



## 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                         | 20                        | V                  |   |
| $V_{GSS}$  | Gate-Source Voltage                          | $\pm 16$                  |                    |   |
| $T_J$  | Maximum Junction Temperature                 | 150                       | $^\circ\text{C}$   |   |
| $T_{STG}$  | Storage Temperature Range                    | -55 to 150                | $^\circ\text{C}$   |   |
| $I_S$  | Diode Continuous Forward Current             | $T=25^\circ\text{C}$<br>8 | A                  |   |
| <b>Mounted on Large Heat Sink</b>                                      |  |                           |                    |   |
| $I_{DP}$   | 300 $\mu\text{s}$ Pulse Drain Current Tested | $T_C=25^\circ\text{C}$    | 50                 | A |
|  |  | $T_C=100^\circ\text{C}$   | 30                 |   |
| $I_D$  | Continuous Drain Current                     | $T_C=25^\circ\text{C}$    | 20                 | A |
|  |  | $T_C=100^\circ\text{C}$   | 12                 |   |
| $P_D$  | 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 | $T_A=25^\circ\text{C}$    | 50                 | A |
|  |  | $T_A=100^\circ\text{C}$   | 30                 |   |
| $I_D$  | Continuous Drain Current                     | $T_A=25^\circ\text{C}$    | 6                  | A |
|  |  | $T_A=100^\circ\text{C}$   | 4                  |   |
| $P_D$  | 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 | $T_A=25^\circ\text{C}$    | 50                 | A |
|  |  | $T_A=100^\circ\text{C}$   | 30                 |   |
| $I_D$  | Continuous Drain Current                     | $T_A=25^\circ\text{C}$    | 5                  | A |
|  |  | $T_A=100^\circ\text{C}$   | 3                  |   |
| $P_D$  | Maximum Power Dissipation                    | $T_A=25^\circ\text{C}$    | 1.6                | W |
|  |  | $T_A=100^\circ\text{C}$   | 0.6                |   |
| $R_{\theta JA}$  | 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   | APM2054NU |      |      | 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  | 20        |      |      | V    |
| I <sub>DSS</sub>                               | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =16V, 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  | 0.6       | 0.7  | 1.5  | V    |
| I <sub>GSS</sub>                               | Gate Leakage Current             | V <sub>GS</sub> =±16V, 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> =12A   |           | 35   | 40   | mΩ   |
|  |                                  | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =6A   |           | 45   | 54   |      |
|  |                                  | V <sub>GS</sub> =2.5V, I <sub>DS</sub> =2A   |           | 110  | 130  |      |
| <b>Diode Characteristics</b>                   |                                  |  |           |      |      |      |
| V <sub>SD</sub> <sup>a</sup>                   | Diode Forward Voltage            | I <sub>SD</sub> =6A, V <sub>GS</sub> =0V   |           | 0.7  | 1.3  | V    |
| <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   |           | 2.3  |      | Ω    |
| C <sub>iss</sub>                               | Input Capacitance                | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =15V,<br>Frequency=1.0MHz  |           | 450  |      | pF   |
| C <sub>oss</sub>                               | Output Capacitance               |  |           | 100  |      |      |
| C <sub>rss</sub>                               | Reverse Transfer Capacitance     |  |           | 60   |      |      |
| t <sub>d(ON)</sub>                             | Turn-on Delay Time               | V <sub>DD</sub> =10V, R <sub>L</sub> =10Ω,<br>I <sub>DS</sub> =1A, V <sub>GEN</sub> =4.5V,<br>R <sub>G</sub> =6Ω |           | 7    | 10   | ns   |
| T <sub>r</sub>                                 | Turn-on Rise Time                |  |           | 15   | 25   |      |
| t <sub>d(OFF)</sub>                            | Turn-off Delay Time              |  |           | 19   | 26   |      |
| T <sub>f</sub>                                 | Turn-off Fall Time               |  |           | 6    | 7    |      |
| <b>Gate Charge Characteristics<sup>b</sup></b> |                                  |  |           |      |      |      |
| Q <sub>g</sub>                                 | Total Gate Charge                | V <sub>DS</sub> =10V, V <sub>GS</sub> =4.5V,<br>I <sub>DS</sub> =12A   |           | 3.8  | 5    | nC   |
| Q <sub>gs</sub>                                | Gate-Source Charge               |  |           | 1.2  |      |      |
| Q <sub>gd</sub>                                | Gate-Drain Charge                |  |           | 1.4  |      |      |

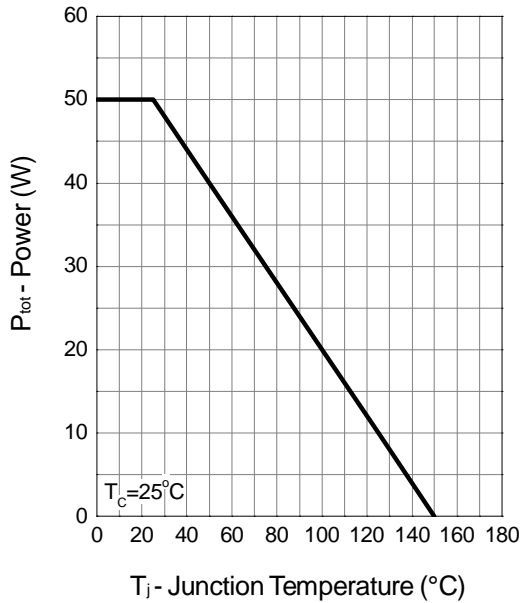
Notes:

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

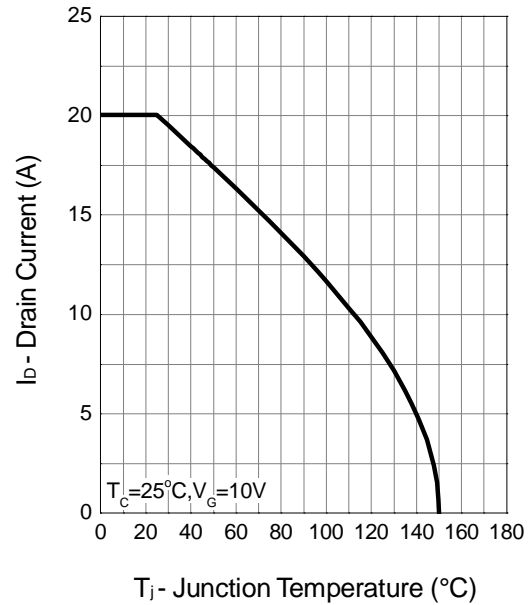
b : Guaranteed by design, not subject to production testing.

## Typical Characteristics

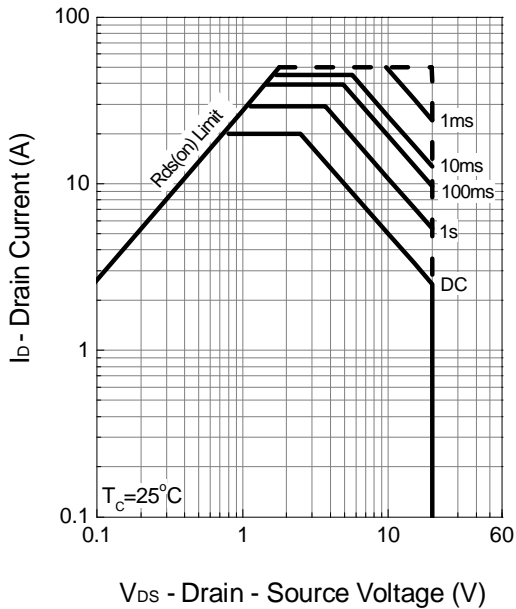
**Power Dissipation**



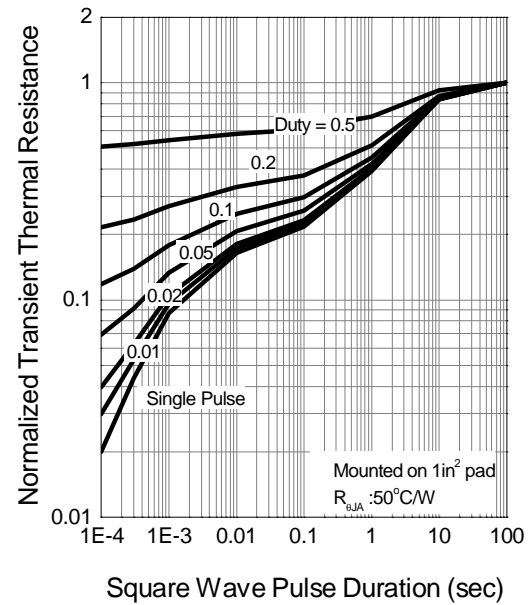
**Drain Current**



**Safe Operation Area**

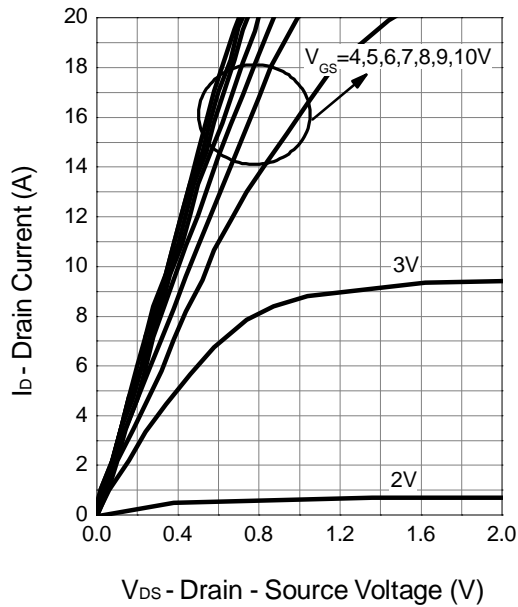


**Thermal Transient Impedance**

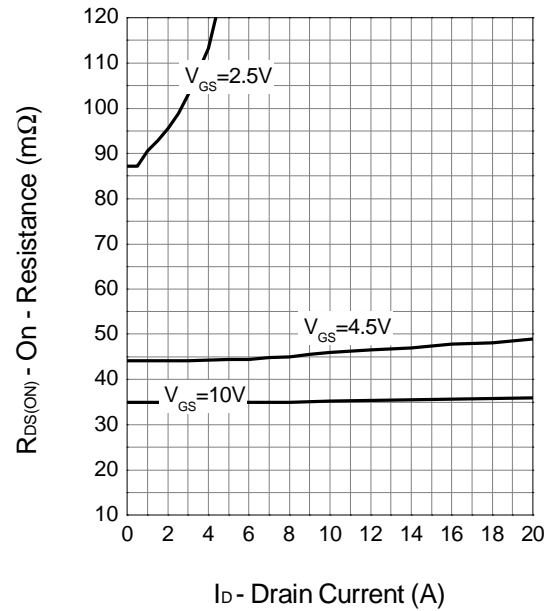


## Typical Characteristics (Cont.)

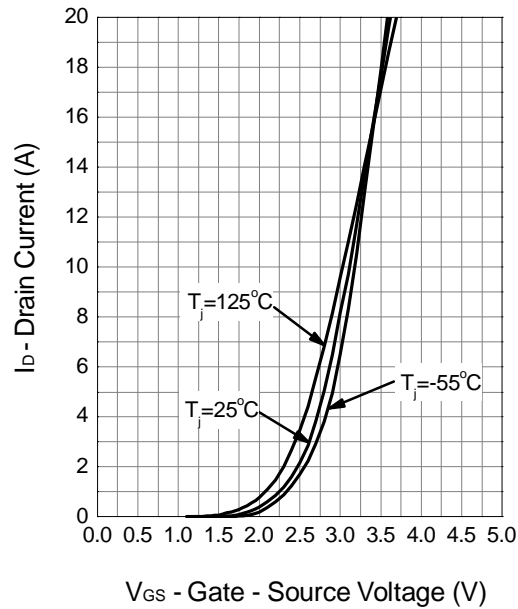
Output Characteristics



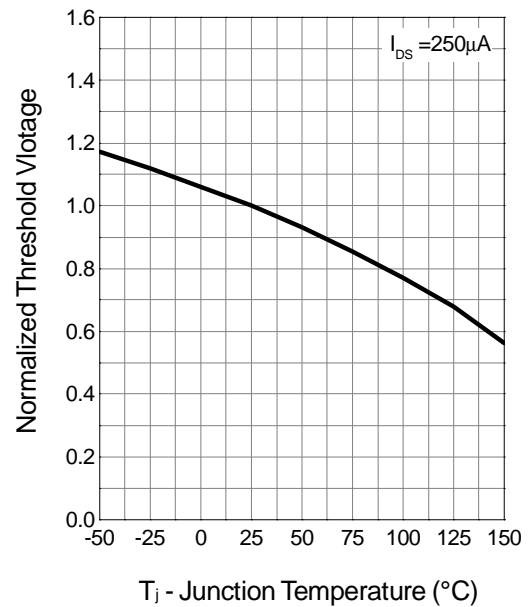
Drain-Source On Resistance



Transfer Characteristics

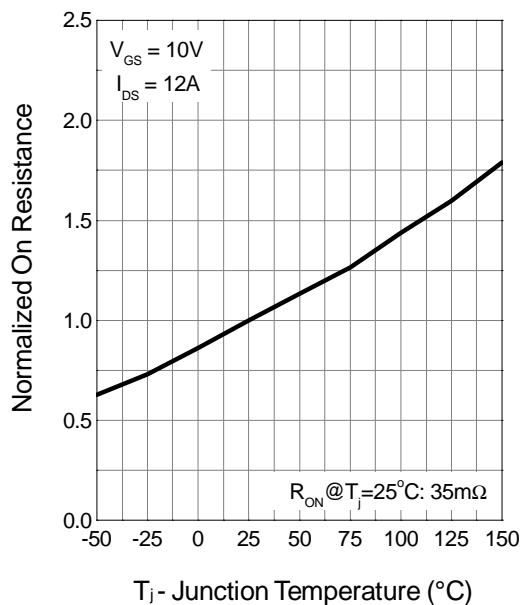


Gate Threshold Voltage

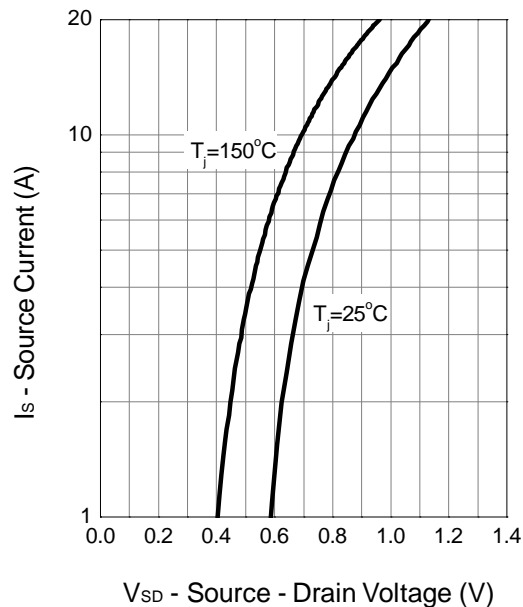


Typical Characteristics (Cont.)

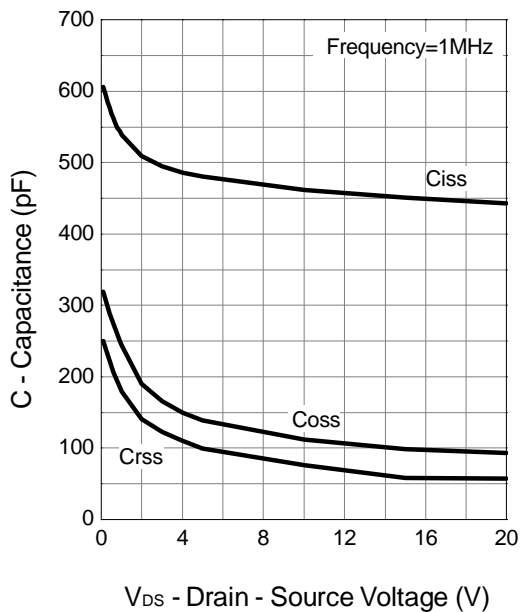
Drain-Source On Resistance



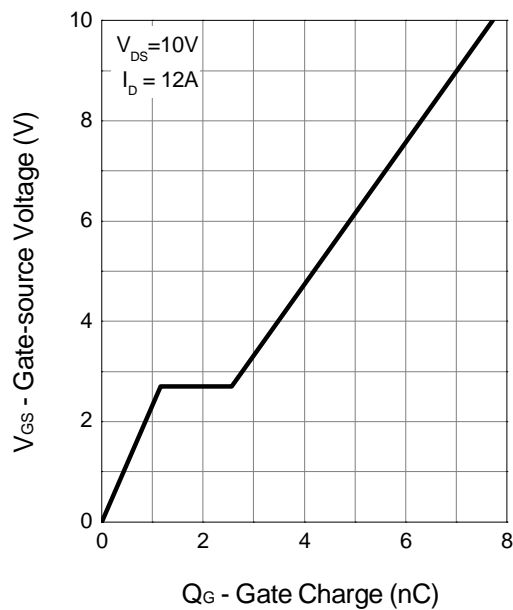
Source-Drain Diode Forward



Capacitance

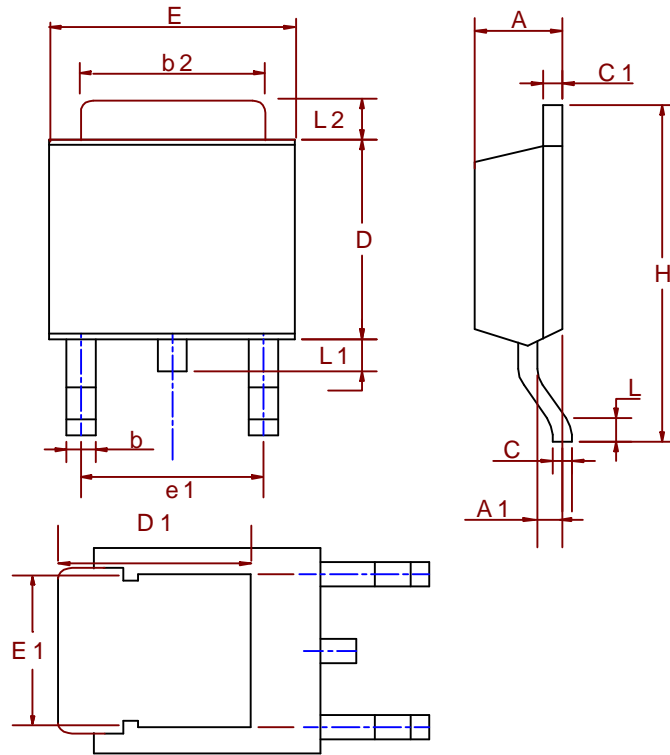


Gate Charge



## Package Information

TO-252 (Reference JEDEC Registration TO-252)

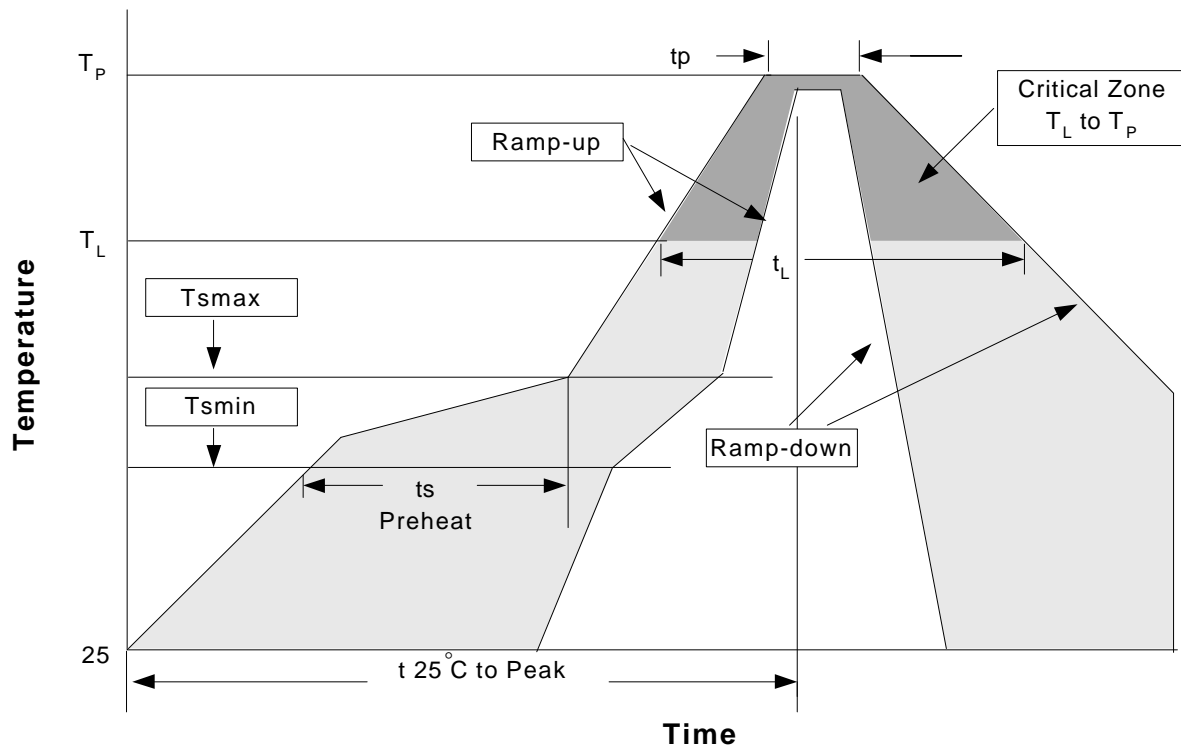


| Dim | Millimeters |       | Inches    |       |
|-----|-------------|-------|-----------|-------|
|     | Min.        | Max.  | Min.      | Max.  |
| A   | 2.18        | 2.39  | 0.086     | 0.094 |
| A1  | 0.89        | 1.27  | 0.035     | 0.050 |
| b   | 0.508       | 0.89  | 0.020     | 0.035 |
| b2  | 5.207       | 5.461 | 0.205     | 0.215 |
| C   | 0.46        | 0.58  | 0.018     | 0.023 |
| C1  | 0.46        | 0.58  | 0.018     | 0.023 |
| D   | 5.334       | 6.22  | 0.210     | 0.245 |
| D1  | 5.2 REF     |       | 0.205 REF |       |
| E   | 6.35        | 6.73  | 0.250     | 0.265 |
| E1  | 5.3 REF     |       | 0.209 REF |       |
| e1  | 3.96        | 5.18  | 0.156     | 0.204 |
| H   | 9.398       | 10.41 | 0.370     | 0.410 |
| L   | 0.51        |       | 0.020     |       |
| L1  | 0.64        | 1.02  | 0.025     | 0.040 |
| L2  | 0.89        | 2.032 | 0.035     | 0.080 |

## 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.         |

### Reflow Condition (IR/Convection or VPR Reflow)



### 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 ( $T_{smin}$ )                     | 100°C                   | 150°C            |
| - Temperature Max ( $T_{smax}$ )                     | 150°C                   | 200°C            |
| - Time (min to max) ( $t_s$ )                        | 60-120 seconds          | 60-180 seconds   |
| Time maintained above:                               |                         |                  |
| - Temperature ( $T_L$ )                              | 183°C                   | 217°C            |
| - Time ( $t_L$ )                                     | 60-150 seconds          | 60-150 seconds   |
| Peak/Classification Temperature ( $T_p$ )            | See table 1             | See table 2      |
| Time within 5°C of actual 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.   |

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 <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

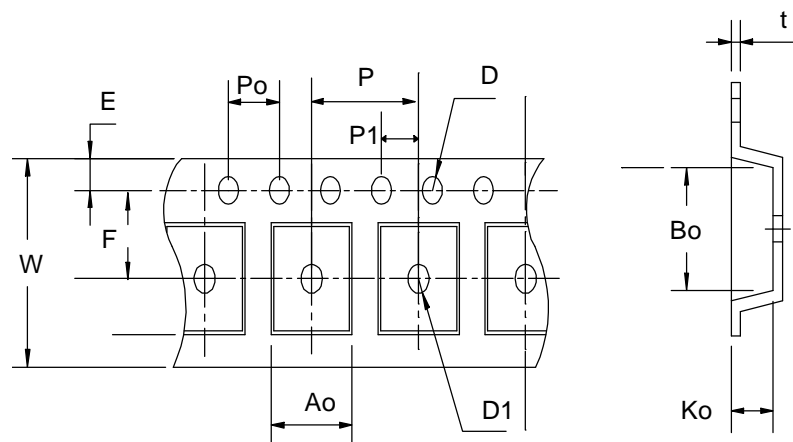
| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>>2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm           | 260 +0°C*                      | 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.

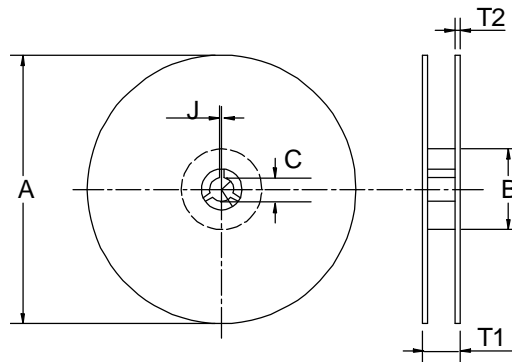
## Reliability Test Program

| 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



Carrier Tape & Reel Dimensions (Cont.)



| Application | A        | B        | C         | J        | T1                | T2       | W               | P        | E         |
|-------------|----------|----------|-----------|----------|-------------------|----------|-----------------|----------|-----------|
| TO-252      | 330 ±3   | 100 ±2   | 13 ±0.5   | 2 ±0.5   | 16.4 +0.3<br>-0.2 | 2.5 ±0.5 | 16+ 0.3<br>-0.1 | 8 ±0.1   | 1.75 ±0.1 |
|             | F        | D        | D1        | Po       | P1                | Ao       | Bo              | Ko       | t         |
|             | 7.5 ±0.1 | 1.5 +0.1 | 1.5 ±0.25 | 4.0 ±0.1 | 2.0 ±0.1          | 6.8 ±0.1 | 10.4 ±0.1       | 2.5 ±0.1 | 0.3 ±0.05 |

(mm)

Cover Tape Dimensions

| Application | Carrier Width | Cover Tape Width | Devices Per Reel |
|-------------|---------------|------------------|------------------|
| TO-252      | 16            | 13.3             | 2500             |

Customer Service

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