

## N-Channel Enhancement Mode MOSFET

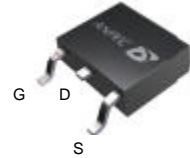
### Features

- 40V/57A,  
 $R_{DS(ON)} = 8.2m\Omega$  (typ.) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 13m\Omega$  (typ.) @  $V_{GS} = 5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

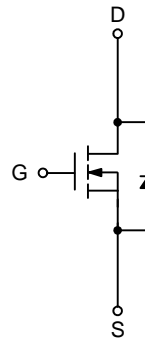
### Applications

- Power Management in LCD monitor/TV inverter.

### Pin Description



Top View of TO-252



N-Channel MOSFET

### Ordering and Marking Information

|  |   |
|--|---|
| <p>APM4010N <span style="border: 1px solid black; padding: 2px;">□□-□□□</span></p> <ul style="list-style-type: none"> <li>└─ Assembly Material</li> <li>└─ Handling Code</li> <li>└─ Temp. Range</li> <li>└─ Package Code</li> </ul> | <p>Package Code<br/>U : TO-252</p> <p>Operating Junction Temp. 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>APM4010N U : <span style="border: 1px solid black; padding: 2px;">APM4010N<br/>XXXXX</span></p>   | <p>XXXXXX - 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

| Symbol   | Parameter                                    | Rating                  | Unit               |   |
|--|--|-------------------------|--------------------|---|
| <b>Common Ratings</b> ( $T_A=25^\circ\text{C}$ Unless Otherwise Noted) |  |                         |                    |   |
| $V_{DSS}$  | Drain-Source Voltage                         | 40                      | V                  |   |
| $V_{GSS}$  | Gate-Source Voltage                          | $\pm 20$                |                    |   |
| $T_J$  | Maximum Junction Temperature                 | 150                     | $^\circ\text{C}$   |   |
| $T_{STG}$  | Storage Temperature Range                    | -55 to 150              | $^\circ\text{C}$   |   |
| $I_S$  | Diode Continuous Forward Current             | 20                      | A                  |   |
| <b>Mounted on Large Heat Sink</b>                                      |  |                         |                    |   |
| $I_{DP}$   | 300 $\mu\text{s}$ Pulse Drain Current Tested | $T_C=25^\circ\text{C}$  | 140                | A |
|  |  | $T_C=100^\circ\text{C}$ | 100                |   |
| $I_D$  | Continuous Drain Current                     | $T_C=25^\circ\text{C}$  | 57                 | A |
|  |  | $T_C=100^\circ\text{C}$ | 35                 |   |
| $P_D$  | Maximum Power Dissipation                    | $T_C=25^\circ\text{C}$  | 50                 | W |
|  |  | $T_C=100^\circ\text{C}$ | 20                 |   |
| $R_{\theta JC}$  | Thermal Resistance-Junction to Case          | 2.5                     | $^\circ\text{C/W}$ |   |
| <b>Mounted on PCB of 1in<sup>2</sup> pad area</b>                      |  |                         |                    |   |
| $I_{DP}$   | 300 $\mu\text{s}$ Pulse Drain Current Tested | $T_C=25^\circ\text{C}$  | 48                 | A |
|  |  | $T_C=100^\circ\text{C}$ | 32                 |   |
| $I_D$  | Continuous Drain Current                     | $T_A=25^\circ\text{C}$  | 12                 | A |
|  |  | $T_A=100^\circ\text{C}$ | 8                  |   |
| $P_D$  | Maximum Power Dissipation                    | $T_A=25^\circ\text{C}$  | 2.5                | W |
|  |  | $T_A=100^\circ\text{C}$ | 1                  |   |
| $R_{\theta JA}$  | Thermal Resistance-Junction to Ambient       | 50                      | $^\circ\text{C/W}$ |   |
| <b>Mounted on PCB of Minimum Footprint</b>                             |  |                         |                    |   |
| $I_{DP}$   | 300 $\mu\text{s}$ Pulse Drain Current Tested | $T_C=25^\circ\text{C}$  | 40                 | A |
|  |  | $T_C=100^\circ\text{C}$ | 24                 |   |
| $I_D$  | Continuous Drain Current                     | $T_A=25^\circ\text{C}$  | 10                 | A |
|  |  | $T_A=100^\circ\text{C}$ | 6                  |   |
| $P_D$  | Maximum Power Dissipation                    | $T_A=25^\circ\text{C}$  | 1.5                | W |
|  |  | $T_A=100^\circ\text{C}$ | 0.5                |   |
| $R_{\theta JA}$  | Thermal Resistance-Junction to Ambient       | 75                      | $^\circ\text{C/W}$ |   |

## Electrical Characteristics (T<sub>A</sub>=25°C Unless Otherwise Noted)

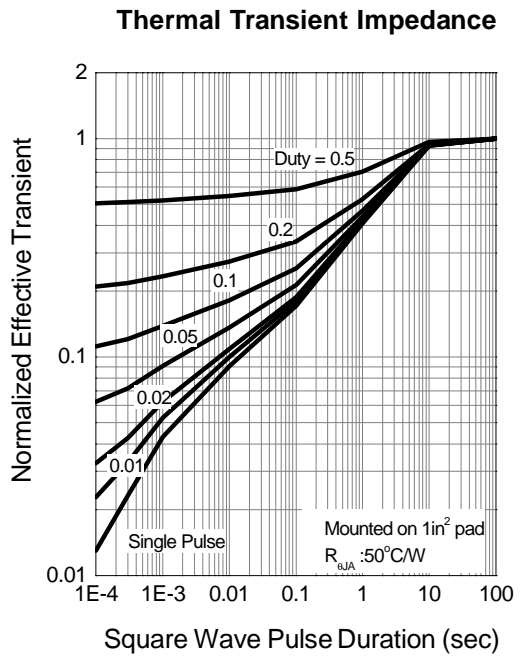
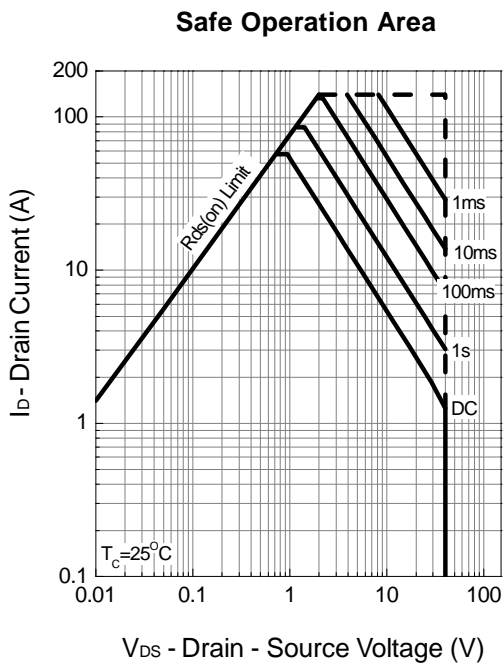
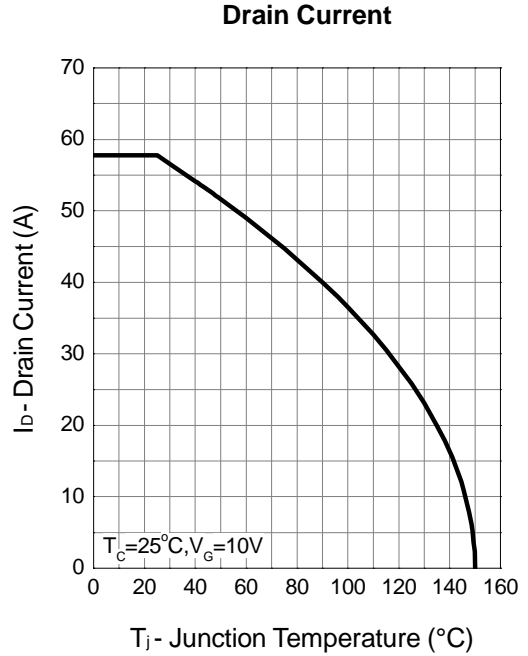
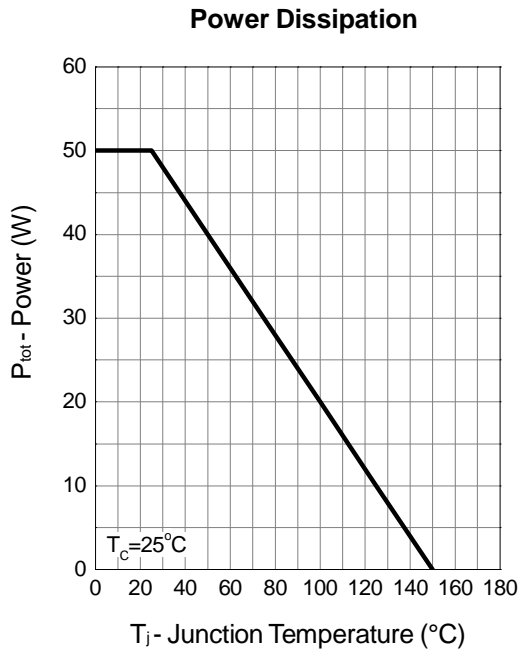
| Symbol   | Parameter                        | Test Condition  | APM4010NU |           |          | Unit |
|--|----------------------------------|---|-----------|-----------|----------|------|
|  |                                  |   | Min.      | Typ.      | Max.     |      |
| <b>Static Characteristics</b>                  |                                  |   |           |           |          |      |
| BV <sub>DSS</sub>                              | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA   | 40        |           |          | V    |
| I <sub>DSS</sub>                               | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =32V, V <sub>GS</sub> =0V<br>T <sub>J</sub> =85°C   |           |           | 1<br>30  | μA   |
| V <sub>GS(th)</sub>                            | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA   | 1.5       | 2         | 2.5      | 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> =15A<br>V <sub>GS</sub> =5V, I <sub>DS</sub> =8A                          |           | 8.2<br>13 | 10<br>17 | mΩ   |
| <b>Diode Characteristics</b>                   |                                  |   |           |           |          |      |
| V <sub>SD</sub> <sup>a</sup>                   | Diode Forward Voltage            | I <sub>SD</sub> =15A, V <sub>GS</sub> =0V   |           | 0.8       | 1.1      | V    |
| t <sub>rr</sub>                                | Reverse Recovery Time            | I <sub>DS</sub> =15A, dI <sub>SD</sub> /dt=100A/μs  |           | 28        |          | ns   |
| Q <sub>rr</sub>                                | Reverse Recovery Charge          |   |           | 25        |          | nC   |
| <b>Gate Charge Characteristics<sup>b</sup></b> |                                  |   |           |           |          |      |
| Q <sub>g</sub>                                 | Total Gate Charge                | V <sub>DS</sub> =20V, V <sub>GS</sub> =10V,<br>I <sub>DS</sub> =15A   |           | 29        | 41       | nC   |
| Q <sub>gs</sub>                                | Gate-Source Charge               |   |           | 3.6       |          |      |
| Q <sub>gd</sub>                                | Gate-Drain Charge                |   |           | 9.6       |          |      |
| <b>Dynamic Characteristics<sup>b</sup></b>     |                                  |   |           |           |          |      |
| 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> =20V,<br>Frequency=1.0MHz   |           | 1400      |          | pF   |
| C <sub>oss</sub>                               | Output Capacitance               |   |           | 215       |          |      |
| C <sub>rss</sub>                               | Reverse Transfer Capacitance     |   |           | 150       |          |      |
| t <sub>d(ON)</sub>                             | Turn-on Delay Time               | V <sub>DD</sub> =20V, R <sub>L</sub> =20Ω,<br>I <sub>DS</sub> =1A, V <sub>GEN</sub> =10V,<br>R <sub>G</sub> =6Ω |           | 12        | 23       | ns   |
| t <sub>r</sub>                                 | Turn-on Rise Time                |   |           | 12        | 23       |      |
| t <sub>d(OFF)</sub>                            | Turn-off Delay Time              |   |           | 37        | 68       |      |
| t <sub>f</sub>                                 | Turn-off Fall Time               |   |           | 12        | 23       |      |

Notes :

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

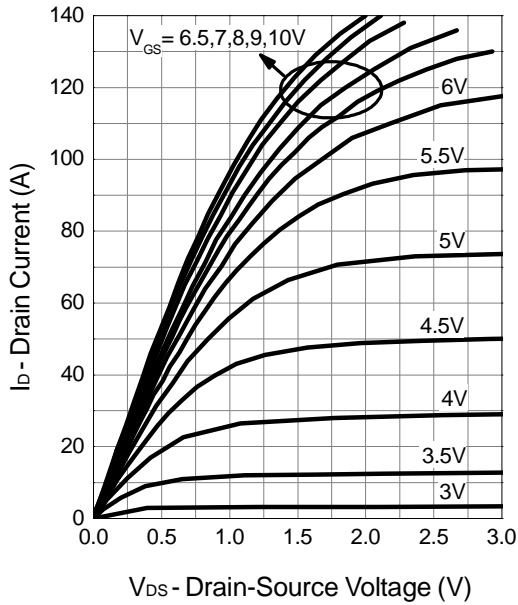
b : Guaranteed by design, not subject to production testing.

### Typical Characteristics

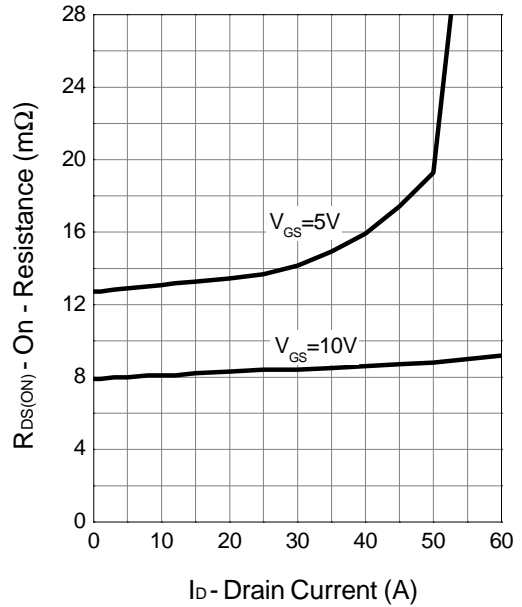


Typical Characteristics (Cont.)

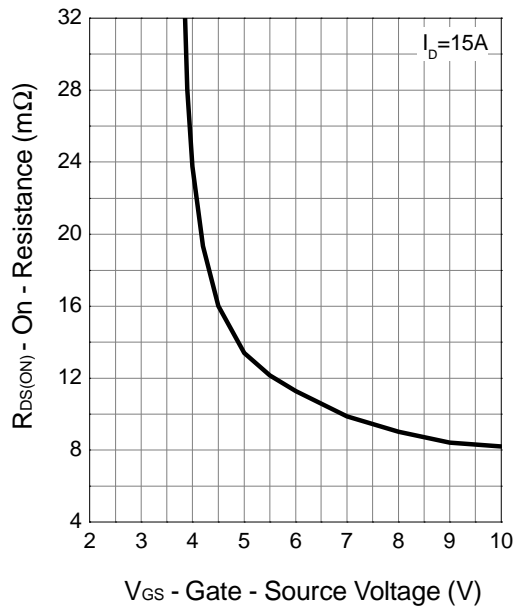
Output Characteristics



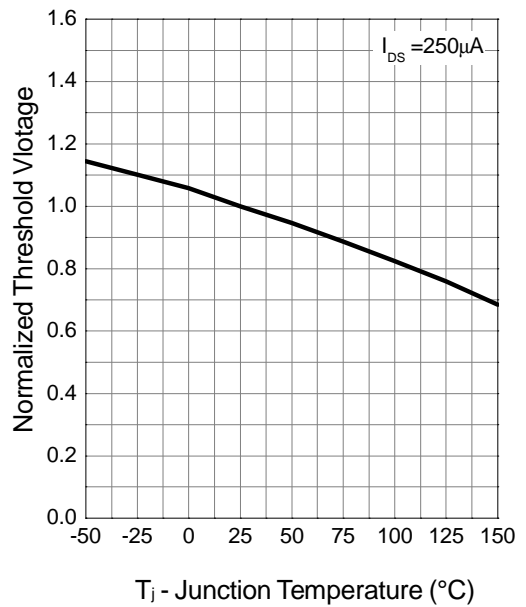
Drain-Source On Resistance



Drain-Source On Resistance

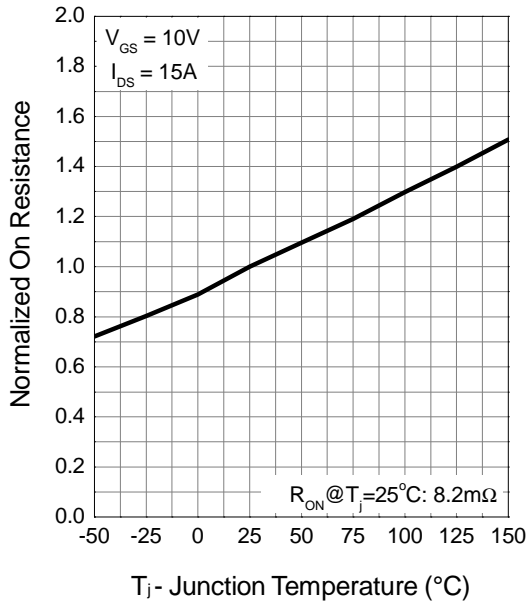


Gate Threshold Voltage

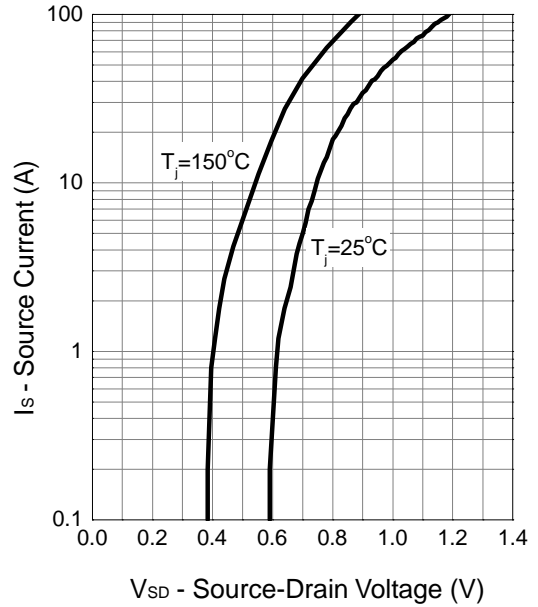


Typical Characteristics (Cont.)

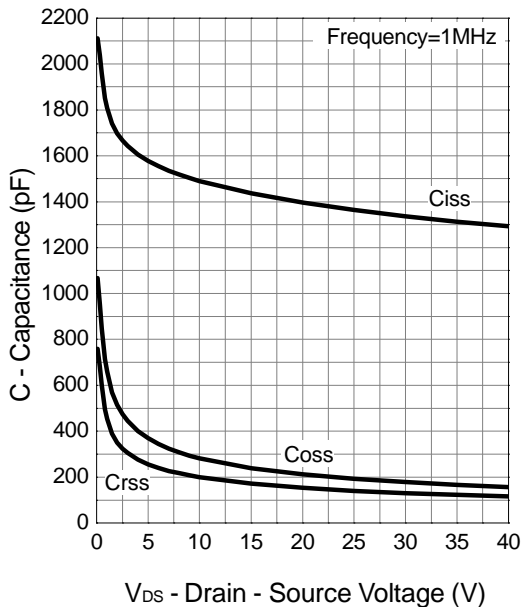
Drain-Source On Resistance



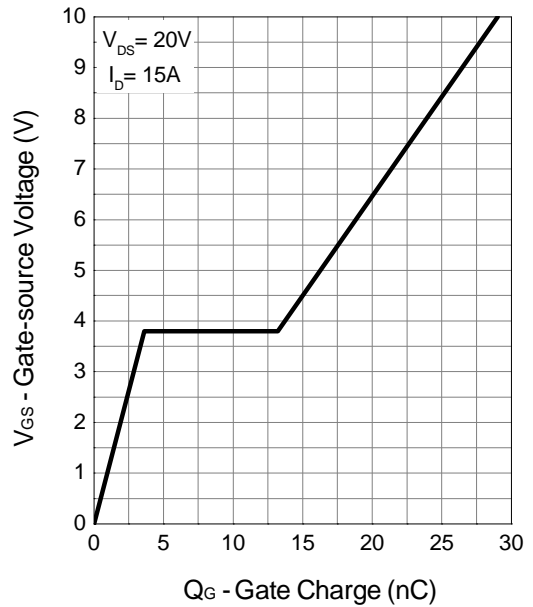
Source-Drain Diode Forward



Capacitance

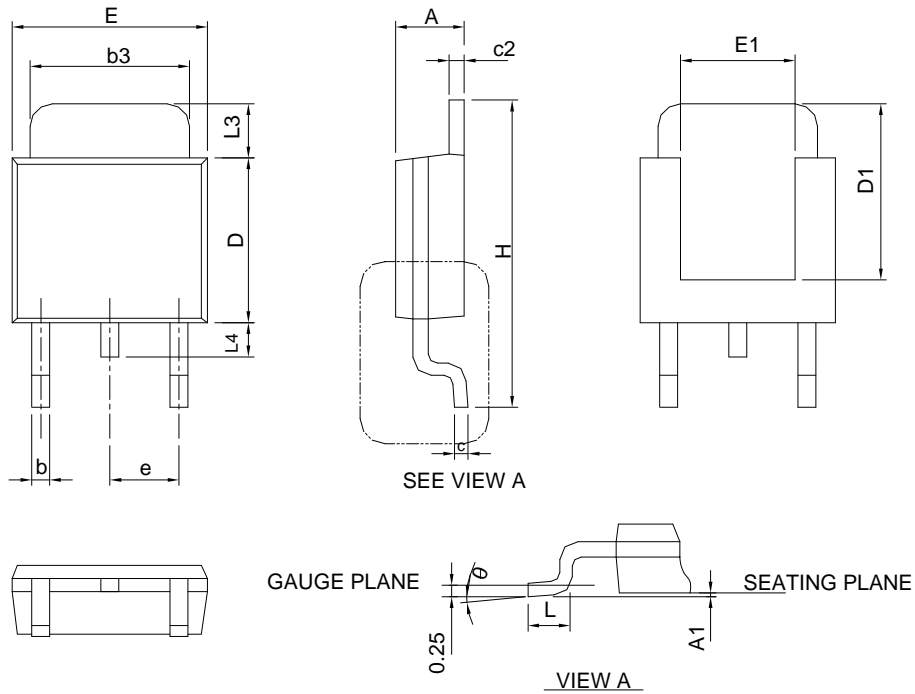


Gate Charge



Package Information

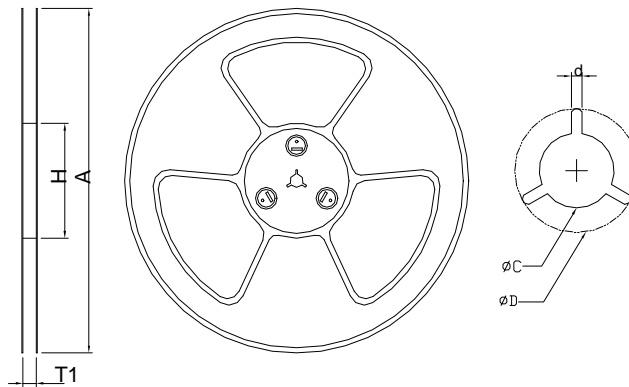
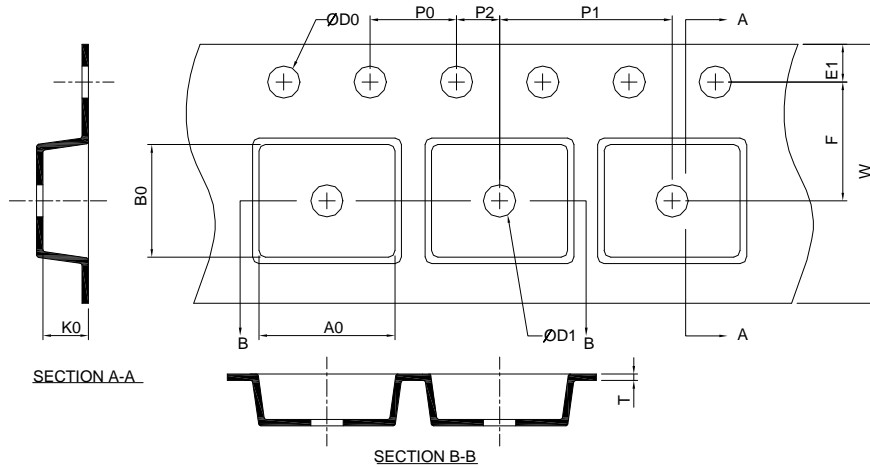
TO-252



| SYMBOL | TO-252      |       |           |       |
|--------|-------------|-------|-----------|-------|
|        | MILLIMETERS |       | INCHES    |       |
|        | MIN.        | MAX.  | MIN.      | MAX.  |
| A      | 2.18        | 2.39  | 0.086     | 0.094 |
| A1     |             | 0.13  |           | 0.005 |
| b      | 0.50        | 0.89  | 0.020     | 0.035 |
| b3     | 4.95        | 5.46  | 0.195     | 0.215 |
| c      | 0.46        | 0.61  | 0.018     | 0.024 |
| c2     | 0.46        | 0.89  | 0.018     | 0.035 |
| D      | 5.33        | 6.22  | 0.210     | 0.245 |
| D1     | 4.57        | 6.00  | 0.180     | 0.235 |
| E      | 6.35        | 6.73  | 0.250     | 0.265 |
| E1     | 3.81        | 6.00  | 0.150     | 0.235 |
| e      | 2.29 BSC    |       | 0.090 BSC |       |
| H      | 9.40        | 10.41 | 0.370     | 0.410 |
| L      | 0.90        | 1.78  | 0.035     | 0.070 |
| L3     | 0.89        | 2.03  | 0.035     | 0.080 |
| L4     |             | 1.02  |           | 0.040 |
| θ      | 0°          | 8°    | 0°        | 8°    |

Note : Follow JEDEC TO-252 .

### Carrier Tape & Reel Dimensions



| Application | A            | H          | T1                 | C                  | d        | D                 | W           | E1           | F           |
|-------------|--------------|------------|--------------------|--------------------|----------|-------------------|-------------|--------------|-------------|
| TO-252      | 330.0 ± 2.00 | 50 MIN.    | 16.4+2.00<br>-0.00 | 13.0+0.50<br>-0.20 | 1.5 MIN. | 20.2 MIN.         | 16.0 ± 0.30 | 1.75 ± 0.10  | 7.50 ± 0.05 |
|             | P0           | P1         | P2                 | D0                 | D1       | T                 | A0          | B0           | K0          |
|             | 4.0 ± 0.10   | 8.0 ± 0.10 | 2.0 ± 0.05         | 1.5+0.10<br>-0.00  | 1.5 MIN. | 0.6+0.00<br>-0.40 | 6.80 ± 0.20 | 10.40 ± 0.20 | 2.50 ± 0.20 |

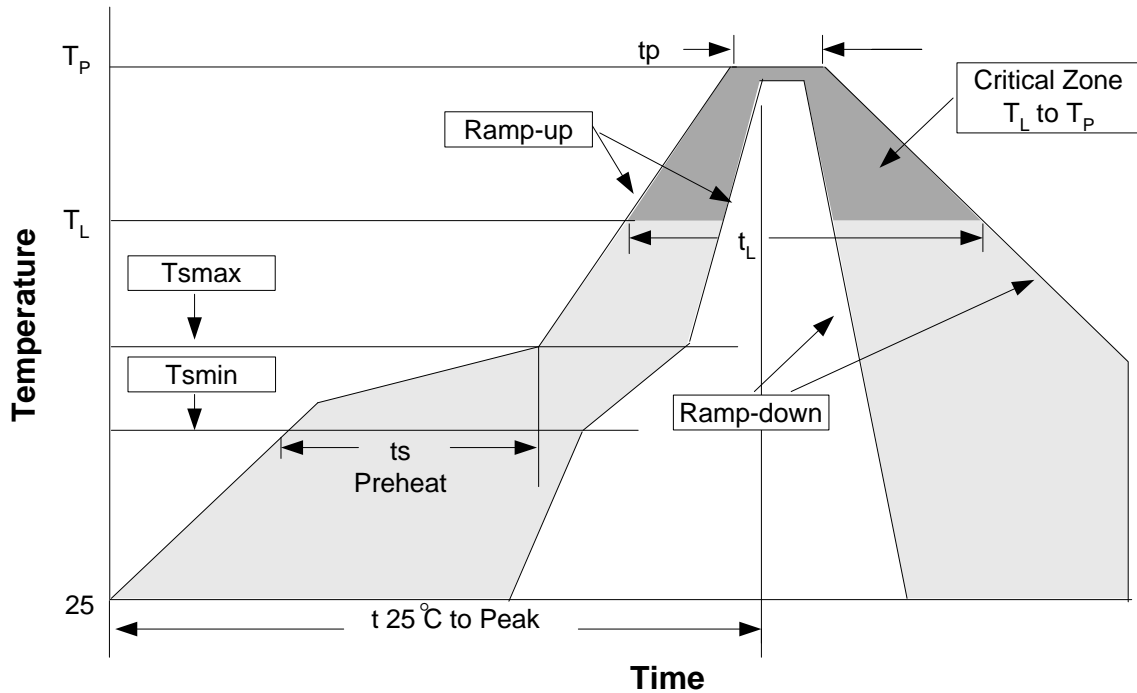
(mm)

### Devices Per Unit

| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| TO-252       | Tape & Reel | 2500     |



**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 (T <sub>L</sub> to T <sub>P</sub> )   | 3°C/second max.                  | 3°C/second max.                  |
| Preheat<br>- Temperature Min (T <sub>min</sub> )<br>- Temperature Max (T <sub>max</sub> )<br>- Time (min to max) (t <sub>s</sub> ) | 100°C<br>150°C<br>60-120 seconds | 150°C<br>200°C<br>60-180 seconds |
| Time maintained above:<br>- Temperature (T <sub>L</sub> )<br>- Time (t <sub>L</sub> )  | 183°C<br>60-150 seconds          | 217°C<br>60-150 seconds          |
| Peak/Classification Temperature (T <sub>p</sub> )  | See table 1                      | See table 2                      |
| Time within 5°C of actual Peak Temperature (t <sub>p</sub> )   | 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.

## Classification Reflow Profiles (Cont.)

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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