

High Sensitivity Hall IC for FAN Driver

Features

- On-Chip Hall Sensor
- Low Operating Supply Voltage: 3V
- High Sensitivity Hall Effect Sensor IC: $\pm 30\text{G}$ (Type.)
- Built-In Reverse Voltage Protection Diode
- Built-In Output Protection Clamping Circuit
- Lock Protection and Auto Restart Function
- Built-In Thermal Protection Circuit
- 4 Pin TO-92M4 Package
- Lead Free and Green Devices Available (RoHS Compliant)

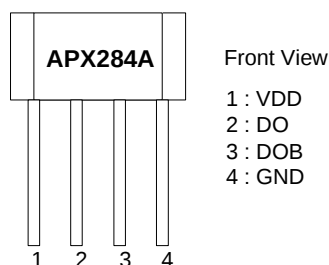
General Description

The APX284A is an integrated Hall Effect Sensor IC designed for electric commutation of two-phase DC brushless motor applications. The device is built-in lock protection. When the fan is locked, the device will enter the lock protection mode. The APX284A is available in a low cost TO-92M4 package.

Pin Description

Applications

- Brushless DC Fans
- Brushless DC Motors



Ordering and Marking Information

APX284A □□□-□□□ Assembly Material Handling Code Temperature Range Package Code	Package Code E : TO-92M4 Temperature Range I : -40 to 105 °C Handling Code PB : Plastic Bag Assembly Material G : Halogen and Lead Free Device
APX284A E : APX 284A XXXXX	XXXXX - Date Code

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. ANPEC defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Note 1)

Symbol	Parameter	Rating	Unit
V_{DD}	VDD Pin Supply Voltage	-0.3 to 20	V
$V_{DO, DOB}$	Output Pin (DO, DOB) Output Voltage	-0.3 to $V_{OUT-CLAMP}$	V
I_{OUT}	Maximum Output Pin (DO, DOB) Sink Current – Continuous (Note 2) Hold	500 800	mA
T_J	Maximum Junction Temperature	150	$^\circ\text{C}$
T_{STG}	Storage Temperature	-65 to 150	$^\circ\text{C}$
T_{SOR}	Maximum Lead Soldering Temperature, 10 Seconds	260	$^\circ\text{C}$

Note 1: Stresses beyond 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 rating conditions for extended periods may affect device reliability.

Note 2: The maximum continuous current rating should refer recommend operating conditions (V_{DD} , T_A , T_J) to guarantee reliability.

Thermal Characteristics

Symbol	Parameter	Typical Value	Unit
θ_{JA}	Thermal Resistance-Junction to Ambient (Note 3) TO-92M4	131	$^\circ\text{C/W}$
P_D	Power Dissipation, $T_A = 25^\circ\text{C}$ TO-92M4	950	mW

Note 3: The maximum allowable power dissipation at any T_A (ambient temperature) is calculated using: $P_D(\text{max}) = (T_J - T_A) / \theta_{JA}$; $T_J = 150^\circ\text{C}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature.

Recommended Operating Conditions

Symbol	Parameter	Range	Unit
V_{DD}	VDD Supply Voltage	3 to 16	V
T_A	Operating Ambient Temperature	-40 to 105	$^\circ\text{C}$
T_J	Junction Temperature	-40 to 125	$^\circ\text{C}$

Electrical Characteristics ($T_A = 25^\circ\text{C}$, $V_{DD} = 12\text{V}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	APX284A			Unit
			Min.	Typ.	Max.	
I_{DD1}	VDD Supply Current	$V_{DD} = 3\text{V}$, Output Open	-	2	4	mA
I_{DD2}		$V_{DD} = 20\text{V}$, Output Open	-	2	4	mA
V_{SAT}	Output Saturation Voltage	$V_{DD} = 12\text{V}$, $I_{OUT} = 300\text{mA}$	-	300	500	mV
$V_{OUT-CLAMP}$	DO, DOB Output Clamp Voltage	DO, DOB Pin Off	24	33	42	V
I_{DOH}	DO Pin High Input Current	$V_{DO} = 12\text{V}$, B<Brp	-	120	200	μA
I_{DOBH}	DOB Pin High Input Current	$V_{DOB} = 12\text{V}$, B>Bop	-	120	200	μA
T_{ON}	Lock Detection On Time		-	1	-	sec
T_{OFF}	Lock Detection Off Time		-	5	-	sec
T_{OTS}	Over-Temperature Shutdown Threshold		-	165	-	$^\circ\text{C}$
	Over-Temperature Shutdown Hysteresis		-	30	-	$^\circ\text{C}$

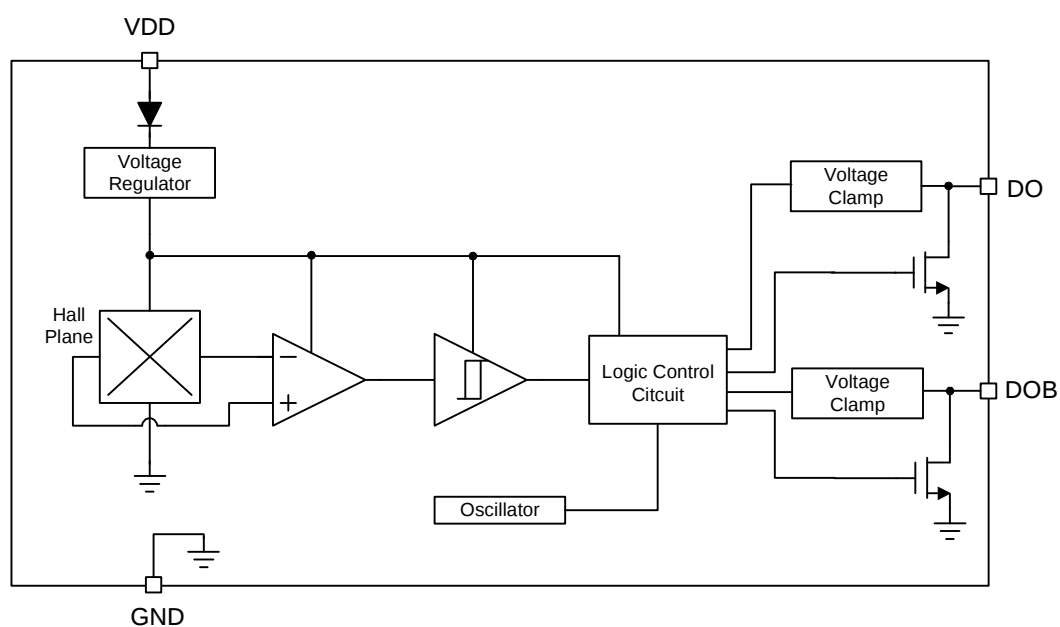
Magnetic Characteristics ($T_A = 25^{\circ}\text{C}$, $V_{DD} = 12\text{V}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	APX284A			Unit
			Min.	Typ.	Max.	
Bop	Magnetic Operation Point		5	30	60	Gauss
Brp	Magnetic Release Point		-60	-30	-5	Gauss
Bhys	Magnetic Hysteresis		30	60	120	Gauss

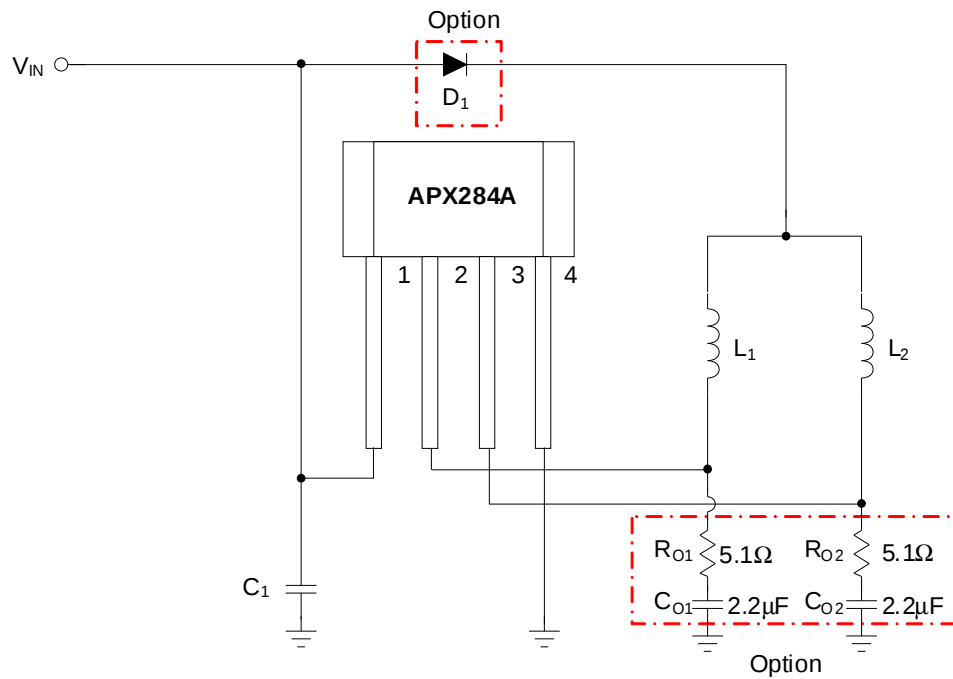
Pin Description

PIN		FUNCTION
NO.	NAME	
1	VDD	Supply Voltage Input.
2	DO	Open Drain Output. Controlled by magnetic field input.
3	DOB	Open Drain Output. Controlled by magnetic field input.
4	GND	Ground of the IC.

Block Diagram



Typical Application Circuit

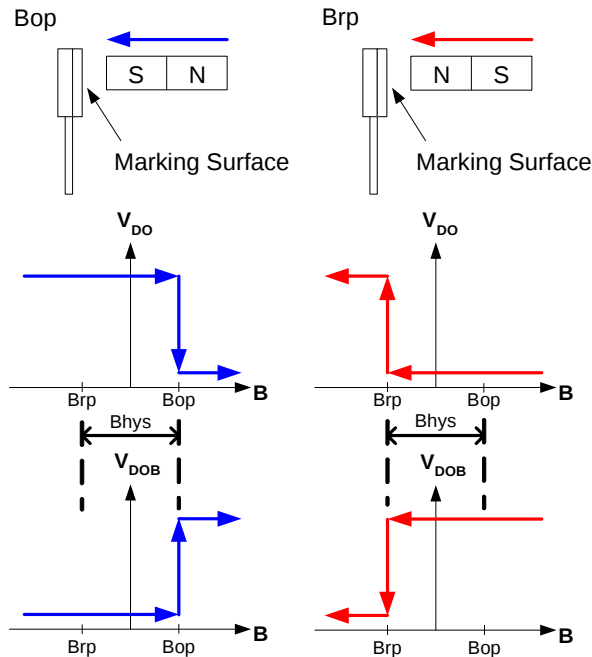


Notes: D_1 is to protect IC and coils when reverse power input
 C_1 : typical 1μF/25V capacitor recommended

Function Description

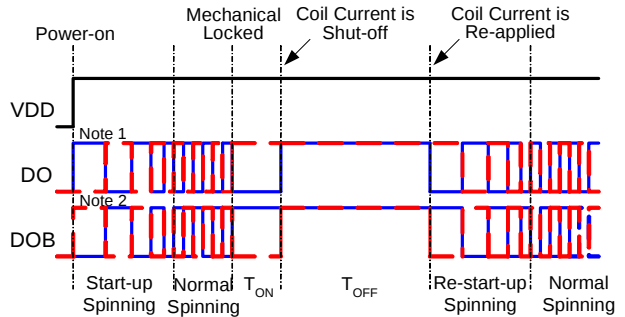
Output Switch Principle

The APX284A builds in a Hall-effect sensor plane to sense the vertical magnetic flux density (B). There are two output drivers in APX284A to drive two-phase DC brushless motor. When the South pole magnetic field is close to the IC marking surface and the magnetic flux density higher than operate point (Bop), the DO pin output will turn ON and the DOB pin output will turn OFF. When the South pole magnetic field far away the IC marking surface and North pole magnetic field close to the IC marking surface until the magnetic flux density higher than release point (Brp), the DO pin output will turn OFF and the DOB pin output will turn ON.



Lockup Protection and Automatic Restart

The APX284A detects the rotation of the motor by internal hall sensor signal, and adjusts lock detection ON time (T_{ON}) and lock detection OFF time (T_{OFF}) by internal counter.



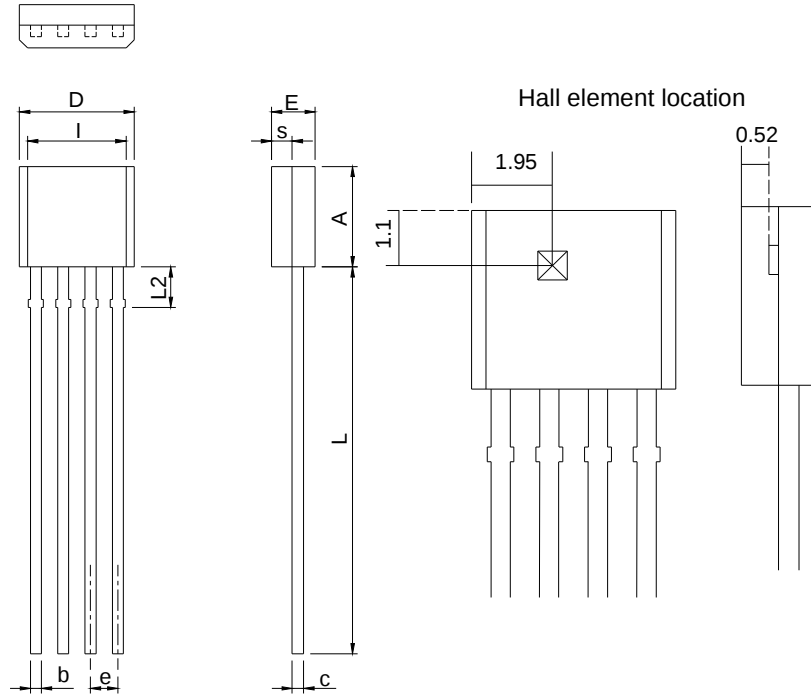
Note 1: — North pole face to the hall IC marking surface at power on.
Note 2: - - South pole face to the hall IC marking surface at power on.

Thermal Protection

The APX284A has a thermal protection. When the internal junction temperature reaches 165°C, the output devices will be switched off. When the IC's junction temperature cools by 30°C, the thermal sensor will turn the output devices on again, resulting in a pulsed output during continuous thermal protection.

Package Information

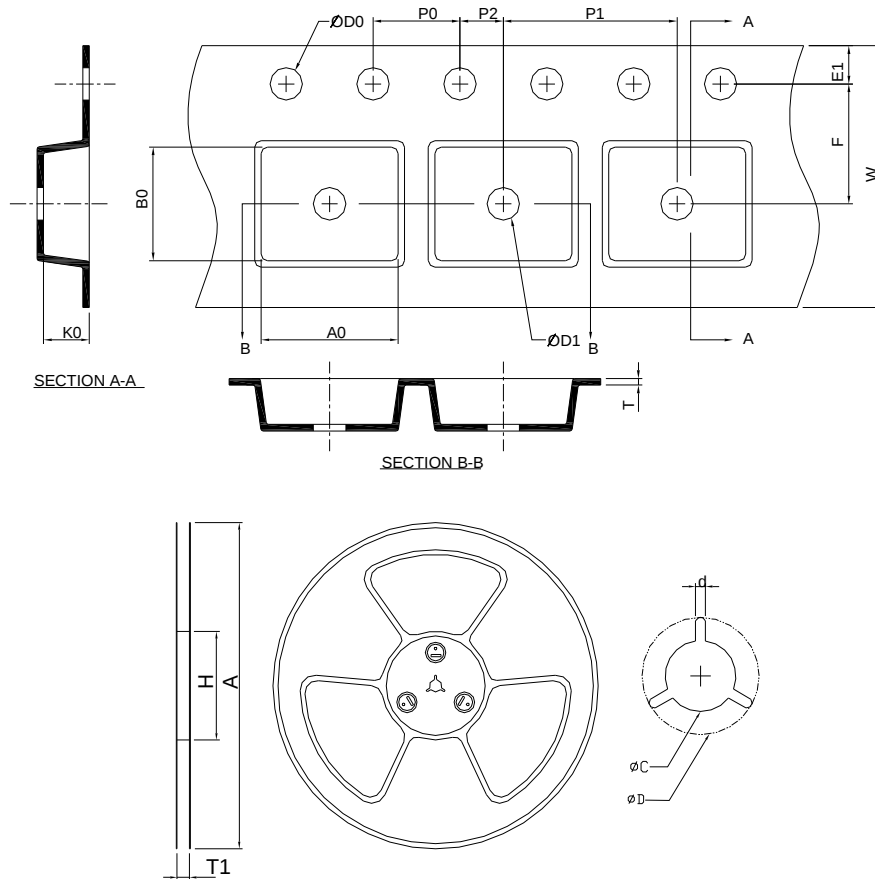
TO-92M4



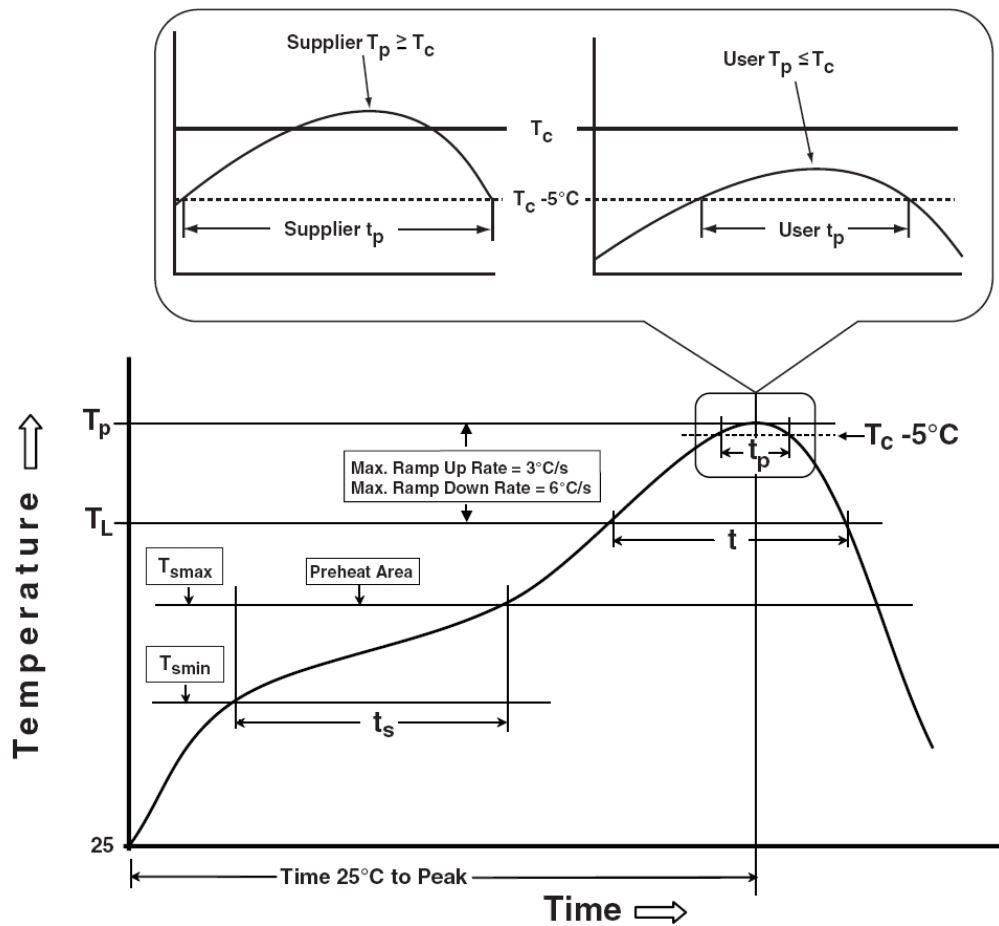
Sensitive Area (0.286x0.286mm²)
 Position of Hall Sensor
 reference to the top-left of package
 $x = 1.1 \pm 0.1 \text{ mm}$
 $y = 1.95 \pm 0.1 \text{ mm}$

SYMBOL	TO-92M4			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	3.45	3.75	0.136	0.148
b	0.31	0.56	0.012	0.022
c	0.35	0.51	0.014	0.020
D	4.98	5.32	0.196	0.209
e	1.27 BSC		0.050 BSC	
E	1.40	1.80	0.055	0.071
I	3.78	4.67	0.149	0.184
L	13.50	15.80	0.531	0.622
L2	1.34	1.65	0.053	0.065
s	0.50	0.90	0.020	0.035

Carrier Tape & Reel Dimensions



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak Temperature min (T_{smin}) Temperature max (T_{smax}) Time (T_{smin} to T_{smax}) (t_s)	100 °C 150 °C 60-120 seconds	150 °C 200 °C 60-120 seconds
Average ramp-up rate (T_{smax} to T_p)	3 °C/second max.	3 °C/second max.
Liquidous temperature (T_L) Time at liquidous (t_L)	183 °C 60-150 seconds	217 °C 60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_p)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum. ** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1. SnPb Eutectic Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HOLT	JESD-22, A108	1000 Hrs, Bias @ $T_j=125^{\circ}\text{C}$
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C
HBM	MIL-STD-883-3015.7	VHBM ≥ 2KV
MM	JESD-22, A115	VMM ≥ 200V
Latch-Up	JESD 78	10ms, $I_{tr} \geq 100\text{mA}$

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