Direct PWM Variable Speed Fan Motor Driver

Features

- **Single Phase Full Wave Fan Driver**
- **Low Supply Current**
- **Built-In Variable Speed Function**
- **Include Hall Bias Circuit**
- **Built-In Lock Protection and Auto Restart Function**
- **FG Output and RD Output Signal available**
- **Built-In Current Limit Circuit**
- **Built-In Thermal Protection Circuit**
- **FG pin HBM/MM ESD can sustain up to 4kV/400V**
- **SSOP-16 Package**
- **Lead Free and Green Devices Available (RoHS Compliant)**

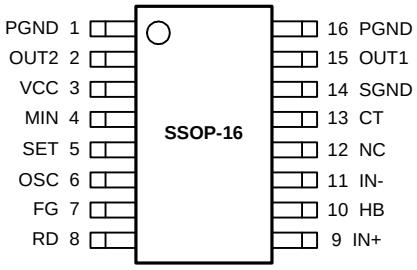
Applications

- **CPU Cooler**
- **Variable Speed Control Fan**

General Description

The APX9262P is a high efficient direct PWM drive IC with single phase and CMOS drive. Such IC design is suitable for variable speed control FAN of personal computer's power supply radiation and CPU cooler. The device is built-in lock protection. When fan is locked, the device will enter the lockup protection mode. It is also with rotation detection output and thermal shut-down function. In normal operation, supply current is 3mA. The APX9262P is available in SSOP-16 package.

Pin Configuration



APX9262P

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.

Ordering and Marking Information

APX9262P □□-□□□ Assembly Material Handling Code Temperature Range Package Code	Package Code N : SSOP-16 Operating Ambient Temperature Range I : -40 to 90 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device
APX9262P N : 	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).

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Ratings	Unit
V_{CC}	VCC Pin Supply Voltage	-0.3 to 18	V
I_{OUT}	OUT1/OUT2 Pin Output Current	0 to 1	A
V_{OUT1}/V_{OUT2}	OUT1/OUT2 Pin Output Voltage	-0.3 to 18	V
I_{HB}	HB Pin Output Current	0 to 10	mA
V_{SET} / V_{MIN}	SET/MIN Pin Input Voltage	-0.3 to 18	V
V_{RD} / V_{FG}	RD/FG Output Voltage	-0.3 to18	V
I_{RD} / I_{FG}	RD/FG Sink Current	0 to 10	mA
$R_{TH,JA}$	Thermal Resistance-Junction to Ambient SSOP-16	125	°C/W
P_D	Power Dissipation (Note2)	1	W
T_J	Junction Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-55 to 150	°C
T_{SDR}	Maximum Lead Soldering Temperature, 10 Seconds	260	°C

Note1: 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.

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{CC}	VCC Pin Supply Voltage	3.5 to 15	V
V_{SET}	SET Pin Input Voltage Range	0 to 6	V
V_{MIN}	MIN Pin Input Voltage Range	0 to 6	V
V_{ICM}	Common-Mode Hall Input Voltage Range	0.2 to 3	V
T_A	Ambient Temperature	-40 to 90	°C

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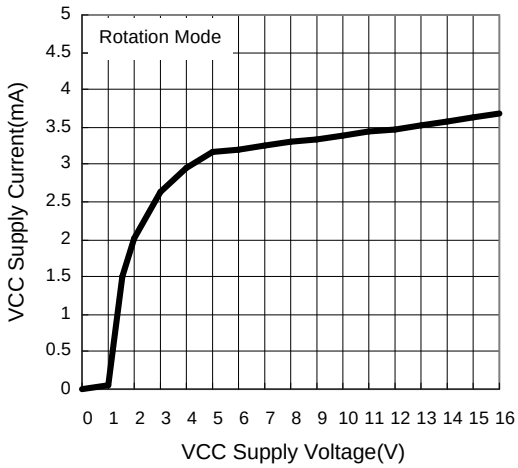
Electrical Characteristics (V_{CC} = 12V, T_A = 25°C, unless otherwise specified)

Symbol	Parameter	Test Conditions	APX9262P			Unit
			Min.	Typ.	Max.	
SUPPLY CURRENT						
V_{HB}	HB Pin Output Voltage	I_{HB} = 5mA	1.15	1.3	1.45	V
I_{CC1}	Operating Current	Rotation Mode	-	3	6	mA
I_{CC2}		Lock Protection Mode	-	3	6	mA
OSCILLATOR						
V_{OSCH}	OSC High Level Voltage	C_{OSC} = 100pF	3.47	3.6	3.73	V
V_{OSCL}	OSC Low Level Voltage	C_{OSC} = 100pF	1.96	2.05	2.14	V
F_{OSC}	OSC Oscillation Frequency	C_{OSC} = 100pF	18	25	32	kHz
LOCK PROTECTION						
V_{CTH}	CT Pin High Level Voltage	C_{CT} = 1µF	3.24	3.6	3.96	V
V_{CTL}	CT Pin Low Level Voltage	C_{CT} = 1µF	1.2	1.4	1.6	V
I_{CT1}	CT Charge Current	V_{CT} = 0V	1.5	2	2.5	µA
I_{CT2}	CT Discharge Current	V_{CT} = 3.6V	0.15	0.2	0.25	µA
R_{CT}	CT Charge/Discharge Current Ratio	$R_{CT} = I_{CT1}/I_{CT2}$	8.5	10	11.5	-
OUTPUT DRIVERS						
V_{OL}	Output Lower Side Saturation	I_{OUT} = 200mA	-	0.1	0.2	V
V_{OH}	Output Upper Side Saturation	I_{OUT} = 200mA	-	0.25	0.5	V
V_{RD}/V_{FG}	RD/FG Pin Low Voltage	I_{FG} = 5mA	-	0.2	0.3	V
I_{RDL}/I_{FGL}	RD/FG Pin Leak Current	V_{FG} = 7V	-	-	0.1	µA
HALL SENSITIVITY						
V_{HN}	Hall Input Sensitivity	Zero to peak including offset and hysteresis	-	10	25	mV
THERMAL SHUTDOWN						
	Over-Temperature Shutdown Threshold		-	175	-	°C
	Over-Temperature Shutdown Hysteresis		-	30	-	
CURRENT LIMIT						
I_{LIM}	Current Limit Value		0.85	1	1.15	A

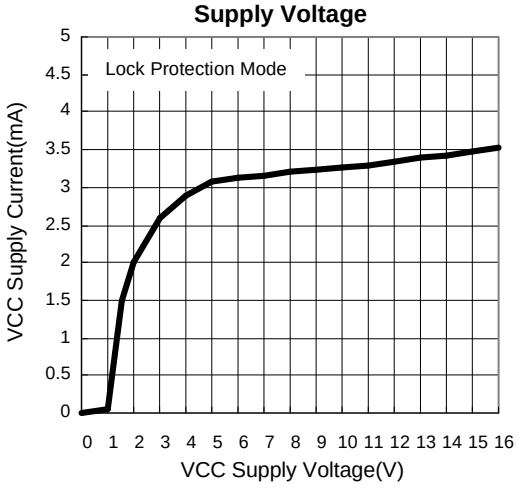
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Typical Operating Characteristics

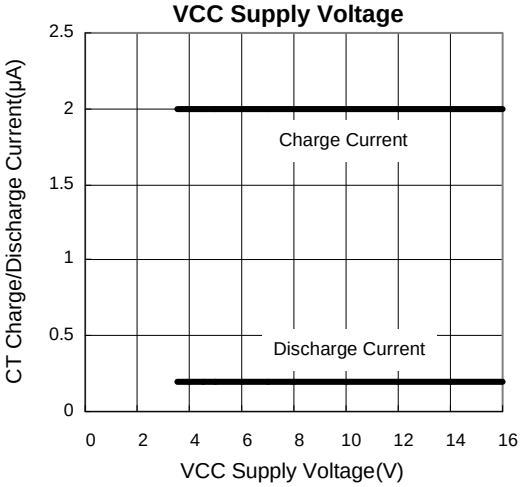
VCC Supply Current vs. VCC Supply Voltage



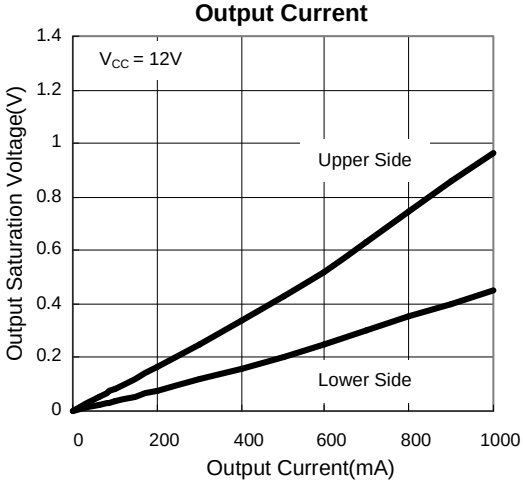
VCC Supply Current vs. VCC Supply Voltage



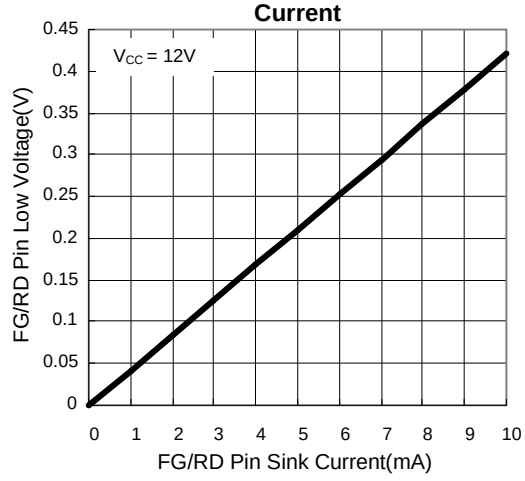
CT Charge/Discharge Current vs. VCC Supply Voltage



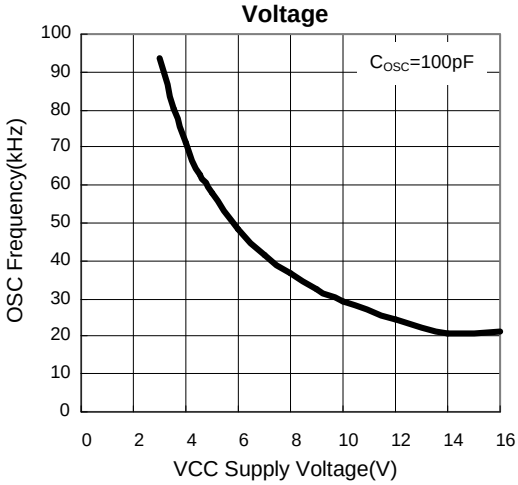
Output Saturation Voltage vs. Output Current



FG/RD Pin Low Voltage vs. Sink Current

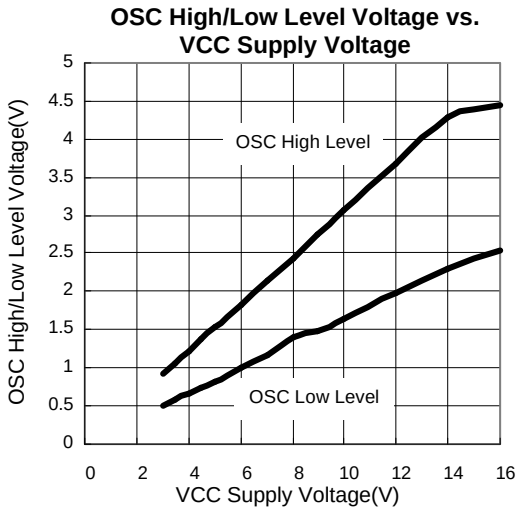


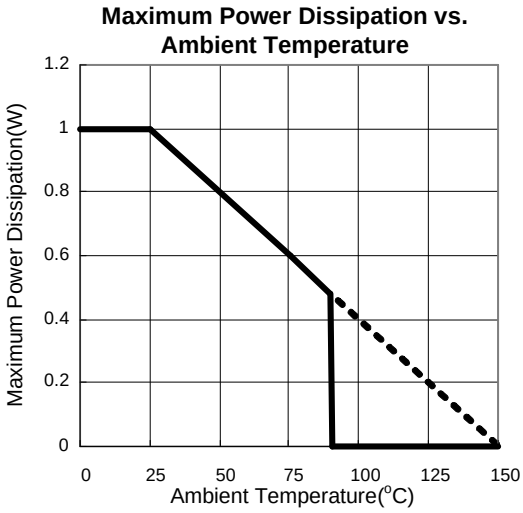
OSC Frequency vs. VCC Supply Voltage



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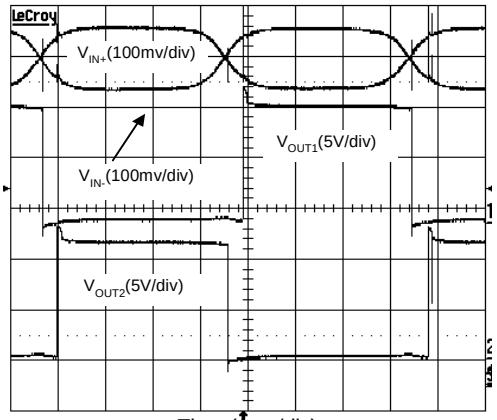
Typical Operating Characteristics





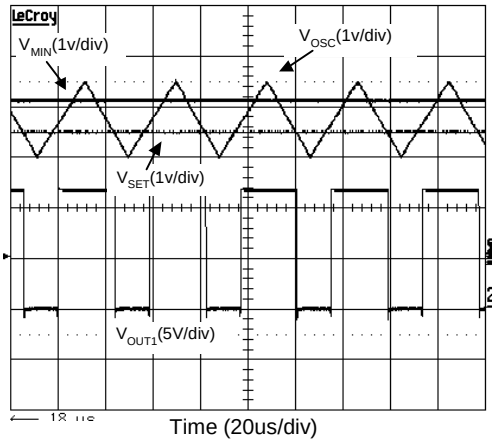
Operating Waveforms

Rotation Waveform 1



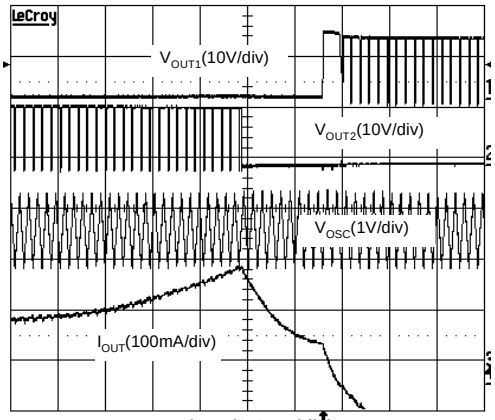
Time (1ms/div)

Rotation Waveform 2



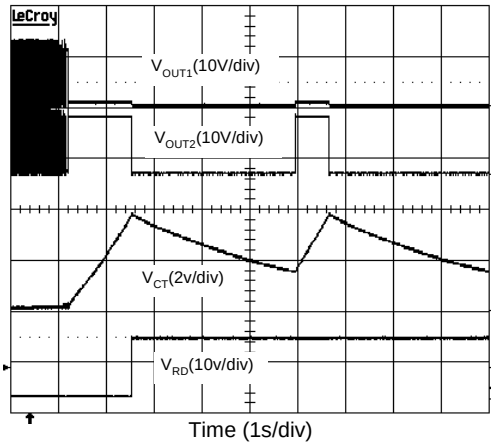
Time (20us/div)

Rotation Waveform 3



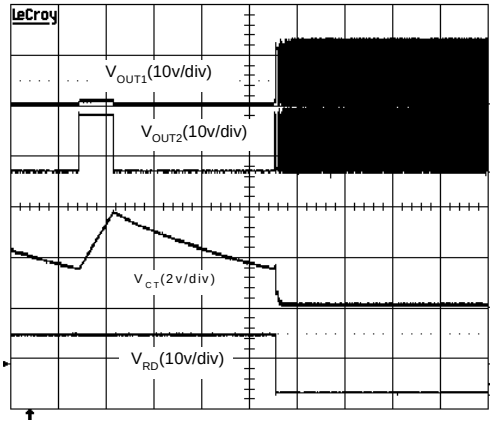
Time (0.2ms/div)

Lock Protection Waveform 1



Time (1s/div)

Lock Protection Waveform 2



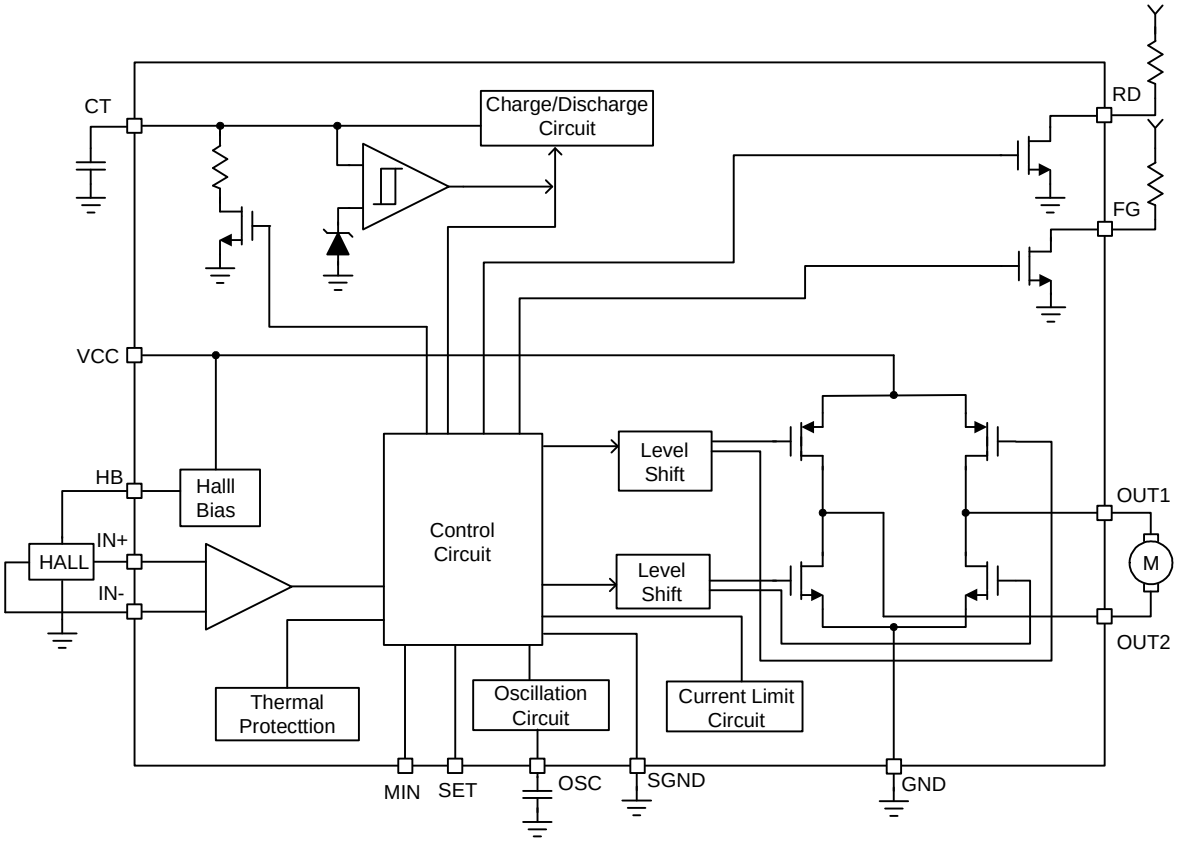
Time (1s/div)

Pin Descriptions

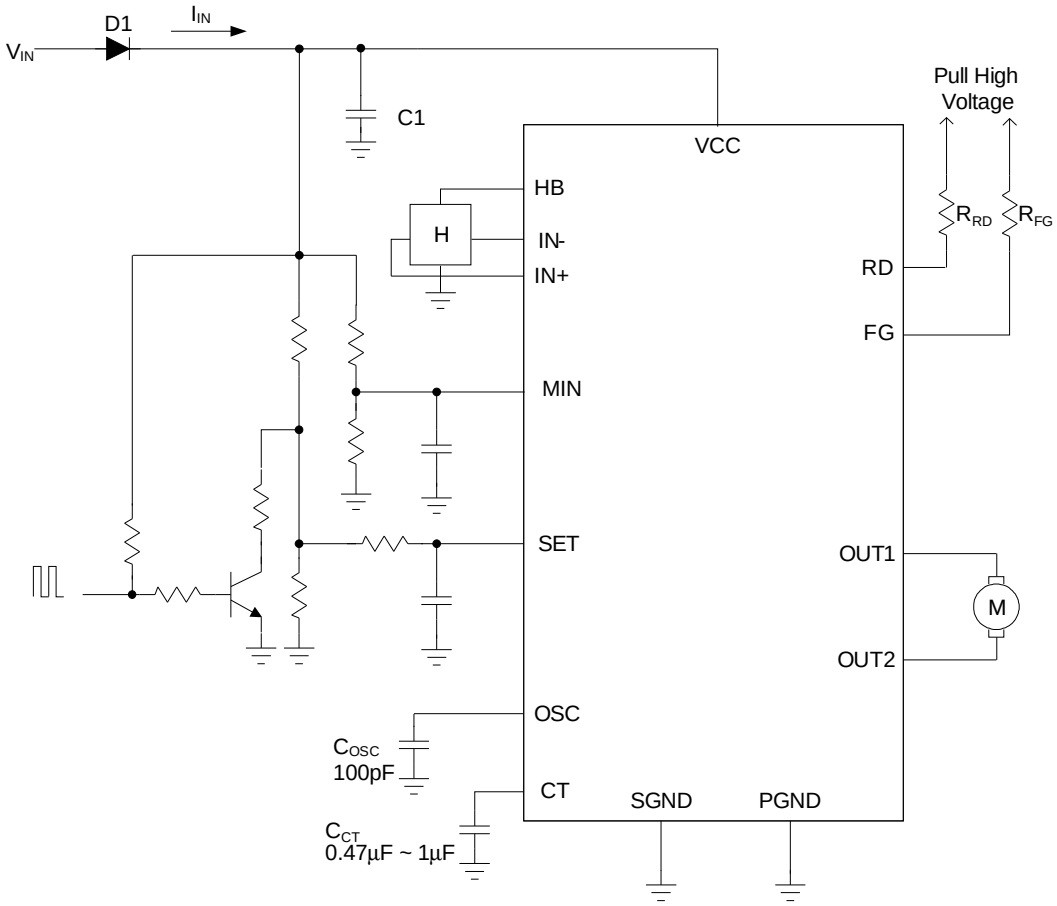
PIN		FUNCTION
NO.	NAME	
1	PGND	Power Stage GND.
2	OUT2	H-bridge Output Connection.
3	VCC	Supply Voltage Input Pin.
4	MIN	Speed Setting. An external voltage into MIN pin to set fan speed.
5	SET	Speed Setting. An external voltage into SET pin to set fan speed.
6	OSC	Oscillation Frequency Setting. Connect a capacitor to GND to set oscillation frequency.
7	FG	Rotation Speed Output. This is an open–drain output.
8	RD	Rotation Detection Output. This is an open–drain output.
9	IN+	Hall Input +. Connect to hall element positive output.
10	HB	Hall Bias. This is a 1.3V constant–voltage output for hall element bias.
11	IN-	Hall Input -. Connect to hall element negative output.
12	NC	No Connection.
13	CT	Shutdown Time and Restart Time Setting. Connect a capacitor to GND to set shutdown time and restart time in lock mode.
14	SGND	Control Stage GND.
15	OUT1	H-bridge Output Connection.
16	PGND	Power Stage GND.

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Block Diagram



Typical Application Circuit



Truth Table

Input				Output				
IN-	IN+	OSC	CT	OUT1	OUT2	FG	RD	Mode
H	L	H	L	H	L	L	L	Rotation (Drive)
L	H			L	H	OFF	L	PWM ON
H	L	L		OFF	L	L	L	Rotation (Re-Circulation)
L	H			L	OFF	OFF	L	PWM OFF
H	L	-	H	L	L	L	OFF	Lock Mode
L	H			L	L	OFF		

Note 4: OSC-H corresponds to OSC>SET and OSC-L corresponds to OSC<SET.

Application Information

Input Protection Diode & Capacitor

The IC should be added a protection diode (D1) to prevent the damage from the power reverse connection. However, the protection diode will cause a voltage drop on the supply voltage. The current rating of the diode must be greater than the maximum output current. For the noise reduction purpose, a capacitor (C1) must connect between VCC and GND. It is the suggestion that C1 should be placed as close as possible to the device VCC pin

HB Pin & Hall Input

1.3V voltage reference is for hall element bias. Wiring needs to be shortened to prevent carrying of the noise. Hall input amplifier has 20mV hysteresis. Then, we recommend the hall input level to be 60mV or over.

CT Capacitor

The capacitor that is connected from CT pin to GND determines the shutdown time and restart time.

$$\text{Locked Detection Time} = \frac{C_{CT} \times (V_{CTH} - 0.2V)}{I_{CT1}}$$

$$\text{Restart Time} = \frac{C_{CT} \times (V_{CTH} - V_{CTL})}{I_{CT1}}$$

$$\text{Shutdown Time} = \frac{C_{CT} \times (V_{CTH} - V_{CTL})}{I_{CT2}}$$

where:

C_{CT} = CT pin capacitor

For example:

V_{CC}= 12V, C_{CT}= 1µF
Locked Detection Time = 1.7s
Restart Time = 1.1s
Shutdown Time = 11s

The value of charge capacitor is recommended from 0.47µF to 1µF.

FG /RD Resistor

The value of the FG/RD resistor could be decided by the following equation:

$$R_{FG} = \frac{V_{DC} - V_{FG}}{I_{FG}}$$

For example:

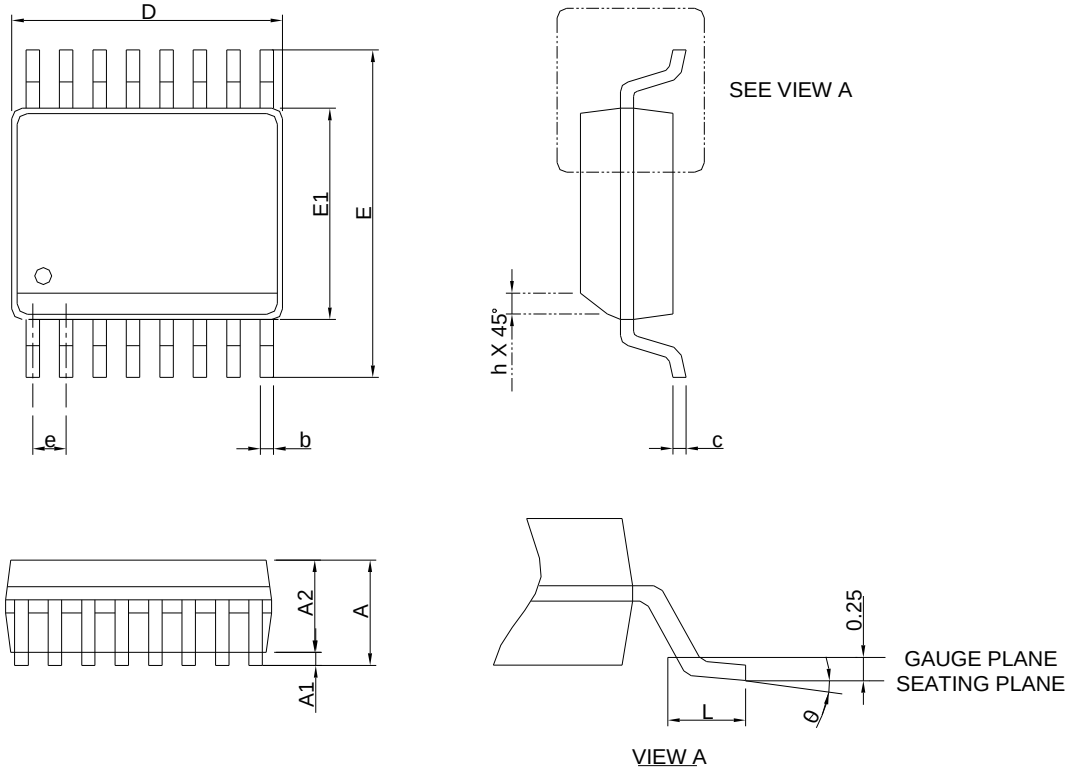
V_{DC} = 6V, I_{FG} = 5mA, V_{FG} = 0.2V, R_{FG} = 1.16kΩ

The value of resistor in the range of 1kΩ to 10kΩ is recommended.

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Package Information

SSOP-16

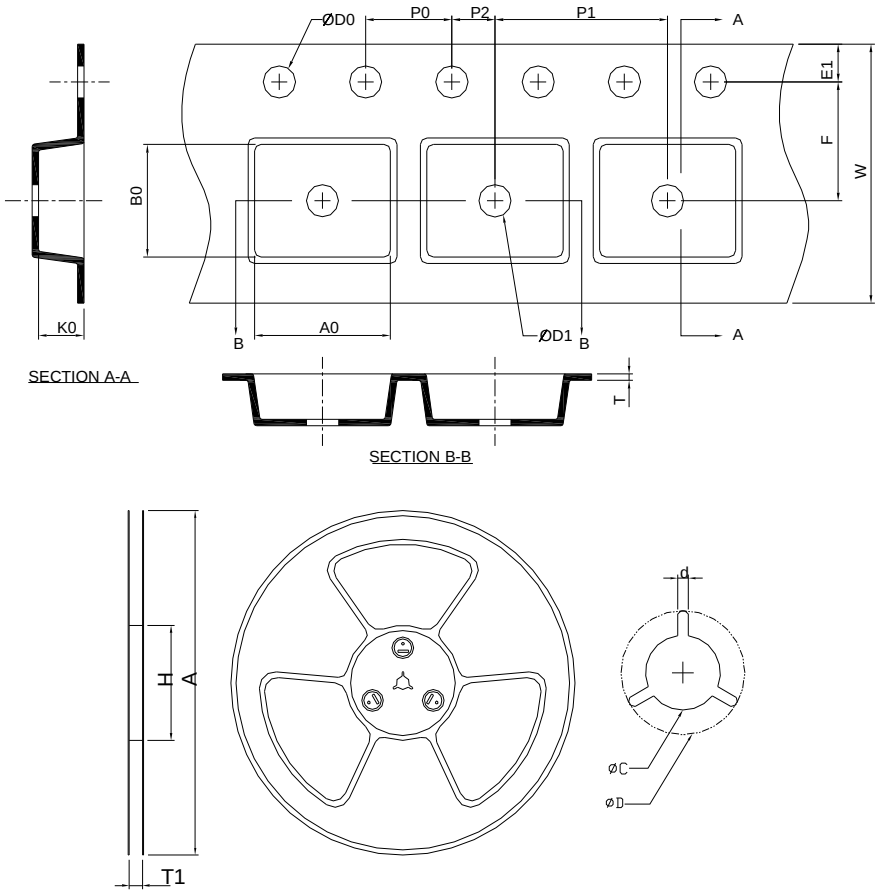


SYMBOL	SSOP-16			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.75		0.069
A1	0.10	0.25	0.004	0.010
A2	1.24		0.049	
b	0.20	0.30	0.008	0.012
c	0.15	0.25	0.006	0.010
D	4.80	5.00	0.189	0.197
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	0.635 BSC		0.025 BSC	
L	0.40	1.27	0.016	0.050
h	0.25	0.50	0.010	0.020
θ	0°	8°	0°	8°

Note : 1. Follow JEDEC MO-137 AB.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.
3. Dimension "E" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

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Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
SSOP-16	330.0±2.00	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0±0.30	1.75±0.10	5.50±0.10
	P0	**P1**	**P2**	**D0**	**D1**	**T**	**A0**	**B0**	**K0**
	4.00±0.10	8.00±0.10	2.00±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	6.40±0.20	5.20±0.20	2.10±0.20

(mm)

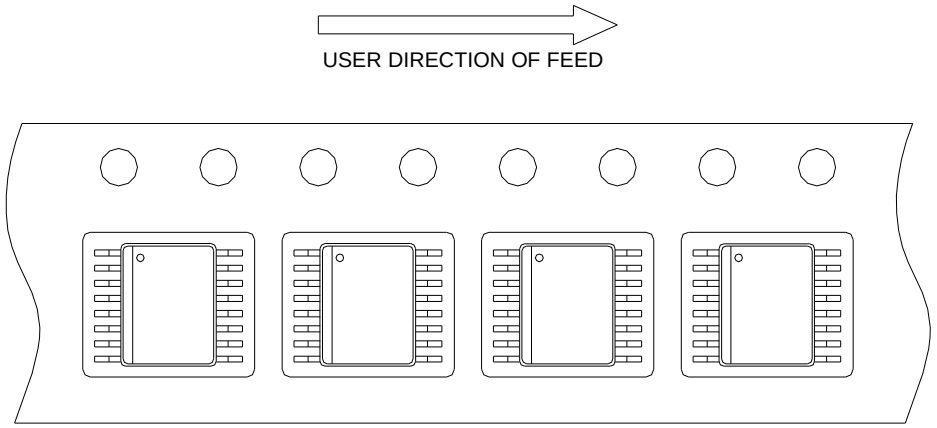
Devices Per Unit

Package Type	Unit	Quantity
SSOP- 16	Tape & Reel	2500

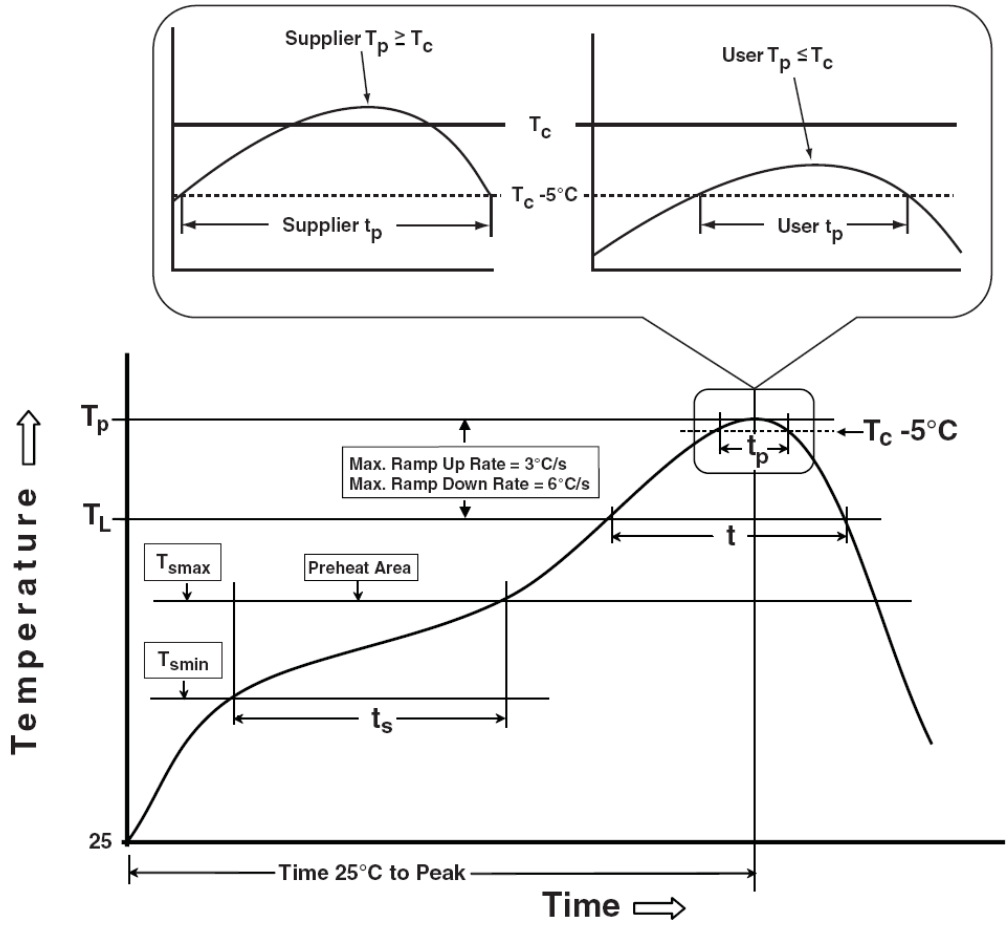
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Taping Direction Information

SSOP-16



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 (Tc)

Package Thickness	Volume mm^3 <350	Volume mm^3 ³350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

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

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 @ Tj=125°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, 1_{tr}≧100mA

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