

**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: 3.5V 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:  $-20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$
- Low Profile TO-94 Package
- ESD Rating: 300V (Machine Model)

## Application

- Dual-coil Brushless DC Fan

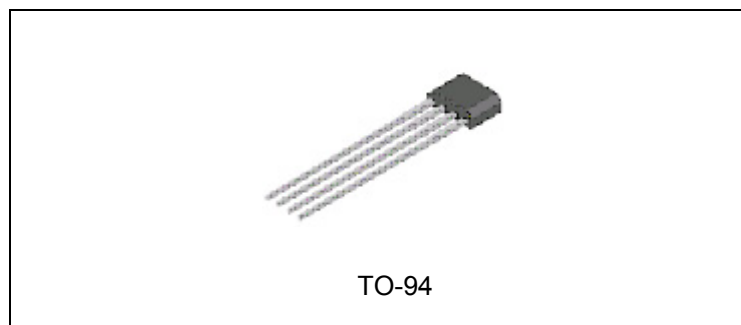


Figure 1. Package Type of AH287

**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287**

**Pin Configuration**

Z4 Package  
(TO-94)

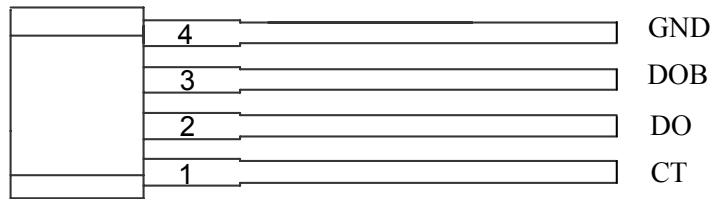


Figure 2. Pin Configuration of AH287 (Front View)

**Pin Description**

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

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**Functional Block Diagram**

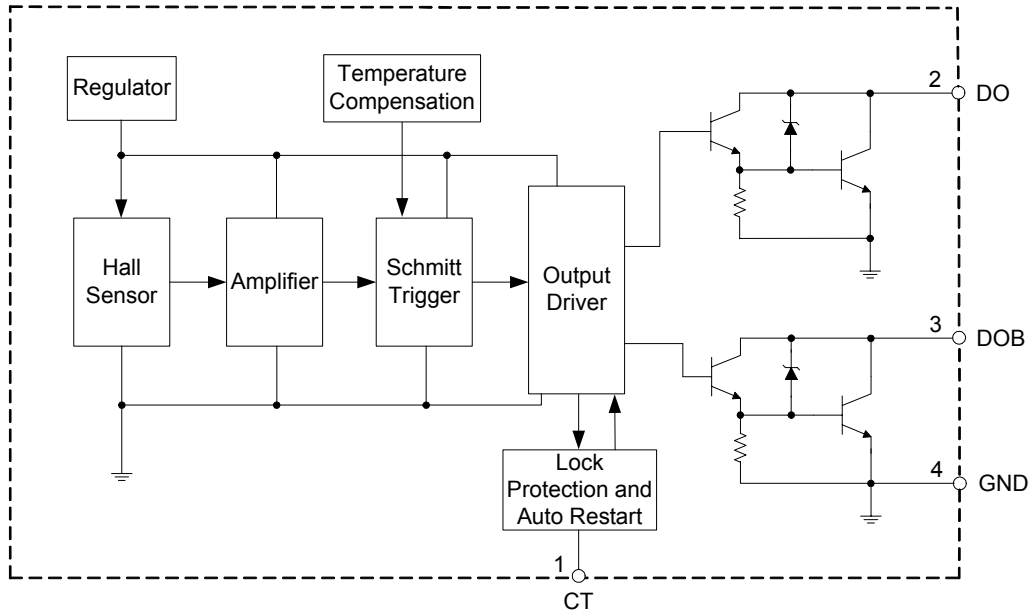
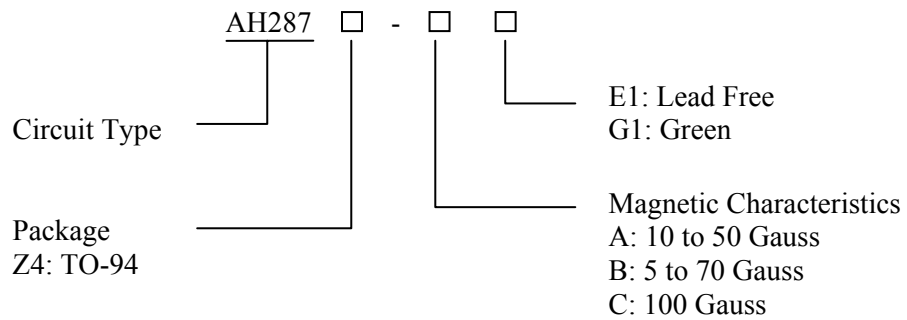


Figure 3. Functional Block Diagram of AH287

**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.

**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287****Absolute Maximum Ratings (Note 1, T<sub>A</sub>=25°C)**

Parameter	Symbol	Value	Unit
Supply Voltage	V <sub>CC</sub>	20	V
Magnetic Flux Density	B	Unlimited	Gauss
Output Current	I <sub>OUT</sub>	Continuous	350 mA
		Hold	550 mA
		Peak (Start Up)	750 mA
Power Dissipation	P <sub>D</sub>	550	mW
Thermal Resistance	Die to Atmosphere	θ <sub>JA</sub>	227 °C/W
	Die to Package Case	θ <sub>JC</sub>	49 °C/W
Junction Temperature	T <sub>J</sub>	150	°C
Storage Temperature	T <sub>STG</sub>	-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 (Note 2)**

Parameter	Symbol	Min	Max	Unit
Supply Voltage*	V <sub>CC</sub>	3.5	18	V
Lock Protection and Automatic Restart Voltage**	V <sub>LOCK</sub>	4.5	18	V
Ambient Temperature	T <sub>A</sub>	-20	85	°C

Note 2: When D1 (see Figure 12) is disconnected,

\* the minimum startup voltage is 3.5V.

\*\* the minimum operation voltage of lock protection and automatic restart is 4.5V.

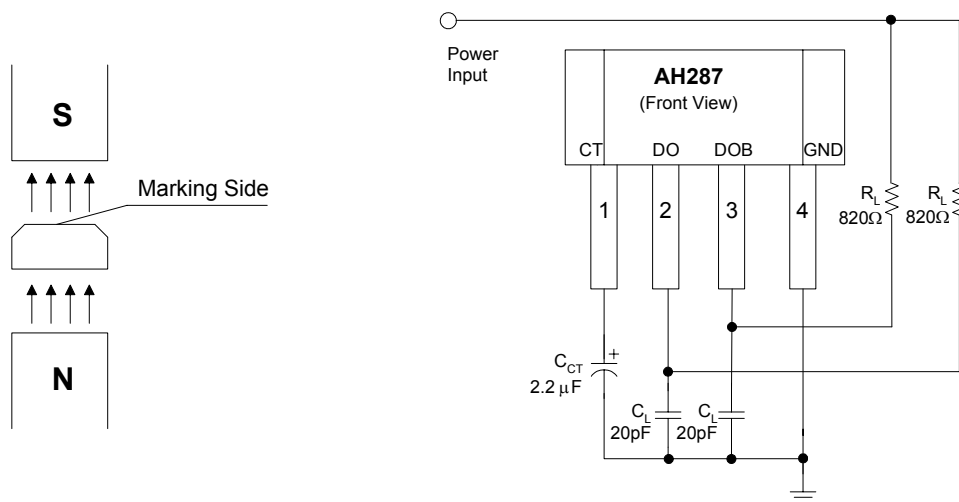
**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287****Electrical Characteristics**

$V_{CC}=14V$ ,  $T_A=25^{\circ}C$ , 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	$t_r$	$R_L=820\Omega$ , $C_L=20pF$		3	10	$\mu s$
Output Fall Time	$t_f$	$R_L=820\Omega$ , $C_L=20pF$		0.3	1.5	$\mu s$
Switch Time Differential	$\Delta t$	$R_L=820\Omega$ , $C_L=20pF$		3	10	$\mu s$
Output Zener Breakdown Voltage	$V_Z$			55		V
Charge Current	$I_{CHG}$	$V_{CT}=1$ to $2.5V$		5		$\mu A$
Discharge Current	$I_{DHG}$	$V_{CT}=3.5$ to $2.5V$		0.5		$\mu A$
Clamp Voltage	$V_{CL}$	Limiting voltage		3.2		V
Comparator Voltage	$V_{CP}$	Limiting voltage		2.2		V

**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287**
**Magnetic Characteristics ( $T_A=25^\circ\text{C}$ )**

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**


**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287**

**Magnetic Hysteresis Characteristics**

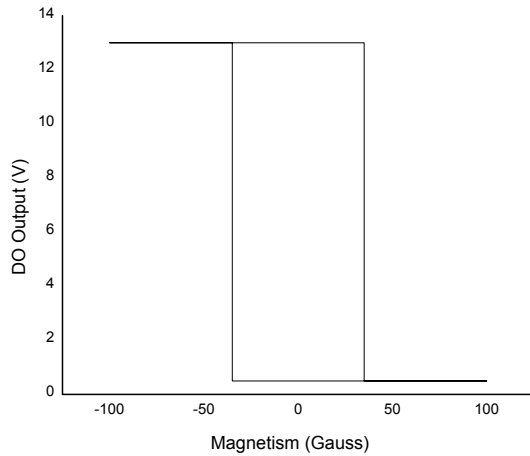


Figure 4. DO Output vs. Magnetism

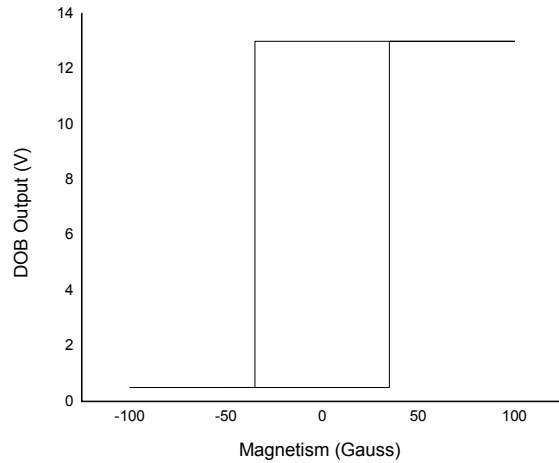


Figure 5. DOB Output vs. Magnetism

**Typical Performance Characteristics**

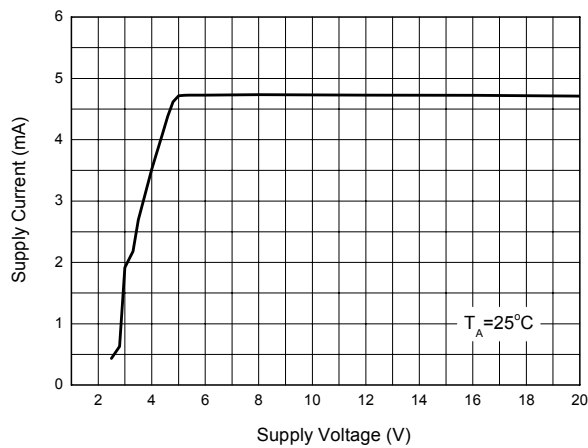


Figure 6. Supply Current vs. Supply Voltage

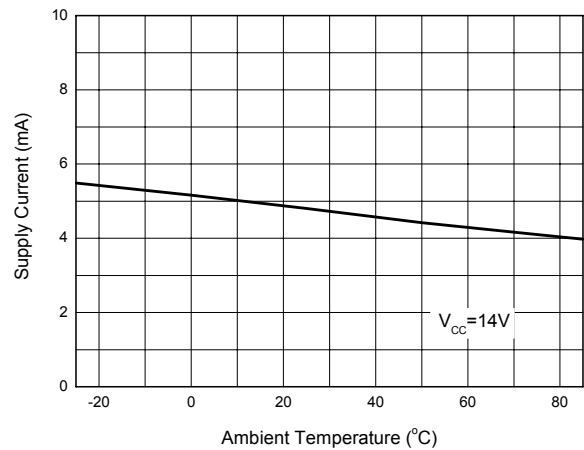


Figure 7. Supply Current vs. Ambient Temperature



**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287**

**Typical Performance Characteristics (Continued)**

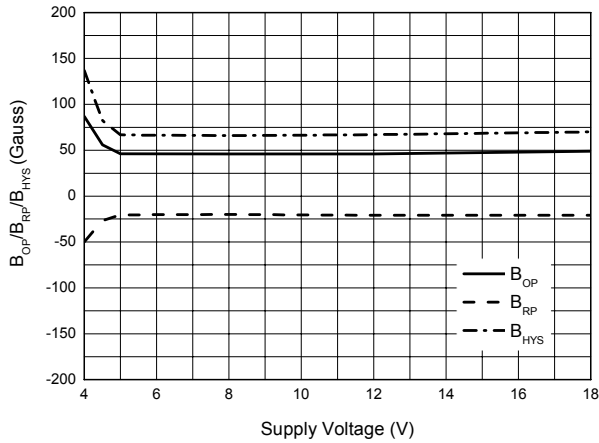


Figure 8.  $B_{OP}/B_{RP}/B_{HYS}$  vs. Supply Voltage

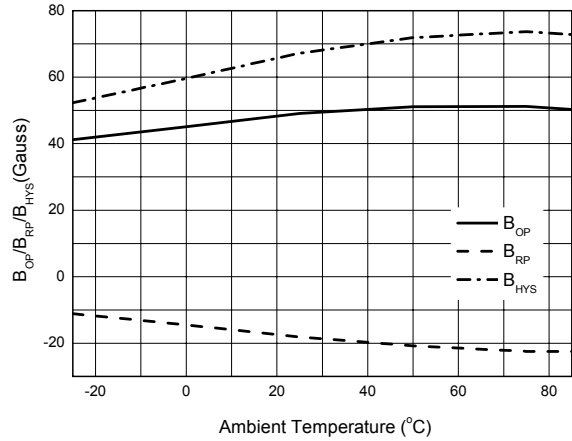


Figure 9.  $B_{OP}/B_{RP}/B_{HYS}$  vs. Ambient Temperature

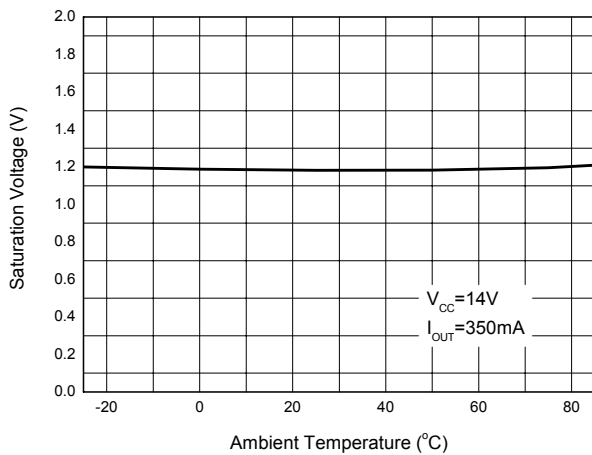


Figure 10. Saturation Voltage vs. Ambient Temperature

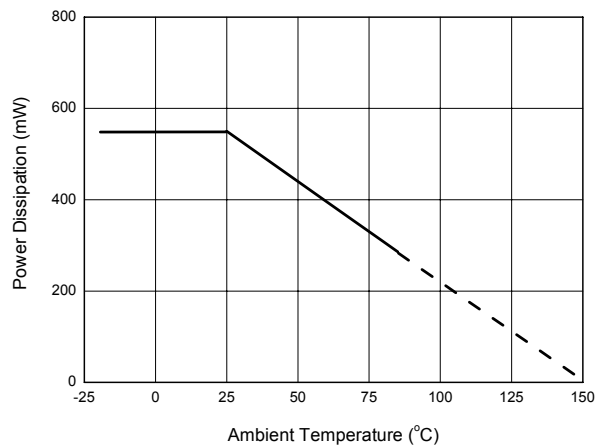
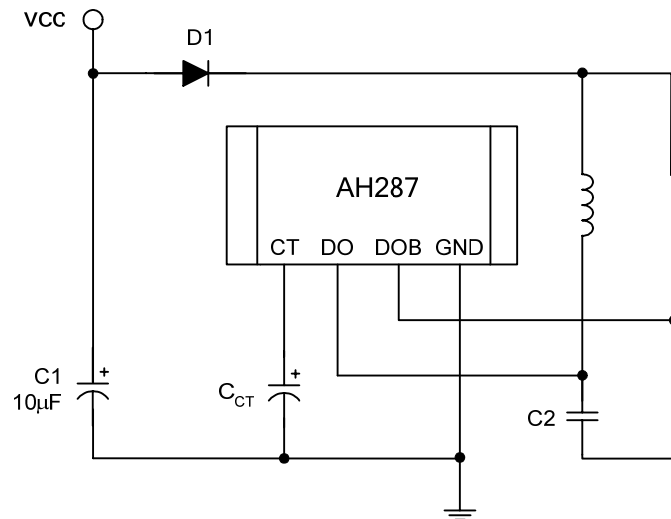


Figure 11. Power Dissipation vs. Ambient Temperature ( Table 1)

**Table 1:**

$T_A$ (°C)	-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
$T_A$ (°C)	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	



**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287**
**Typical Application (Note 3)**


Note 3:

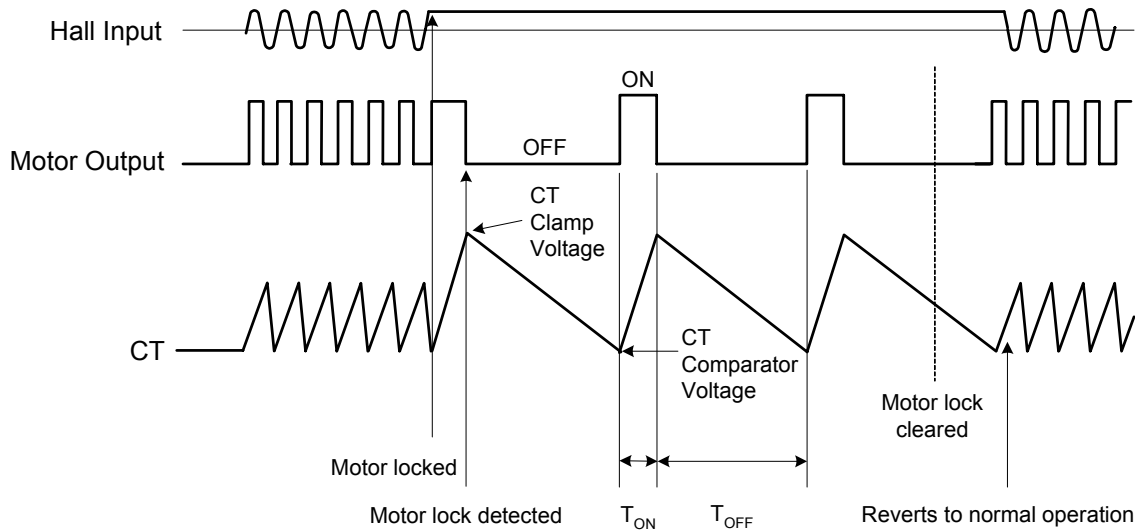
1. Due to the special internal circuit of AH287, the minimum operation voltage of lock protection and automatic restart is higher than the minimum startup voltage. It is 4.5V.
2. The capacitances of  $C_{CT}$  and  $C_2$  are adjustable base on system requirements. The recommended values are as below:

$C_{CT}$	$C_2$
1µF/9V~2.2µF/9V	1µF/50V~2.2µF/50V

Figure 12. Typical Application of AH287

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**Operating Diagram (Note 4)**



Note 4: 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.

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

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

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

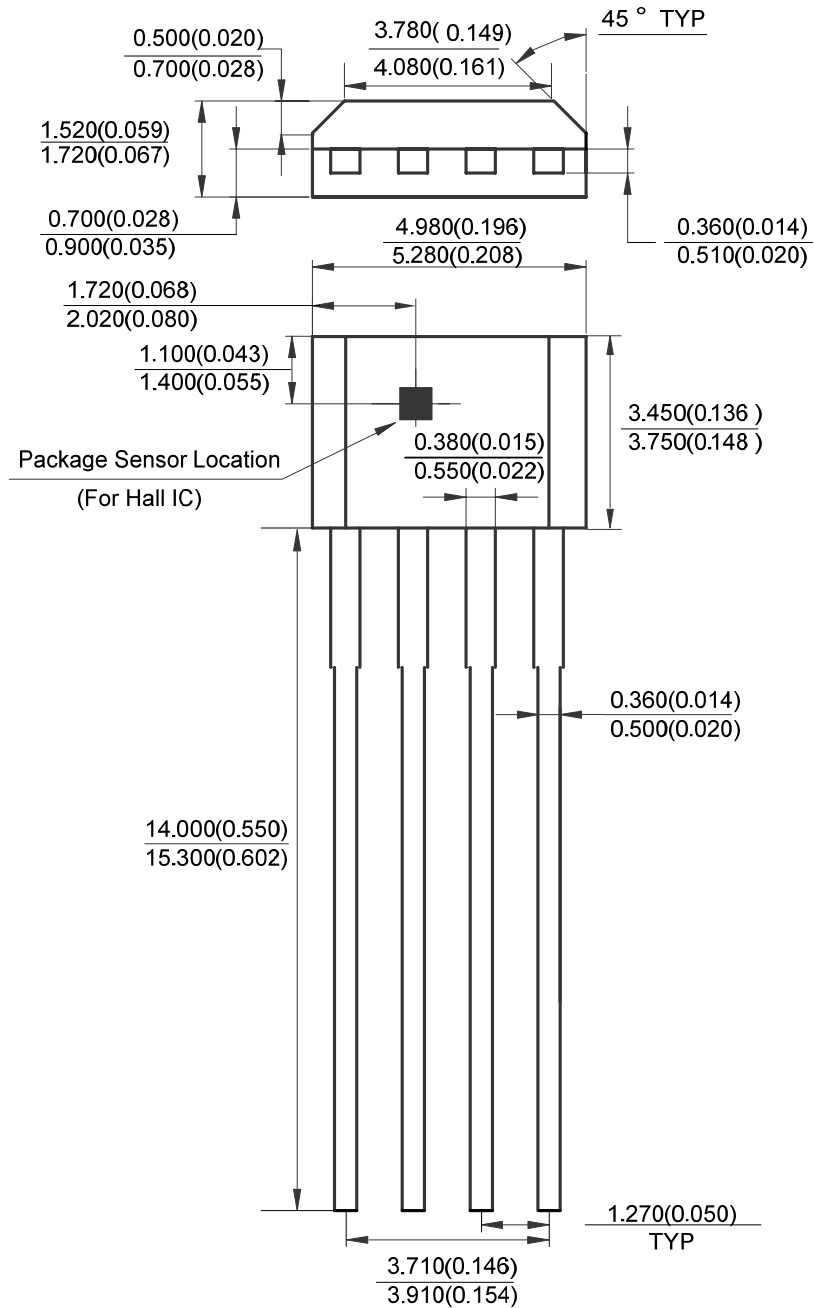
Figure 13. Control Timing Diagram of AH287

**TWO PHASE HALL EFFECT LATCH WITH LOCKED PROTECTION AH287**

**Mechanical Dimensions**

**TO-94**

**Unit: mm(inch)**





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