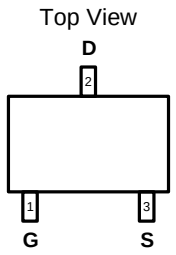
# P-Channel Enhancement Mode MOSFET

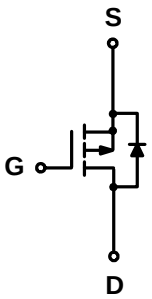
## Features

- -20V/-2.5A,
  $R_{DS(ON)}$= 90mΩ (typ.) @ $V_{GS}$= -4.5V
  $R_{DS(ON)}$= 120mΩ (typ.) @ $V_{GS}$= -2.5V
- Super High Dense Cell Design
- Reliable and Rugged

## Pin Description




SOT-23




P Channel MOSFET

## Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems.

## Ordering and Marking Information

| | |
|---|---|
| FL2301A □□-□□□<br>Lead Free Code<br>Handing Code<br>Temp. Range<br>Package Code | Package Code<br>A : SOT-23<br>Operating Junction Temp. Range<br>C : -55 to 150°C<br>Handling Code<br>TU : Tube TR : Tape & Reel<br>Lead Free Code<br>L : Lead Free Device<br>Blank : Original Device |
| FL2301 A: A1SHB/A1T | XXXXX – Date Code |

# P-Channel Enhancement Mode MOSFET

## Absolute Maximum Ratings ($T_A$=25°C Unless Otherwise Noted)

| Symbol | Parameter | | Rating | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | -20 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±12 | |
| $I_D$* | Continue Drain Current | | -2.5 | A |
| $I_{DM}$* | Pulsed Drain Current | | -10 | |
| $I_S$* | Diode continuous forward current | | -1.5 | A |
| $T_J$ | Maximum Junction Temperature | | 150 | °C |
| $T_{STG}$ | Storage Temperature Range | | -55 to 150 | |
| $P_D$* | Maximum Power Dissipation | $T_A$=25°C | 0.83 | W |
| | | $T_A$=100°C | 0.3 | |
| $R_{\theta JA}$* | Thermal Resistance-Junction to Ambient | | 150 | °C/W |

Notes：

*Surface Mounted on 1in$^2$ pad area, t ≤ 10sec.

## Electrical Characteristics ($T_A$=25°C Unless Otherwise Noted)

| Symbol | Parameter | Test Condition | FL2301A | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V, $I_{DS}$=-250μA | -20 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-16V, $V_{GS}$=0V | | | -1 | μA |
| | | $T_J$=85°C | | | -30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_{DS}$=-250μA | -0.45 | -0.7 | -1 | V |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$=±12V, $V_{DS}$=0V | | | ±100 | nA |
| $R_{DS(ON)}$ | Drain-Source On-state Resistance | $V_{GS}$=-4.5V, $I_{DS}$=-2.5A | | 85 | 110 | mΩ |
| | | $V_{GS}$=-2.5V, $I_{DS}$=-2A | | 110 | 150 | |
| $V_{SD}$ | Diode Forward Voltage | $I_{SD}$=-0.5A , $V_{GS}$=0V | | -0.8 | -1.3 | V |
| **Gate Charge Characteristics** [b] | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$=-10V, $V_{GS}$=-4.5V, $I_{DS}$=-2.5A | | 5 | 7 | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 0.7 | | |
| $Q_{gd}$ | Gate-Drain Charge | | | 0.6 | | |

# P-Channel Enhancement Mode MOSFET

## Electrical Characteristics (Cont.) ($T_A$=25°C Unless Otherwise Noted)

| Symbol | Parameter | Test Condition | AM2301A | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **Dynamic Characteristics** [b] | | | | | | |
| $R_G$ | Gate Resistance | $V_{GS}$=0V,$V_{DS}$=0V,F=1MHz | | 9.2 | | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-15V, Frequency=1.0MHz | | 360 | | pF |
| $C_{oss}$ | Output Capacitance | | | 80 | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 50 | | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$=-10V, $R_L$=10Ω $I_{DS}$=-1A, $V_{GEN}$=-4.5V, $R_G$=6Ω | | 8 | 16 | ns |
| $T_r$ | Turn-on Rise Time | | | 7 | 15 | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | | 18 | 35 | |
| $T_f$ | Turn-off Fall Time | | | 8 | 15 | |

Notes：

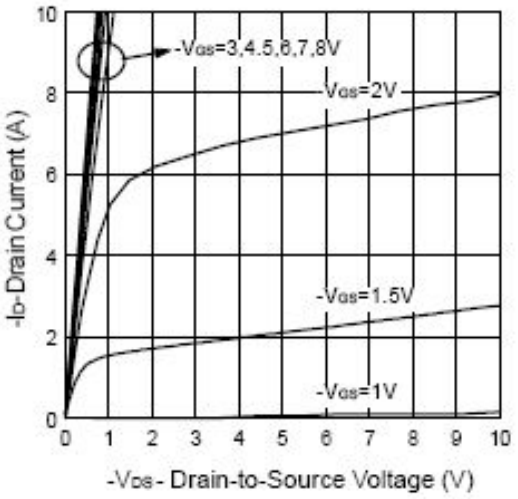
a : Pulse test ; pulse width≤300μs, duty cycle≤2%.

b : Guaranteed by design, not subject to production testing.

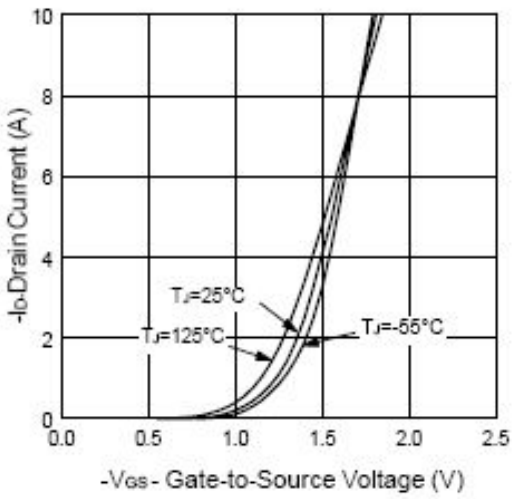
# P-Channel Enhancement Mode MOSFET

## Typical Characteristics

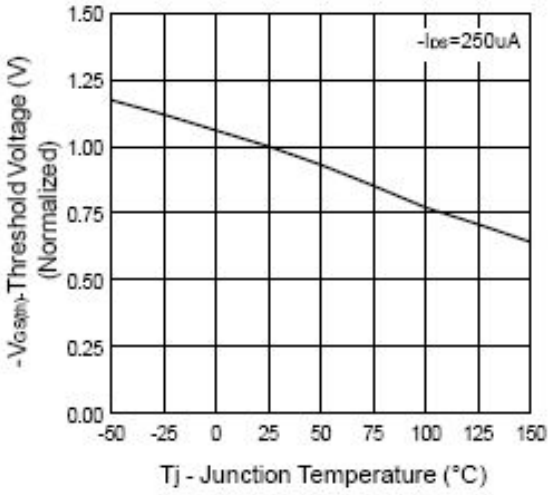
Output Characteristics



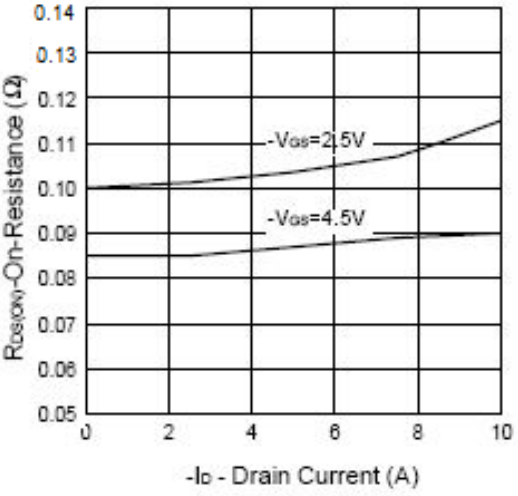

Transfer Characteristics




Threshold Voltage vs. Junction Temperature



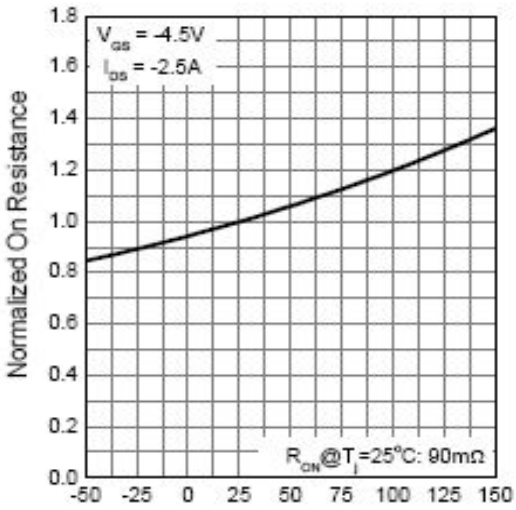

On-Resistance vs. Drain Current



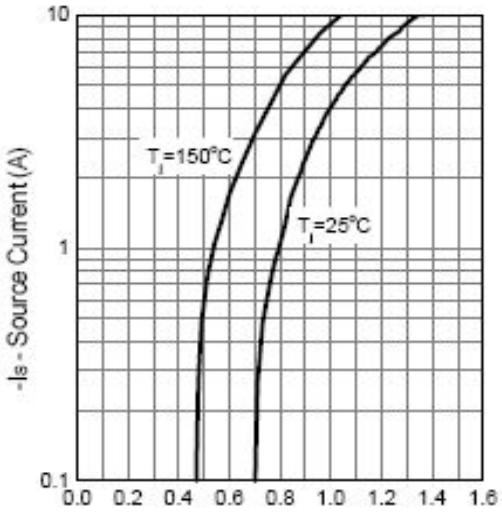
# P-Channel Enhancement Mode MOSFET

## Typical Characteristics

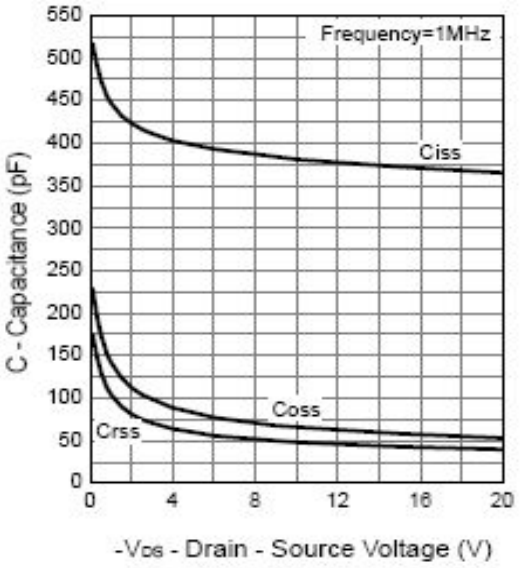
Drain-Source On Resistance



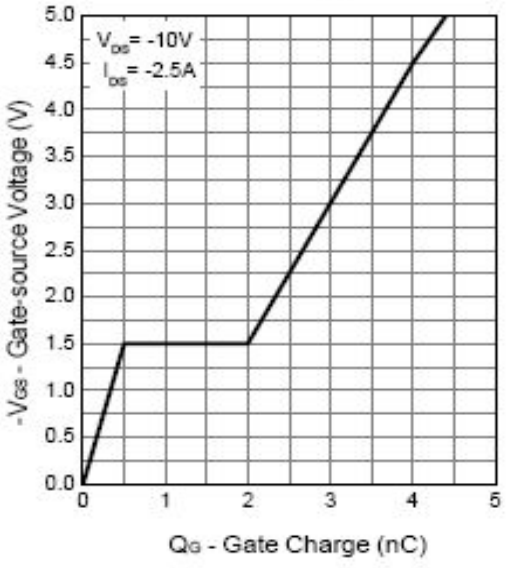

Source-Drain Diode Forward




Capacitance

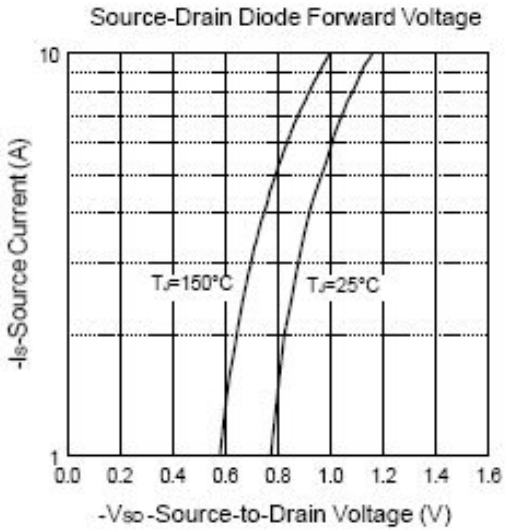


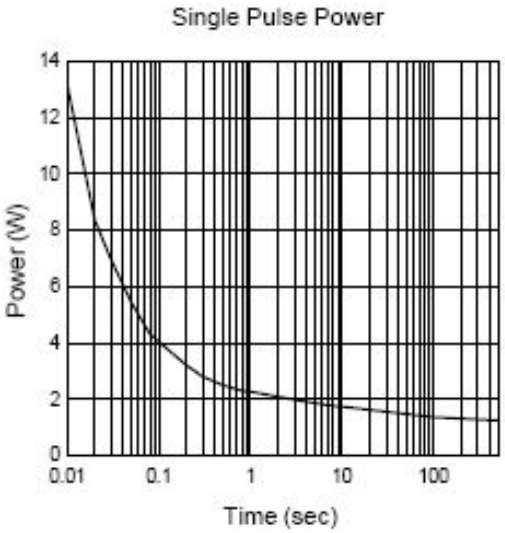

Gate Charge

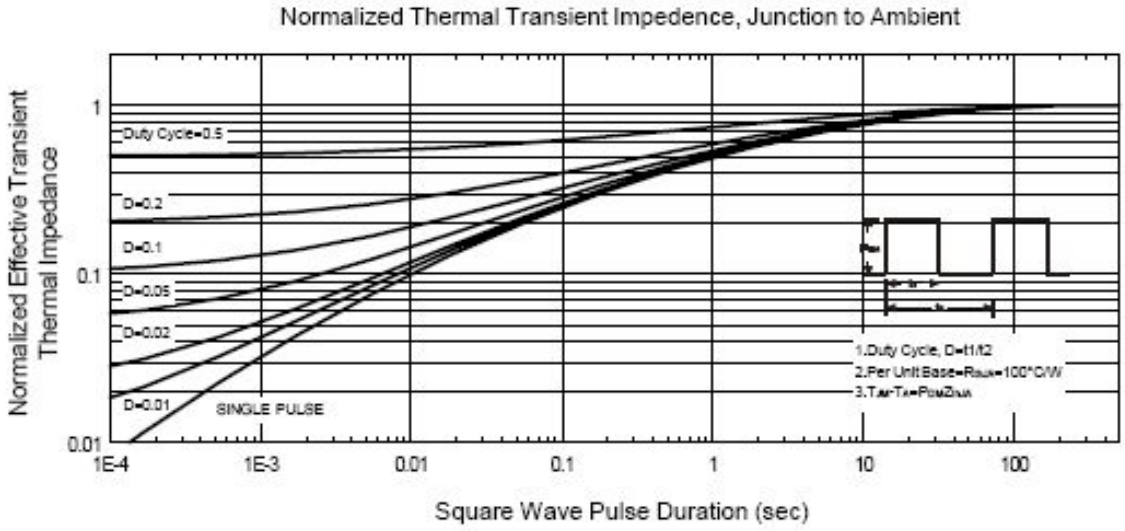


# P-Channel Enhancement Mode MOSFET

## Typical Characteristics



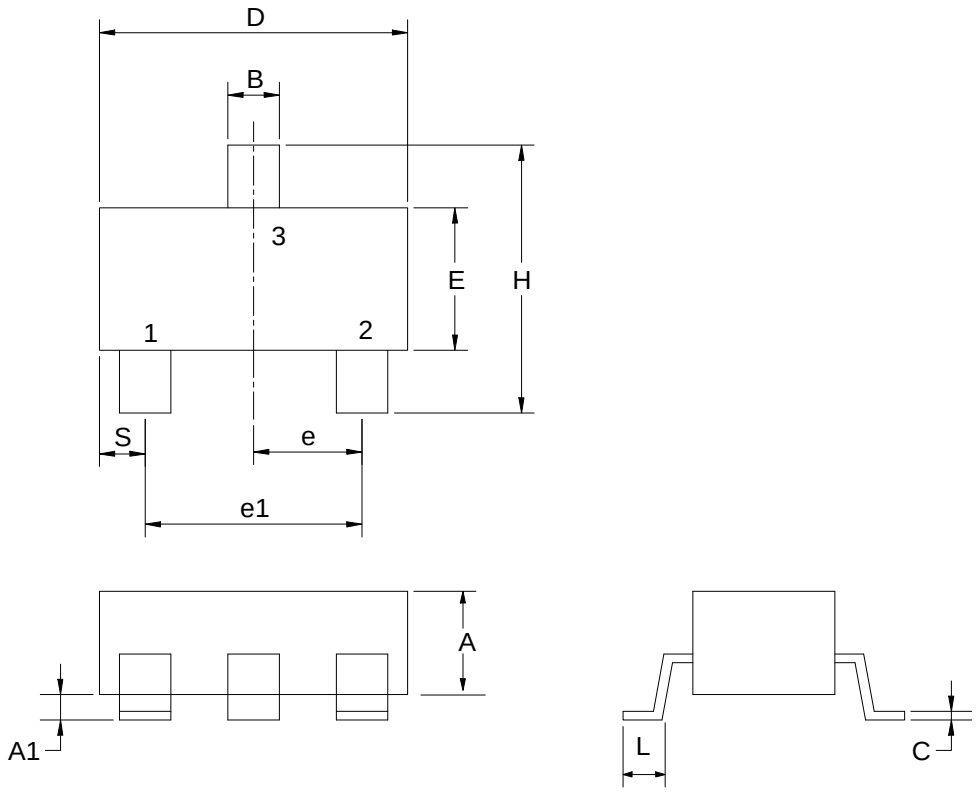



# P-Channel Enhancement Mode MOSFET

## Package Information

SOT-23




| Dim | Millimeters | | Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 1.00 | 1.30 | 0.039 | 0.051 |
| A1 | 0.00 | 0.10 | 0.000 | 0.004 |
| B | 0.35 | 0.51 | 0.014 | 0.020 |
| C | 0.10 | 0.25 | 0.004 | 0.010 |
| D | 2.70 | 3.10 | 0.106 | 0.122 |
| E | 1.40 | 1.80 | 0.055 | 0.071 |
| e1 | 1.90 TYP | | 0.075 TYP. | |
| H | 2.40 | 3.00 | 0.094 | 0.118 |
| L | 0.37 | | 0.015 | |

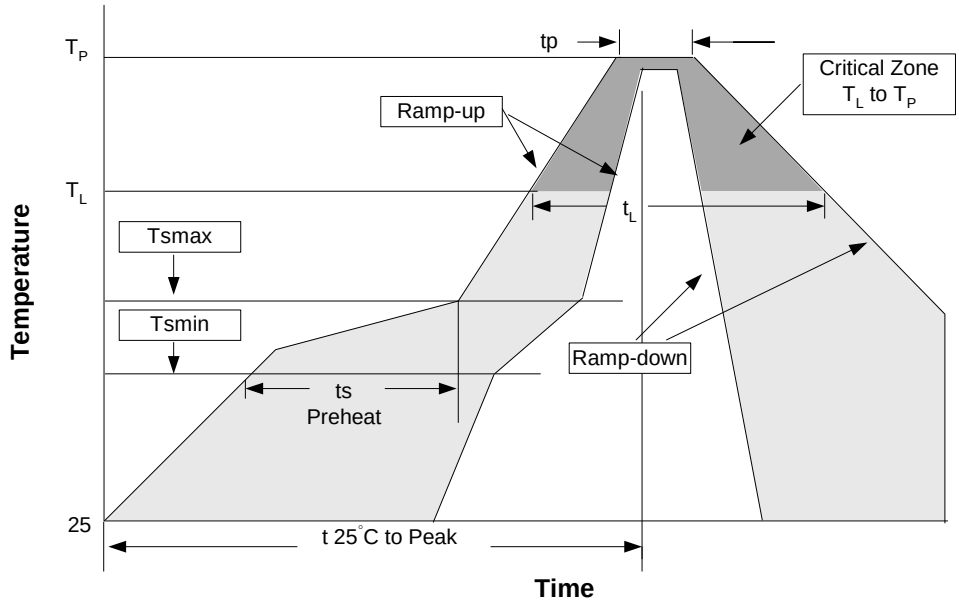
## Physical Specifications

| | |
|---|---|
| Terminal Material | Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb,100%Sn). |
| Lead Solderability | Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3. |

# P-Channel Enhancement Mode MOSFET

## Reflow Condition

(IR/Convection or VPR Reflow)




## Classification Reflow Profiles

| Profile Feature | Sn-Pb Eutectic Assembly | | Pb-Free Assembly | |
|---|---|---|---|---|
| | Large Body | Small Body | Large Body | Small Body |
| Average ramp-up rate ($T_L$ to $T_P$) | 3°C/second max. | | 3°C/second max. | |
| Preheat<br>- Temperature Min (Tsmin)<br>- Temperature Max (Tsmax)<br>- Time (min to max) (ts) | 100°C<br>150°C<br>60-120 seconds | | 150°C<br>200°C<br>60-180 seconds | |
| Tsmax to $T_L$<br>- Ramp-up Rate | | | 3°C/second max | |
| Time maintained above:<br>- Temperature ($T_L$)<br>- Time ($t_L$) | 183°C<br>60-150 seconds | | 217°C<br>60-150 seconds | |
| Peak Temperature (Tp) | 225 +0/-5°C | 240 +0/-5°C | 245 +0/-5°C | 250 +0/-5°C |
| Time within 5°C of actual Peak Temperature (tp) | 10-30 seconds | 10-30 seconds | 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.

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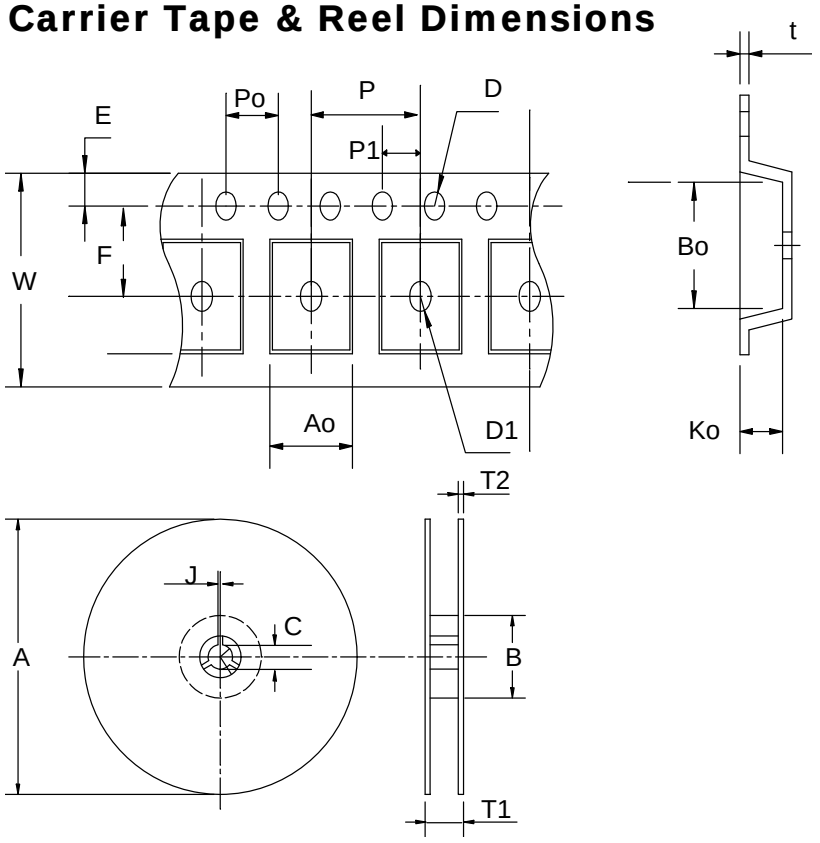
## Package Reflow Conditions

| pkg. thickness ≥ 2.5mm and all bags | pkg. thickness < 2.5mm and pkg. volume ≥ 350mm$^3$ | 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 220 +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 |

## Carrier Tape & Reel Dimensions




| Application | A | B | C | J | T1 | T2 | W | P | E |
|---|---|---|---|---|---|---|---|---|---|
| SOT- 23 | 178±1 | 60 ± 1.0 | 12.0 | 2.5 ± 0.15 | 9.0 ± 0.5 | 1.4 | 8.0+ 0.3 - 0.3 | 4.0 | 1.75 |
| | F | D | D1 | Po | P1 | Ao | Bo | Ko | t |
| | 3.5 ± 0.05 | 1.5 +0.1 | φ 0.1MIN | 4.0 | 2.0 ± 0.05 | 3.1 | 3.0 | 1.3 | 0.2±0.03 |

(mm)

## Cover Tape Dimensions

| Application | Carrier Width | Cover Tape Width | Devices Per Reel |
|---|---|---|---|
| SOT-23 | 8 | 5.3 | 3000 |