

Hall Effect Sensor IC

Features

- On-chip Hall Sensor
- Low Operating Supply Voltage : 3 V with Reverse Voltage Protection
- Versatile sensitivity and hysteresis setting
- Reliable and Rugged
- TO-92M3 and SOT-89 packages

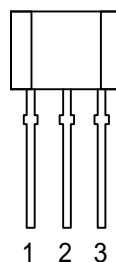
Applications

- Brushless DC Motor
- Brushless DC Fan
- Speed Measurement
- Revolution Counting

General Description

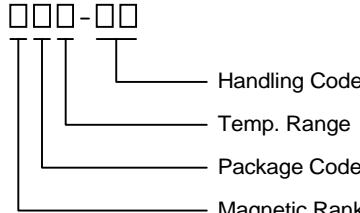
The APX9031 is an integrated Hall Effect Sensor IC designed for electric commutation of DC brushless motor applications. Even with a reverse voltage protection diode, the APX9031 still can operate at as low as 3 volts. The APX9031 is available in low cost TO-92M3 and SOT-89 packages with 3 different magnetic ranks.

Pin Description



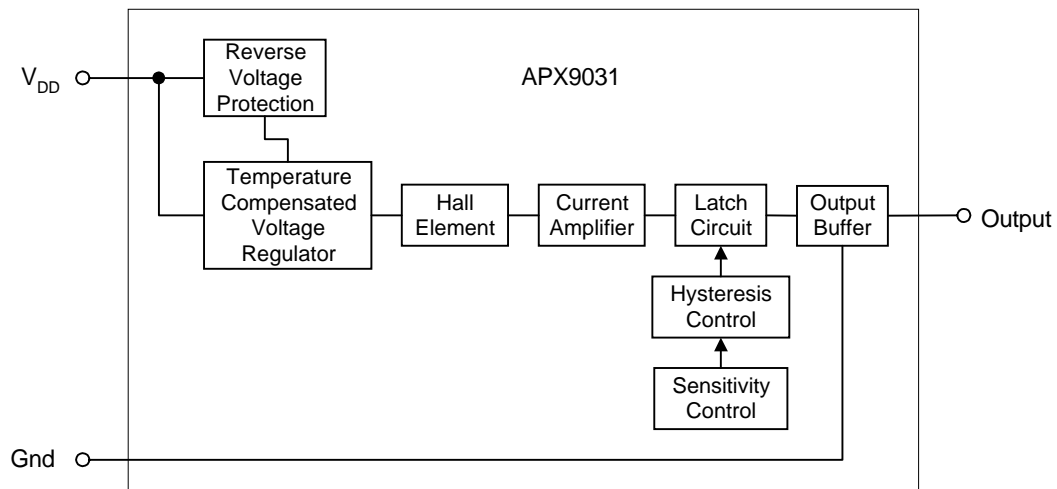
Front View
 1 : V_{DD}
 2 : GND
 3 : OUTPUT

Ordering Information

| | |
|--|---|
| <p>APX9031 □□□-□□</p> <div style="margin-left: 20px;">  </div> | <p>Magnetic Rank A : I Bop , Brp I < 70Gauss B : I Bop , Brp I < 100 Gauss C : I Bop , Brp I < 150 Gauss</p> <p>Package Code E : TO - 92M D : SOT - 89</p> <p>Temp. Range E : - 20 to 85 °C</p> <p>Handling Code PB : Plastic Bag TR : Tape & Reel</p> |
|--|---|

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.

Block Diagram



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

| Symbol | Parameter | Rating | Unit |
|-----------|------------------------------------|------------|------|
| V_{DD} | Supply Voltage | 20 | V |
| I_{DD} | Supply Current | 8 | mA |
| I_O | Output Current | 20 | mA |
| P_D | Maximum Power Dissipation | 400 | mW |
| T_A | Operating Ambient Temperature | -20 to 85 | °C |
| T_{STG} | Storage Temperature Range | -55 to 150 | |
| T_S | Soldering Temperature (10 seconds) | 260 | |

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

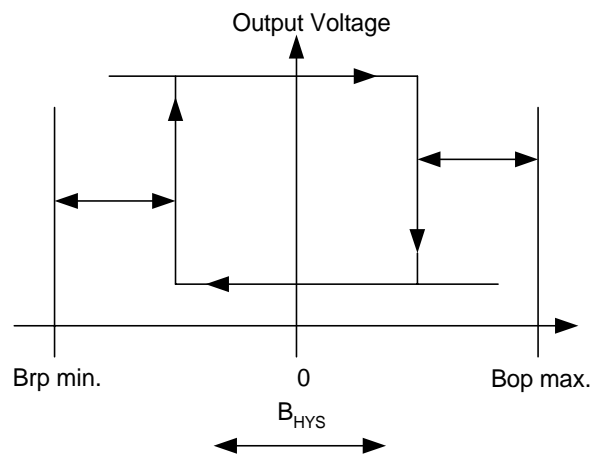
| Symbol | Parameter | Test Condition | APX9031 | | | Unit |
|------------|---------------------------|---|---------|------|------|---------------|
| | | | Min. | Typ. | Max. | |
| V_{DD} | Supply Voltage | Operating | 3 | | 20 | V |
| V_{SAT} | Output Saturation Voltage | $I_{OUT}=20\text{mA}$, $B > Bop$ | | | 0.2 | V |
| I_{DD} | Supply Current | $V_{DD}=20\text{V}$, $B < Brp$ | | 3.5 | 6 | mA |
| I_{Leak} | Output Leakage Current | $V_{OUT}=20\text{V}$, $B < Brp$ | | 0.5 | 2 | μA |
| t_r^a | Output Rise Time | $V_{DD}=12\text{V}$, $R_L=820\Omega$, $C_L=20\text{pF}$ | | 0.6 | | μs |
| t_f^a | Output Fall Time | | | 0.3 | | μs |

Notes ^a: use Figure 1

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

| Rank | Maximum Operate Point Bop | Maximum Release Point Brp | Unit |
|------|------------------------------|------------------------------|-------|
| A | +70 | -70 | Gauss |
| B | +100 | -100 | |
| C | +150 | -150 | |

Definition of Magnetic Switching Points and Hysteresis



Test Information

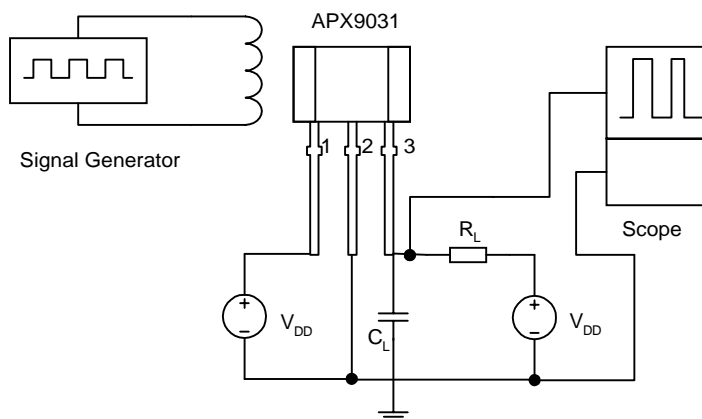


Figure 1 : Switching Circuit for Output Rise Time and Fall Time Measurement

Application Circuit

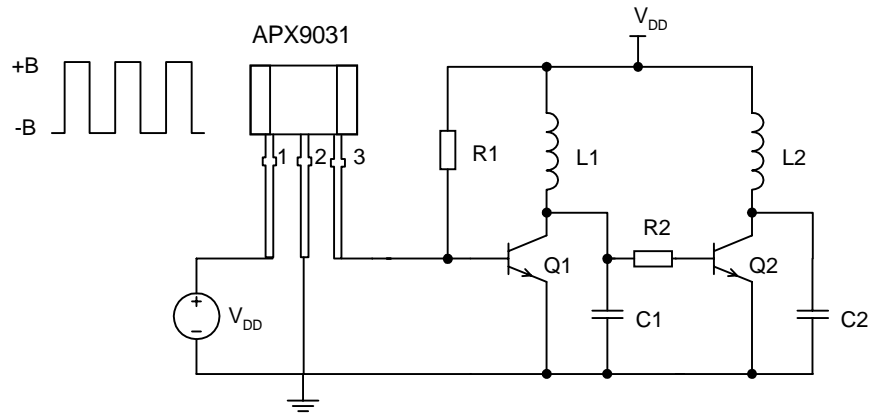
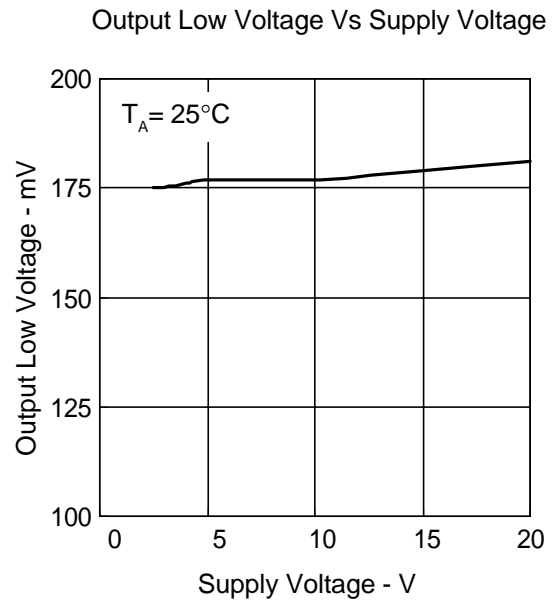
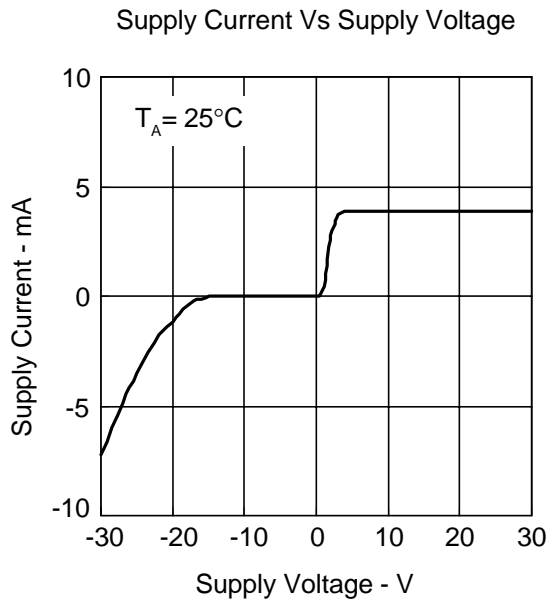


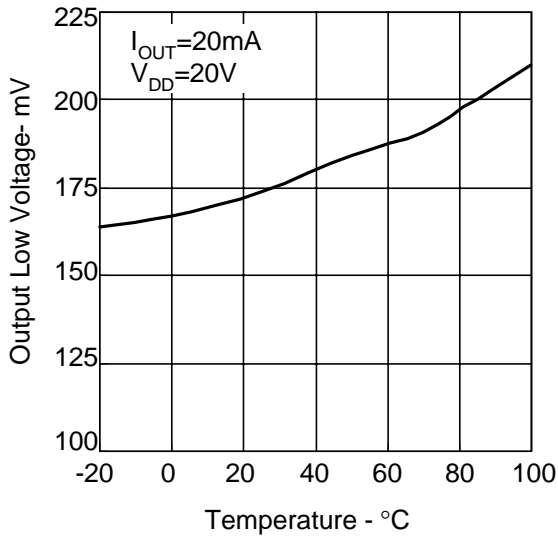
Figure 2 Typical DC brushless fan application circuit

Typical Characteristics

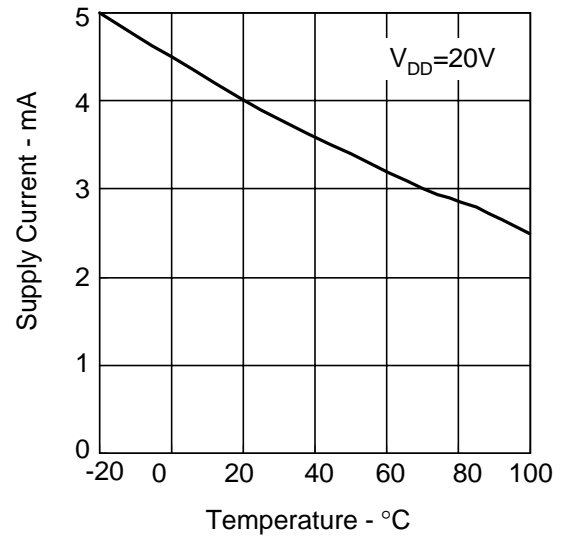


Typical Characteristics Cont.

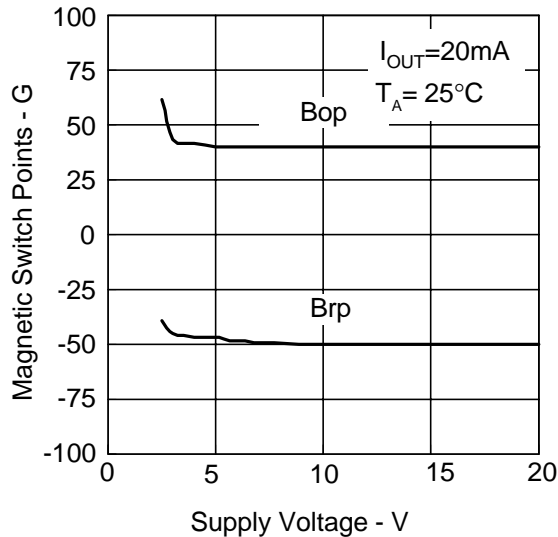
Output Low Voltage vs Ambient Temperature



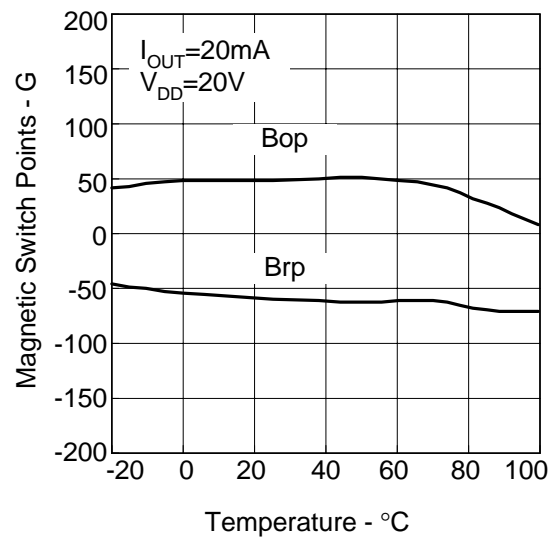
Supply Current vs Temperature



Magnetic Switch Points vs Supply Voltage

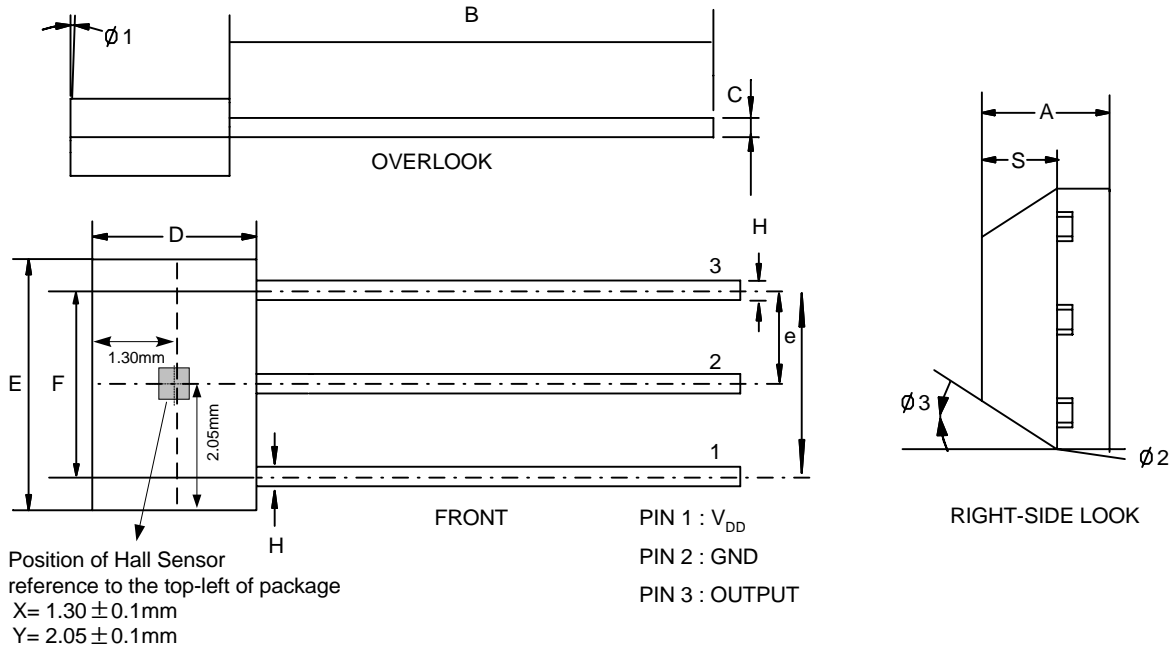


Magnetic Switch Points vs Temperature



Package Information

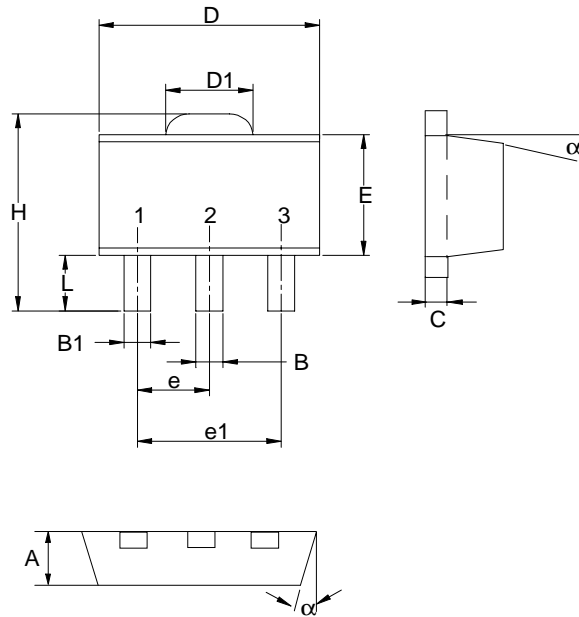
TO-92M3



| Dim | Millimeters | | Inches | |
|-----|-------------|------|--------|-------|
| | Min. | Max. | Min. | Max. |
| A | 1.40 | 1.60 | 0.055 | 0.063 |
| B | 10 | 11 | 0.394 | 0.433 |
| | 14 | 15 | 0.551 | 0.591 |
| C | 0.35 | 0.41 | 0.014 | 0.016 |
| D | 2.80 | 3.20 | 0.110 | 0.126 |
| e | 1.24 | 1.30 | 0.049 | 0.051 |
| E | 3.90 | 4.30 | 0.154 | 0.169 |
| F | 2.34 | 2.64 | 0.092 | 0.104 |
| G | 4.04 | 4.24 | 0.159 | 0.167 |
| H | 0.35 | 0.41 | 0.014 | 0.016 |
| I | 2.51 | 2.57 | 0.099 | 0.101 |
| S | 0.63 | 0.81 | 0.025 | 0.032 |
| φ 1 | 5° | | 5° | |
| φ 2 | 3° | | 3° | |
| φ 3 | 45° | | 45° | |

Packaging Information

SOT-89 (Reference EIAJ ED-7500A Registration SC-62)



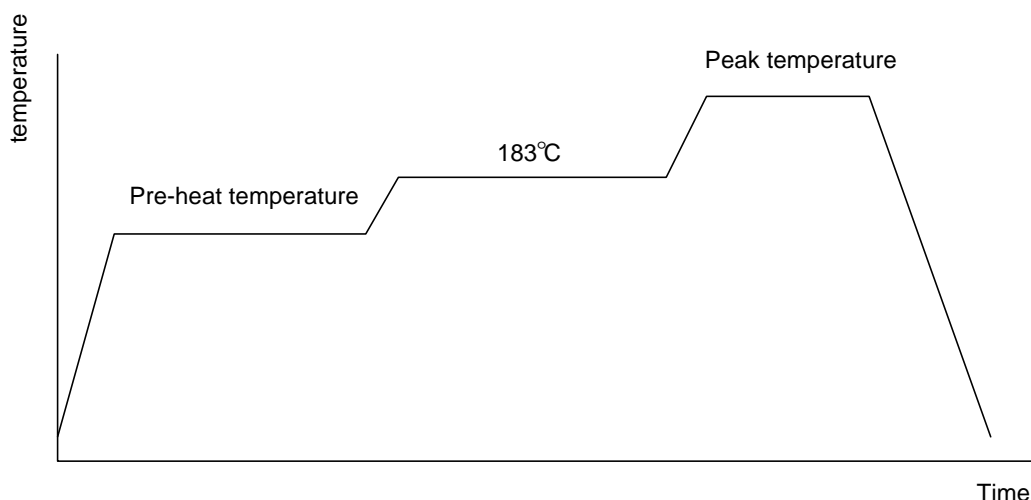
| Dim | Millimeters | | Inches | |
|----------|-------------|------|-----------|-------|
| | Min. | Max. | Min. | Max. |
| A | 1.40 | 1.60 | 0.055 | 0.063 |
| B | 0.40 | 0.56 | 0.016 | 0.022 |
| B1 | 0.35 | 0.48 | 0.014 | 0.019 |
| C | 0.35 | 0.44 | 0.014 | 0.017 |
| D | 4.40 | 4.60 | 0.173 | 0.181 |
| D1 | 1.35 | 1.83 | 0.053 | 0.072 |
| e | 1.50 BSC | | 0.059 BSC | |
| e1 | 3.00 BSC | | 0.118 BSC | |
| E | 2.29 | 2.60 | 0.090 | 0.102 |
| H | 3.75 | 4.25 | 0.148 | 0.167 |
| L | 0.80 | 1.20 | 0.031 | 0.047 |
| α | | 10° | | 10° |

Physical Specifications

| | |
|--------------------|--|
| Terminal Material | Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb) |
| Lead Solderability | Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3. |
| Packaging | 1000 devices per reel |

Reflow Condition (IR/Convection or VPR Reflow)

Reference JEDEC Standard J-STD-020A APRIL 1999



Classification Reflow Profiles

| | Convection or IR/ Convection | VPR |
|--|---------------------------------|--------------------------|
| Average ramp-up rate(183°C to Peak) | 3°C/second max. | 10 °C /second max. |
| Preheat temperature 125 ± 25°C) | 120 seconds max | |
| Temperature maintained above 183°C | 60 – 150 seconds | |
| Time within 5°C of actual peak temperature | 10 –20 seconds | 60 seconds |
| Peak temperature range | 220 +5/-0°C or 235 +5/-0°C | 215-219°C or 235 +5/-0°C |
| Ramp-down rate | 6 °C /second max. | 10 °C /second max. |
| Time 25°C to peak temperature | 6 minutes max. | |

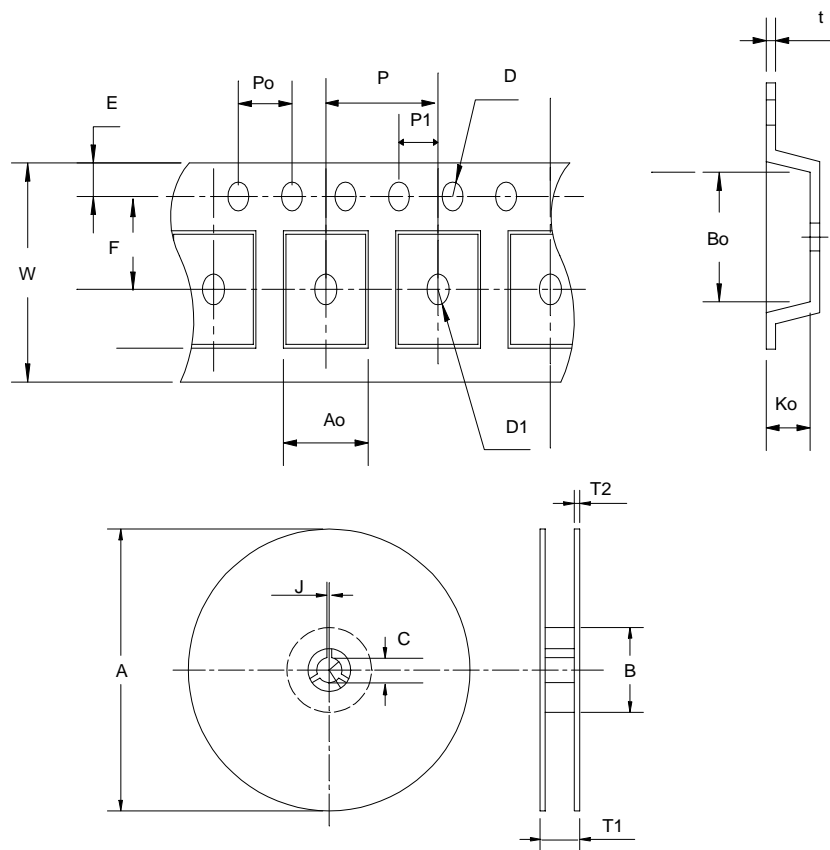
Package Reflow Conditions

| pkg. thickness ≥ 2.5mm and all bgas | pkg. thickness < 2.5mm and pkg. volume ≥ 350 mm ³ | pkg. thickness < 2.5mm and pkg. volume < 350mm ³ |
|--|---|--|
| Convection 220 +5/-0 °C | | Convection 235 +5/-0 °C |
| VPR 215-219 °C | | VPR 235 +5/-0 °C |
| IR/Convection 220 +5/-0 °C | | IR/Convection 235 +5/-0 °C |

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 , I _{tr} > 100mA |

Carrier Tape & Reel Dimensions



| | | | | | | | | | |
|--------------------|------------|----------|-----------|-----------|-----------|-----------|-------------------|----------|-----------|
| Application | A | B | C | J | T1 | T2 | W | P | E |
| SOT-89 | 178±1 | 70 ± 1.5 | 13.5+0.15 | 3 ± 0.15 | 14 ±0.2 | 1.3± 0.3 | 12 + 0.3 - 0.1 | 8± 0.1 | 1.75± 0.1 |
| Application | F | D | D1 | Po | P1 | Ao | Bo | Ko | t |
| SOT-89 | 5.5 ± 0.05 | 1.5+0.1 | 1.5+0.1 | 4.0 ± 0.1 | 2.0 ± 0.1 | 4.8 ± 0.1 | 4.5± 0.1 | 1.8± 0.1 | 0.3±0.013 |

(mm)

Cover Tape Dimensions

| | |
|------------------|-----|
| Carrier Width | 12 |
| Cover Tape Width | 9.3 |

(mm)

Customer Service

Anpec Electronics Corp.

Head Office :

5F, No. 2 Li-Hsin Road, SBIP,

Hsin-Chu, Taiwan, R.O.C.

Tel : 886-3-5642000

Fax : 886-3-5642050

Taipei Branch :

24F-1. No. 268, Sec. 2, PeiHsin Rd.

HsinDian, Taipei County, Taiwan, R. O. C.

Tel : 886-2-86658533

Fax : 886-2-86658529