Single-Phase Full-Wave Motor Driver for Silent Fan Motor

Features

- **Single Phase Full Wave Fan Driver**
- **Silent Driver**
- **Low Supply Current**
- **Low Standby Current (Lock mode T_{OFF}),**
  Supply current less than 220㎂
- **Lock Protection and Auto Restart Function**
- **Built-in FG Output**
- **Built-in Thermal Protection Circuit**
- **Lead Free and Green Devices Available**
  (RoHS Compliant)

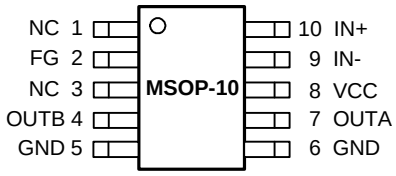
Applications

- **Motor Drivers For Silent Fan Motors**

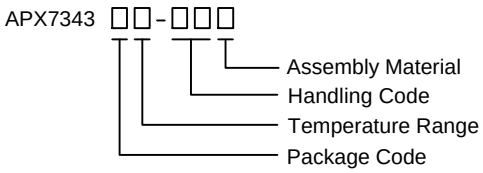
General Description

The APX7343 is a single-phase full-wave motor driver for DC fan motor. The output signal of this IC is the amplified hall input signal. It is suitable for both game machine and CPU cooler that need silent drivers. The device is equipped with built-in lock protection. When fan is locked, the device will enter the lockup protection mode. It is also with thermal protection function. In normal operation, supply current is less than 5mA; however, in lock mode, it is just around 150μA, moreover, this feature will shutdown amplifier and FG. The APX7343 is available in MSOP-10 package.

Pin Configuration



Ordering and Marking Information



Package Code
X : MSOP - 10
Operating Ambient Temperature Range
I : -40 to 105°C
Handling Code
TR : Tape & Reel
Assembly Material
L : Lead Free Device G : Halogen and Lead Free Device

APX7343 X : A7343 XXX XX — 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-020C 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	Rating	Unit
V_{CC}	VCC Pin Supply Voltage	-0.3 to 7	V
I_{OUT}	OUTA/OUTB Pin Output Current	-1 to 1	A
V_{OUTA}/V_{OUTB}	OUTA/OUTB Pin Output Voltage	-0.3 to V_{CC}+0.3	V
V_{FG}	FG Pin Output Voltage	-0.3 to V_{CC}+0.3	V
I_{FG}	FG Pin Sink Current	0 to 10	mA

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 (Cont.)

Symbol	Parameter	Rating	Unit
P_D	Power Dissipation	0.8	W
T_J	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature Range	-65 to 150	°C
T_{SDR}	Maximum Lead Soldering Temperature, 10 seconds	260	°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be Impaired.

Thermal Characteristics

Symbol	Parameter	Typical Value	Unit
$R_{TH, JA}$	Thermal Resistance-Junction to Ambient MSOP-10	192	°C/W

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{CC}	VCC Pin Supply Voltage	2.2 to 5.5	V
V_{Hall}	Hall Input Voltage Range	0.2 to Vcc-1.1	V
T_A	Ambient Temperature	-40 to 105	°C

Electrical Characteristics (V_{CC}=5V, T_A= 25°C, unless otherwise specified)

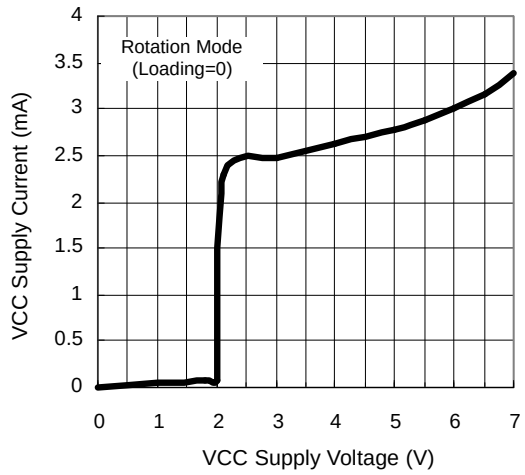
Symbol	Parameter	Test Conditions	APX7343			Unit
			Min.	Typ.	Max.	
I_{CC1}	Operating Current	Rotation Mode, Loading=0	-	3	5	mA
I_{CC2}	Standby Supply Current	Lock Mode	-	150	220	µA
V_{HOFS}	Input Offset Voltage		-6	-	6	mV
G_{IO}	Input-Output Gain	Ratio of (V_{OUTA}-V_{OUTB}) to (V_{IN+}-V_{IN-})	45	48	51	dB
V_{OL}	Output Lower Side Saturation	I_{OUT}=250mA	-	0.15	0.22	V
V_{OH}	Output Upper Side Saturation	I_{OUT}=250mA	-	0.15	0.22	V
	FG Pin Low Voltage	I_{FG}=5mA	-	0.2	0.3	V
I_{FGL}	FG Pin Leak Current	V_{FG}=5V	-	-	1	µA
I_{IN+}/I_{IN-}	Hall Signal Input Pin Leak Current	V_{IN+}=V_{IN-}=1.3V	-	-	1	µA
T_{ON}	Lock Protection On Time		0.35	0.5	0.65	sec
T_{OFF}	Lock Protection Off Time		3.5	5	6.5	sec
	Thermal Protection Temperature		-	170	-	°C
	Thermal Protection Hysteresis		-	35	-	°C

Pin Description

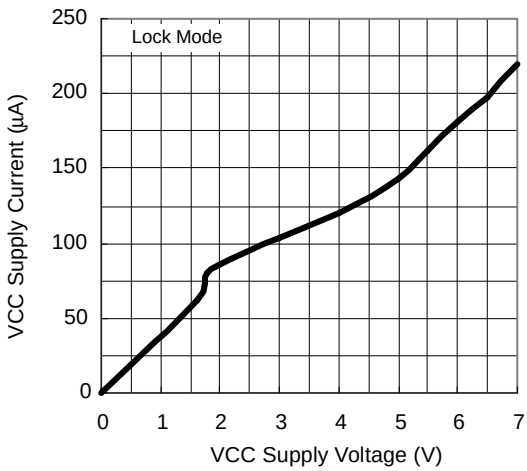
PIN		FUNCTION
NO.	NAME	
1	NC	No Connection.
2	FG	Rotation Speed Output. This is an open-drain output.
3	NC	No Connection.
4	OUTB	H-bridge Output Connection. The output stage is a H-bridge formed by four transistors and four-protection diode for switching applications.
5	GND	Ground.
6	GND	Ground.
7	OUTA	H-bridge Output Connection. The output stage is a H-bridge formed by four transistors and four-protection diode for switching applications.
8	VCC	Supply Voltage Input Pin.
9	IN-	Hall Input -. Connect to hall element negative output.
10	IN+	Hall Input +. Connect to hall element positive output.

Typical Operating Characteristics

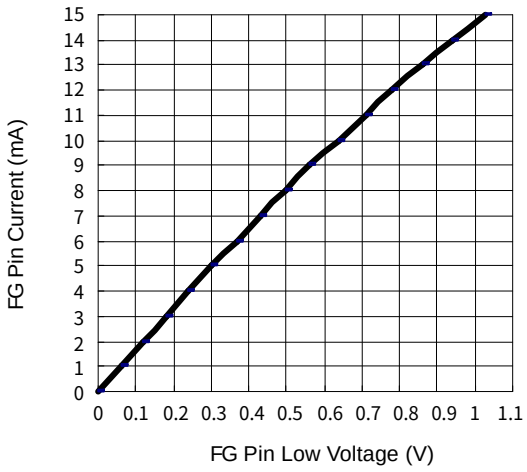
VCC Supply Current vs. VCC Supply Voltage



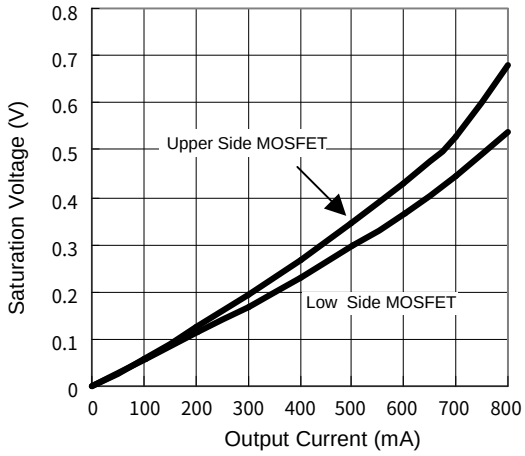
VCC Supply Current vs. VCC Supply Voltage



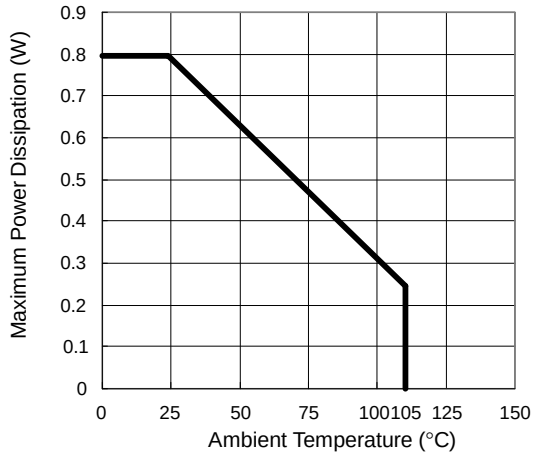
FG Pin Current vs. FG Pin Low Voltage



Saturation Voltage vs. Output Current



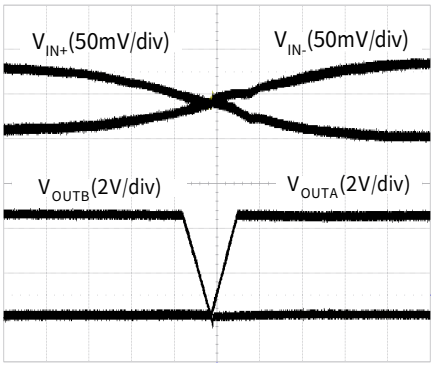
Maximum Power Dissipation vs. Ambient Temperature



VCC Supply Voltage(V)

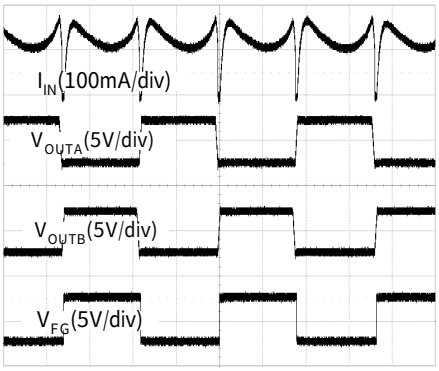
Operating Waveforms

Rotation Waveform 1



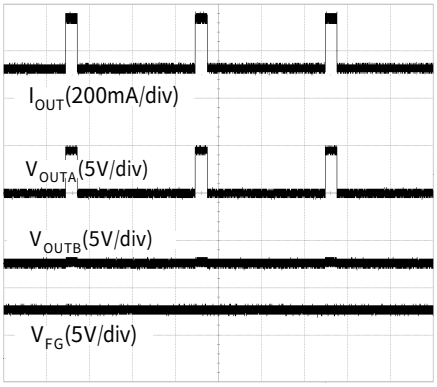
Time (0.2ms/div)

Rotation Waveform 2



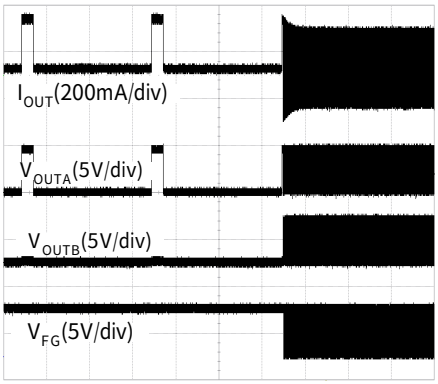
Time (2ms/div)

Lock Protection Waveform 1



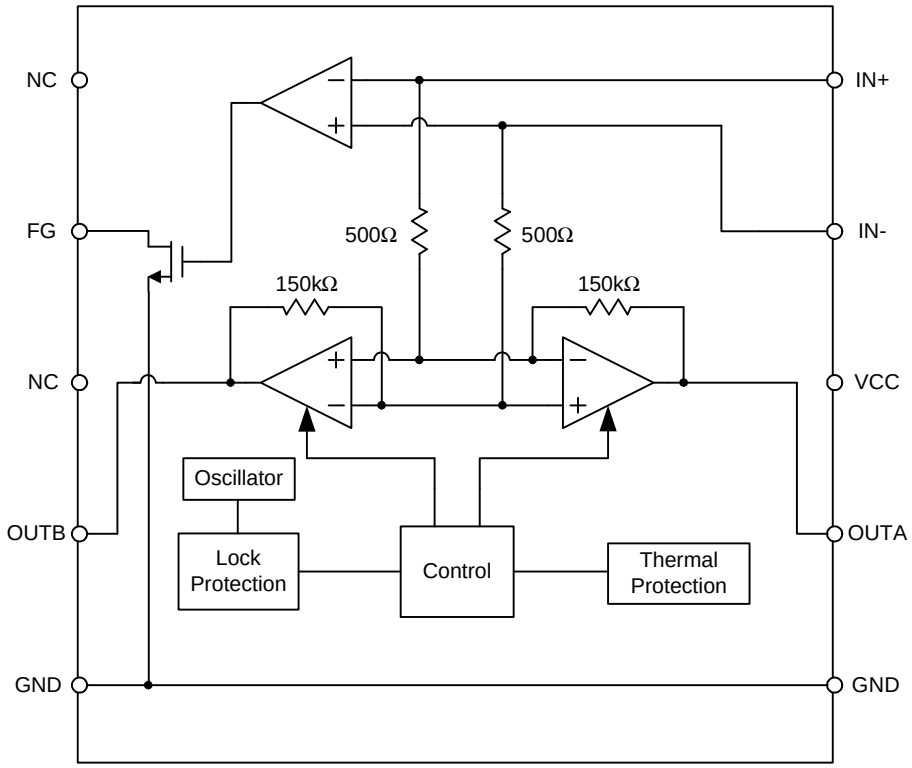
Time (2s/div)

Lock Protection Waveform 2

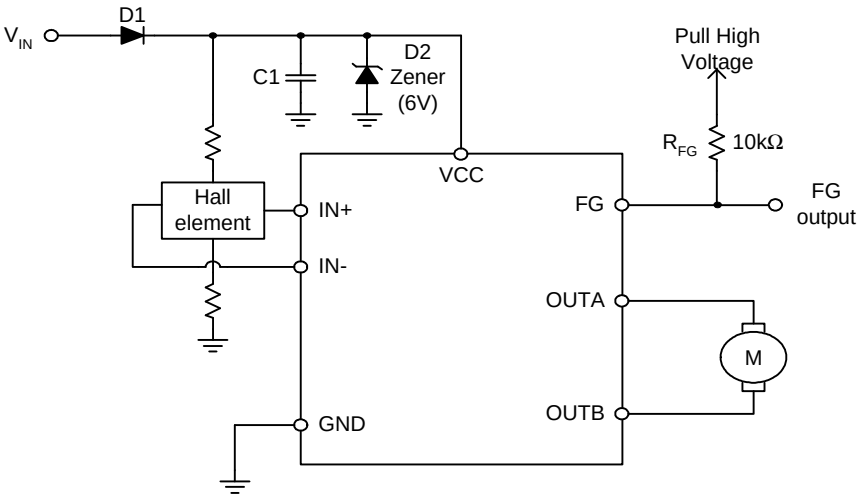


Time (2s/div)

Block Diagram



Typical Application Circuit



Note 2: In hot plug application, it's necessary to protect against a hot plug input voltage overshoot. Add an input zener diode, between the VCC and GND, to clamp the overshoot. In normal operation, the zener diode isn't stressed because output current doesn't reverse to VCC.

Function Description

Lockup Protection and Automatic Restart

This IC detects the rotation of the motor by hall signal, and adjusts lock detection ON time (T_{ON}) and lock detection OFF time (T_{OFF}) by internal counter. These times (T_{NO}, T_{OFF}) are shown below.

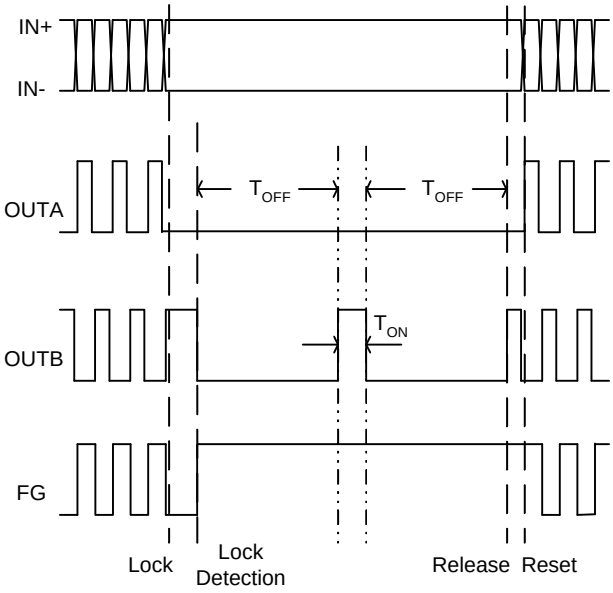


Figure 1. Lock Protection and Automatic Restart Waveform

Frequency Generator Function

The FG pin is an open-drain output, connecting a pull up resistor to a high level voltage for the frequency generator function. During the lock mode, the FG will be always high (switch off). (See Truth Table) Open the terminal when not in using.

Thermal Protection

The APX7343 is equipped with thermal protection. When internal junction temperature reaches 170°C, the output devices will be switched off. On the contrary, when the IC's junction temperature cools by 35°C, the thermal sensor will turn the output devices on again, resulting in a pulsed output during continuous thermal protection.

Truth Table

Input		Output			Mode
IN+	IN-	OUTA	OUTB	FG	
L	H	H	L	L	Rotation Mode
H	L	L	H	OFF	
L	H	L	L	OFF	Lock Mode
H	L	L	L	OFF	

Application Information

Input Protection Diode & Capacitor

It is necessary to add in a protection diode (D1) to protect 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 larger than the maximum output current. For the noise reduction purpose, a capacitor (C1) 1μF is connected between VCC and GND (see Typical Application Circuit).

Hall input

Please adjust hall input voltage by value of resistance so that hall signal contains amplitude input within range GND~V_{CC}-1.1V.

The output signal of this IC is the amplified hall input signal, therefore, the output signal depends on hall input. When the hall input is small, the output signal becomes gentle. Oppositely, the input signal is large, the output becomes steep (See Figure 2. Different of output signal depending on the shape of hall input signal). The input/output gain is 48dB (typ.). Thus, please adjust the amplitude of hall input to meet the adequate output voltage.

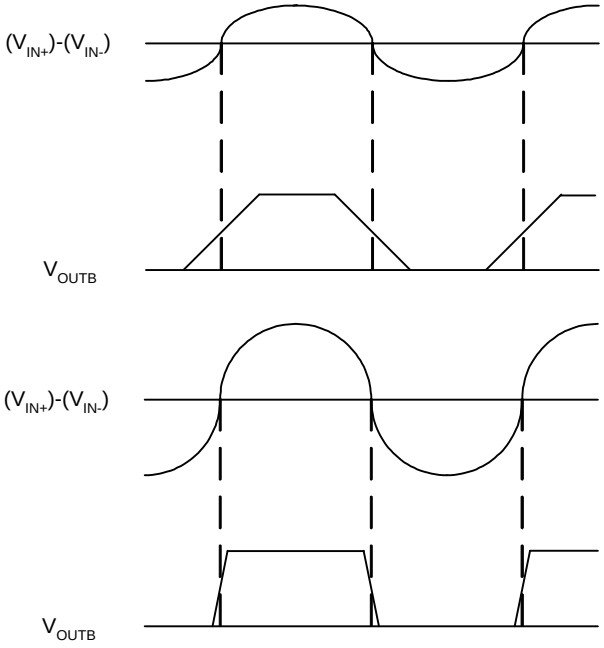


Figure 2. Different of Output Signal Depending on the Shape of Hall Input Signal

FG Resistor

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

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

For example:

V_{CC}=5V, I_{FG}=3mA, V_{FG}=0.2V, R_{FG}=1.6kΩ

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

Application Information (Cont.)

Thermal Consideration

Refre to to "Maximum Power Dissipation vs. Ambient Temperature", the IC is safe to operate below the curve and it will cause the thermal protection if the operating area is above the line. For example, T_A= 75°C, the maximum power dissipation is about 0.47W.

The power dissipation can be calculated by the following equation:

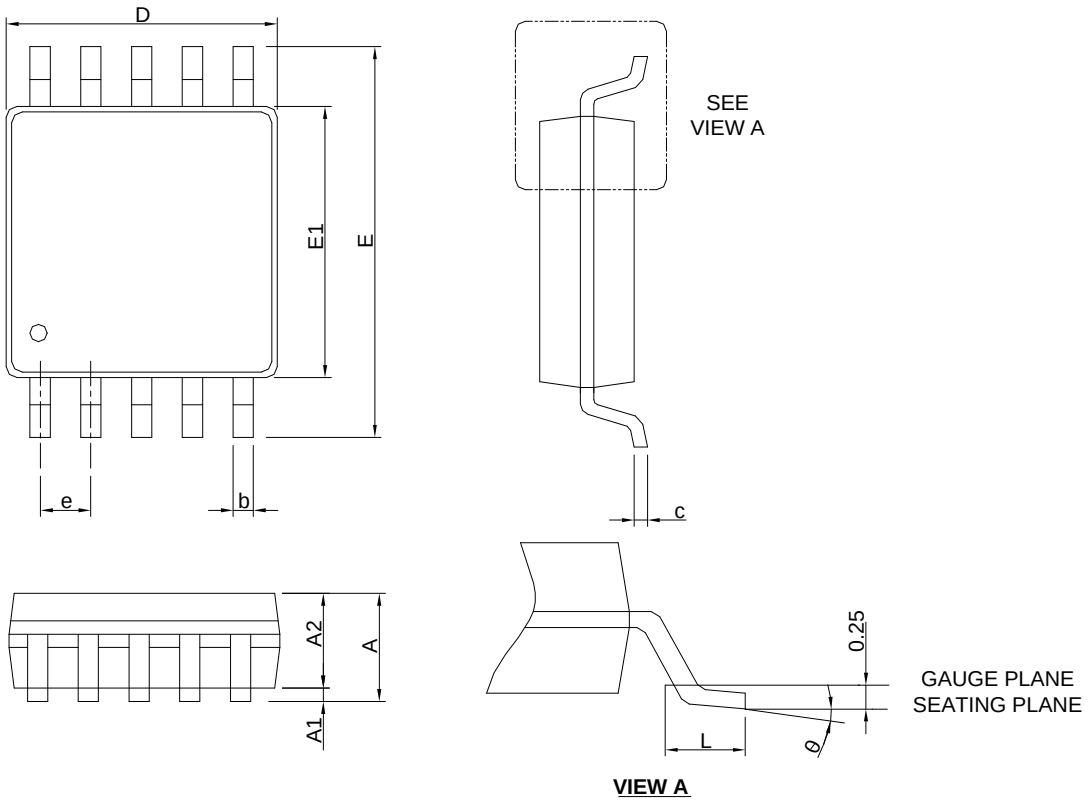
$$P_D = (V_{CC} - |V_{OUTA} - V_{OUTB}|) \times I_{OUT} + V_{CC} \times I_{CC}$$

For example:
V_{CC} = 5V, I_{CC} = 4mA, I_{OUT} = 270mA, V_{OUTA} = 4.83V,
V_{OUTB} = 0.17V, then P_D= 0.111w

The GND pin provides an electrical connection to ground and channeling heat away. The printed circuit board (PCB) forms a heat sink and dissipates most of the heat into ambient air.

Package Information

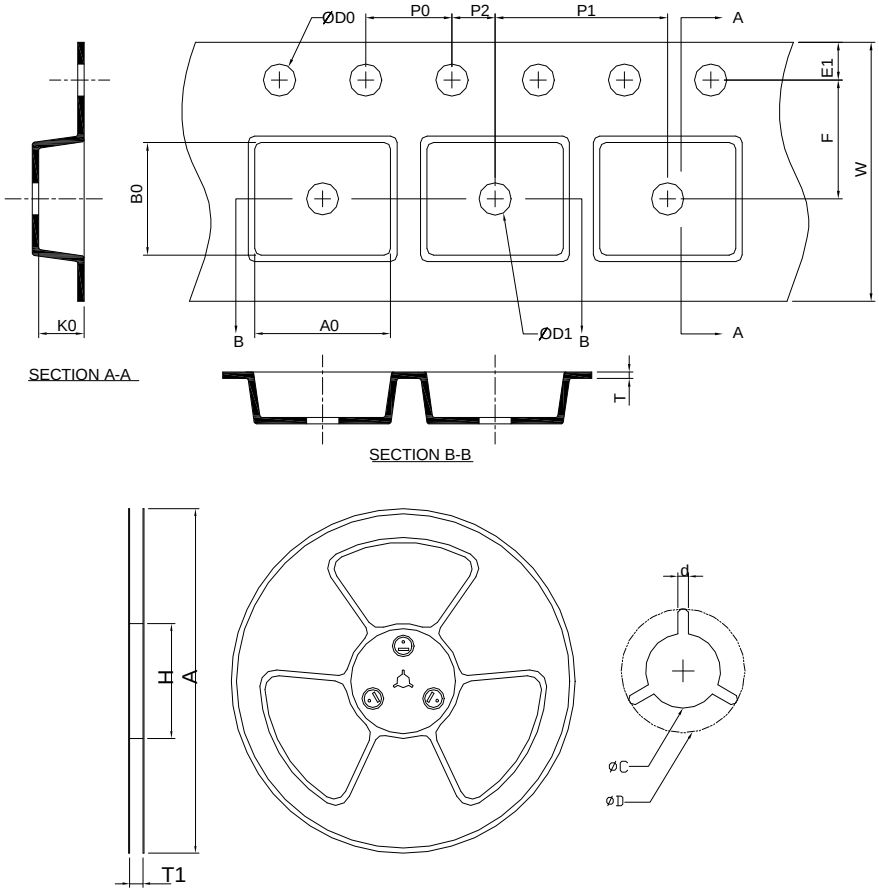
MSOP-10



SYMBOL	MSOP-10			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.10		0.043
A1	0.00	0.15	0.000	0.006
A2	0.75	0.95	0.030	0.037
b	0.17	0.33	0.007	0.013
c	0.08	0.23	0.003	0.009
D	2.90	3.10	0.114	0.122
E	4.70	5.10	0.185	0.201
E1	2.90	3.10	0.114	0.122
e	0.50 BSC		0.020 BSC	
L	0.40	0.80	0.016	0.031
θ	0°	8°	0°	8°

Note: 1. Follow JEDEC MO-187 BA.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not flash or protrusions.
3. Dimension "E1" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 6 mil per side.

Carrier Tape & Reel Dimensions



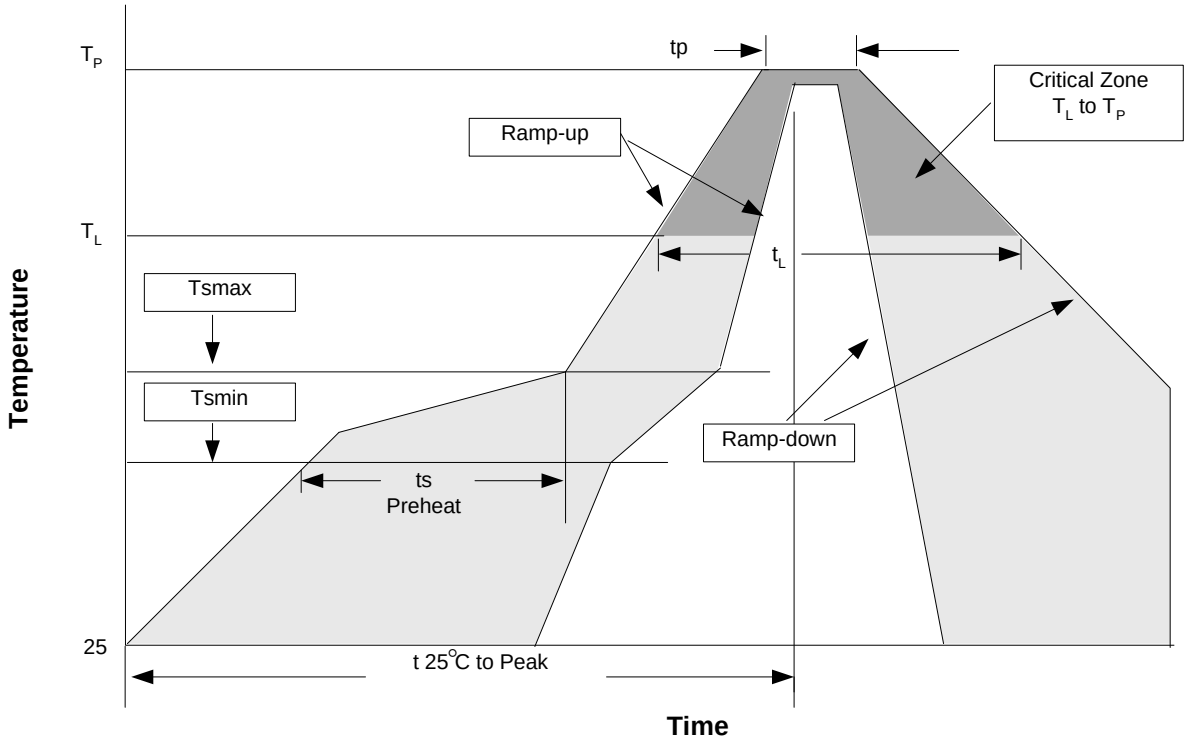
Application	A	H	T1	C	d	D	W	E1	F
MSOP-10	330.0±2.00	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0±0.30	1.75±0.10	5.5±0.10
	P0	**P1**	**P2**	**D0**	**D1**	**T**	**A0**	**B0**	**K0**
	4.00±0.10	8.00±0.10	2.00±0.10	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	6.70±0.20	3.30±0.20	1.40±0.20

(mm)

Devices Per Unit

Package Type	Unit	Quantity
MSOP- 10	Tape & Reel	3000

Reflow Condition (IR/Convection or VPR Reflow)



Reliability Test Program

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C, 5 sec
HOLT	MIL-STD-883D-1005.7	1000 Hrs Bias @125°C
PCT	JESD-22-B,A102	168 Hrs, 100%RH, 121°C
TST	MIL-STD-883D-1011.9	-65°C~150°C, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms, 1_{tr} > 100mA

Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	3°C/second max.	3°C/second max.
Preheat - Temperature Min (Tsmin) - Temperature Max (Tsmax) - Time (min to max) (ts)	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
Time maintained above: - Temperature (T_L) - Time (t_L)	183°C 60-150 seconds	217°C 60-150 seconds
Peak/Classification Temperature (Tp)	See table 1	See table 2
Time within 5°C of actual Peak Temperature (tp)	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.	6°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

Notes: All temperatures refer to topside of the package. Measured on the body surface.

Classification Reflow Profiles (Cont.)

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 ³350
<2.5 mm	240 +0/-5°C	225 +0/-5°C
≥2.5 mm	225 +0/-5°C	225 +0/-5°C

Table 2. Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 350-2000	Volume mm^3 >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

* Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.

Customer Service

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