TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287

General Description

The AH287 is an integrated Hall sensor with output drivers for brushless DC motor application. This IC consists of two complementary outputs for motor's coil driving and has automatic lock protection and auto- restart function relatively. To avoid coil burning, rotor lock shutdown protection circuit shut down the output driver if the rotor blocked and then the automatic recovery circuit will try to restart the motor. This function repeats while rotor is blocked. Until the blocking is removed, the motor recovers running normally. In addition, the auto-restart time is flexible by adjusting the capacitance (C_{CT}).

Placing the device in a variable magnetic field, if the magnetic flux density is larger than threshold B_{OP}, the DO is turned to sink and DOB is turned to drive. This output state is held until a magnetic flux density reversal falls below B_{RP}, causing DO to be turned to drive and DOB turned to sink.

This IC is available in TO-94 package.

Features

- On-chip Hall Sensor
- Operating Voltage: 4V to 18V
- Maximum Output Current: 350mA (ave)
- Rotor-locked Protection
- Automatic Restart
- Adjustable Auto-restart Time
- Internal Band-gap Regulator for Temperature Compensation
- Operating Temperature: -20˚C to 85˚C
- Low Profile TO-94 Package
- ESD Rating: 300V (Machine Model)

Application

- Dual-coil Brushless DC Fan

TO-94

Figure 1. Package Type of AH287

Pin Configuration

Z4 Package
(TO-94)

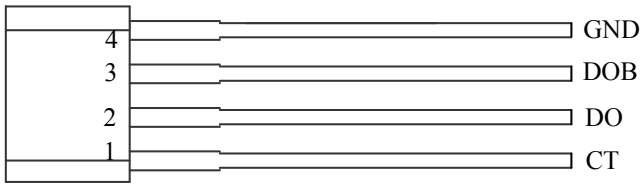


Figure 2. Pin Configuration of AH287 (Front View)

Pin Description

Pin Number	Pin Name	Function
1	CT	Timing capacitance
2	DO	Output 1
3	DOB	Output 2
4	GND	Ground

Functional Block Diagram

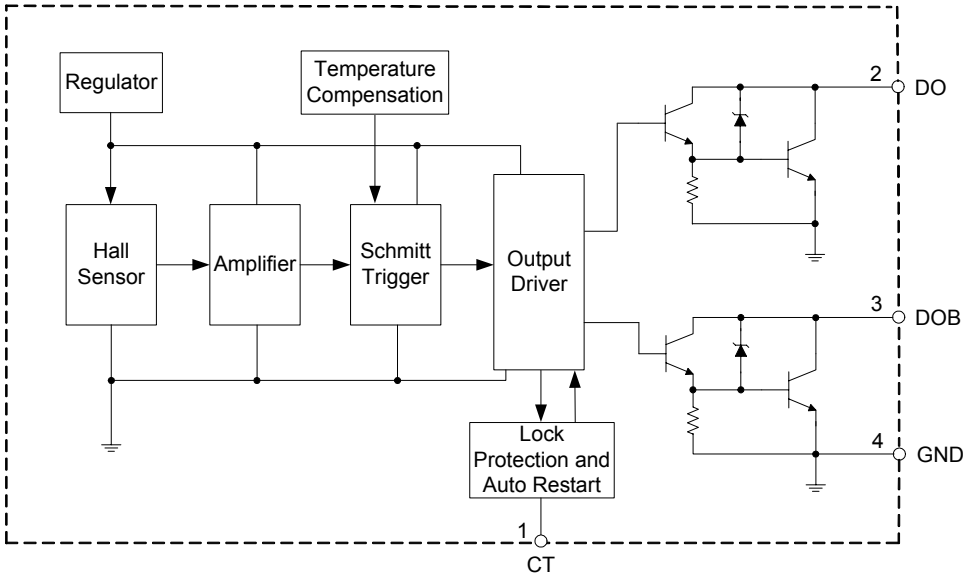
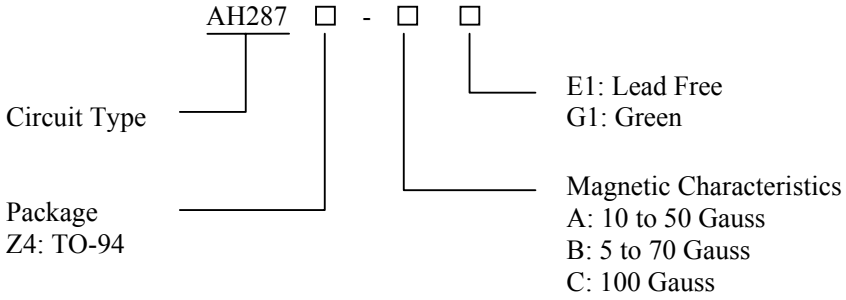


Figure 3. Functional Block Diagram of AH287

Ordering Information



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Lead Free	Green	Lead Free	Green	
TO-94	-20 to 85°C	AH287Z4-AE1	AH287Z4-AG1	AH287Z4-E1	AH287Z4-G1	Bulk
		AH287Z4-BE1	AH287Z4-BG1	AH287Z4-E1	AH287Z4-G1	Bulk
		AH287Z4-CE1	AH287Z4-CG1	AH287Z4-E1	AH287Z4-G1	Bulk

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green package.

Absolute Maximum Ratings (Note 1, T_A=25°C)

Parameter		Symbol	Value	Unit
Supply Voltage		V_{CC}	20	V
Magnetic Flux Density		B	Unlimited	Gauss
Output Current	Continuous	I_{OUT}	350	mA
	Hold		550	mA
	Peak (Start Up)		750	mA
Power Dissipation		P_D	550	mW
Thermal Resistance	Die to Atmosphere	θ_{JA}	227	°C/W
	Die to Package Case	θ_{JC}	49	°C/W
Junction Temperature		T_J	150	°C
Storage Temperature		T_{STG}	-50 to 150	°C
ESD (Machine Model)			300	V
ESD (Human Body Model)			3000	V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	4	18	V
Ambient Temperature	T_A	-20	85	°C

Electrical Characteristics

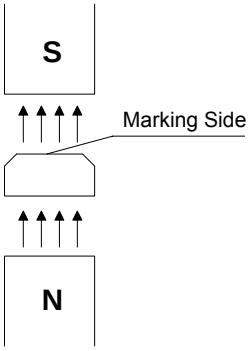
V_{CC} =14V, T_A =25°C, unless otherwise specified.

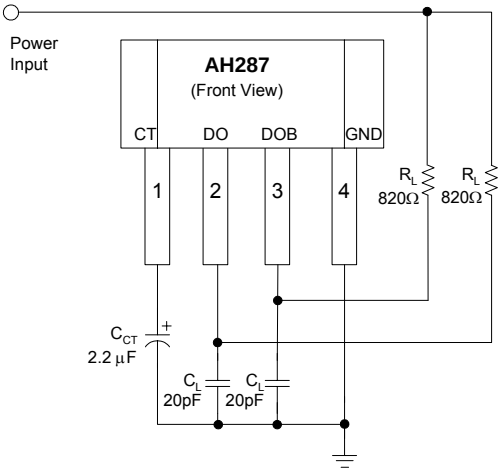
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Saturation Voltage	V_{SAT}	B>150 Gauss, V_{CC}=5V, V_{DOB}=V_{CC}, I_{DO}=100mA (or B<-150 Gauss, V_{CC} =5V, V_{DO}= V_{CC}, I_{DOB}=100mA)		1	1.15	V
		B>150 Gauss, V_{DOB}= V_{CC}, I_{DO}=350mA (or B<-150 Gauss, V_{DO}= V_{CC}, I_{DOB}=350mA)		1.2	1.35	V
Supply Current	I_{CC}	B>150 Gauss, V_{DOB}=V_{CC} (or B<-150 Gauss, V_{DO}=V_{CC})		5	6.5	mA
Output Rise Time	tr	R_L=820Ω, C_L=20pF		3	10	μs
Output Fall Time	tf	R_L=820Ω, C_L=20pF		0.3	1.5	μs
Switch Time Differential	Δt	R_L=820Ω, C_L=20pF		3	10	μs
Output Zener Breakdown Voltage	V_Z			55		V
Charge Current	I_{CHG}	V_{CT}=1 to 2.5V		5		μA
Discharge Current	I_{DHG}	V_{CT}=3.5 to 2.5V		0.5		μA
Clamp Voltage	V_{CL}	Limiting voltage		3.2		V
Comparator Voltage	V_{CP}	Limiting voltage		2.2		V

Magnetic Characteristics (T_A=25°C)

Parameter	Symbol	Grade	Min	Typ	Max	Unit
Operating Point	B_{OP}	A	10		50	Gauss
		B	5		70	
		C			100	
Releasing Point	B_{RP}	A	-50		-10	Gauss
		B	-70		-5	
		C	-100			
Hysteresis	B_{HYS}			70		Gauss

Test Circuit





Magnetic Hysteresis Characteristics

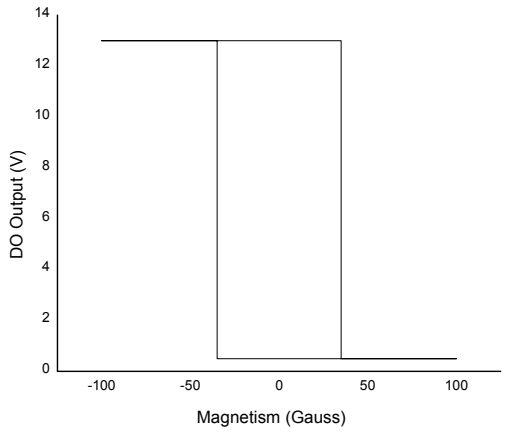


Figure 4. DO Output vs. Magnetism

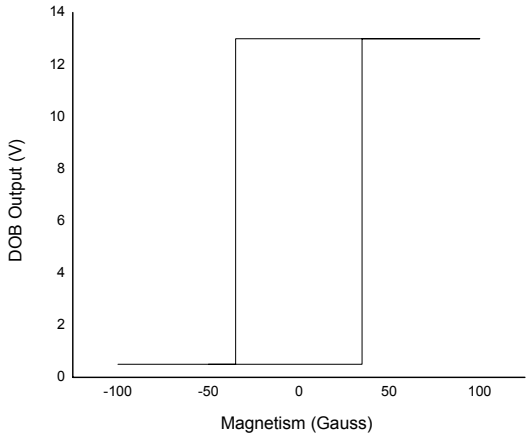


Figure 5. DOB Output vs. Magnetism

Typical Performance Characteristics

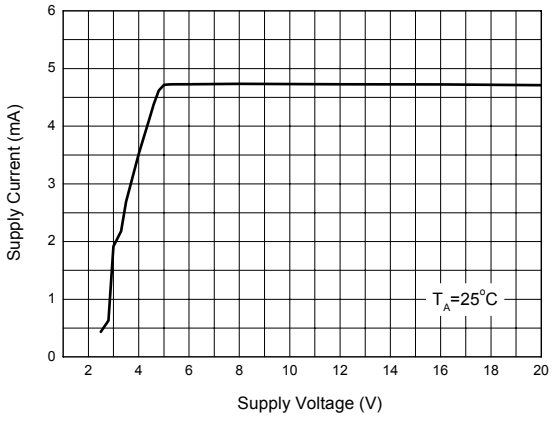


Figure 6. Supply Current vs. Supply Voltage

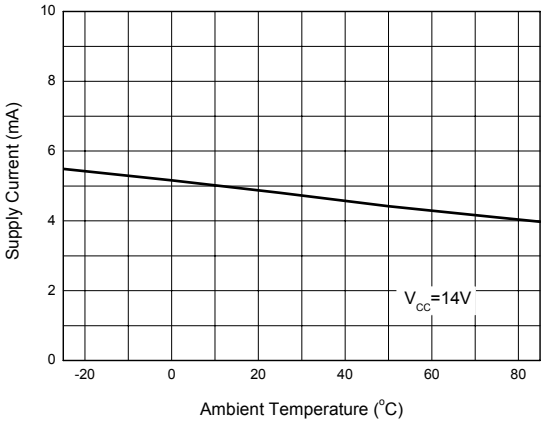


Figure 7. Supply Current vs. Ambient Temperature

Typical Performance Characteristics (Continued)

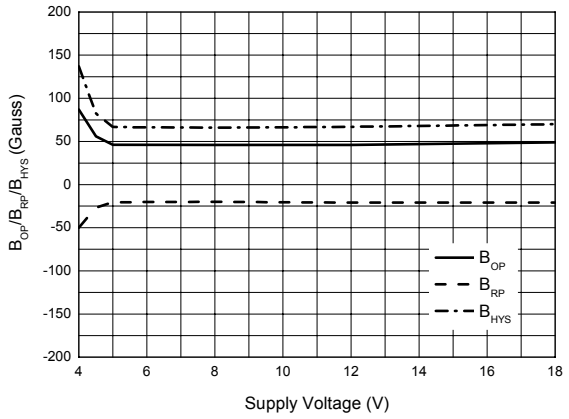


Figure 8. $B_{OP}/B_{RP}/B_{HYS}$ vs. Supply Voltage

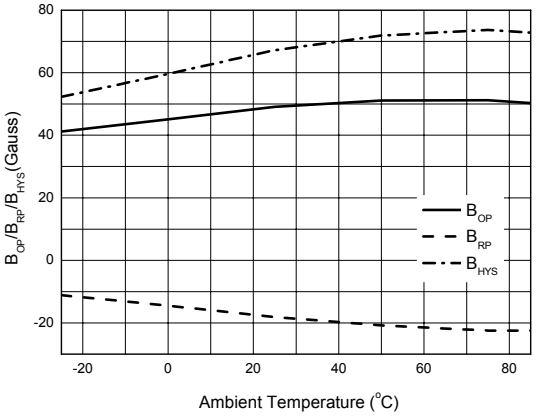


Figure 9. $B_{OP}/B_{RP}/B_{HYS}$ vs. Ambient Temperature

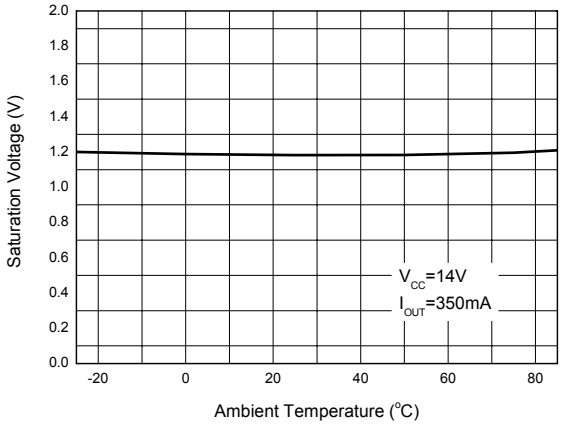


Figure 10. Saturation Voltage vs. Ambient Temperature

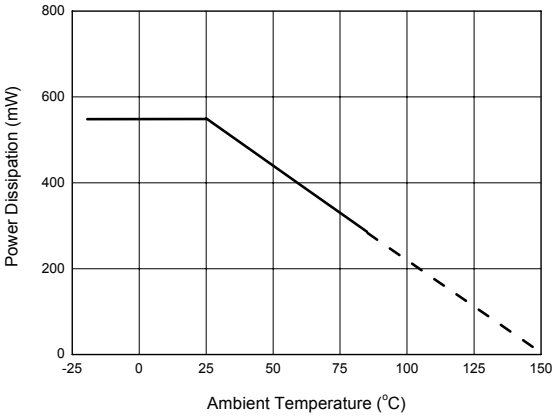
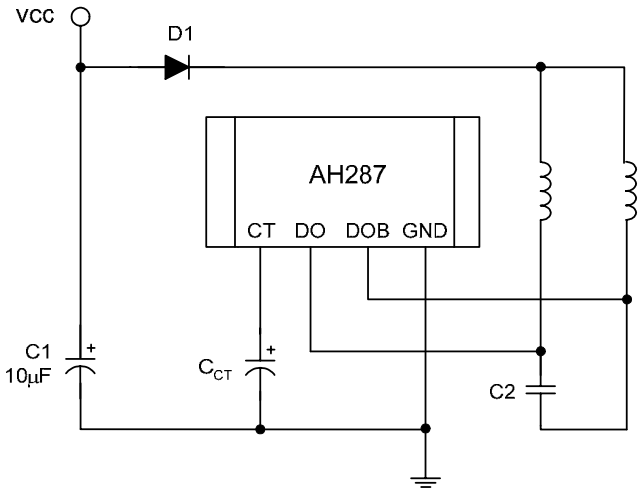


Figure 11. Power Dissipation vs. Ambient Temperature (Table 1)

Table 1:

T_A (℃)	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65
P_D (mW)	551	551	551	551	551	551	551	551	551	551	529	507	485	463	441	419	396	374
T_A (℃)	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	
P_D (mW)	352	330	308	286	264	242	220	198	176	154	132	110	88	66	44	22	0	

Typical Application (Note 2)



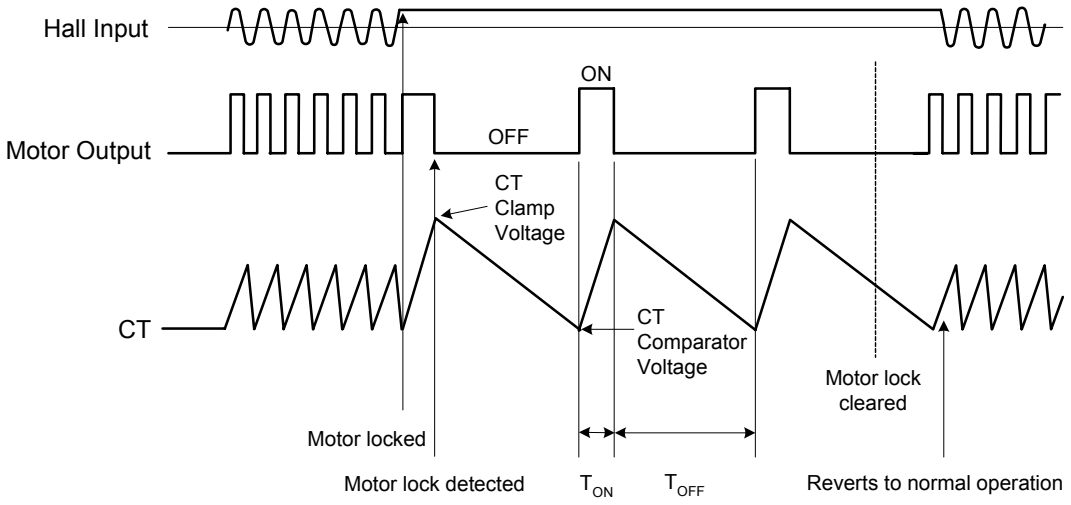
Note 2:

1. The minimum startup voltage is 3.5V when D1 is disconnected.
2. The capacitances of C_{CT} and C2 are adjustable base on system requirements. The recommended values are as below:

C_{CT}	C2
1μF/9V~2.2μF/9V	1μF/50V~2.2μF/50V

Figure 12. Typical Application of AH287

Operating Diagram (Note 3)



Note 3: The automatic restart circuit detects a motor lock condition and automatically turns off the output current. When the lock is cleared, the IC automatically restarts and allows the motor to run. In AH287, automatic restart is performed in the following manner. A motor lock condition is detected when the Hall signal stops switching. The output is ON when CT pin is being charged, and OFF when CT pin is being discharged.

$$T_{ON} = \frac{C * (V_{CL} - V_{CP})}{I_{CHG}} (Sec)$$

$$T_{OFF} = \frac{C * (V_{CL} - V_{CP})}{I_{DHG}} (Sec)$$

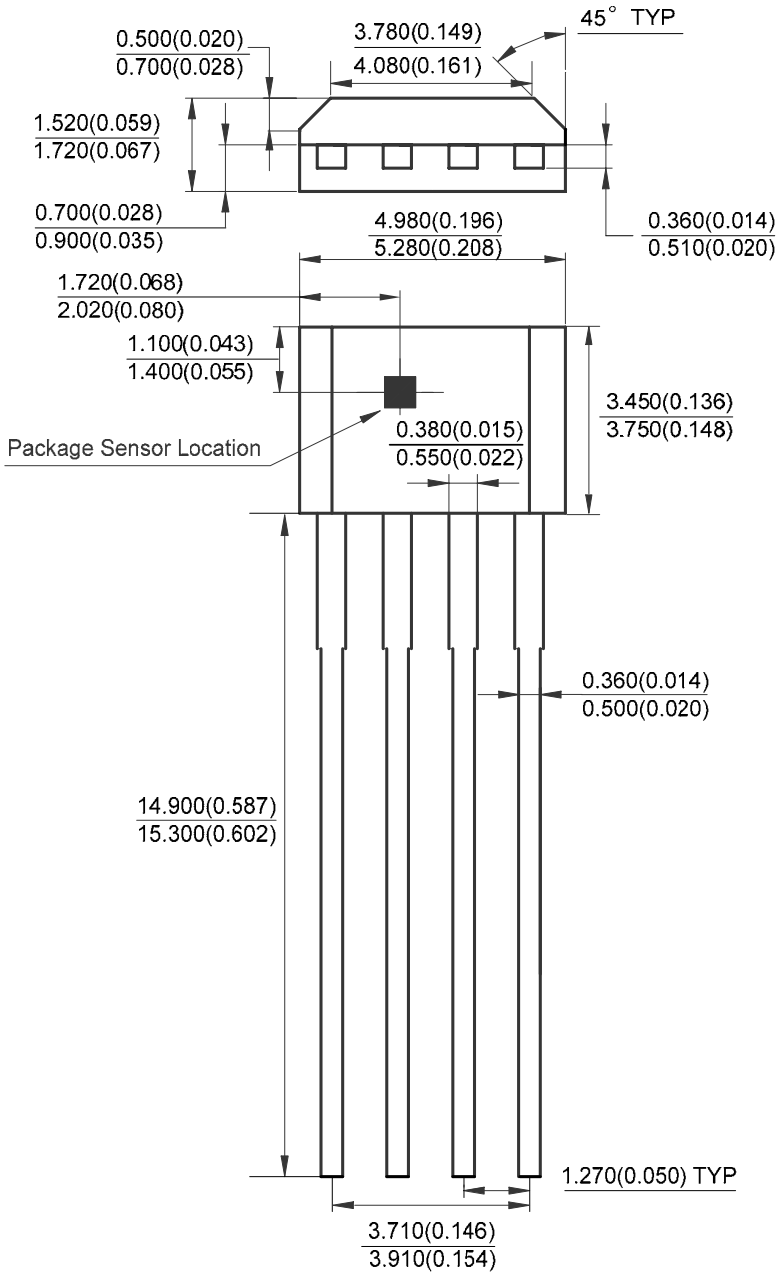
Output ON time (T_{ON}) and OFF time (T_{OFF}) are determined by C, the capacitance of the CT pin external capacitor.

V_{CL} is the CT pin clamp voltage
V_{CP} is the CT pin comparator voltage
I_{CHG} is the CT pin charge current
I_{DHG} is the CT pin discharge current

Figure 13. Control Timing Diagram of AH287

Mechanical Dimensions

TO-94 **Unit: mm(inch)**



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