$$E_{TOT(\pm)} = \left(1 - \frac{V_{IOUT\_Actual(\pm I)}}{V_{IOUT\_Ideal(\pm I)}}\right) * 100\%$$

where

$$V_{IOUT\_Actual(I\pm)} = \pm I \times Sens_{Actual} + QVO_{Actual}$$

and

$$V_{IOUT\_Ideal(I\pm)} = \pm I \times Sens_{Ideal} + V_{REF\_Actual}$$

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 fields, Total Output Error will be mostly due to Offset Voltage (V_{OE}). In fact, at I = 0, Total Output Error approaches infinity due to the offset. An example of total error at FS can be seen in Figure 12.

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

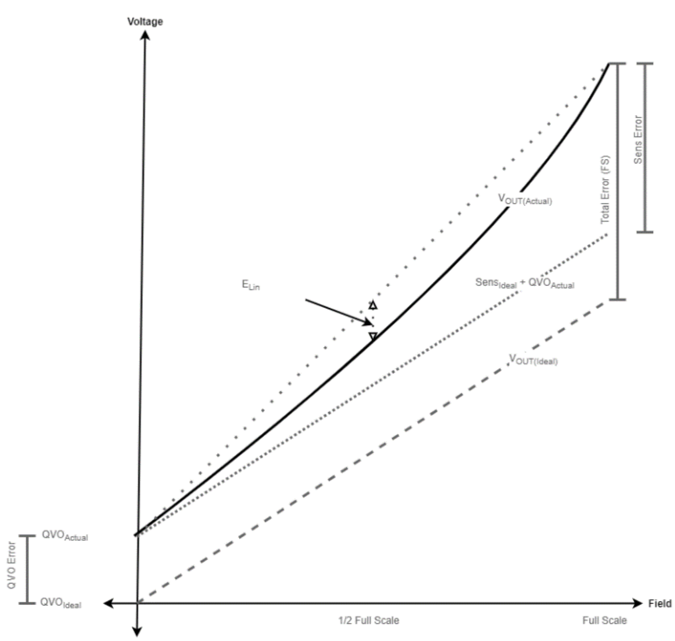

Figure 12: Accuracy Error

Power Supply Offset Error (V_{PS})

Power Supply Offset Error or V_{PS} is defined at the offset error in mV between V_{CC} and V_{CC} ±10% V_{CC}. For a 5 V device, this is 5 to 4.5 V and 5 to 5.5 V. For a 3.3 V device, this is 3.3 to 3 V and 3.3 to 3.6 V.

Offset Power Supply Rejection Ratio (PSRRO)

The Offset Power Supply Rejection Ratio or PSRRO is defined as 20 × log of the ratio of the change of QVO in volts over a ±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 % sensitivity error measured between V_{CC} and V_{CC} ±10%. For a 5 V device, this is 5 to 4.5 V and 5 to 5.5 V. For a 3.3 V device, this is 3.3 to 3 V and 3.3 to 3.6 V.

Sensitivity Power Supply Rejection Ratio (PSRRS)

The Sensitivity Power Supply Rejection Ratio or PSRRS is defined as 20 × log of the ratio of the % change the sensitivity over the % change in V_{CC} (±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:

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

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FAULT BEHAVIOR

Overcurrent Fault (OCF)

As the output swings because of a sensed current, 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 already 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 13 as [9] along with the FAULT pin functionality.

OVERCURRENT FAULT HYSTERESIS ($I_{OCF-HYST}$)

Overcurrent Fault Hysteresis or $I_{OCF-HYST}$ is defined as the magnitude of current in percentage of the 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 15. Note the MASK and HOLD functionality are independent of each other. The ACS37002 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. If a larger hysteresis is desired, ask an Allegro representative for options.

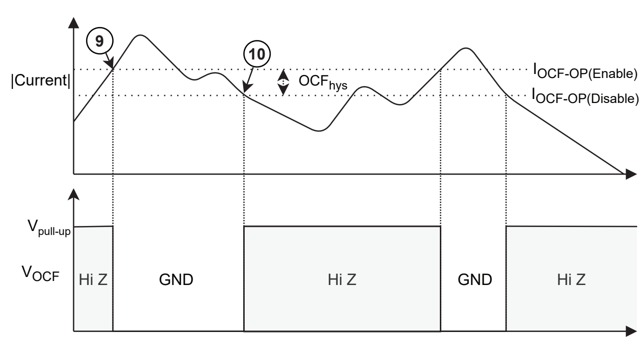

Figure 13: Fault Thresholds and OCF Pin Functionality

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 defined regions of 0.2 to 2 V and <0.2 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 14. When V_{OC} <0.2 V, the internal EEPROM fault level will be used.

The resulting equation for the fault is:

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

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

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		Factory Default (100%)	
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%

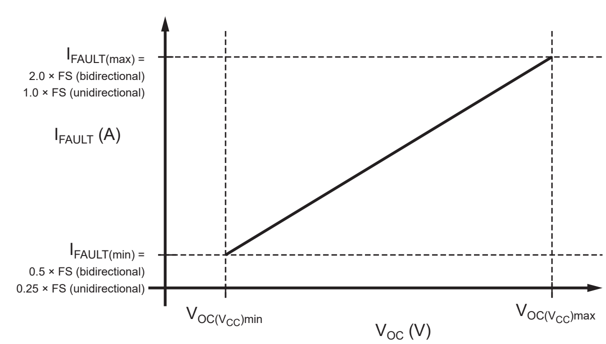

Figure 14: VOC Functional Range

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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 15) until the devices FAULT 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 15 until the FAULT pin reaches V_{OCF-ON} at point [F] with the OCF mask disable. 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 15 [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 16). This prevents short transient spikes from causing erroneous OCF flagging. Factory default setting is $t_{OCF-MASK}$ = 0.5 µs. Ask an Allegro representative for further information.

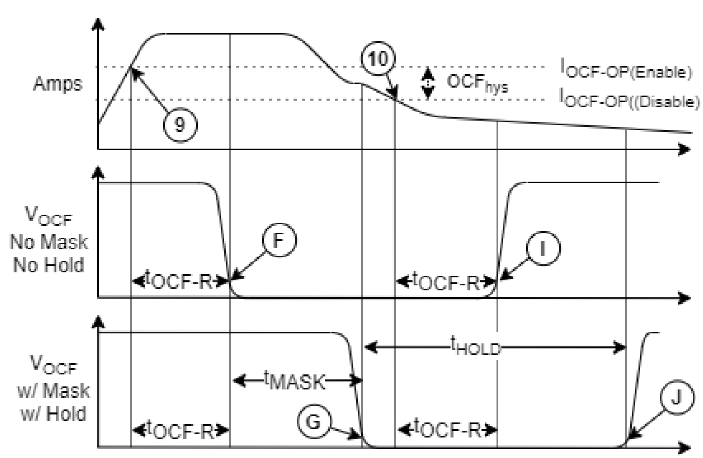

**Figure 15: General Fault Timing.
Note: the MASK and HOLD functionality
are independent of each other**

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 15 [G] until [J]) or persist if the OCF condition is still present (seen in Figure 17 [G] until [J]). Factory default is 0 ms. Ask an Allegro representative for further information.

OVERCURRENT FAULT PERSIST

The ACS37002 has a fault persist option that will maintain the OCF flag if a flag occurred until a POR event. Ask an Allegro representative for further information.

OCF DISABLE

The ACS37002 also contains the ability to disable overcurrent fault functionality. When this bit is set to 1, the FAULT pin will remain in high Z. Ask an Allegro representative for further information.

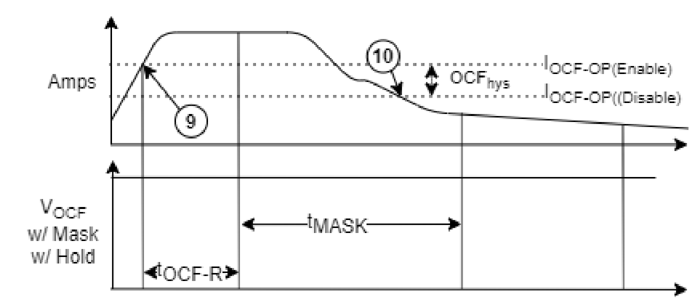

**Figure 16: Fault Condition Clearing
Before Mask Time Is Reached**

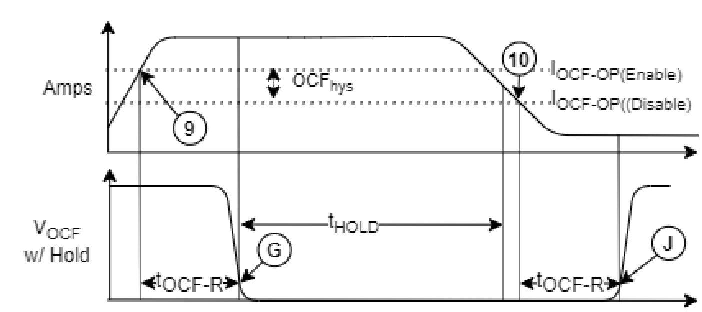

Figure 17: Fault Hold with Clear Fault After Hold Time

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DYNAMIC RESPONSE PARAMETERS

The descriptions in this section assume: temperature =25°C, and output loads are within specifications provided. The step applied is a input step that corresponds to 1 V excursion on the output, unless otherwise stated.

Propagation Time (t_{pd})

The time interval between a) when the sensed field reaches 10% of its stable value, and b) when the sensor output reaches 10% of its stable value for a step input. See Figure 18.

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 18.

Response Time ($t_{RESPONSE}$)

The time interval between a) when the sensed field reaches 90% of its stable value, and b) when the sensor output reaches 90% of its stable value. See Figure 18 for visual description of parameter.

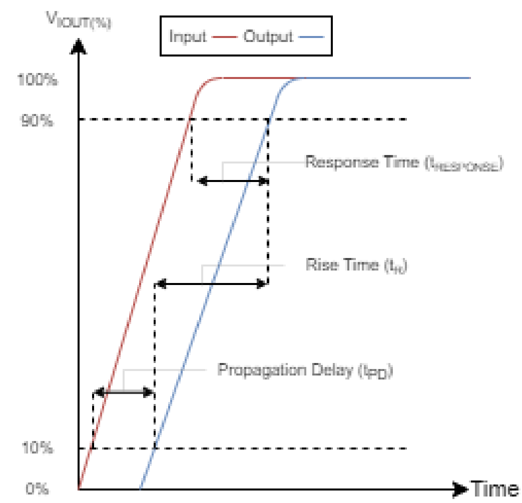

Figure 18: Dynamic Response Parameters

Overshoot

The amount, in percent of step size, the output voltage (V_{IOUT}) rises past the steady state output voltage. The equation used to calculate this is shown below, see Figure 19 for description of parameters in the equation.

Settling Time

The amount of time it takes for the output voltage (V_{IOUT}) to settle to between ± 3% of the steady state output. see Figure 19.

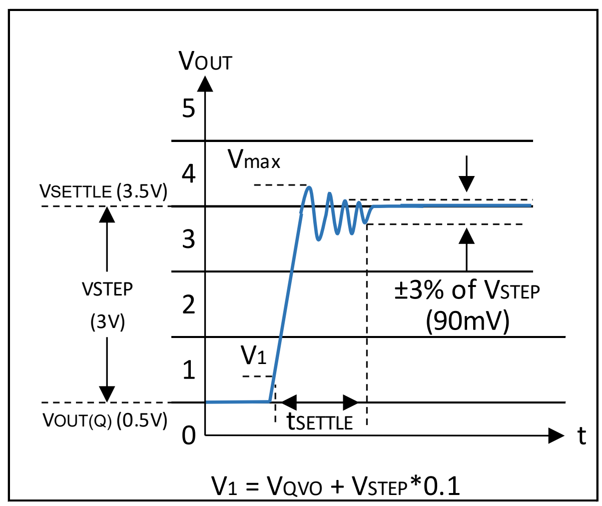

Figure 19: Overshoot and Settling Time (3 V step shown)

Temperature Compensation

To remove the effects temperature has on the performance of the ACS37002, an internal temperature sensor is integrated. This sensor and compensation algorithms help to standardize device performance over the full range of operating temperatures.

Temperature Compensation Update Rate

There is about 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.

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APPLICATION AND THEORY

Application Circuits

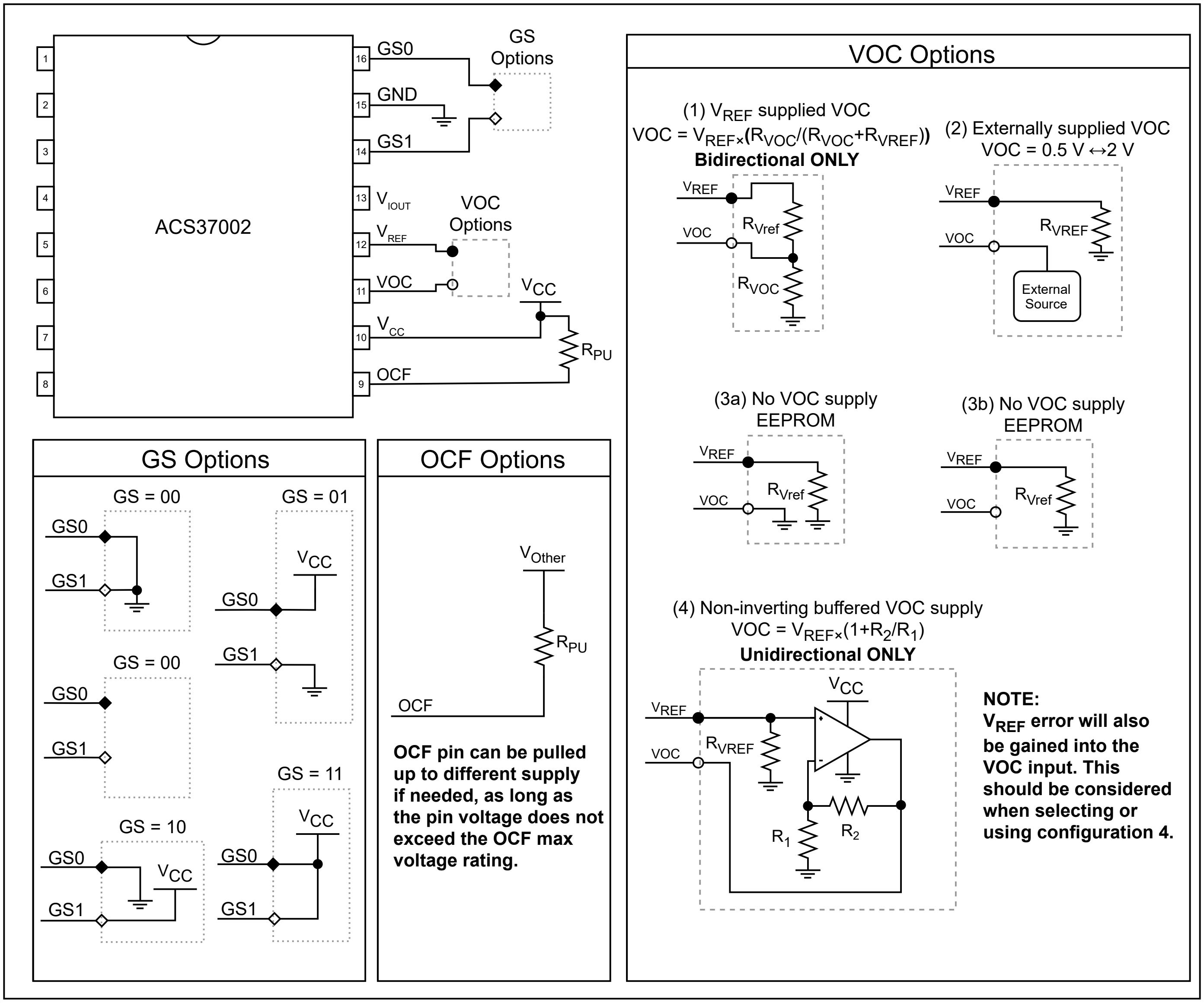

Figure 20: Applications Circuits for GAIN_SEL, VOC, and FAULT pin

These configurations are simplified to the network required for functionality.

Bypass and load capacitors are recommend for best performance.

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Theory and Functionality – VOC and OCF

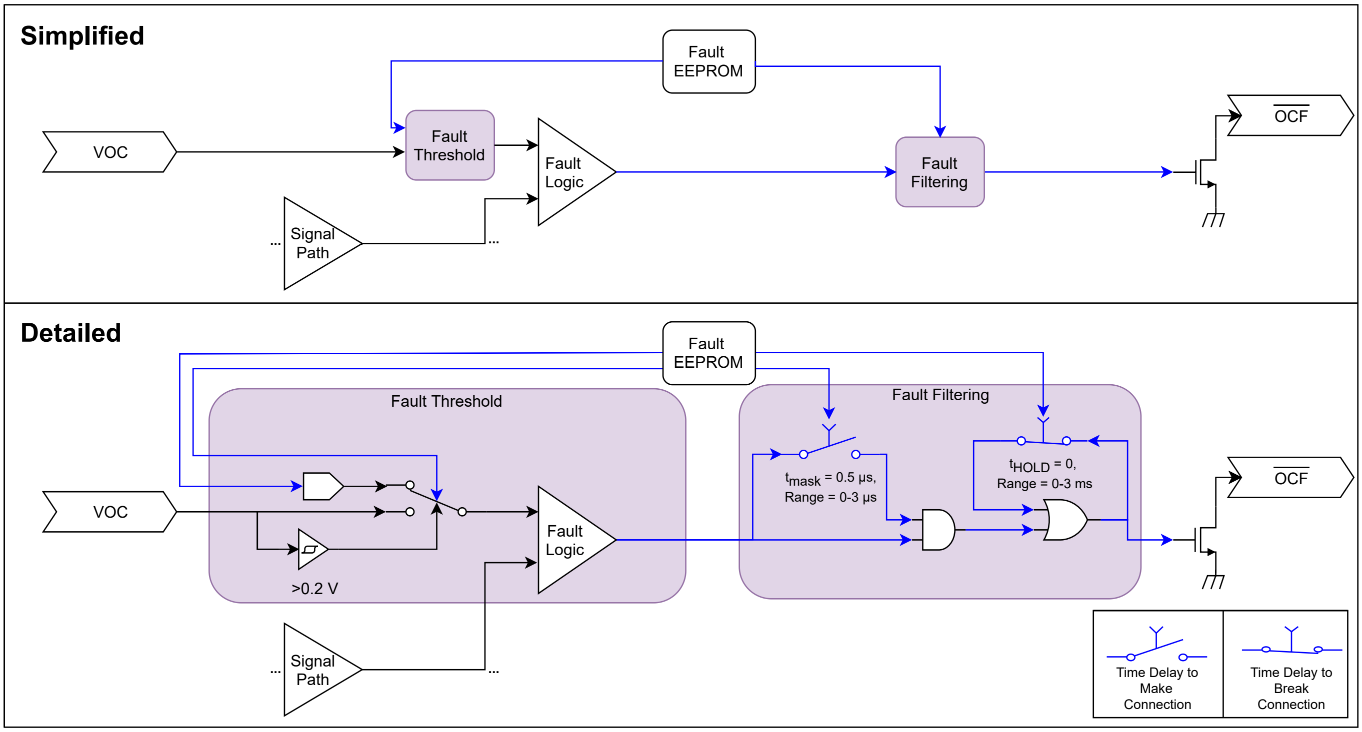

Figure 21: OCF Signal Path Simplified and Detailed Blocks of Functionality

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 GM = 4 for the non-inverting op-amp, 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. With less than 1 nF C_{LOAD} on the outputs, use 100 nF C_{BYPASS}; if 2 to 3 nF C_{LOAD}, use 1 µF C_{BYPASS}; if C_{LOAD} is 6 nF, use 10 µF C_{BYPASS}.

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Dynamically Change Gain in a System

The ACS37002 has GAIN_SEL pins that are used to change the gain of a device on startup. If a more dynamic gain is desired, then drop 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 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 devices V_{IOUT} comes out of high Z will not affect gain. The cycle time to complete this operation is up to 2 × t_{POD}.

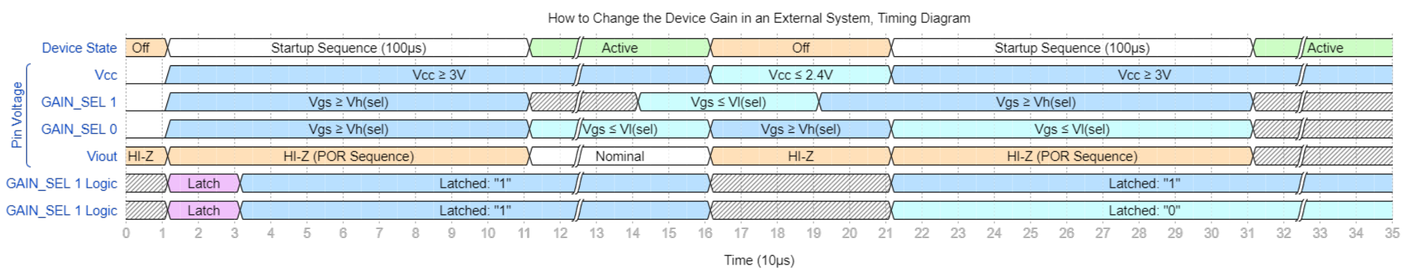

Figure 22: GAIN_SEL Dynamic Gain Changing Timing Diagram

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THERMAL PERFORMANCE

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 23 shows the measured rise in steady-state die temperature of the ACS37002 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 24 shows the maximum continuous current at a given T_A. Surges beyond the maximum current listed in Figure 25 are allowed given the maximum junction temperature, $T_{J(MAX)}$ (165°C), is not exceeded.

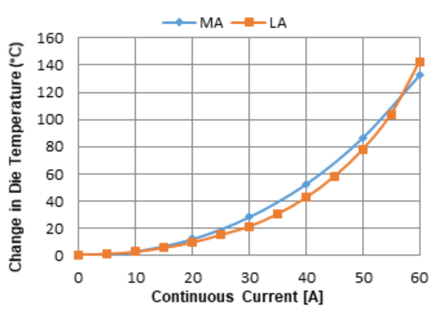

Figure 23: Self heating in the MA and LA package due to current flow

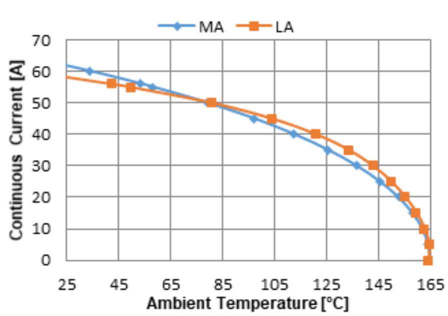

Figure 24: Maximum Continuous Current at a Given T_A

The thermal capacity of the ACS37002 should be verified by the end user in the application's specific conditions. The maximum junction temperature, $T_{J(MAX)}$ (165°C), 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.

Evaluation Board Layout

Thermal data shown in Figure 23 and Figure 24 was collected using the ASEK37002 Evaluation Board (TED-0002825). This board includes 750 mm^2 of 4 oz. copper (0.1388 mm) 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 25.

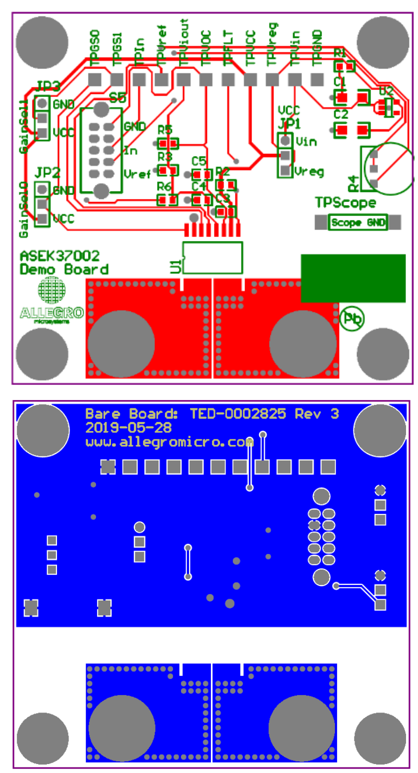

Figure 25: Top and Bottom Layers for ASEK37002 Evaluation Board

Gerber files for the ASEK37002 evaluation board are available for download from the Allegro website. See the technical documents section of the ACS37002 webpage.

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PACKAGE OUTLINE DRAWINGS

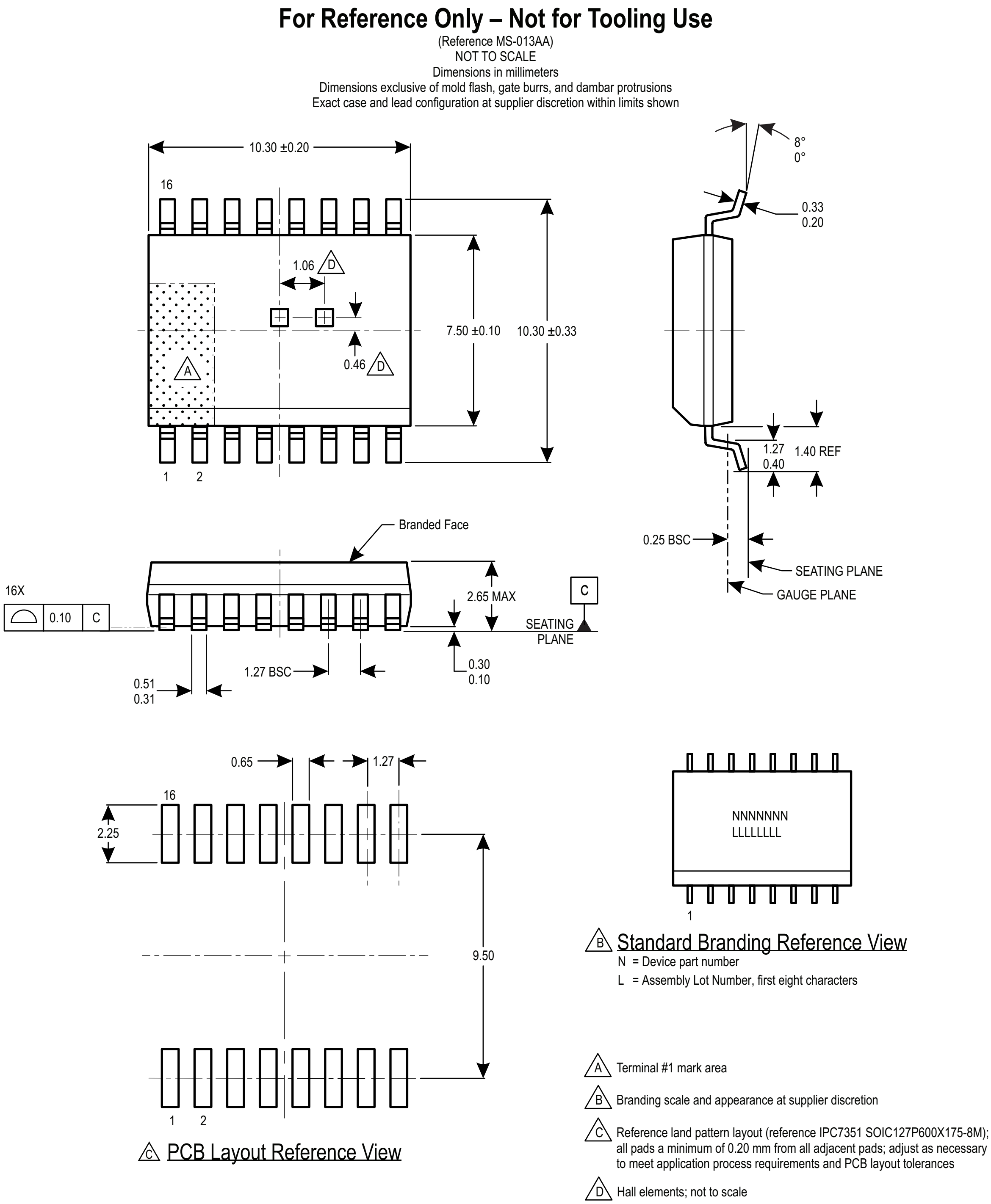

Figure 26: Package MA, 16-Pin SOICW

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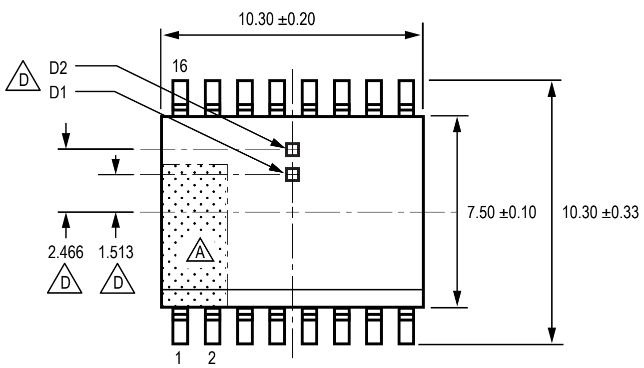
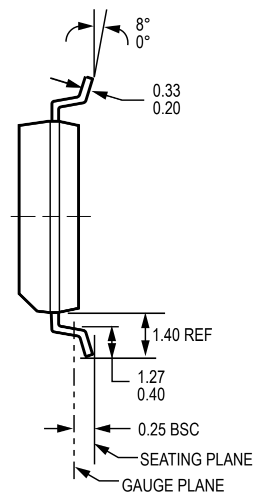
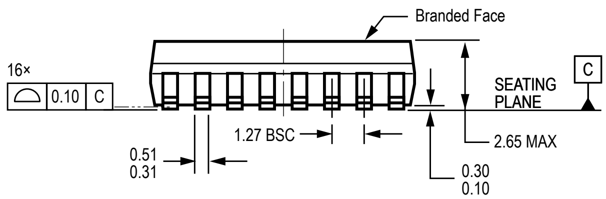
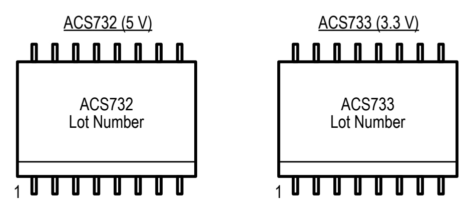








For Reference Only; not for tooling use (reference MS-013AA)
Dimensions in millimeters
Dimensions exclusive of mold flash, gate burrs, and dambar protrusions
Exact case and lead configuration at supplier discretion within limits shown

A Terminal #1 mark area

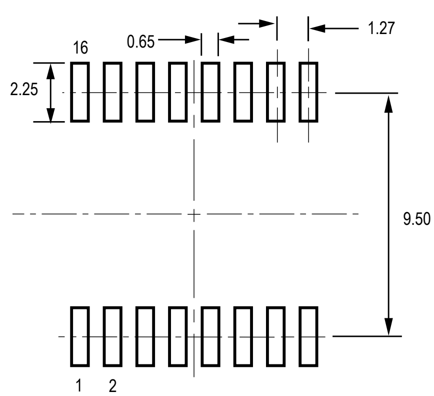
B Branding scale and appearance at supplier discretion

C Reference land pattern layout (reference IPC7351 SOIC127P600X175-8M); all pads a minimum of 0.20 mm from all adjacent pads; adjust as necessary to meet application process requirements and PCB layout tolerances

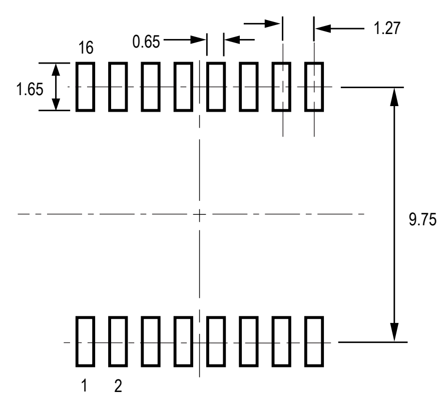
D Hall elements (D1, D2); not to scale

B Standard Branding Reference View

Line 1: Part Number
Line 2: First 9 characters of Assembly Lot Number



C PCB Layout Reference View



High-Isolation PCB Layout Reference View

Figure 27: Package LA, 16-PIN SOICW

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Revision History

Number	Date	Description
–	June 23, 2020	Initial release

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