

## N-Channel Enhancement Mode MOSFET

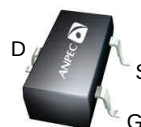
### Features

- 30V/3.5A ,  
 $R_{DS(ON)} = 42m\Omega (typ.) @ V_{GS} = 10V$   
 $R_{DS(ON)} = 70m\Omega (typ.) @ V_{GS} = 5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices Available  
 (RoHS Compliant)

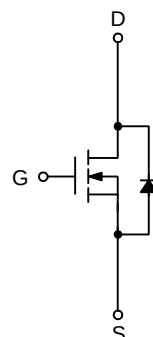
### Applications

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

### Pin Description



Top View of SOT-23



N-Channel MOSFET

### Ordering and Marking Information

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>APM2306</p> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 15px; height: 15px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 15px; height: 15px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 15px; height: 15px;"></div> </div> <div> <p>Assembly Material</p> <p>Handling Code</p> <p>Temperature Range</p> <p>Package Code</p> </div> </div> | <p>Package Code<br/>           A : SOT-23</p> <p>Operating Junction Temperature Range<br/>           C : -55 to 150 °C</p> <p>Handling Code<br/>           TR : Tape &amp; Reel</p> <p>Assembly Material<br/>           L : Lead Free Device<br/>           G : Halogen and Lead Free Device</p> |
| <p>APM2306 A : <span style="border: 1px solid black; padding: 2px 5px;">M06X</span></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>X - Date Code</p>                                                                                                                                                                                                                                                                             |

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).

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)

| Symbol             | Parameter                              |                       | Rating     | Unit |
|--------------------|----------------------------------------|-----------------------|------------|------|
| V <sub>DSS</sub>   | Drain-Source Voltage                   |                       | 30         | V    |
| V <sub>GSS</sub>   | Gate-Source Voltage                    |                       | ±20        |      |
| I <sub>D</sub> *   | Continuous Drain Current               | V <sub>GS</sub> =10V  | 3.5        | A    |
| I <sub>DM</sub> *  | 300μs Pulsed Drain Current             |                       | 14         |      |
| I <sub>S</sub> *   | Diode Continuous Forward Current       |                       | 1.3        | A    |
| T <sub>J</sub>     | Maximum Junction Temperature           |                       | 150        | °C   |
| T <sub>STG</sub>   | Storage Temperature Range              |                       | -55 to 150 |      |
| P <sub>D</sub> *   | Maximum Power Dissipation              | T <sub>A</sub> =25°C  | 0.83       | W    |
|                    |                                        | T <sub>A</sub> =100°C | 0.3        |      |
| R <sub>θJA</sub> * | Thermal Resistance-Junction to Ambient |                       | 150        | °C/W |

Note : \*Surface Mounted on 1in<sup>2</sup> pad area,  $t \leq 10\text{sec}$ .

## Electrical Characteristics $(T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol                                   | Parameter                        | Test Conditions                                                      | APM2306A |      |      | Unit |
|------------------------------------------|----------------------------------|----------------------------------------------------------------------|----------|------|------|------|
|                                          |                                  |                                                                      | Min.     | Typ. | Max. |      |
| STATIC CHARACTERISTICS                   |                                  |                                                                      |          |      |      |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA                          | 30       | -    | -    | V    |
| I <sub>DSS</sub>                         | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =24V, V <sub>GS</sub> =0V                            | -        | -    | 1    | μA   |
|                                          |                                  | T <sub>J</sub> =85°C                                                 | -        | -    | 30   |      |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA            | 1        | 1.5  | 2    | V    |
| I <sub>GSS</sub>                         | Gate Leakage Current             | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                           | -        | -    | ±100 | nA   |
| R <sub>DS(ON)</sub> <sup>a</sup>         | Drain-Source On-State Resistance | V <sub>GS</sub> =10V, I <sub>DS</sub> =3.5A                          | -        | 42   | 65   | mΩ   |
|                                          |                                  | V <sub>GS</sub> =5V, I <sub>DS</sub> =2.8A                           | -        | 70   | 90   |      |
| V <sub>SD</sub> <sup>a</sup>             | Diode Forward Voltage            | I <sub>SD</sub> =1.25A, V <sub>GS</sub> =0V                          | -        | 0.8  | 1.3  | V    |
| GATE CHARGE CHARACTERISTICS <sup>b</sup> |                                  |                                                                      |          |      |      |      |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =15V, V <sub>GS</sub> =10V,<br>I <sub>DS</sub> =3.5A | -        | 12.5 | 16   | nC   |
| Q <sub>gs</sub>                          | Gate-Source Charge               |                                                                      | -        | 2.4  | -    |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge                |                                                                      | -        | 1.3  | -    |      |

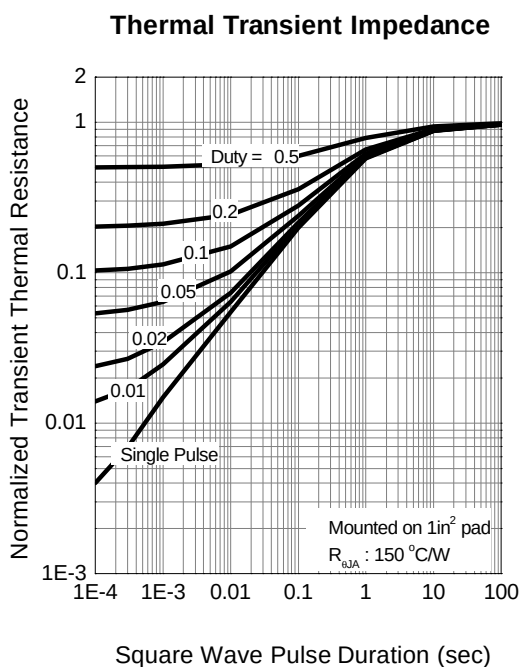
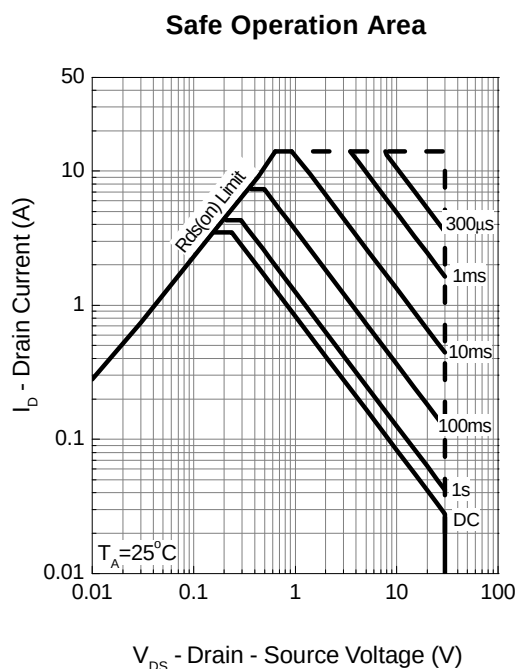
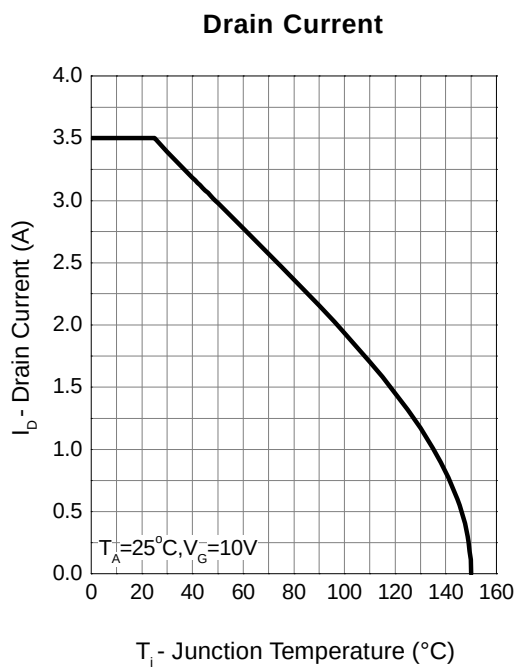
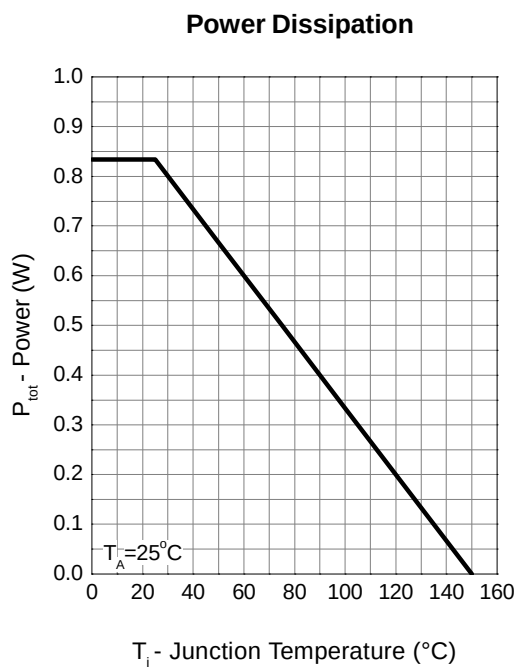
## Electrical Characteristics (Cont.) ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol                               | Parameter                    | Test Conditions                                                                                                 | APM2306A |      |      | Unit |
|--------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------|----------|------|------|------|
|                                      |                              |                                                                                                                 | Min.     | Typ. | Max. |      |
| DYNAMIC CHARACTERISTICS <sup>b</sup> |                              |                                                                                                                 |          |      |      |      |
| R <sub>G</sub>                       | Gate Resistance              | V <sub>GS</sub> =0V,V <sub>DS</sub> =0V,F=1MHz                                                                  | -        | 1.5  | -    | Ω    |
| C <sub>iss</sub>                     | Input Capacitance            | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =25V,<br>Frequency=1.0MHz                                               | -        | 400  | -    | pF   |
| C <sub>oss</sub>                     | Output Capacitance           |                                                                                                                 | -        | 80   | -    |      |
| C <sub>rss</sub>                     | Reverse Transfer Capacitance |                                                                                                                 | -        | 45   | -    |      |
| t <sub>d(ON)</sub>                   | Turn-on Delay Time           | V <sub>DD</sub> =15V, R <sub>L</sub> =15Ω,<br>I <sub>DS</sub> =1A, V <sub>GEN</sub> =10V,<br>R <sub>G</sub> =6Ω | -        | 10   | 19   | ns   |
| T <sub>r</sub>                       | Turn-on Rise Time            |                                                                                                                 | -        | 8    | 15   |      |
| t <sub>d(OFF)</sub>                  | Turn-off Delay Time          |                                                                                                                 | -        | 19   | 35   |      |
| T <sub>f</sub>                       | Turn-off Fall Time           |                                                                                                                 | -        | 6.2  | 12   |      |

Note a : Pulse test ; pulse width $\leq 300\mu\text{s}$ , duty cycle $\leq 2\%$ .

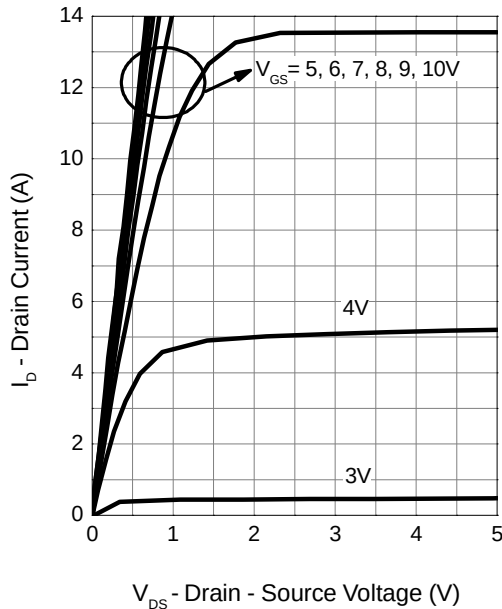
Note b : Guaranteed by design, not subject to production testing.

## Typical Operating Characteristics

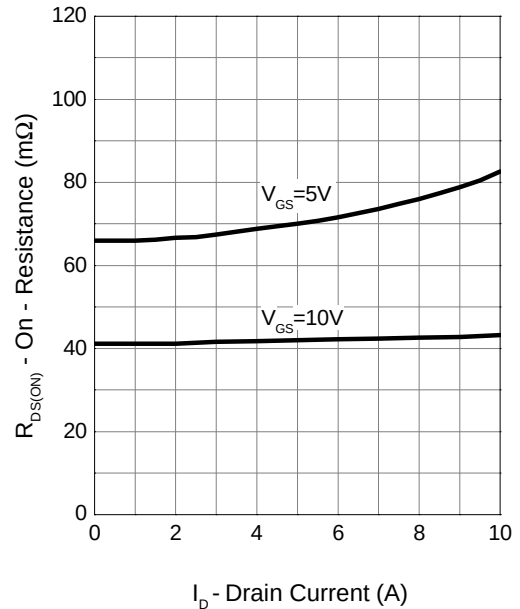


## Typical Operating Characteristics (Cont.)

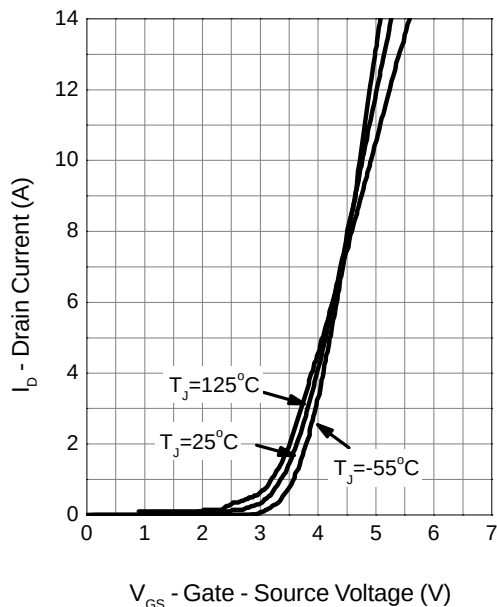
Output Characteristics



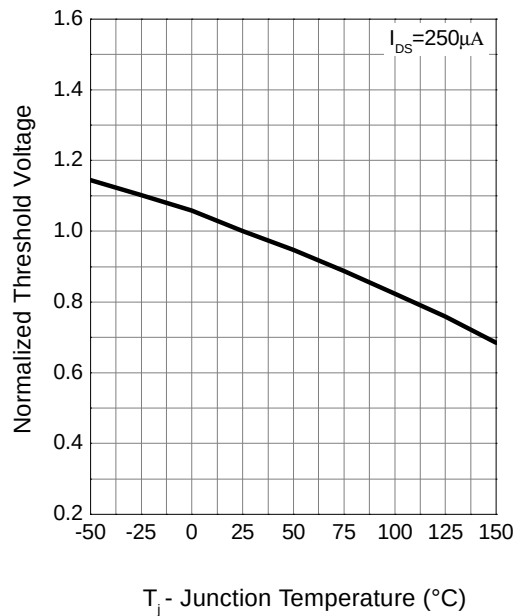
Drain-Source On Resistance



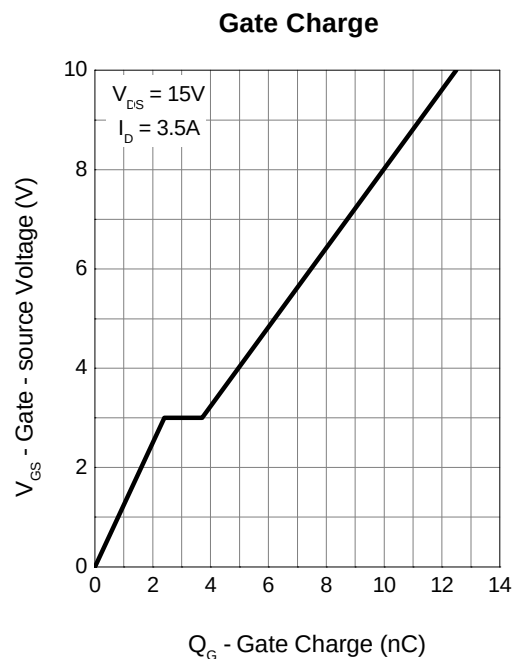
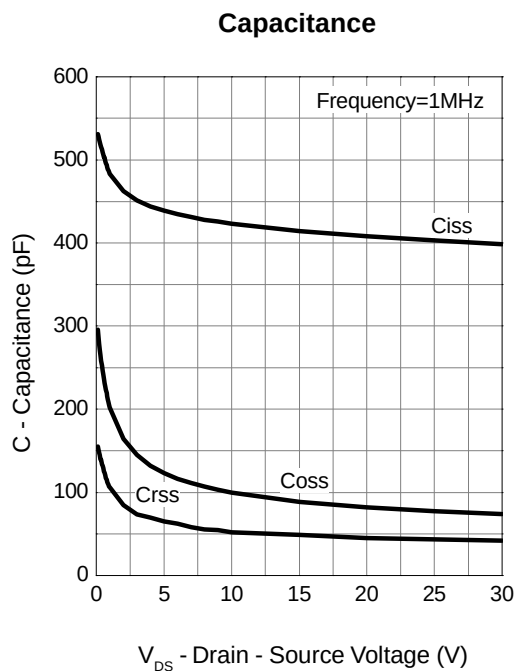
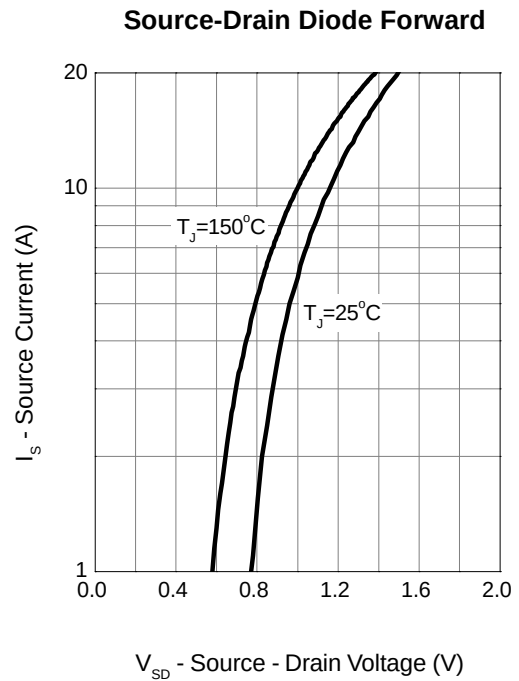
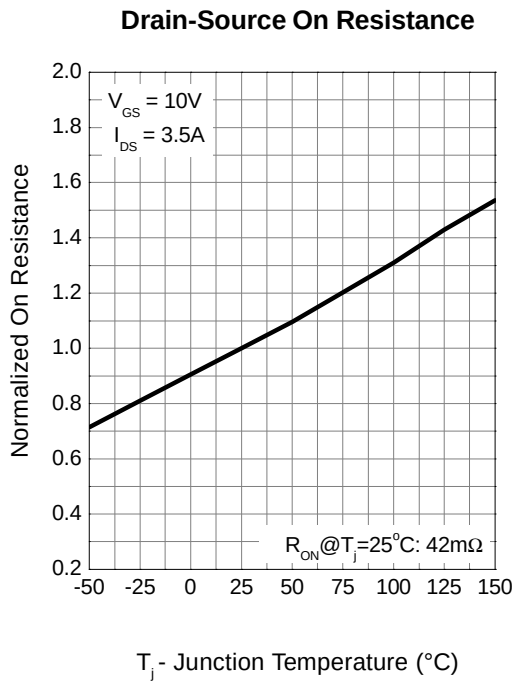
Transfer Characteristics



Gate Threshold Voltage

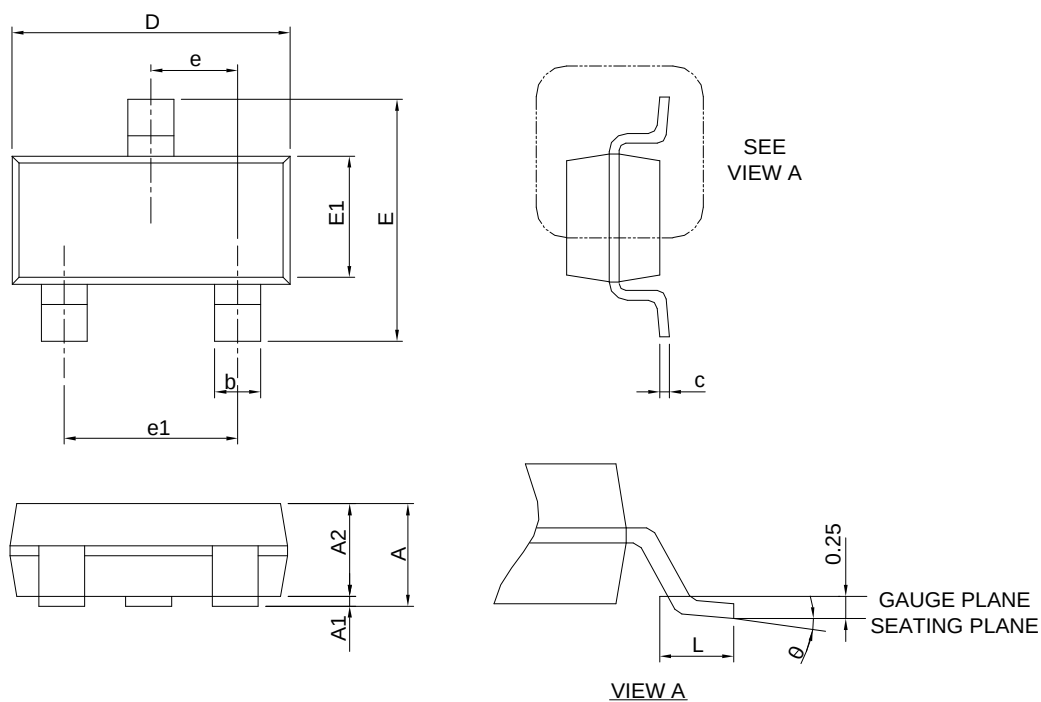


## Typical Operating Characteristics (Cont.)



## Package Information

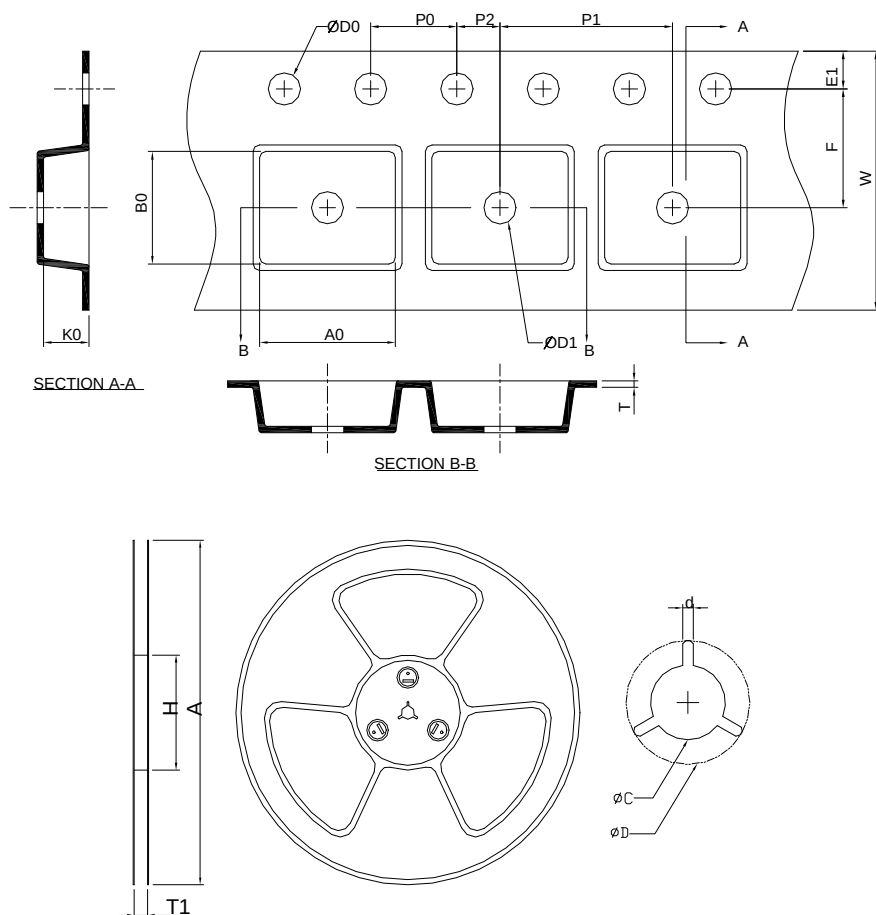
SOT-23



| SYMBOL | SOT-23      |      |           |       |
|--------|-------------|------|-----------|-------|
|        | MILLIMETERS |      | INCHES    |       |
|        | MIN.        | MAX. | MIN.      | MAX.  |
| A      |             | 1.45 |           | 0.057 |
| A1     | 0.00        | 0.15 | 0.000     | 0.006 |
| A2     | 0.90        | 1.30 | 0.035     | 0.051 |
| b      | 0.30        | 0.50 | 0.012     | 0.020 |
| c      | 0.08        | 0.22 | 0.003     | 0.009 |
| D      | 2.70        | 3.10 | 0.106     | 0.122 |
| E      | 2.60        | 3.00 | 0.102     | 0.118 |
| E1     | 1.40        | 1.80 | 0.055     | 0.071 |
| e      | 0.95 BSC    |      | 0.037 BSC |       |
| e1     | 1.90 BSC    |      | 0.075 BSC |       |
| L      | 0.30        | 0.60 | 0.012     | 0.024 |
| θ      | 0°          | 8°   | 0°        | 8°    |

Note : Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.

## Carrier Tape & Reel Dimensions



| Application | A                | H              | T1                      | C                        | d         | D                       | W               | E1              | F               |
|-------------|------------------|----------------|-------------------------|--------------------------|-----------|-------------------------|-----------------|-----------------|-----------------|
| SOT-23      | $178.0 \pm 2.00$ | 50 MIN.        | $8.4 + 2.00$<br>$-0.00$ | $13.0 + 0.50$<br>$-0.20$ | 1.5 MIN.  | 20.2 MIN.               | $8.0 \pm 0.30$  | $1.75 \pm 0.10$ | $3.5 \pm 0.05$  |
|             | <b>P0</b>        | <b>P1</b>      | <b>P2</b>               | <b>D0</b>                | <b>D1</b> | <b>T</b>                | <b>A0</b>       | <b>B0</b>       | <b>K0</b>       |
|             | $4.0 \pm 0.10$   | $4.0 \pm 0.10$ | $2.0 \pm 0.05$          | $1.5 + 0.10$<br>$-0.00$  | 1.0 MIN.  | $0.6 + 0.00$<br>$-0.40$ | $3.20 \pm 0.20$ | $3.10 \pm 0.20$ | $1.50 \pm 0.20$ |

(mm)

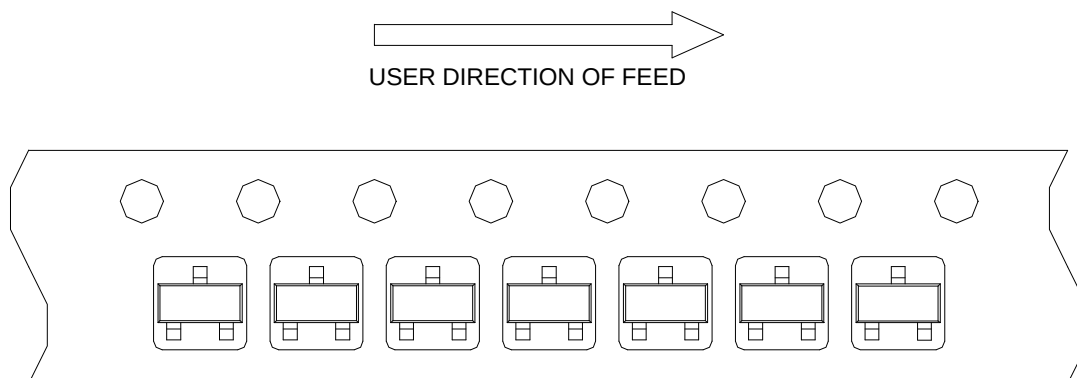
## Devices Per Unit

| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| SOT-23       | Tape & Reel | 3000     |

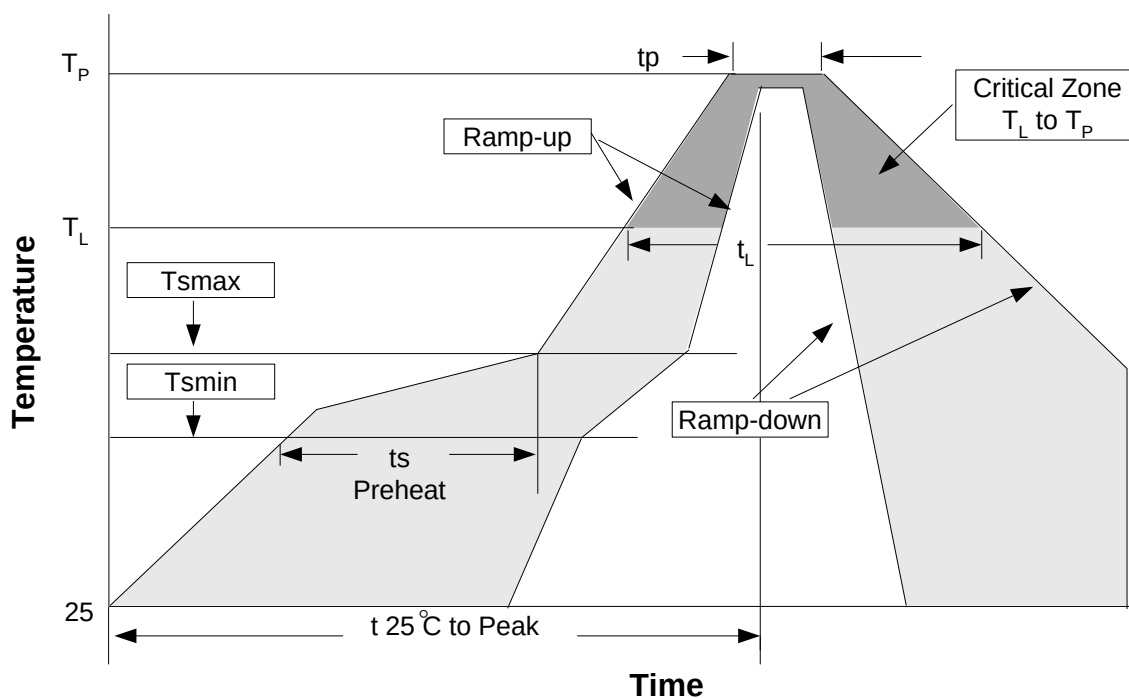


## Taping Direction Information

SOT-23



## 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 |

## Classification Reflow Profiles

| Profile Feature                                                                                                                                                                          | Sn-Pb Eutectic Assembly          | Pb-Free Assembly                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|
| Average ramp-up rate<br>( $T_L$ to $T_P$ )                                                                                                                                               | 3°C/second max.                  | 3°C/second max.                  |
| Preheat <ul style="list-style-type: none"> <li>- Temperature Min (<math>T_{smin}</math>)</li> <li>- Temperature Max (<math>T_{smax}</math>)</li> <li>- Time (min to max) (ts)</li> </ul> | 100°C<br>150°C<br>60-120 seconds | 150°C<br>200°C<br>60-180 seconds |
| Time maintained above: <ul style="list-style-type: none"> <li>- Temperature (<math>T_L</math>)</li> <li>- Time (<math>t_L</math>)</li> </ul>                                             | 183°C<br>60-150 seconds          | 217°C<br>60-150 seconds          |
| Peak/Classification Temperature ( $T_P$ )                                                                                                                                                | See table 1                      | See table 2                      |
| Time within 5°C of actual<br>Peak Temperature ( $t_P$ )                                                                                                                                  | 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.                   |

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

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350 |
|-------------------|--------------------------------|-------------------------------|
| <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 <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>>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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