



Description

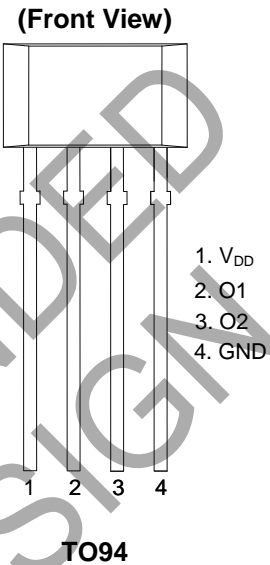
The AH5772 is a single chip solution for driving single-coil brushless direct current (BLDC) fans and motors. The integrated full-bridge driver output stage uses soft switching to minimize audible switching noise and electromagnetic interference (EMI) providing a low noise solution.

To simplify system circuit and minimize external components, the device integrates a stable high sensitivity Hall-Effect sensor, voltage and temperature compensated internal references, amplifiers and the output H-bridge power switches with low $R_{DS(on)}$.

To help protect the motor coil, the AH5772 provides Rotor Lock Protection which shuts down the output drive if rotor lock is detected. The device automatically re-starts when the rotor lock is removed. In case of over voltage, the device shuts down the output drive and enters standby mode to help prevent over voltage stress on the coil. Over temperature shutdown provides thermal protection for the device.

The AH5772 is available in industry standard TO94 package.

Pin Assignments



Features

- Supports Single-phase Full Wave BLDC Fan/Motor Drive
- Wide Operating Voltage Range: 2.4V to 18V
- Built-in High Sensitivity Hall Effect Sensor
 - Very Low Temperature and Voltage Coefficient of the Magnetic Operating Switch Points
- Built-in H-Bridge with Low $R_{DS(on)}$ Resistance
- Soft Switching for Low Noise DC Fan Motor Applications
- Rotor Lock Protection (Lock Detection, Output Shutdown and Automatic Re-start)
- Over Voltage Shutdown
- Thermal Protection
- No External Timing Capacitor - Reduces the Numbers of External Components Required
- Industry Standard TO94 Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

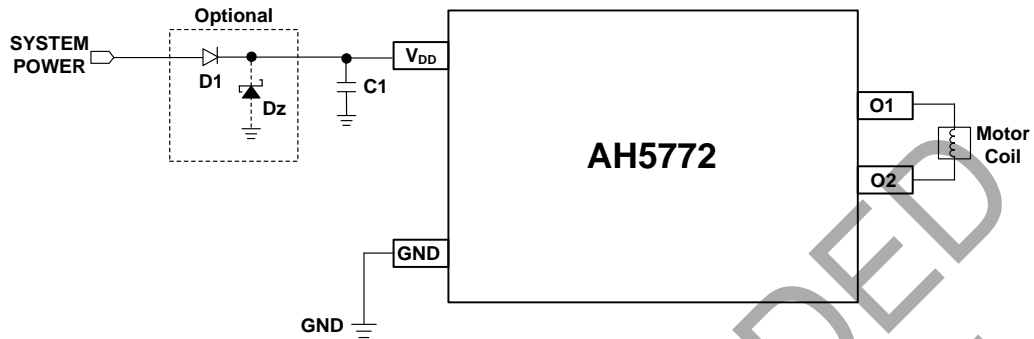
Applications

- 5V / 9V / 12V / 15V Min. BLDC Cooling Fans
- Netbook/ Notebook and Desktop BLDC Fans
- Instruments Cooling Fans
- Medium Voltage/ Low Power BLDC Motors

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html 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.

Typical Applications Circuit

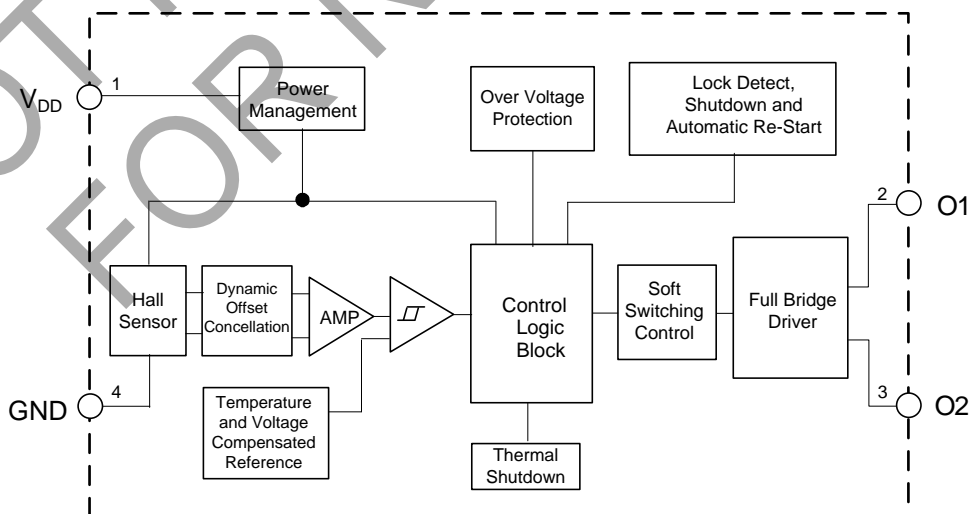


Note: 4. C1 is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 0.1 μ F for small motor current to 1 μ F or higher for larger motor current. The value of C1 should be selected adequately to support the motor current.

Pin Descriptions

Pin Number	Pin Name	Description
1	V _{DD}	Power supply input pin
2	O1	Output drive sourcing & sinking pin
3	O2	Output drive sourcing & sinking pin
4	GND	Ground pin

Functional Block Diagram



Absolute Maximum Ratings (Notes 5 and 6) @ $T_A = +25^\circ\text{C}$, unless otherwise specified.

Symbol	Characteristics	Values	Unit	
V_{DD_MAX}	Maximum Supply Voltage (Note 6)	24	V	
$V_{REVERSE}$	Reverse Supply Voltage on All Pins	-0.3	V	
$I_{O(PEAK)}$	Maximum Output Current (Peak)	1000	mA	
B	Maximum Magnetic Flux Density	Unlimited	-	
P_D	Power Dissipation	TO94	1500	mW
T_{STG}	Storage Temperature Range	-65 to +150	$^\circ\text{C}$	
T_J	Maximum Junction Temperature	+150	$^\circ\text{C}$	
ESD HBM	Human Body Model ESD Capability	V_{DD} , O1, O2 and GND pins	4	kV

- Notes:
- Stresses greater than the 'Absolute Maximum Ratings' specified above may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.
 - The absolute maximum V_{DD} of 24V is a transient stress rating and is not meant as a functional operating condition. It is not recommended to operate the device at the absolute maximum rated conditions for any period of time.

Recommended Operating Conditions

Symbol	Characteristic	Conditions	Min	Max	Unit
V_{DD}	Supply Voltage	Operating	2.4	18	V
T_A	Operating Temperature Range	Operating	-40	+105	$^\circ\text{C}$

Electrical Characteristics (Note 7) (@ $T_A = +25^\circ\text{C}$, $V_{DD} = 12\text{V}$, unless otherwise specified.)

Symbol	Characteristics	Conditions	Min	Typ	Max	Unit
I_{DD}	Supply Current	No Load, PWM switching or high	-	3	4.5	mA
V_{OV_TH}	Over Voltage Protection Threshold for Shutdown to Standby Mode	Voltage increasing	19	21	23	V
V_{OV_RLTH}	Over Voltage Release Threshold	Voltage decreasing	18	20	22	V
V_{OH}	Output Voltage High	$V_{DD} = 12\text{V}$, $I_{OUT} = 500\text{mA}$	$V_{DD} - 0.65$	$V_{DD} - 0.35$	-	V
		$V_{DD} = 12\text{V}$, $I_{OUT} = 500\text{mA}$ $T_A = -40^\circ\text{C}$ to $+105^\circ\text{C}$	$V_{DD} - 0.75$	$V_{DD} - 0.35$	-	V
		$V_{DD} = 3\text{V}$, $I_{OUT} = 300\text{mA}$	$V_{DD} - 0.35$	$V_{DD} - 0.23$	-	V
		$V_{DD} = 3\text{V}$, $I_{OUT} = 300\text{mA}$ $T_A = -40^\circ\text{C}$ to $+105^\circ\text{C}$	$V_{DD} - 0.45$	$V_{DD} - 0.23$	-	V
V_{OL}	Output Voltage Low	$V_{DD} = 12\text{V}$, $I_{OUT} = 500\text{mA}$	-	0.29	0.40	V
		$V_{DD} = 12\text{V}$, $I_{OUT} = 500\text{mA}$ $T_A = -40^\circ\text{C}$ to $+105^\circ\text{C}$	-	0.29	0.55	V
		$V_{DD} = 3\text{V}$, $I_{OUT} = 300\text{mA}$	-	0.19	0.26	V
		$V_{DD} = 3\text{V}$, $I_{OUT} = 300\text{mA}$ $T_A = -40^\circ\text{C}$ to $+105^\circ\text{C}$	-	0.19	0.35	V

- Note:
- Typical data is measured at $T_A = +25^\circ\text{C}$, $V_{DD} = 12\text{V}$. The maximum and minimum parameters values over operating temperature range are not tested in production, they are guaranteed by design, characterization and process control.

Electrical Characteristics (continued) (Note 8) (@T_A = +25°C, V_{DD} = 12V, unless otherwise specified.)

Symbol	Characteristics	Conditions	Min	Typ	Max	Unit
R _{ON_TOTAL}	Combined N- and PMOS R _{DS(on)} Including Bond Wire Resistance	V _{DD} = 12V, I _{OUT} = 500mA	–	1.28	2.1	Ω
		V _{DD} = 12V, I _{OUT} = 500mA T _A = -40°C to +105°C	–	1.28	2.6	Ω
		V _{DD} = 3V, I _{OUT} = 300mA	–	1.40	2.03	Ω
		V _{DD} = 3V, I _{OUT} = 300mA T _A = -40°C to +105°C	–	1.40	2.67	Ω
t _{SW}	Output Soft Switch Time	17Ω load on out1/out2	–	200	–	μs
t _{ON}	On Time - Lock Detect Time	–	–	420	–	ms
R _{DR}	Duty Ratio - Lock Detect to Shutdown Time	t _{OFF} / t _{ON}	–	10	–	–
T _{J_SDN_TH}	IC Junction Temperature Thermal Shutdown Threshold	–	–	+170	–	°C
T _{J_SDN_HYST}	IC Junction Temperature Thermal Shutdown Hysteresis	–	–	+25	–	°C

Note: 8. Typical data is measured at T_A = +25°C, V_{DD} = 12V. The maximum and minimum parameters values over operating temperature range are not tested in production, they are guaranteed by design, characterization and process control.

Magnetic Characteristics (Note 9, 10, 11) (@T_A = -40°C to +105°C, V_{DD} = 2.4V to 18V, unless otherwise specified.)

(1mT = 10 G)

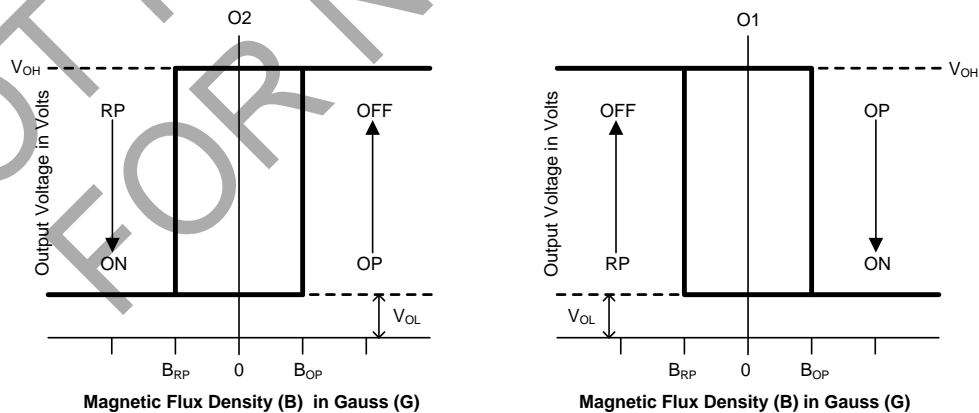
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
B _{OP} (South Pole to Part Marking Side)	Operate Point	(Note 10, 11)	5	20	35	Gauss
B _{RP} (North Pole to Part Marking Side)	Release Point	(Note 10, 11)	-35	-20	-5	
B _{HY} (B _{OP} -B _{RP})	Hysteresis	–	–	40	–	

Notes: 9. Typical data is measured at T_A = +25°C, V_{DD} = 12V. The maximum and minimum parameters values over operating temperature range are not tested in production, they are guaranteed by design, characterization and process control.

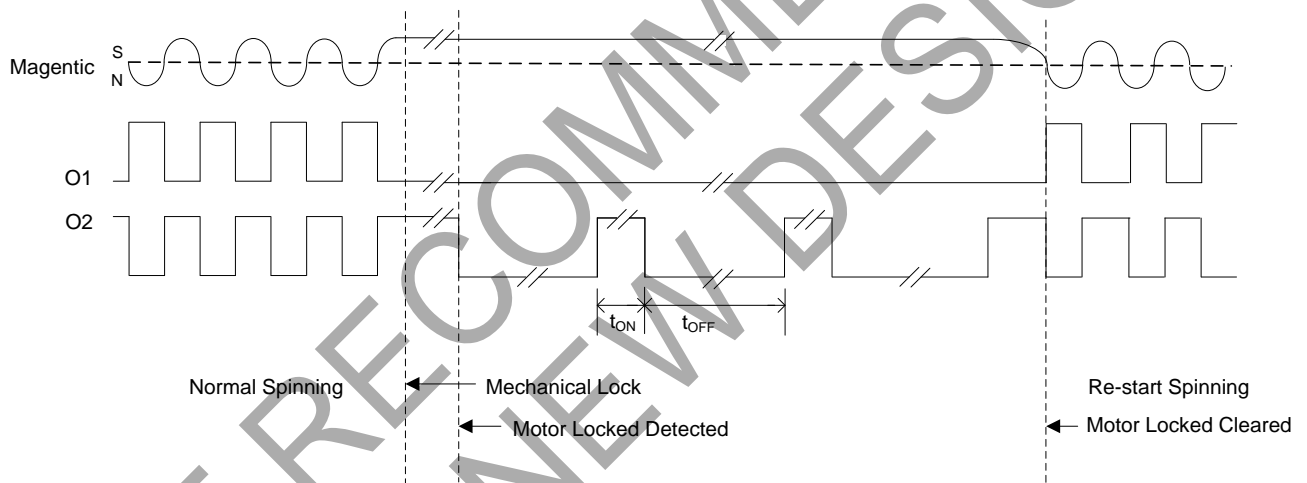
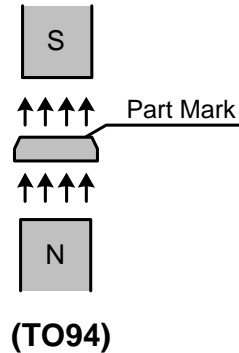
10. Magnetic characteristics may vary with supply voltage, operating temperature and after soldering.

11. The peak amplitude of the rotating motor magnetic flux density at the sensor location should be greater than +/-70G.

Operating Characteristics



Operating Characteristics (Continued) (Notes 12 and 13)



Truth Table

O1	O2	Magnetic Flux Density B
H	L	$B < B_{RP}$
L	H	$B > B_{OP}$

- Notes:
- When the motor locks with South pole at the Hall element, O2 is kept on "L" and O1 is a clock with t_{ON}/t_{OFF} ratio. When motor locks with North pole at the Hall element, O1 is kept on "L", O2 is a clock with t_{ON}/t_{OFF} ratio.
 - When "Re-start spinning" occurs, the motor speed ramps up to the "Normal Spinning" speed from zero. Speed ramp-up profile depends on motor characteristics.

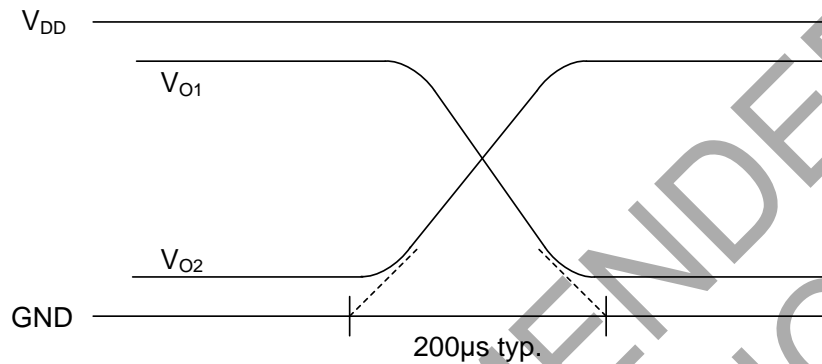
Application Note

DC Supply Voltage Speed Control

Motor speed can be controlled by varying the V_{DD} supply voltage. For example, with 12V nominal motor, changing supply voltage between 12V to 2.4V, speed can be reduced from 100% to 20% typically.

Soft Switching

AH5772 uses soft switching of the motor coil current during commutation to minimize audible switching noise and electromagnetic interference (EMI) to provide a low noise solution.



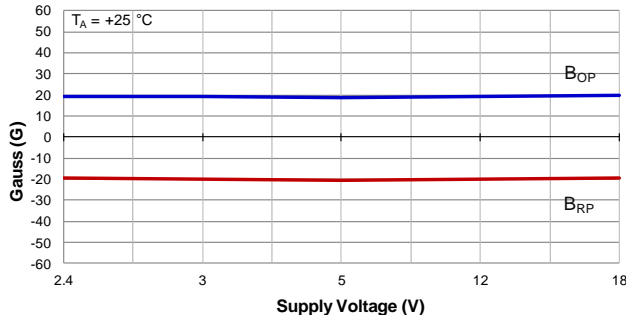
Overvoltage Shutdown of Output Drive

When the supply voltage reaches the over voltage shutdown threshold, $V_{OV,TH}$, the AH5772 shuts down all the output drive switches and enters standby mode to help prevent over voltage stress on the coil.

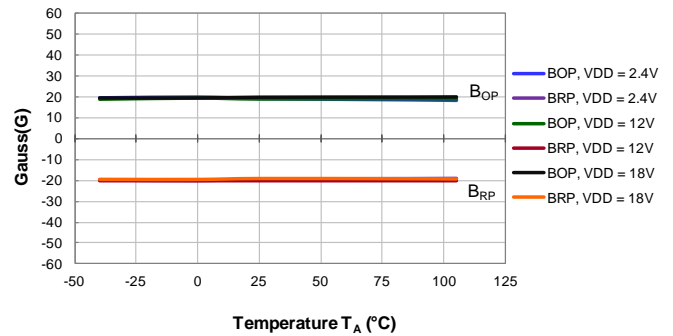
NOT RECOMMENDED
FOR NEW DESIGN

Typical Operating Characteristics

Magnetic Operating Switch Points

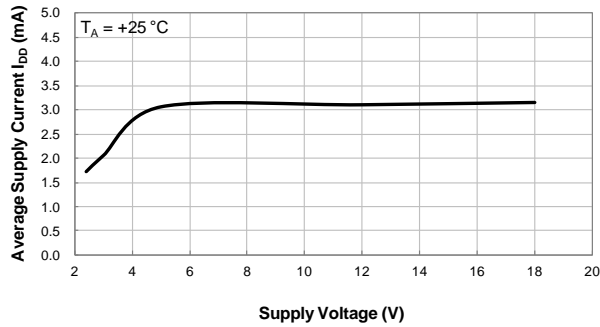


Magnetic Switch Points Bop & Brp vs. Supply Voltage

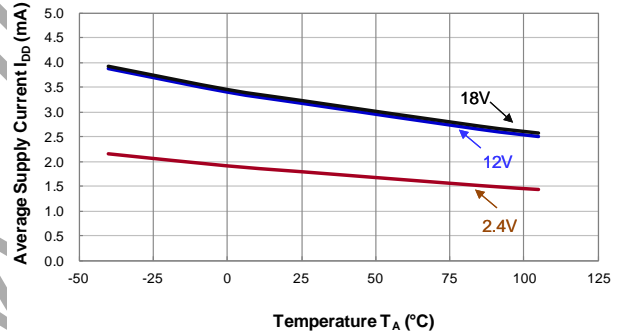


Magnetic Switch Points Bop & Brp vs. Temperature

Average Supply Current

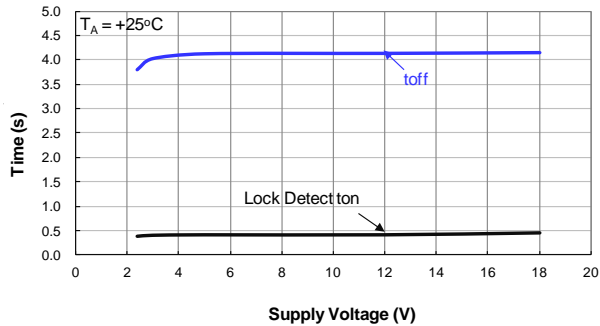


Average Supply Current vs. Supply Voltage

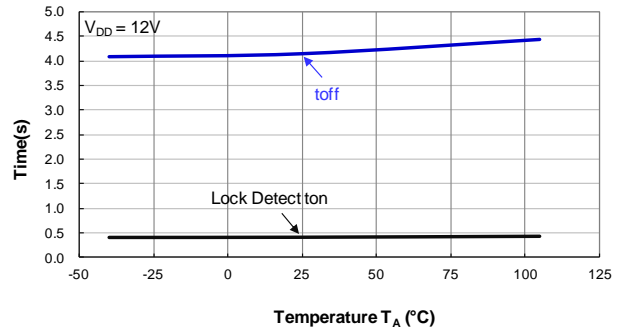


Average Supply Current vs. Temperature

Lock Detect Ton and Shutdown Toff Periods



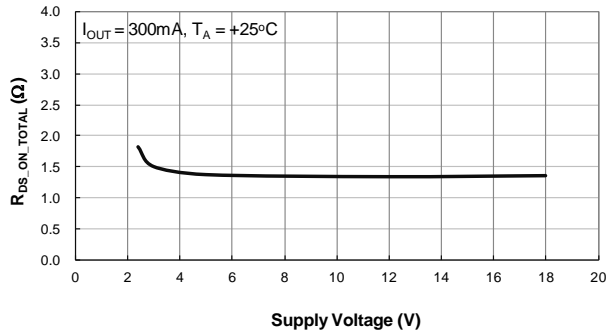
Lock Detect Ton and Toff vs. Supply Voltage



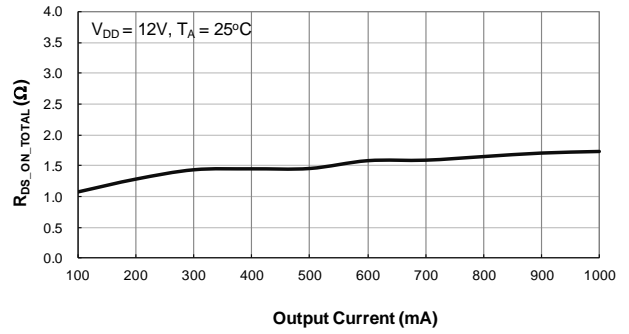
Lock Detect Ton and Toff vs. Temperature

Typical Operating Characteristics (Continued)

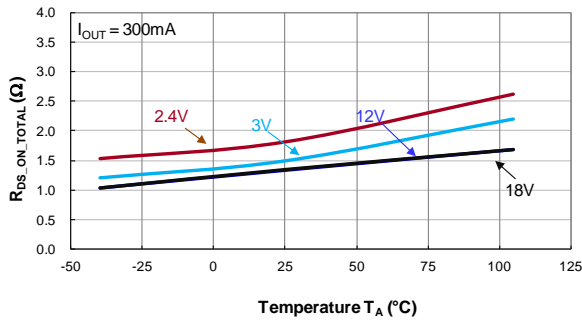
Total H-Bridge Path Resistance – Total $R_{DS(ON)}$ of High Side and Low Side Switches



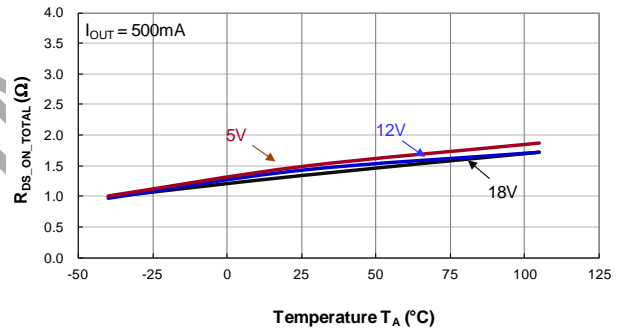
High+Low Side Resistance $R_{DS_ON_TOTAL}$ vs. Supply Voltage



High+Low Side Resistance $R_{DS_ON_TOTAL}$ vs. Current



High+Low Side Resistance $R_{DS_ON_TOTAL}$ vs. Temperature

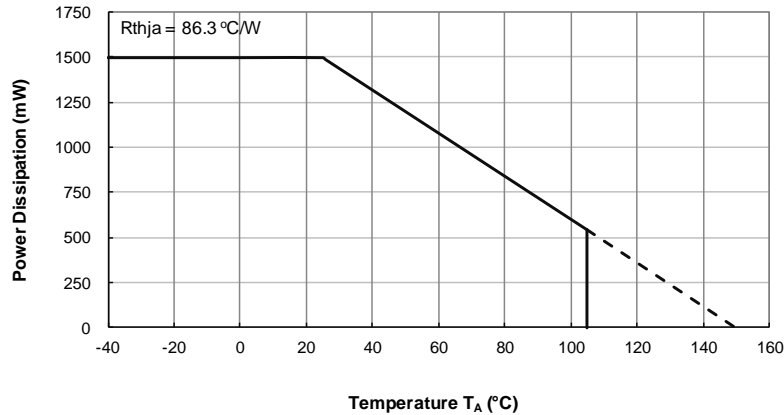


High+Low Side Resistance $R_{DS_ON_TOTAL}$ vs. Temperature

Thermal Performance

TO94 Power Dissipation De-rating Curve (Note 14)

T _A (°C)	-40	0	25	50	60	70	80	85	90	95	100	105	110	120	125	130	140	150
P _D (mW)	1500	1500	1500	1200	1080	960	840	780	720	660	600	540	480	360	300	240	120	0

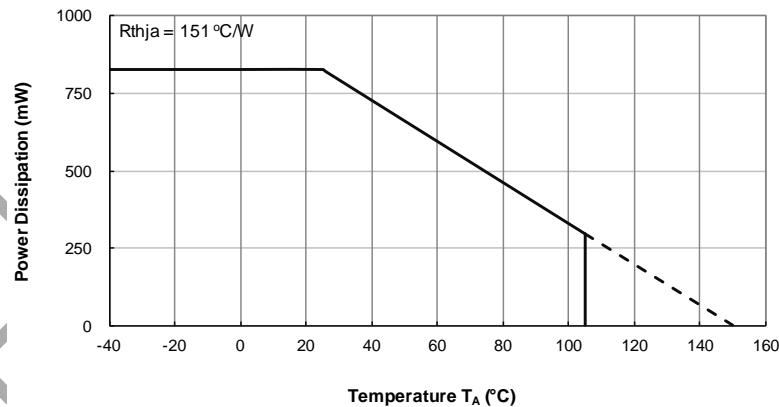


TO94 Thermal Derating Curve

Note 14: TO94 through-hole mounted to minimum recommended landing pads (through holes) on a 2"x2" two-layer 2oz.copper FR4 PCB (1.6mm thickness) with copper flood on the top but without copper flood on the bottom layer.

TO94 Power Dissipation De-rating Curve for Circular PCB with Center Hole Cut-Out (Note 15)

T _A (°C)	-40	0	25	50	60	70	80	85	90	95	100	105	110	120	125	130	140	150
P _D (mW)	827	827	827	662	595	529	463	430	397	364	331	298	298	265	198	165	132	0



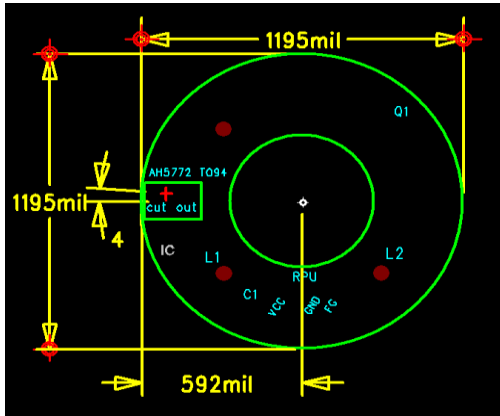
TO94 Thermal Derating Curve
(Custom Circular PCB with Centre Hole Cut-Out)

Note 15: TO94 through-hole mounted in a circular PCB with center hole cutout, single-layer 2oz.copper FR4 PCB (1.6mm thickness) with partial copper flood on the bottom layer. The circular PCB diameter is 1.2" with the centre circular cutout diameter of 0.53". The TO94 space cut-out is 0.2"x0.135". See below for details.

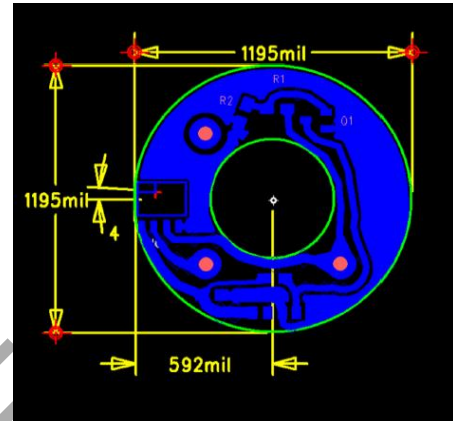
Thermal Performance (Continued)

Circular PCB Dimensions

The circular PCB diameter is 1.2" with the centre circular cutout diameter of 0.53". The TO94 space cut-out is 0.2"x0.135". single-layer 2oz.copper FR4 PCB (1.6mm thickness) with partial copper flood on the bottom layer.



Custom Circular PCB – Top View



Custom Circular PCB – Bottom View

Ordering Information

AH5772 - P - B

Package

Packing

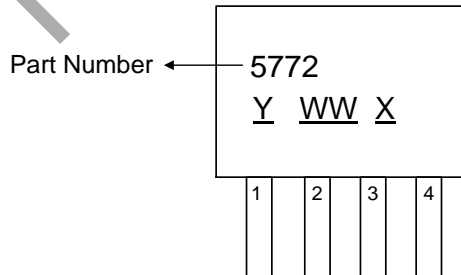
P : TO94

B : Bulk

Part Number	Package Code	Packaging	Bulk	
			Quantity	Part Number Suffix
AH5772-P-B	P	TO94	1000	-B

Marking Information

(1) Package Type: TO94

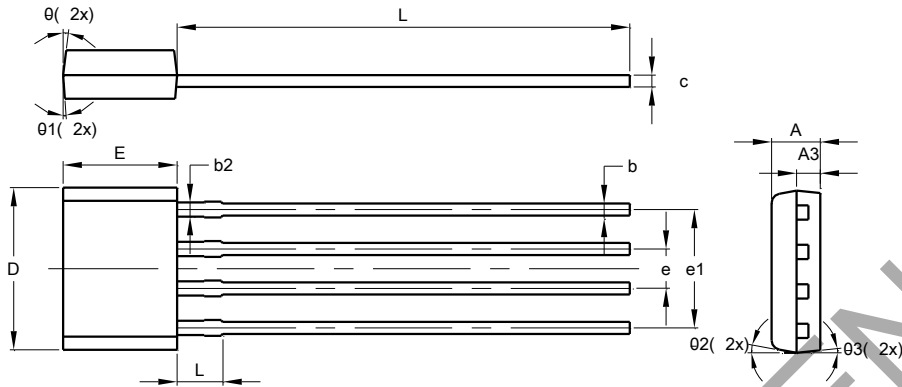


Y : Year : 0~9
 WW : Week : 01 ~ 52;
 52 represents 52 and 53 week
 X : Internal code

Package Outline Dimensions (All dimensions in mm.)

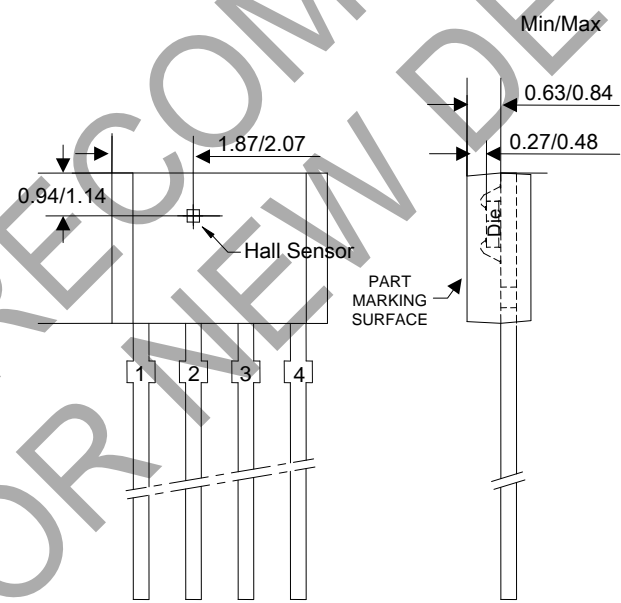
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

(1) Package Type: TO94



TO94			
Dim	Min	Max	Typ
A	1.46	1.66	1.56
A3	-	-	0.76
b	0.35	0.56	0.39
b2	-	-	0.46
c	0.36	0.51	0.38
D	5.12	5.32	5.22
E	3.55	3.75	3.65
e	-	-	1.27
e1	-	-	3.81
L	13.50	15.50	14.50
L1	-	-	1.42
S	0.63	0.83	0.73
theta	-	-	6°
theta1	-	-	4°
theta2	-	-	11°
theta3	-	-	6°

All Dimensions in mm



Sensor Location

IMPORTANT NOTICE

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.
5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.
9. This Notice may be periodically updated with the most recent version available at <https://www.diodes.com/about/company/terms-and-conditions/important-notice>

The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.
All other trademarks are the property of their respective owners.
© 2024 Diodes Incorporated. All Rights Reserved.

www.diodes.com