5V LINEAR HALL EFFECT CURRENT SENSOR WITH COMMON-MODE FIELD REJECTION

Description

The AHC1724 current sensor IC is an economical and precise solution for AC or DC current sensing in industrial, automotive, commercial, and communications systems. The small package is ideal for space-constrained applications while also saving costs due to reduced board area.

The device consists of a precise, low-offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. The current is sensed differentially to reject common-mode fields, improving accuracy in magnetically noisy environments.

The inherent device accuracy is optimized through the close proximity of the magnetic field to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper-stabilized architecture which is programmed for accuracy after packaging. The output of the device has a positive slope when an increasing current flows through the primary copper conduction path (from pins 1 and 2 to pins 3 and 4), which is the path used for current sensing. The internal resistance of this conductive path is 1.2mΩ typical, providing low power loss.

The terminals of the conductive path are electrically isolated from the sensor leads (pins 5 through 8). This allows the AHC1724 current sensor IC to be used in high-side current sense applications without the use of high-side differential amplifiers or other costly isolation techniques.

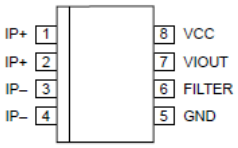
The AHC1724 is provided in a small, low-profile surface-mount SO-8 (Type CJ2) package. The leadframe is plated with 100% matte tin, which is compatible with standard lead (Pb) free printed circuit board assembly processes.

Features

- -40°C to +150°C Operating Temperature
- Ratiometric Output from 5V Supply Operating Voltage Range
- High-Bandwidth 120kHz Analog Output for Faster Response Time
- Differential Hall Sensing Rejects Common-Mode Fields
- 1.2mΩ Primary Conductor Resistance for Low-Power Loss and High Inrush Current Withstand Capability
- ESD HBM: 6kV, CDM: 2kV
- Industrial-Standard SO-8 (Type CJ2) Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

Pin Assignments

(Top View)



SO-8 (Type CJ2)

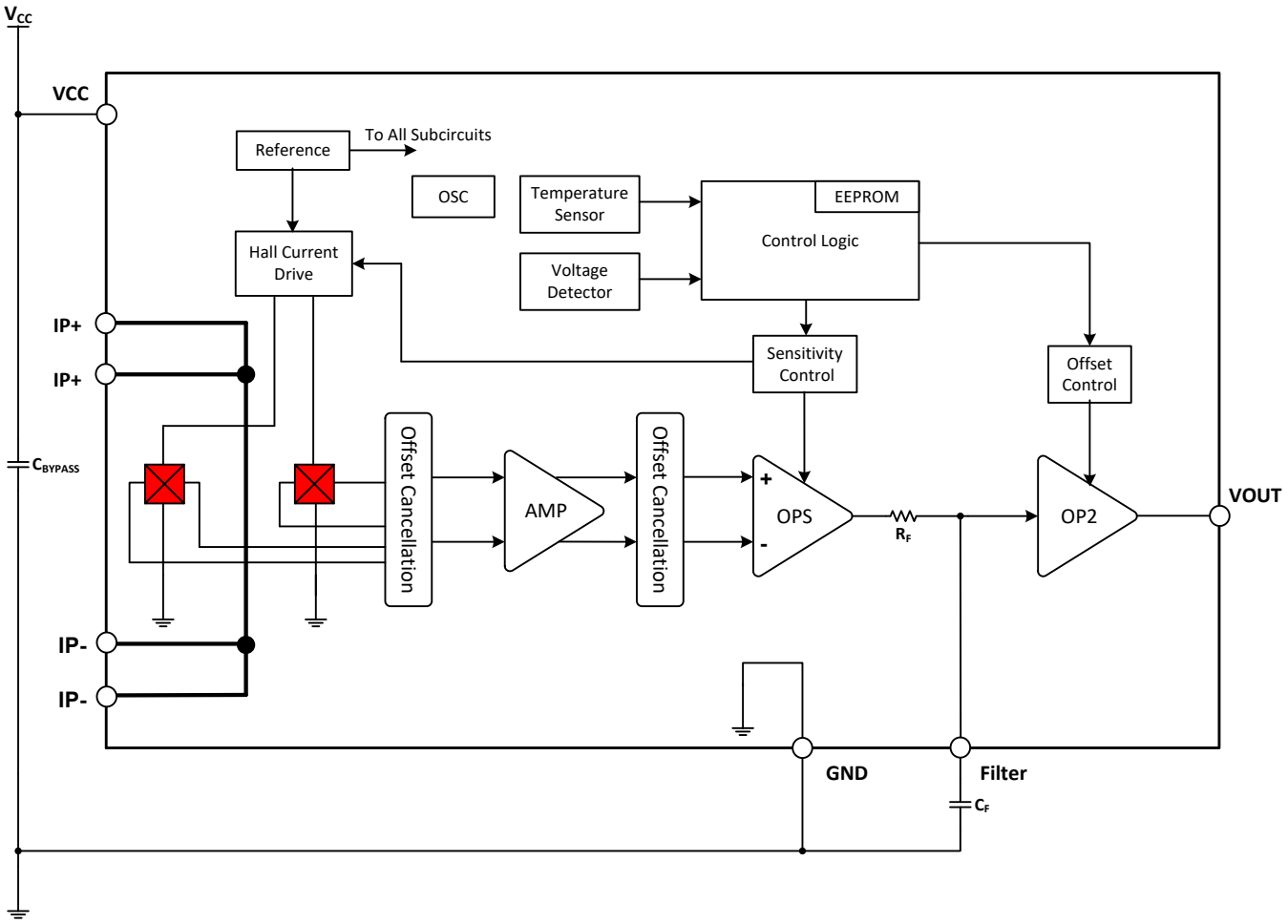
Applications

- Motor control
- Load detection and management
- Switch-mode power supplies
- Overcurrent fault protection
- Solar micro inverters
- Base station radio power amplifiers
- Server power, PSU, PDU, UPS

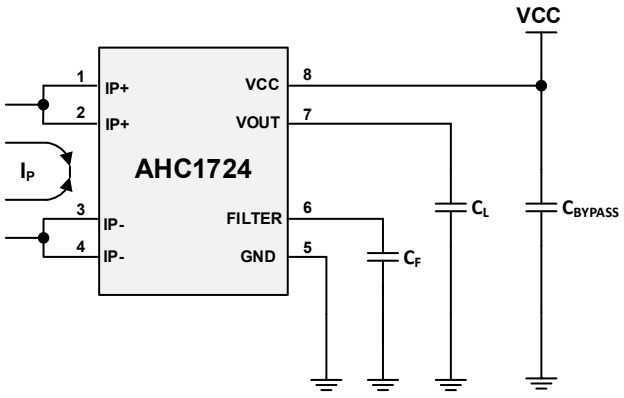
Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

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Functional Block Diagram



Typical Applications Circuit (Note 4)



Note: 4. The AHC1724 outputs an analog signal, VOUT, that changes proportionally with the bidirectional AC or DC primary sensed current, I_P, within the specified measurement range. The FILTER pin can be used to decrease the bandwidth in order to optimize the noise performance. C_F = 4.7nF, C_L = 1nF, C_{BYPASS} = 100nF.

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Pin Descriptions

Package: SO-8 (Type CJ2)

Pin Number	Pin Name	Function
1, 2	IP+	Primary current (+). Terminals for current being sensed; fused internally
3, 4	IP-	Primary current (-). Terminals for current being sensed; fused internally
5	GND	Signal ground terminal
6	FILTER	Terminal for external capacitor that sets bandwidth
7	VOUT	Analog output signal
8	VCC	Device power supply terminal

Selection Guide

Part Number	I_{PR} (A)	Sens (Typ) at V_{CC} = 5V (mV/A)	T_A (°C)	Packing
AHC1724-2P5B	±2.5	800	-40 to 150	Tape and Reel, 4000 Pieces per Reel
AHC1724-05U	5			
AHC1724-05B	±5	400		
AHC1724-10U	10			
AHC1724-10B	±10	200		
AHC1724-20U	20			
AHC1724-20B	±20	100		
AHC1724-30U	30	133		
AHC1724-30B	±30	66		
AHC1724-50B	±50	40		

Absolute Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

Symbol	Characteristic	Value	Unit
V_{CC}	Supply Voltage	6	V
V_{RCC}	Reverse Supply Voltage	-0.1	V
V_{OUT}	Output Voltage	VCC + 0.5	V
V_{ROUT}	Reverse Output Voltage	-0.1	V
T_A	Operating Ambient Temperature	-40 to 150	°C
$T_{J(MAX)}$	Junction Temperature	165	°C
T_{STG}	Storage Temperature	-65 to 165	°C
ESD HBM	Electrostatic Discharge Withstand Capability — Human Body Model	6	kV
ESD CDM	Electrostatic Discharge Withstand Capability — Charged Device Model	2	kV

Isolation Characteristics

Symbol	Characteristics	Conditions	Rating	Unit
V_{SURGE}	Dielectric Surge Strength Test Voltage	Tested ±5 pulses at 2/minute in compliance to IEC 61000-4-5 1.2µs (Rise) / 50µs (Width).	6000	V
V_{ISO}	Dielectric Strength Test Voltage	Agency type-tested for 60 seconds per UL standard UL 62368-1; production-tested at VISO for 1 second, in accordance with UL 62368-1.	2400	V_{RMS}
V_{WVBI}	Working Voltage for Basic Isolation	Maximum approved working voltage for basic (single) isolation according to UL 62368-1.	420	V_{PK} or VDC
			297	V_{RMS}
D_D	Clearance	Minimum distance through air from IP leads to signal leads.	4.2	mm
D_{CR}	Creepage	Minimum distance along package body from IP leads to signal leads.	4.2	mm
CTI	Comparative Tracking Index	Material Group II	400 to 599	V

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Package Thermal Information (Note 5)

Symbol	Characteristics	Rating (Note 5)	Unit
θ_{JA}	Junction to Ambient	65.55	°C/W
$\theta_{JC(TOP)}$	Junction to Case (Top)	27.54	°C/W
θ_{JB}	Junction to Board (Bottom)	23.91	°C/W
ψ_{JT}	Junction to Top Characterization Parameter	1.47	°C/W
ψ_{JB}	Junction to Board Characterization Parameter	23.60	°C/W
$\theta_{JC(BOT)}$	Junction to Case (Bottom)	21.80	°C/W

Thermal Characteristics

Symbol	Characteristics	Conditions	Rating	Unit
$R_{\theta JA}$	Package Thermal Resistance (Junction to Ambient)	Mounted on the Diodes TDBH0203 evaluation board with 1700 mm^2 of 4oz. copper on each side, connected to pins 1 and 2, and to pins 3 and 4, with thermal vias connecting the layers. Performance values include the power consumed by the PCB.	30	°C/W

Common Electrical Characteristics (Note 6) (Valid through the full range of T_A, V_{CC} = 5V, C_F = 0F, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	—	4.5	—	5.5	V
Supply Current	I_{CC}	V_{CC} = 5V, Output Open	—	8	14	mA
Output Capacitance Load	C_L	VOUT to GND	—	—	10	nF
Output Resistive Load	R_L	VOUT to GND	4.7	—	—	kΩ
Primary Conductor Resistance	R_{IP}	T_A = 25°C	—	1.2	—	mΩ
Primary Conductor Inductance	L_{IP}	T_A = 25°C	—	2	—	nH
Internal Filter Resistance (Note 7)	$R_{F(INT)}$	—	—	1.8	—	kΩ
Common Mode Field Rejection Ratio	CMFRR	Uniform External Magnetic Field	—	40	—	dB
Primary Hall Coupling Factor	G1	T_A = 25°C	—	11	—	G/A
Secondary Hall Coupling Factor	G2	T_A = 25°C	—	2.8	—	G/A
Hall Plate Sensitivity Matching	Sensmatch	T_A = 25°C	—	±1	—	%
Rise Time	t_R	T_A = 25°C, C_L = 1nF	—	3	—	µs
Propagation Delay	t_{PD}	T_A = 25°C, C_L = 1nF	—	2	—	µs
Response Time	$t_{RESPONSE}$	T_A = 25°C, C_L = 1nF	—	4	—	µs
Bandwidth	B_W	Small Signal -3Db, C_L = 1nF	—	120	—	kHz
Noise Density	I_{ND}	Input-Referenced Noise Density, T_A = 25°C, C_L = 1nF	—	150	—	µA(rms)/√Hz
Noise	I_N	Input-Referenced Noise: C_F = 4.7nF, C_L = 1nF, BW = 18kHz, T_A = 25°C	—	25	—	mA(rms)
Nonlinearity	E_{LIN}	Through Full Range of I_P	-1.5	—	1.5	%
Sensitivity Ratiometry Coefficient	SENS_RAT_COEF	V_{CC} = 4.5V to 5.5V, T_A = 25°C	—	1.3	—	—
Zero-Current Output Ratiometry Coefficient	QVO_RAT_COEF	V_{CC} = 4.5V to 5.5V, T_A = 25°C	—	1	—	—

Notes:
5. Device mounted on FR-4 substrate, JEDEC 2S2P 4 layer 114mm x 76mm PCB board (2oz copper), with minimum recommended pad layout.
6. Device may be operated at higher primary current levels, I_P, ambient temperatures, T_A, and internal leadframe temperatures, provided the Maximum Junction Temperature, $T_{J(MAX)}$, is not exceeded.
7. $R_{F(INT)}$ forms an RC circuit via the FILTER pin.

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Common Electrical Characteristics (Note 6) (Valid through the full range of T_A, V_{CC} = 5V, C_F = 0F, unless otherwise specified.) (continued)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Saturation Voltage (Note 8)	V_{OH}	R_L = 4.7kΩ	—	VCC – 0.3	—	V
Supply Current	V_{OL}	R_L = 4.7kΩ	—	0.3	—	V
Power-On Time	t_{PO}	T_A = 25°C, $V_{CC} \geq V_{CC}$ (Min) to Valid Output	—	80	—	µs
Shorted Output-to-Ground Current	$I_{SC(GND)}$	T_A = 25°C	—	3.3	—	mA
Shorted Output-to-VCC Current	$I_{SC(VCC)}$	T_A = 25°C	—	45	—	mA

AHC1724-2P5B (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	-2.5	—	2.5	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	800	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$)	Bidirectional, I_P = 0A	—	V_{CC} × 0.5	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±1.5	2.5	%
		$I_P = I_{PR(MAX)}$), T_A = -40°C to 25°C	-6.5	±4.5	6.5	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$), T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$), T_A = -40°C to 25°C	-6	±4.5	6	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-20	±7	20	mV
		I_P = 0A, T_A = -40°C to 25°C	-40	±13	40	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

AHC1724-05U (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	0	—	5	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	800	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$)	Unidirectional, I_P = 0A	—	V_{CC} × 0.1	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±0.9	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6.5	±4.6	6.5	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4.5	6	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-20	±10	20	mV
		I_P = 0A, T_A = -40°C to 25°C	-40	±18	40	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

Notes:
6. Device may be operated at higher primary current levels, I_P, ambient temperatures, T_A, and internal leadframe temperatures, provided the Maximum Junction Temperature, $T_{J(MAX)}$, is not exceeded.
7. $R_{F(INT)}$ forms an RC circuit via the FILTER pin.
8. The sensor IC will continue to respond to current beyond the range of I_P until the high or low saturation voltage; however, the nonlinearity in this region will be worse than through the rest of the measurement range.
9. Typical values with +/- are 3 sigma values.
10. Percentage of I_P, with $I_P = I_{PR(MAX)}$.

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AHC1724-05B (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	-5	—	5	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	400	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$	Bidirectional, I_P = 0A	—	V_{CC} × 0.5	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±1.5	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4.5	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4.5	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-15	±7	15	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±13	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENSE_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

AHC1724-10U (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	0	—	10	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	400	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$)	Unidirectional, I_P = 0A	—	V_{CC} × 0.1	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±1.5	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4.5	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4.5	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-15	±7	15	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±13	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

AHC1724-10B (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	-10	—	10	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	200	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$)	Bidirectional, I_P = 0A	—	V_{CC} × 0.5	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±1	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4.5	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4.5	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-10	±6	10	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±8	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

Notes: 9. Typical values with +/- are 3 sigma values.
10. Percentage of I_P, with $I_P = I_{PR(MAX)}$.

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AHC1724-20U (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	0	—	20	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	200	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$)	Unidirectional, I_P = 0A	—	V_{CC} × 0.1	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±0.7	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-10	±6	10	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±8	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

AHC1724-20B (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	-20	—	20	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	100	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$)	Bidirectional, I_P = 0A	—	V_{CC} × 0.5	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±0.8	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-10	±5	10	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±6	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

AHC1724-30U (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	0	—	30	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	133	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$)	Unidirectional, I_P = 0A	—	V_{CC} × 0.1	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±0.7	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-10	±6	10	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±7	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

Notes: 9. Typical values with +/- are 3 sigma values.
10. Percentage of I_P, with $I_P = I_{PR(MAX)}$.

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AHC1724-30B (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	-30	—	30	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	66	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$	Bidirectional, I_P = 0A	—	V_{CC} × 0.5	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±0.8	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-10	±6	10	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±6	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

AHC1724-50B (Valid at T_A = -40°C to +150°C, V_{CC} = 5V, unless otherwise specified.)

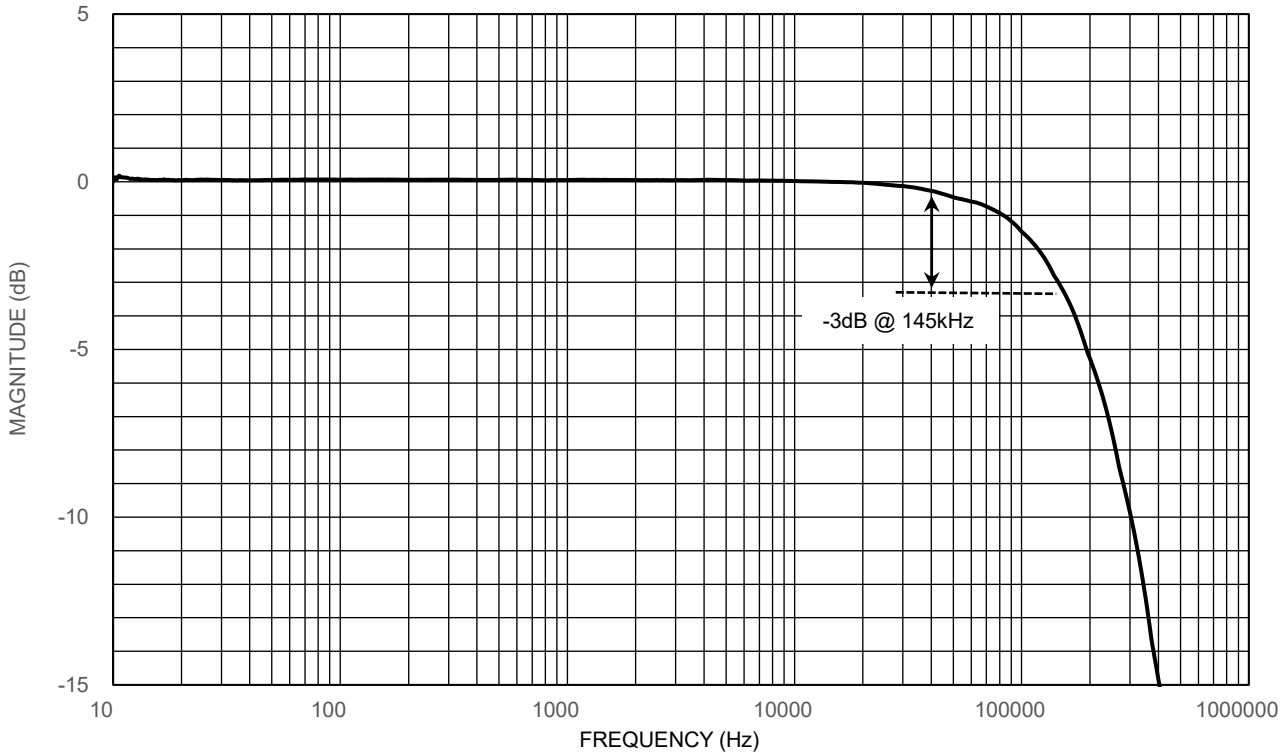
Characteristic	Symbol	Test Conditions	Min	Typ (Note 9)	Max	Unit
NORMAL PERFORMANCE						
Current Sensing Range	I_{PR}	—	-50	—	50	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	—	40	—	mV/A
Zero-Current Output Voltage	$V_{OUT(Q)}$	Bidirectional, I_P = 0A	—	V_{CC} × 0.5	—	V
ACCURACY PERFORMANCE						
Total Output Error (Note 10)	E_{TOT}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2.5	±0.8	2.5	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-6	±4	6	%
Sensitivity Error	E_{SENS}	$I_P = I_{PR(MAX)}$, T_A = 25°C to 150°C	-2	±1	2	%
		$I_P = I_{PR(MAX)}$, T_A = -40°C to 25°C	-5.5	±4	5.5	%
Voltage Offset Error	V_{OE}	I_P = 0A, T_A = 25°C to 150°C	-10	±6	10	mV
		I_P = 0A, T_A = -40°C to 25°C	-30	±6	30	mV
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	E_{SENS_DRIFT}	—	-3	±1	3	%
Total Output Error Lifetime Drift	E_{TOT_DRIFT}	—	-3	±1	3	%

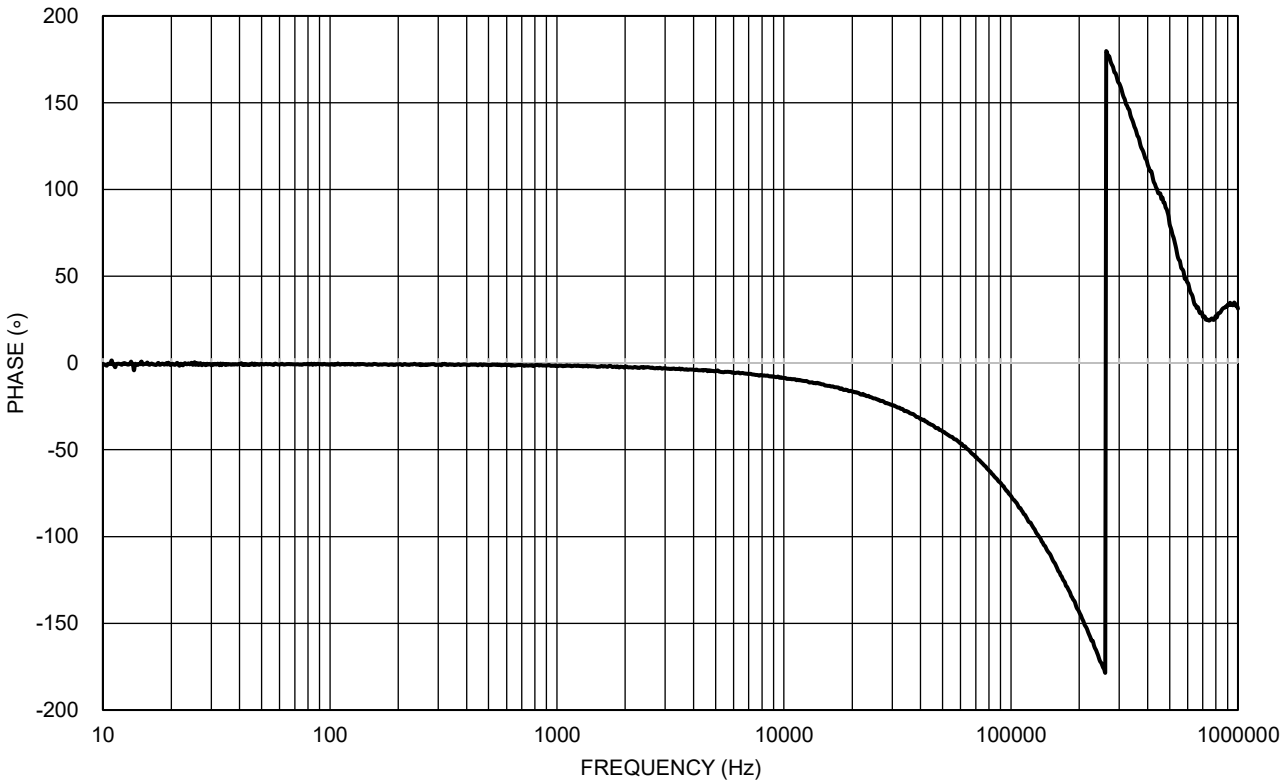
Notes: 9. Typical values with +/- are 3 sigma values.
10. Percentage of I_P, with $I_P = I_{PR(MAX)}$.

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Performance Characteristics

AHC1724 Typical Frequency Response





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Response Characteristics Definitions and Performance Data

Response Time ($t_{RESPONSE}$)

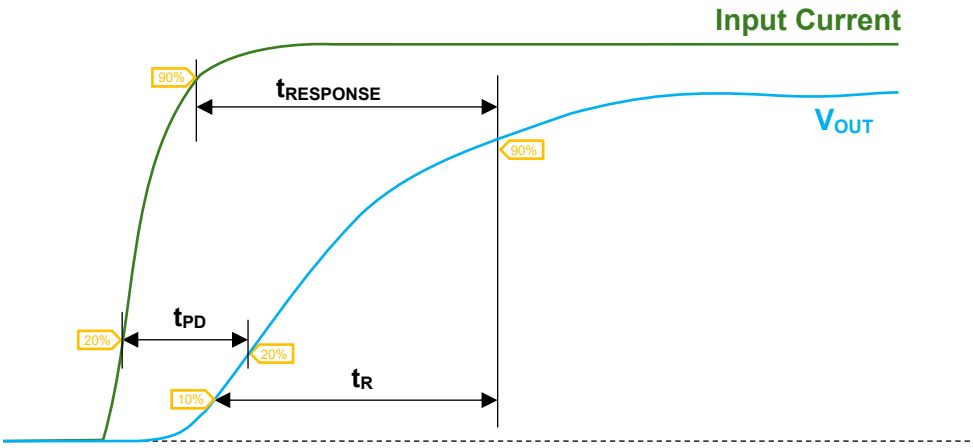
The time interval between (a) when the sensed input current reaches 90% of its final value and (b) when the sensor output reaches 90% of its full-scale value.

Propagation Delay (t_{PD})

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

Rise Time (t_R)

The time interval between (a) when the sensor reaches 10% of its full-scale value and (b) when it reaches 90% of its full-scale value.



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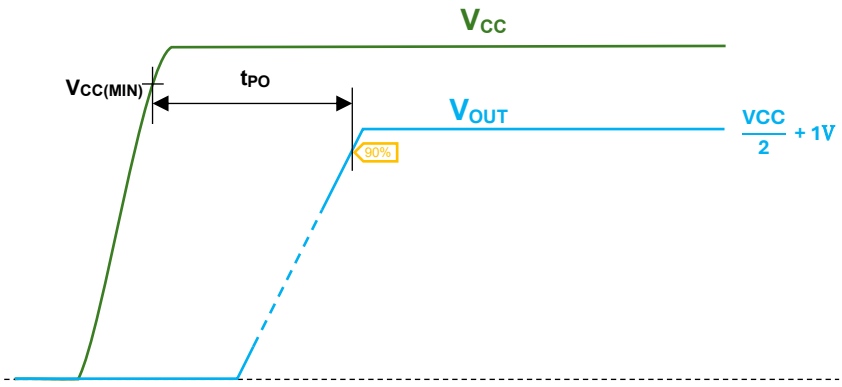
Power-On Functional Description and Performance Data

Power-On Time (t_{PO})

When the supply is ramped to its operating voltage, the device requires a finite amount of time to power its internal components before responding to an input magnetic field. Power-On Time (t_{PO}) is defined as the time interval between (a) when the power supply has reached its minimum specified operating voltage ($V_{CC(MIN)}$) and (b) when the sensor output has settled within ±10% of its steady-state value under an applied magnetic field.

A pull-down resistor (R_{PD}) was used on the output of the tested device.

Test Conditions: T_A = +25°C, C_{BYPASS} = 0.1µF, C_F = 0F, R_{PD} = 10kΩ
1V Output Swing



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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 1 shows the measured rise in steady-state die temperature of the AHC1724 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 2 shows the maximum continuous current at a given T_A. Surges beyond the maximum current listed in Figure 2 are allowed given the maximum junction temperature, $T_{J(MAX)}$ (+165ºC), is not exceeded.

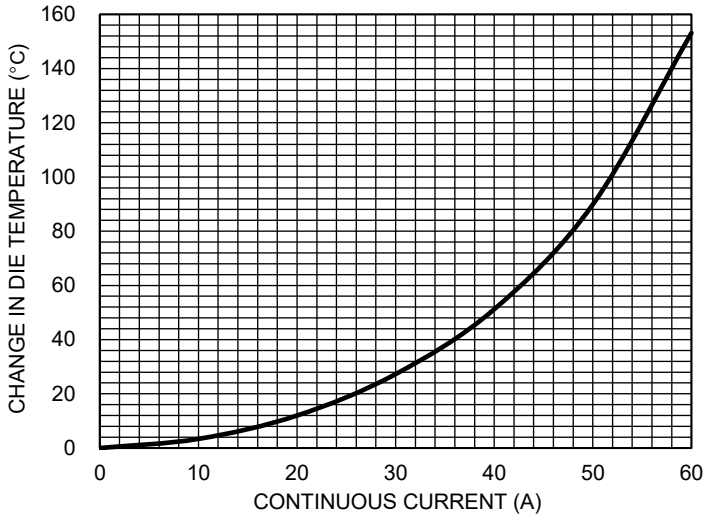


Figure 1. Self-Heating in the SO-8 (Type CJ2) Due to Current Flow

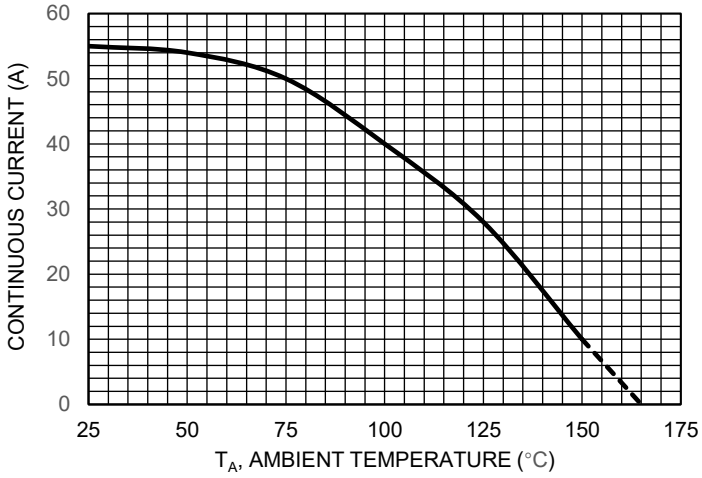


Figure 2. Maximum Continue Current at T_A

The thermal capacity of the AHC1724 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.

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Application Information (continued)

Evaluation Board Layout

Thermal data shown in Figure 3 was collected using the AHCEVB-SO8 Evaluation Board (TDBH0203). This board includes 1700mm^2 of 4oz. copper (0.1388mm) connected to pins 1 and 2, and to pins 3 and 4, with thermal vias connecting the layers. Top and Bottom layers of the PCB are shown below in Figure 3.

Gerber files for the evaluation board are available for download from the Diodes website. Please see the technical documents section on the device webpage.

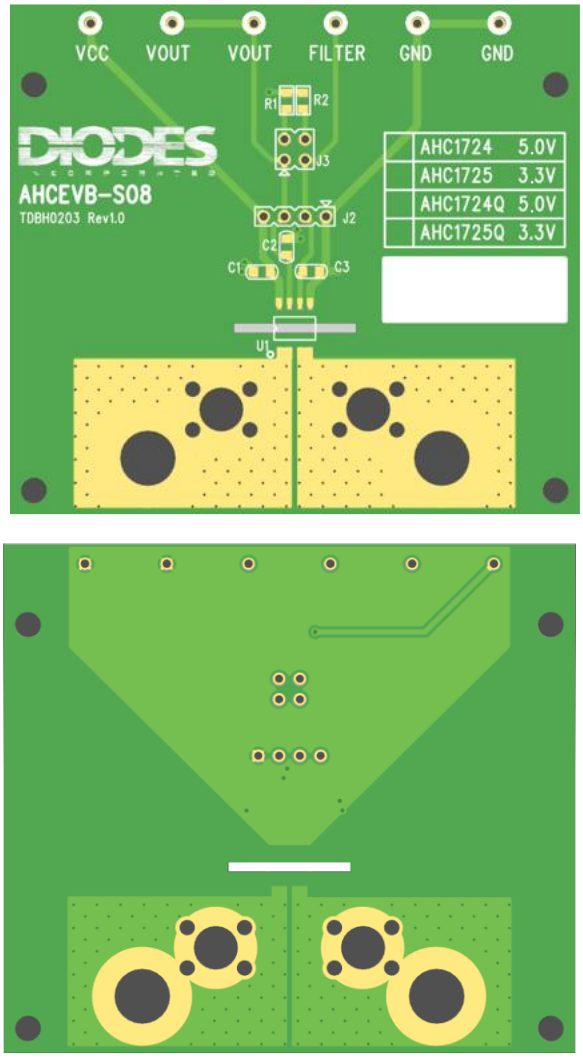


Figure 3. Top and Bottom layers of PCB

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Definitions of Accuracy Characteristics

Sensitivity (Sens)

The change in sensor IC output in response to a 1A change through the primary conductor. The sensitivity is the product of the magnetic circuit sensitivity (G/A) (1G = 0.1mT) and the linear IC amplifier gain (mV/G). The linear IC amplifier gain is programmed at the factory to optimize the sensitivity (mV/A) for the full-scale current of the device.

Sensitivity Error (E_{SENS})

Sensitivity error refers to the percentage deviation between the actual measured sensitivity and the ideal sensitivity.

$$E_{SENS} = \frac{SENS_{Meas(VCC)} - SENS_{Ideal(VCC)}}{Sens_{ideal(VCC)}} \times 100(\%)$$

Sensitivity Temperature Drift (E_{SENS_DRIFT})

Over the entire operating temperature drift is defined as:

$$E_{SENS_drift} = \frac{SENS_{Meas(TA)} - SENS_{Ideal(25℃)}}{Sens_{ideal(25℃)}} \times 100(\%)$$

Nonlinearity (E_{LIN})

The nonlinearity is a measure of how linear the output of the sensor IC is over the full current measurement range. The nonlinearity is calculated as:

$$E_{LIN} = \left\{1 - \left[\frac{V_{OUT}\left(I_{PR(max)} - V_{OUT(Q)}\right)}{2 \times \left(V_{OUT}\left(\frac{I_{PR(\max)}}{2}\right) - V_{OUT(Q)}\right)}\right]\right\} \times 100(\%)$$

where V_{OUT} ($I_{PR(MAX)}$) is the output of the sensor IC with the maximum measurement current flowing through it and V_{OUT} ($I_{PR(MAX)}$/2) is the output of the sensor IC with half of the maximum measurement current flowing through it.

Zero-Current Output Voltage ($V_{OUT(Q)}$)

The output of the sensor when the primary current is zero. For a unipolar supply voltage, it nominally remains at 0.5 × V_{CC} for a bidirectional device and 0.1 × V_{CC} for a unidirectional device. For example, in the case of a bidirectional output device, V_{CC} = 5V translates into $V_{OUT(Q)}$ = 2.5V. Variation in $V_{OUT(Q)}$ can be attributed to the resolution of the Diodes linear IC quiescent voltage trim and thermal drift.

Voltage Offset Error (V_{OE})

The deviation of the device output from its ideal quiescent value of 0.5 × V_{CC} (bidirectional) or 0.1 × V_{CC} (unidirectional) due to nonmagnetic causes. To convert this voltage to amperes, divide by the device sensitivity, Sens.

Voltage Offset Temperature Drift (V_{OE_DRIFT})

Due to internal circuit tolerances and heat dissipation, the static output voltage may shift with the operating temperature. Operating temperature drift is defined as:

$$V_{OE_drift} = \frac{V_{OUT(QTA)} - V_{OUT(Q25℃)}}{V_{OUT(Q25℃)}} \times 100(\%)$$

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Definitions of Accuracy Characteristics (continued)

Total Output Error (E_{TOT})

The difference between the current measurement from the sensor IC and the actual current (I_P), is 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 current flowing through the primary conduction path:

$$E_{TOT}(I_P) = \frac{V_{OUT_ideal}(I_P) - V_{OUT}(I_P)}{Sens_{ideal}(I_P) \times I_P} \times 100(\%)$$

The Total Output Error incorporates all sources of error and is a function of I_P. At relatively high currents, E_{TOT} will be mostly due to sensitivity error, and at relatively low currents, E_{TOT} will be mostly due to Voltage Offset Error (V_{OE}). In fact, at I_P = 0A, E_{TOT} approaches infinity due to the offset. This is illustrated in Figure 4 and Figure 5. Figure 4 shows a distribution of output voltages versus I_P at +25°C and across temperature. Figure 5 shows the corresponding E_{TOT} versus I_P.

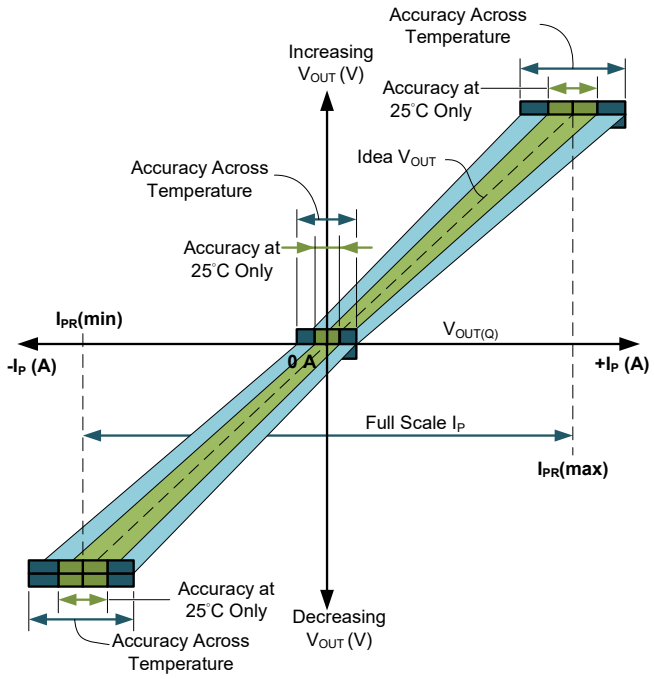


Figure 4. Output Error versus Sensed Current

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Definitions of Accuracy Characteristics (continued)

Total Output Error (E_{TOT}) (continued)

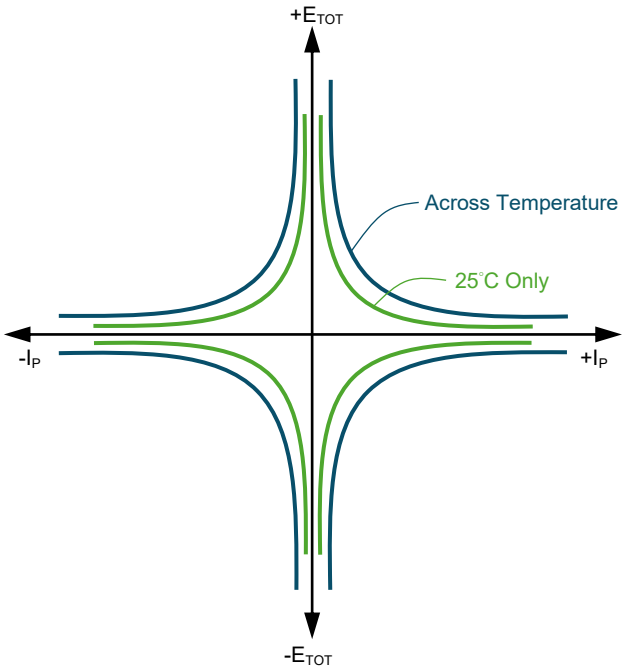


Figure 5. Total Output Error versus Sensed Current

Sensitivity Ratiometry Coefficient (SENS_RAT_COEF)

The coefficient defining how the sensitivity scales with VCC. The ideal coefficient is 1, meaning the sensitivity scales proportionally with V_{CC}. A 10% increase in V_{CC} results in a 10% increase in sensitivity. A coefficient of 1.1 means that the sensitivity increases by 10% more than the ideal proportionality case. This means that a 10% increase in V_{CC} results in an 11% increase in sensitivity. This relationship is described by the following equation:

$$Sens(V_{CC}) = Sens(V)\left[1 + \frac{(V_{CC} - 5V) \times SENS_RAT_COFE}{5V}\right]$$

This can be rearranged to define the sensitivity ratiometry coefficient as:

$$SENS_RAT_COEF = \left[\frac{Sens(V_{CC})}{Sens(5V)} - 1\right] \times \frac{5V}{(V_{CC} - 5V)}$$

Zero-Current Output Ratiometry Coefficient (QVO_RAT_ COEF)

The coefficient defines how the zero-current output voltage scales with V_{CC}. The ideal coefficient is 1, meaning the output voltage scales proportionally with V_{CC}, always being equal to $V_{CC}/2$. A coefficient of 1.1 means that the zero-current output voltage increases 10% more than in the ideal proportionality case. This means that a 10% increase in V_{CC} results in an 11% increase in the zero-current output voltage. This relationship is described by the following equation:

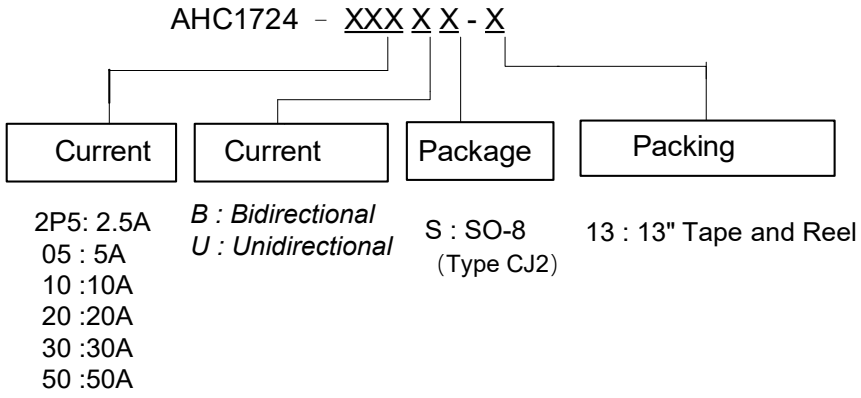
$$VOUTQ(V_{CC}) = VOUTQ(5V)\left[1 + \frac{(V_{CC} - 5V) \times QVO_RAT_COEF}{5V}\right]$$

This can be rearranged to define the zero-current output ratiometry coefficient as:

$$QVO_RAT_COEF = \left[\frac{VOUTQ(V_{CC})}{VOUTQ(5V)} - 1\right] \times \frac{5V}{(V_{CC} - 5V)}$$

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Ordering Information (Note 11)

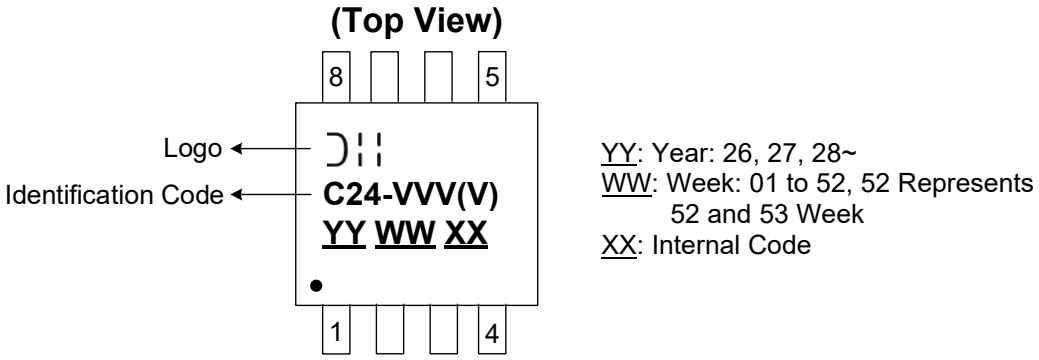


Orderable Part Number	Package Code	Package	Packing	
			Qty.	Carrier
AHC1724-2P5BS-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-05US-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-05BS-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-10US-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-10BS-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-20US-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-20BS-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-30US-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-30BS-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel
AHC1724-50BS-13	S	SO-8 (Type CJ2)	4000	13” Tape and Reel

Note: 11. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

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Marking Information



YY: Year: 26, 27, 28~
WW: Week: 01 to 52, 52 Represents 52 and 53 Week
XX: Internal Code

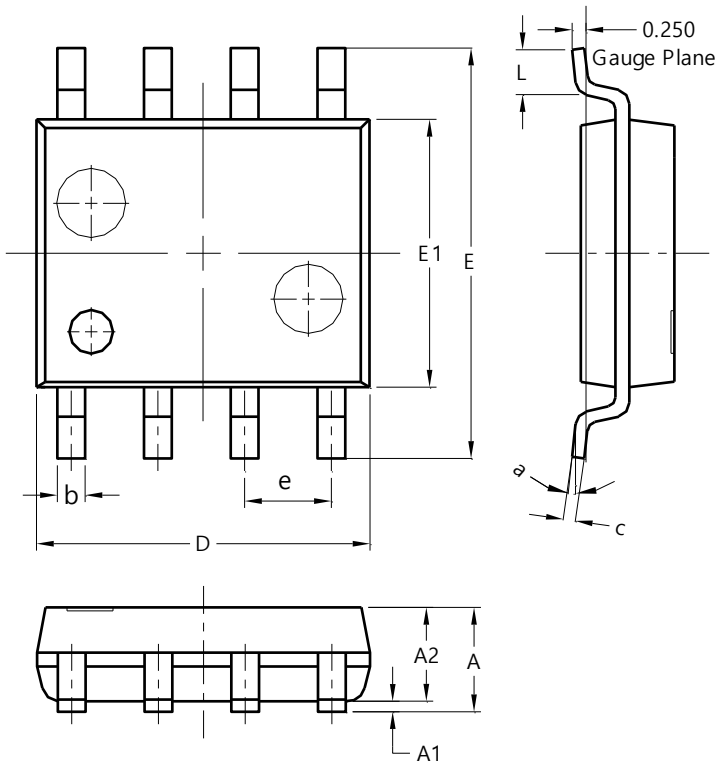
Orderable Part Number	Package	Identification Code
AHC1724-2P5BS-13	SO-8 (Type CJ2)	C24-2P5B
AHC1724-05US-13	SO-8 (Type CJ2)	C24-05U
AHC1724-05BS-13	SO-8 (Type CJ2)	C24-05B
AHC1724-10US-13	SO-8 (Type CJ2)	C24-10U
AHC1724-10BS-13	SO-8 (Type CJ2)	C24-10B
AHC1724-20US-13	SO-8 (Type CJ2)	C24-20U
AHC1724-20BS-13	SO-8 (Type CJ2)	C24-20B
AHC1724-30US-13	SO-8 (Type CJ2)	C24-30U
AHC1724-30BS-13	SO-8 (Type CJ2)	C24-30B
AHC1724-50BS-13	SO-8 (Type CJ2)	C24-50B

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Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

SO-8 (Type CJ2)



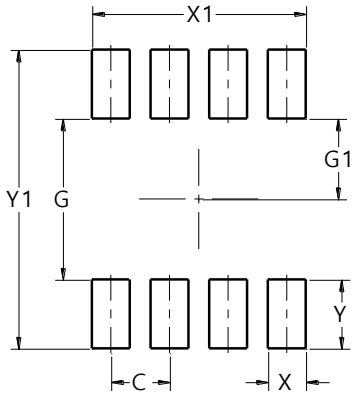
SO-8 (Type CJ2)			
Dim	**Min**	**Max**	**Typ**
A	1.450	1.750	--
A1	0.100	0.250	--
A2	1.350	1.550	--
b	0.330	0.510	--
c	0.170	0.250	--
D	4.700	5.100	--
E	5.800	6.200	--
E1	3.800	4.000	--
e	1.27 BSC		
L	0.400	1.270	--
A	0°	8°	--
All Dimensions in mm			

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Suggested Pad Layout

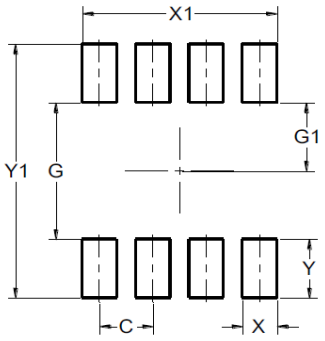
Please see http://www.diodes.com/package-outlines.html for the latest version.

SO-8 (Type CJ2)



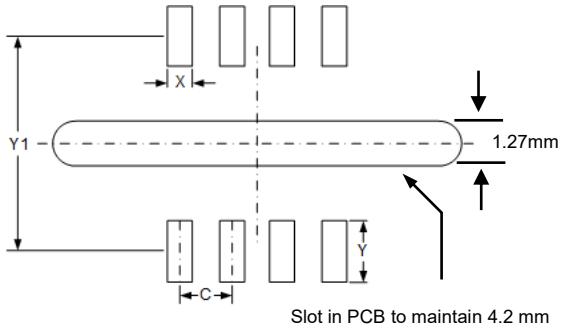
Dimensions	Value (in mm)
C	1.270
G	3.500
G1	1.750
X	0.820
X1	4.630
Y	1.500
Y1	6.500

PCB Layout Reference View 1



For PCB assemblies that cannot support a slotted design, the above stretched footprint

PCB Layout Reference View 2



Slot in PCB to maintain 4.2 mm creepage once part is on PCB.

Mechanical Data

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads. Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.008 grams (Approximate)

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