



## 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             | $T_C=25^\circ\text{C}$<br>-4 | A                  |   |
| <b>Mounted on Large Heat Sink</b>                                      |  |                              |                    |   |
| $I_{DP}$   | 300 $\mu\text{s}$ Pulse Drain Current Tested | $T_C=25^\circ\text{C}$       | -20                | A |
|  |  | $T_C=100^\circ\text{C}$      | -12                |   |
| $I_D$  | Continuous Drain Current                     | $T_C=25^\circ\text{C}$       | -8                 | A |
|  |  | $T_C=100^\circ\text{C}$      | -5                 |   |
| $P_D$  | 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 | $T_A=25^\circ\text{C}$       | -20                | A |
|  |  | $T_A=100^\circ\text{C}$      | -12                |   |
| $I_D$  | Continuous Drain Current                     | $T_A=25^\circ\text{C}$       | -4                 | A |
|  |  | $T_A=100^\circ\text{C}$      | -3                 |   |
| $P_D$  | 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 | $T_A=25^\circ\text{C}$       | -20                | A |
|  |  | $T_A=100^\circ\text{C}$      | -12                |   |
| $I_D$  | Continuous Drain Current                     | $T_A=25^\circ\text{C}$       | -3                 | A |
|  |  | $T_A=100^\circ\text{C}$      | -2                 |   |
| $P_D$  | 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 ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol   | Parameter                        | Test Condition  | APM2070PU |           |            | Unit      |
|--|----------------------------------|---|-----------|-----------|------------|-----------|
|  |                                  |   | Min.      | Typ.      | Max.       |           |
| <b>Static Characteristics</b>                  |                                  |   |           |           |            |           |
| $BV_{DSS}$                                     | Drain-Source Breakdown Voltage   | $V_{GS}=0V, I_{DS}=-250\mu A$   | -20       |           |            | V         |
| $I_{DSS}$                                      | Zero Gate Voltage Drain Current  | $V_{DS}=-16V, V_{GS}=0V$<br>$T_J=85^\circ\text{C}$                            |           |           | -1<br>-30  | $\mu A$   |
| $V_{GS(th)}$                                   | Gate Threshold Voltage           | $V_{DS}=V_{GS}, I_{DS}=-250\mu A$   | -0.7      | -0.9      | -1.5       | V         |
| $I_{GSS}$                                      | Gate Leakage Current             | $V_{GS}=\pm 16V, V_{DS}=0V$   |           |           | $\pm 100$  | nA        |
| $R_{DS(ON)}^a$                                 | Drain-Source On-state Resistance | $V_{GS}=-10V, I_{DS}=-5A$<br>$V_{GS}=-4.5V, I_{DS}=-2.8A$                     |           | 78<br>120 | 102<br>150 | $m\Omega$ |
| <b>Diode Characteristics</b>                   |                                  |   |           |           |            |           |
| $V_{SD}^a$                                     | Diode Forward Voltage            | $I_{SD}=-0.5A, V_{GS}=0V$   |           | -0.7      | -1.3       | V         |
| <b>Dynamic Characteristics<sup>b</sup></b>     |                                  |   |           |           |            |           |
| $R_G$  | Gate Resistance                  | $V_{GS}=0V, V_{DS}=0V, F=1\text{MHz}$   |           | 13        |            | $\Omega$  |
| $C_{iss}$                                      | Input Capacitance                | $V_{GS}=0V,$<br>$V_{DS}=-15V,$<br>Frequency=1.0MHz                            |           | 500       |            | pF        |
| $C_{oss}$                                      | Output Capacitance               |   |           | 150       |            |           |
| $C_{rss}$                                      | Reverse Transfer Capacitance     |   |           | 120       |            |           |
| $t_{d(ON)}$                                    | Turn-on Delay Time               | $V_{DD}=-10V, R_L=10\Omega,$<br>$I_{DS}=-1A, V_{GEN}=-4.5V,$<br>$R_G=6\Omega$ |           | 13        | 25         | ns        |
| $T_r$  | Turn-on Rise Time                |   |           | 36        | 67         |           |
| $t_{d(OFF)}$                                   | Turn-off Delay Time              |   |           | 45        | 83         |           |
| $T_f$  | Turn-off Fall Time               |   |           | 37        | 69         |           |
| <b>Gate Charge Characteristics<sup>b</sup></b> |                                  |   |           |           |            |           |
| $Q_g$  | Total Gate Charge                | $V_{DS}=-10V, V_{GS}=-4.5V,$<br>$I_{DS}=-5A$                                  |           | 17        | 22         | nC        |
| $Q_{gs}$                                       | Gate-Source Charge               |   |           | 4         |            |           |
| $Q_{gd}$                                       | Gate-Drain Charge                |   |           | 5.2       |            |           |

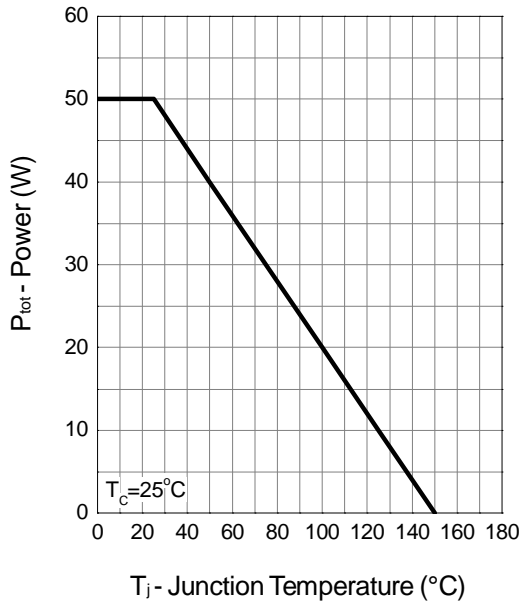
Note:

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

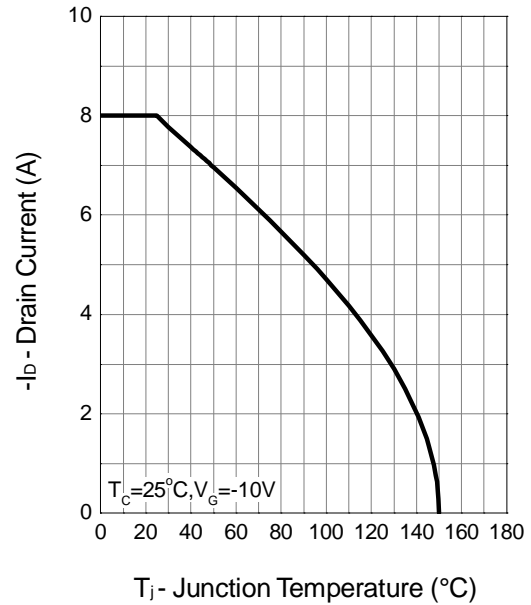
b : Guaranteed by design, not subject to production testing.

## Typical Characteristics

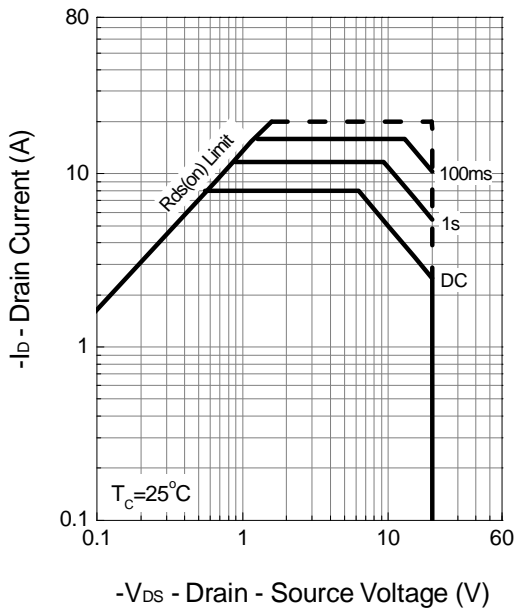
**Power Dissipation**



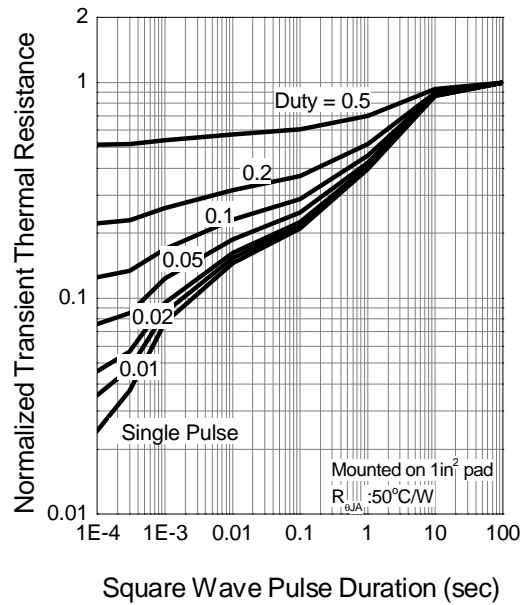
**Drain Current**



**Safe Operation Area**

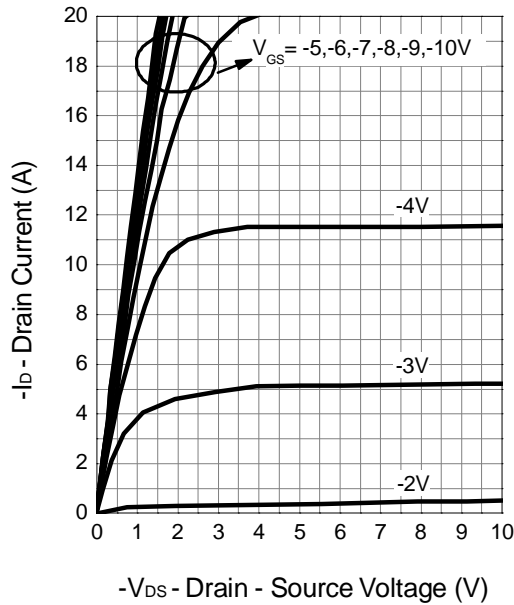


**Thermal Transient Impedance**

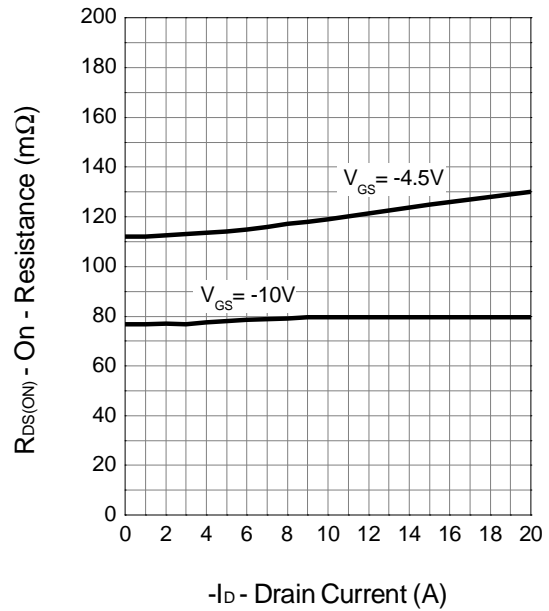


## Typical Characteristics (Cont.)

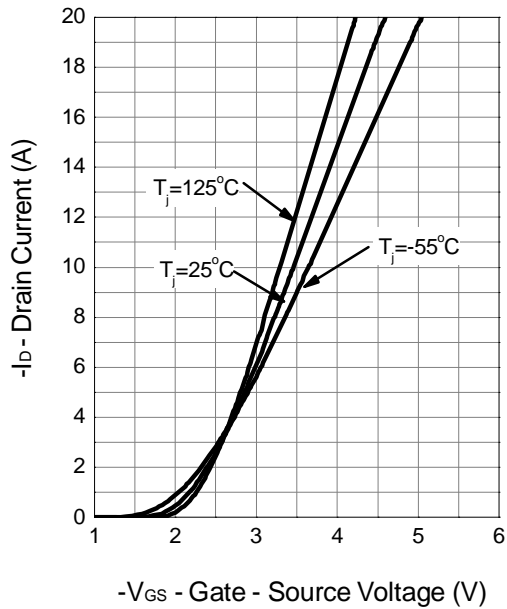
Output Characteristics



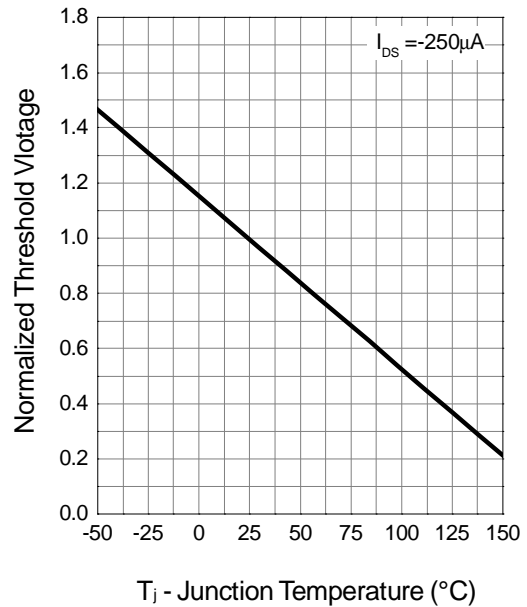
Drain-Source On Resistance



Transfer Characteristics

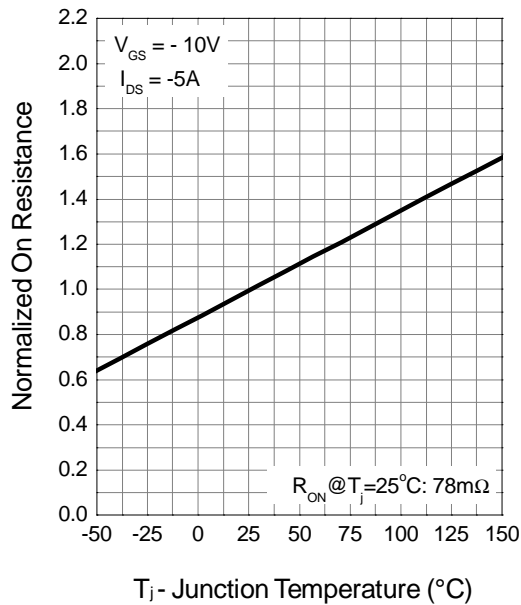


Gate Threshold Voltage

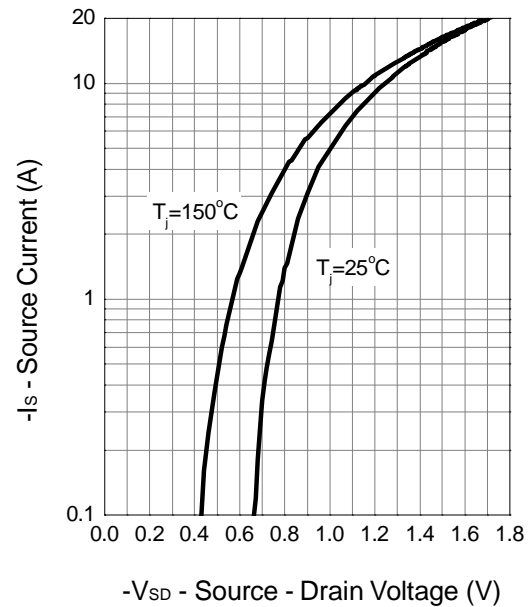


## Typical Characteristics (Cont.)

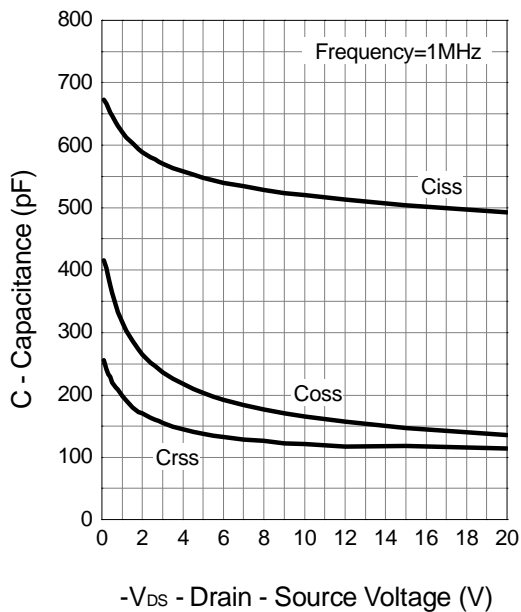
Drain-Source On Resistance



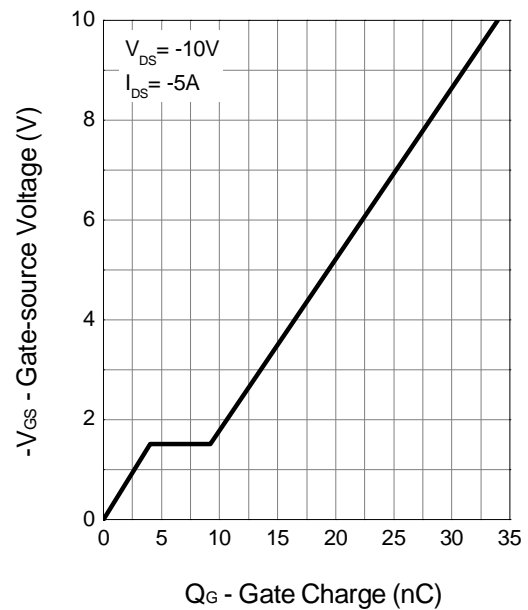
Source-Drain Diode Forward



Capacitance

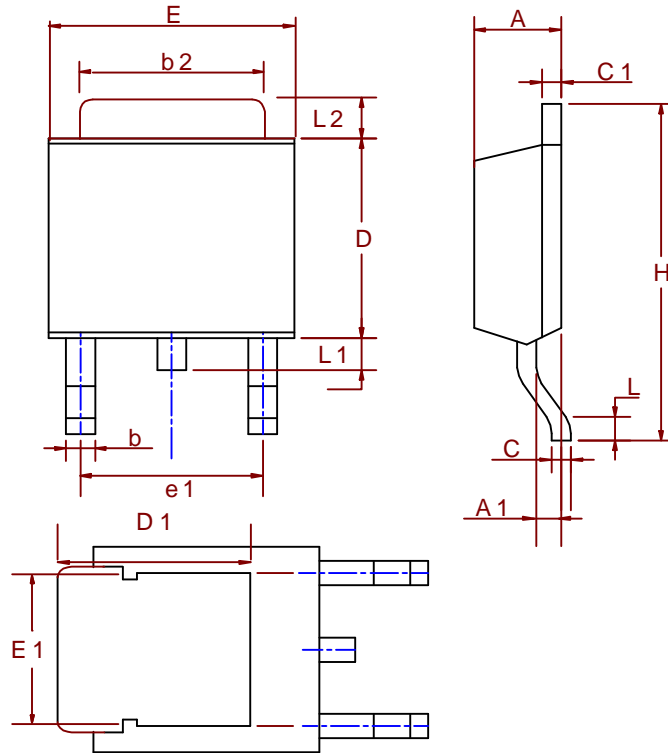


Gate Charge



## Package Information

TO-252 (Reference JEDEC Registration TO-252)

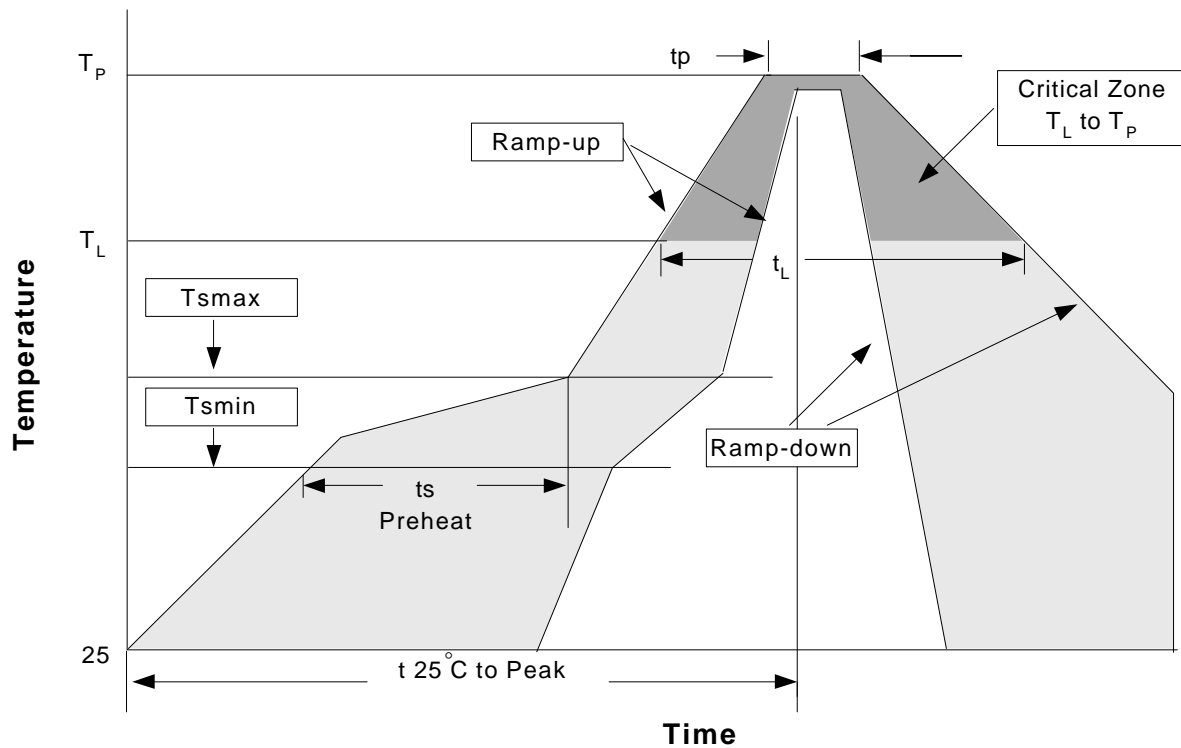


| Dim | Millimeters |       | Inches    |       |
|-----|-------------|-------|-----------|-------|
|     | Min.        | Max.  | Min.      | Max.  |
| A   | 2.18        | 2.39  | 0.086     | 0.094 |
| A1  | 0.89        | 1.27  | 0.035     | 0.050 |
| b   | 0.508       | 0.89  | 0.020     | 0.035 |
| 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

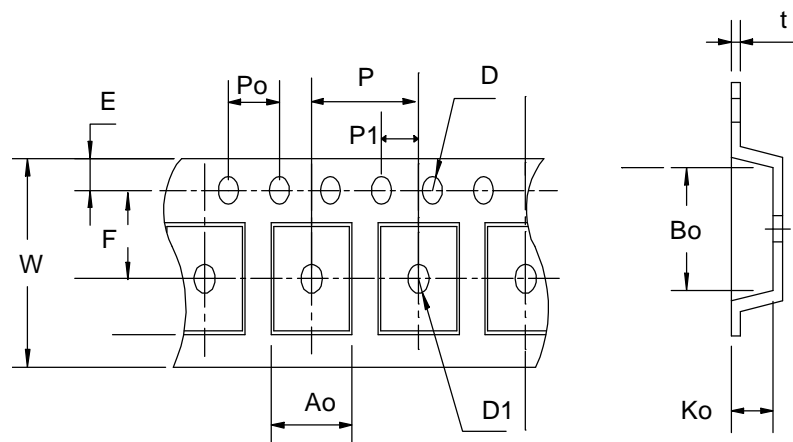
| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>>2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm           | 260 +0°C*                 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

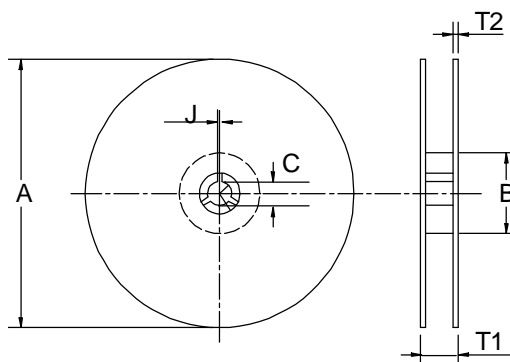
## Reliability Test Program

| 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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