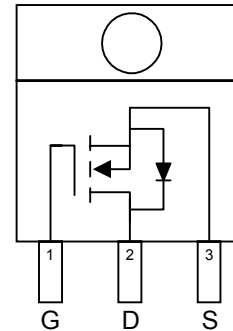


## N-Channel Enhancement Mode MOSFET

### Features

- 30V/70A ,  $R_{DS(ON)} = 7m\Omega (typ.) @ V_{GS} = 10V$   
 $R_{DS(ON)} = 11m\Omega (typ.) @ V_{GS} = 4.5V$
- Super High Dense Advanced Cell Design for Extremely Low  $R_{DS(ON)}$
- Reliable and Rugged
- TO-220 , TO-252 and TO-263 Packages

### Pin Description



Top View of TO-220, TO-252 and TO-263

### Applications

- Power Management in Desktop Computer or DC/DC Converters.

### Ordering and Marking Information

|                                                                                                             |                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>APM3009N □□-□□</p> <p>Handling Code</p> <p>Temp. Range</p> <p>Package Code</p>                           | <p>Package Code</p> <p>F : TO-220    G : TO-263    U : TO-252</p> <p>Operating Junction Temp. Range</p> <p>C : -55 to 125°C</p> <p>Handling Code</p> <p>TU : Tube</p> <p>TR : Tape &amp; Reel</p> |
| <p>APM3009N F/G/U :</p>  | <p>XXXXX - Date Code</p>                                                                                                                                                                          |

### Absolute Maximum Ratings ( $T_A = 25^\circ C$ unless otherwise noted)

| Symbol    | Parameter                          | Rating   | Unit |
|-----------|------------------------------------|----------|------|
| $V_{DSS}$ | Drain-Source Voltage               | 30       | V    |
| $V_{GSS}$ | Gate-Source Voltage                | $\pm 20$ |      |
| $I_D^*$   | Maximum Drain Current – Continuous | 60       | A    |
| $I_{DM}$  | Maximum Drain Current – Pulsed     | 110      |      |

\* Surface Mounted on FR4 Board,  $t \leq 10$  sec.

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

| Symbol          | Parameter                                          |                           |        | Rating     | Unit                 |
|-----------------|----------------------------------------------------|---------------------------|--------|------------|----------------------|
| $P_D$           | Maximum Power Dissipation                          | $T_A=25^{\circ}\text{C}$  | TO-252 | 50         | W                    |
|                 |                                                    |                           | TO-263 | 62.5       |                      |
|                 |                                                    | $T_A=100^{\circ}\text{C}$ | TO-252 | 20         |                      |
|                 |                                                    |                           | TO-263 | 25         |                      |
| $T_J, T_{STG}$  | Maximum Operating and Storage Junction Temperature |                           |        | -55 to 150 | $^{\circ}\text{C}$   |
| $R_{\theta JA}$ | Thermal Resistance – Junction to Ambient           |                           | TO-252 | 50         | $^{\circ}\text{C/W}$ |
|                 |                                                    |                           | TO-263 | 60         |                      |
| $R_{\theta JC}$ | Thermal Resistance – Junction to Case              |                           | TO-252 | 2.5        | $^{\circ}\text{C/W}$ |
|                 |                                                    |                           | TO-263 | 2          |                      |

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

| Symbol                           | Parameter                       | Test Condition                                                                             | APM3009N |      |      | Unit |
|----------------------------------|---------------------------------|--------------------------------------------------------------------------------------------|----------|------|------|------|
|                                  |                                 |                                                                                            | Min.     | Typ. | Max. |      |
| Static                           |                                 |                                                                                            |          |      |      |      |
| BV <sub>DSS</sub>                | Drain-Source Breakdown          | 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   |
| V <sub>GS(th)</sub>              | Gate Threshold Voltage          | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA                                  | 1        |      | 3    | 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           | V <sub>GS</sub> =10V, I <sub>DS</sub> =35A                                                 |          | 7    | 9    | mΩ   |
|                                  | Resistance                      | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =20A                                                |          | 11   | 15   |      |
| V <sub>SD</sub> <sup>a</sup>     | Diode Forward Voltage           | I <sub>SD</sub> =35A, V <sub>GS</sub> =0V                                                  | 0.6      |      | 1.3  | V    |
| Dynamic <sup>b</sup>             |                                 |                                                                                            |          |      |      |      |
| Q <sub>g</sub>                   | Total Gate Charge               | V <sub>DS</sub> =15V, I <sub>DS</sub> =20A<br>V <sub>GS</sub> =4.5V,                       |          | 22   | 28   | nC   |
| Q <sub>gs</sub>                  | Gate-Source Charge              |                                                                                            |          | 12.8 |      |      |
| Q <sub>gd</sub>                  | Gate-Drain Charge               |                                                                                            |          | 5    |      |      |
| t <sub>d(ON)</sub>               | Turn-on Delay Time              | V <sub>DD</sub> =15V, I <sub>DS</sub> =1A,<br>V <sub>GEN</sub> =10V, R <sub>G</sub> = 0.2Ω |          | 10   | 15   | ns   |
| T <sub>r</sub>                   | Turn-on Rise Time               |                                                                                            |          | 7    | 13   |      |
| t <sub>d(OFF)</sub>              | Turn-off Delay Time             |                                                                                            |          | 35   | 50   |      |
| T <sub>f</sub>                   | Turn-off Fall Time              |                                                                                            |          | 10   | 20   |      |
| C <sub>iss</sub>                 | Input Capacitance               | V <sub>GS</sub> =0V                                                                        |          | 2400 |      | pF   |
| C <sub>oss</sub>                 | Output Capacitance              | V <sub>DS</sub> =15V                                                                       |          | 500  |      |      |
| C <sub>rss</sub>                 | Reverse Transfer Capacitance    | Frequency =1.0MHz                                                                          |          | 240  |      |      |

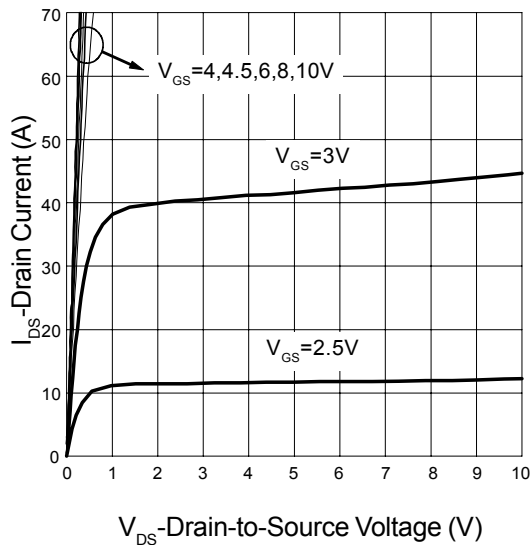
### Notes

<sup>a</sup> : Pulse test ; pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$

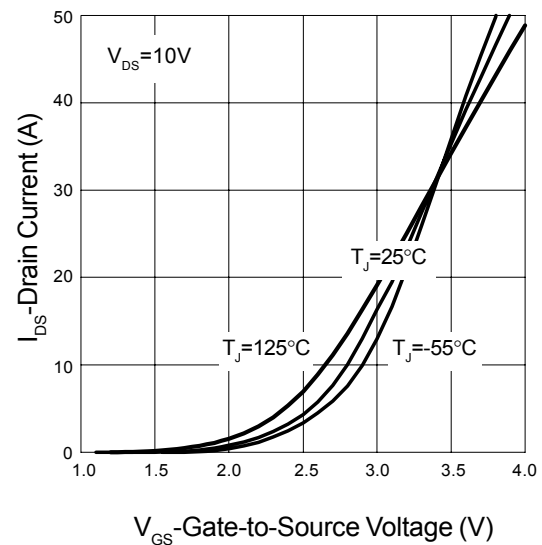
<sup>b</sup> : Guaranteed by design, not subject to production testing

## Typical Characteristics

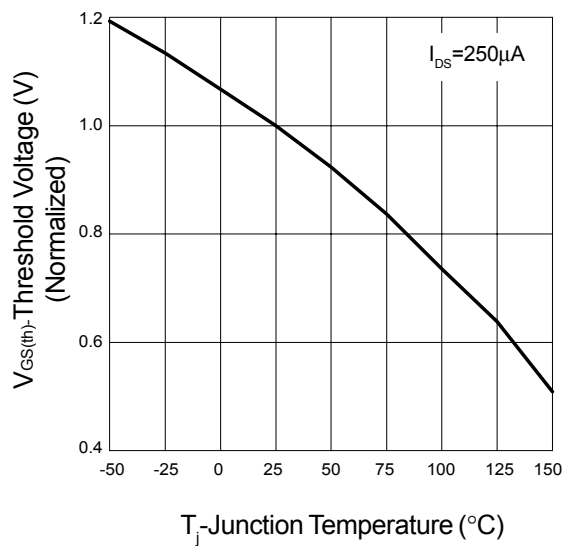
Output Characteristics



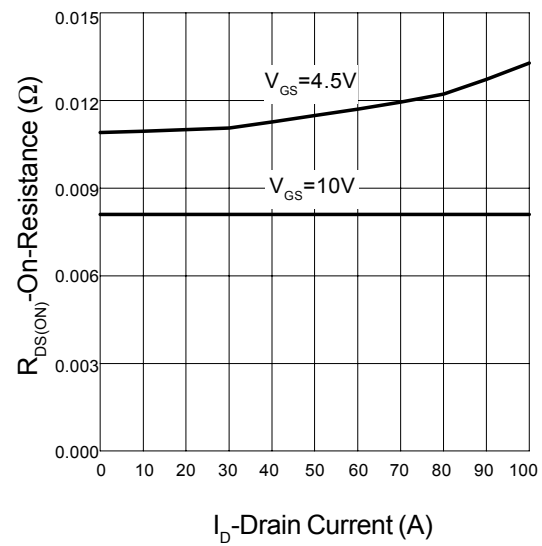
Transfer Characteristics



Threshold Voltage vs. Junction Temperature

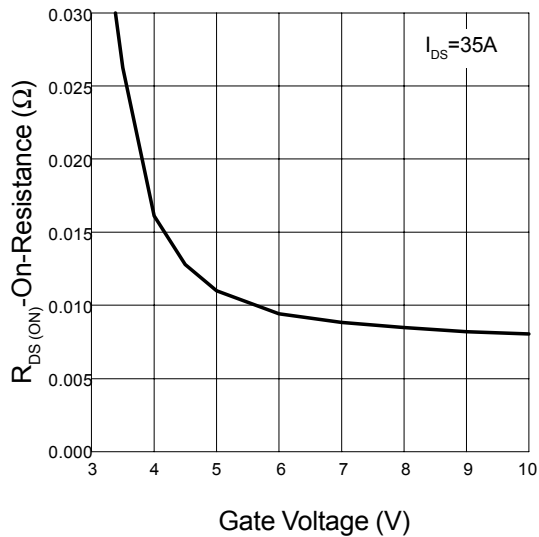


On-Resistance vs. Drain Current

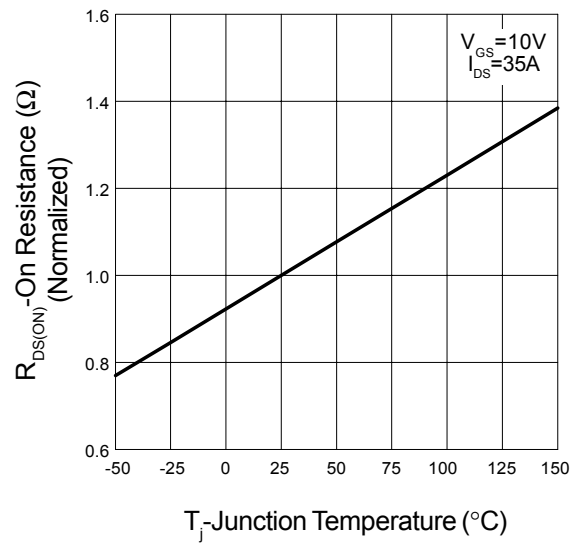


## Typical Characteristics Cont.

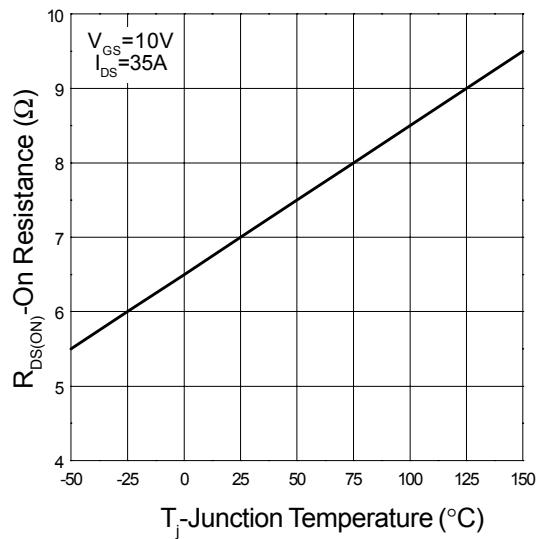
On-Resistance vs. Gate-to-Source Voltage



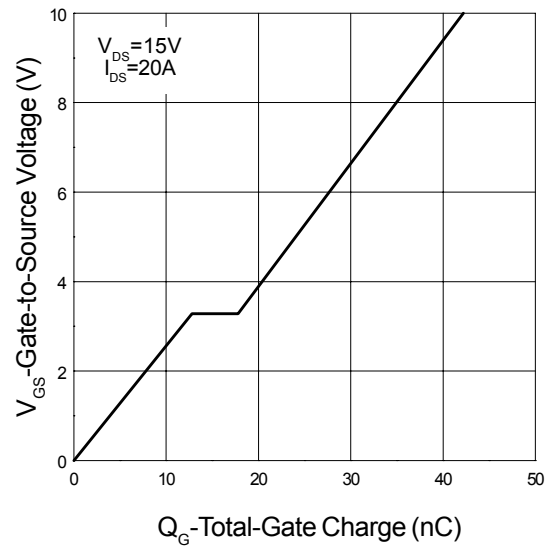
On-Resistance vs. Junction Temperature



On-Resistance vs. Junction Temperature

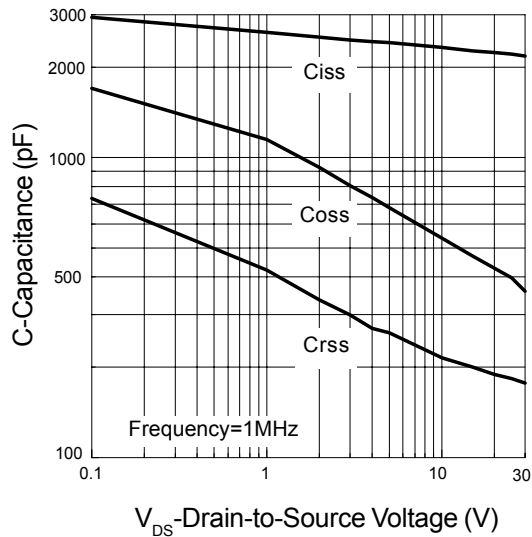


Gate Charge

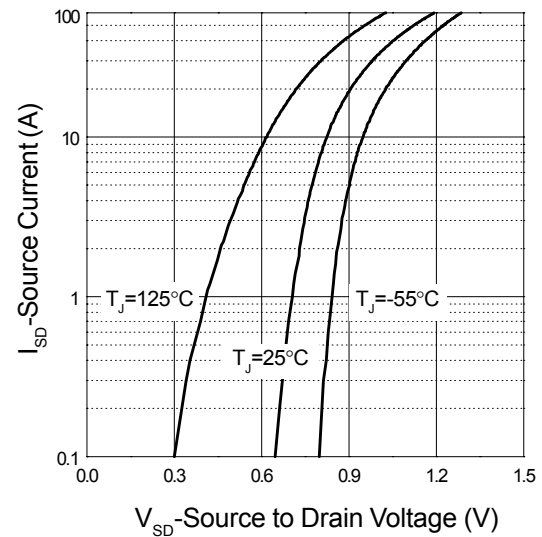


## Typical Characteristics Cont.

Capacitance Characteristics

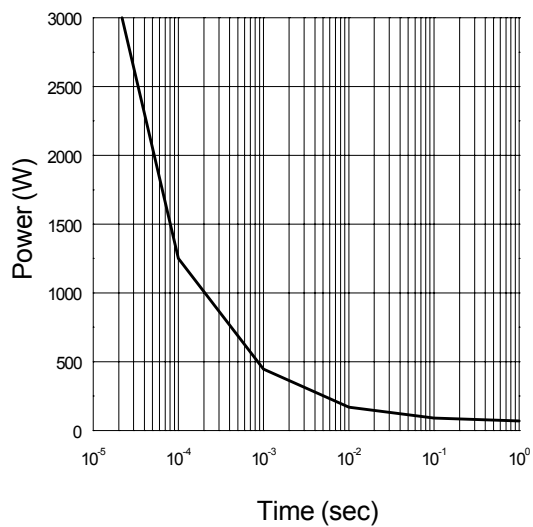


Source-Drain Diode Forward Voltage



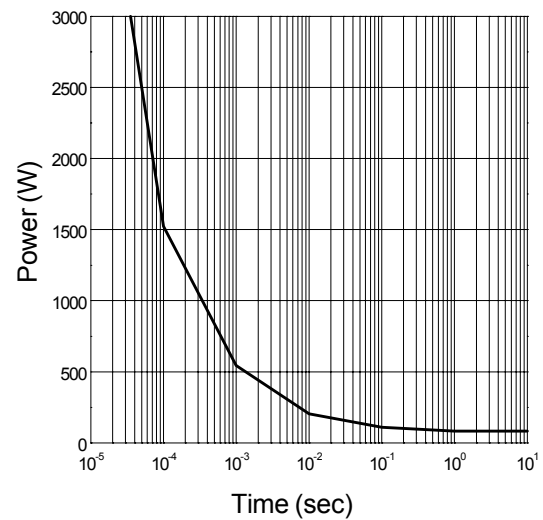
Single Pulse Power

TO-252

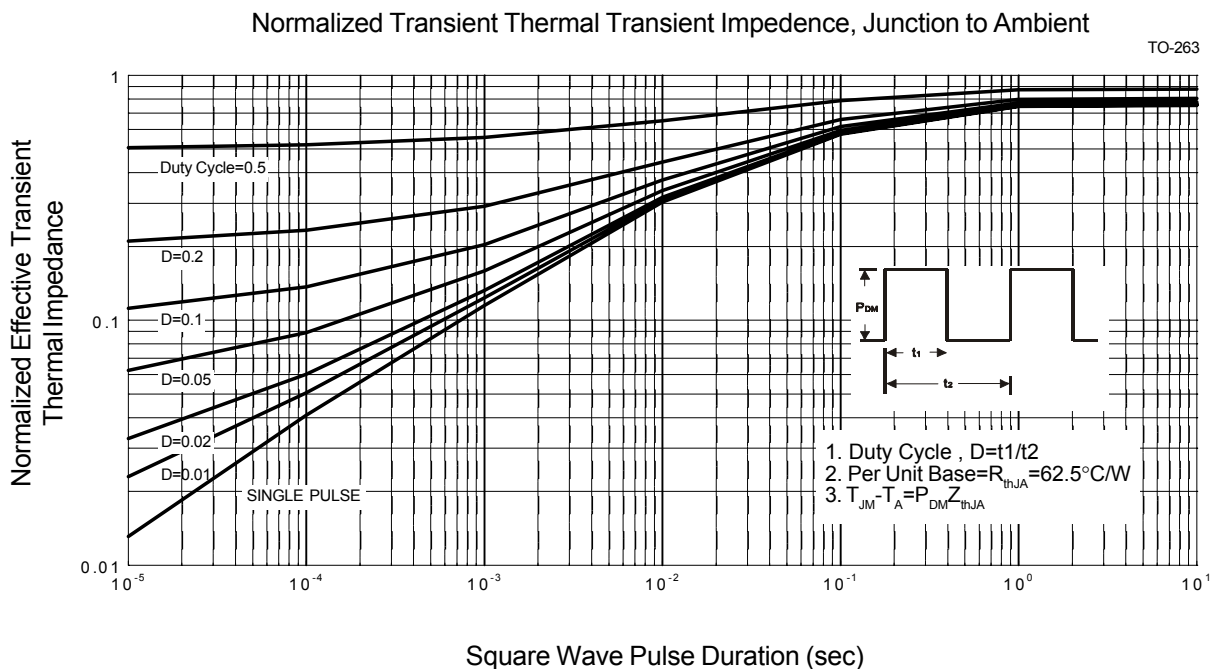
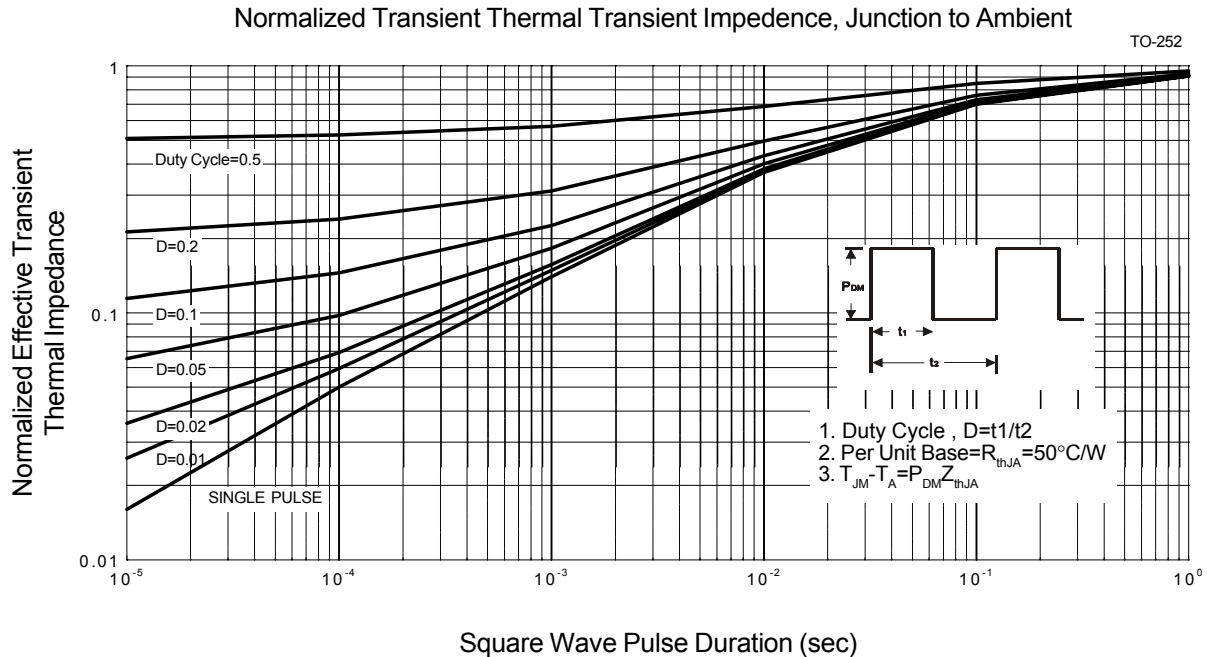


Single Pulse Power

TO-263

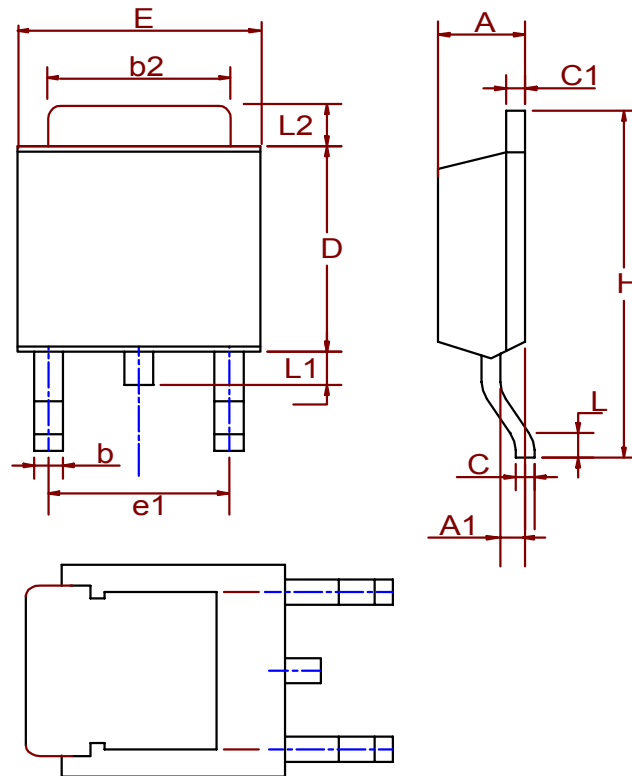


## Typical Characteristics Cont.



## Package Informaion

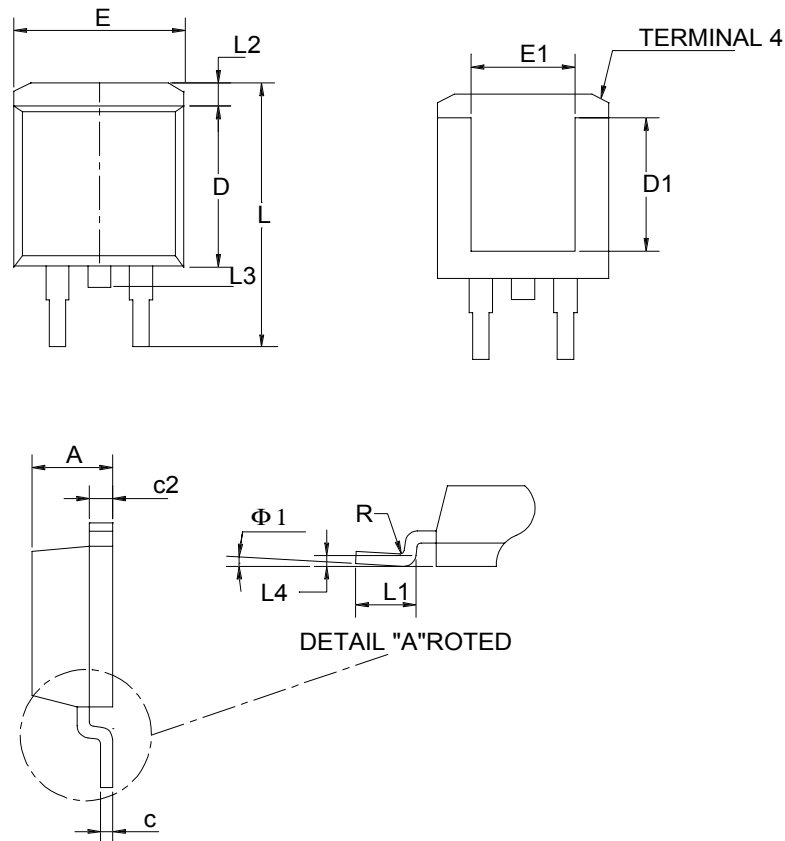
TO-252( Reference JEDEC Registration TO-252)



| 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 |
| E   | 6.35        | 6.73  | 0.250  | 0.265 |
| 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 |

## Packaging Information Cont.

TO-263 ( Reference JEDEC Registration TO-263)

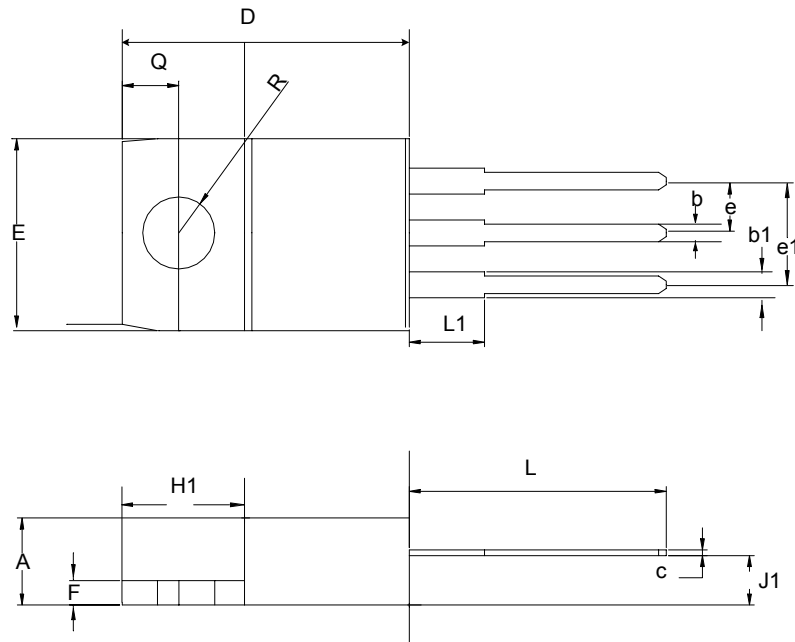


| Dim | Millimeters |       | Inches     |       |
|-----|-------------|-------|------------|-------|
|     | Min.        | Max.  | Min.       | Max.  |
| A   | 4.06        | 4.83  | 0.160      | 0.190 |
| b   | 0.51        | 1.016 | 0.02       | 0.040 |
| b2  | 1.14        | 1.651 | 0.045      | 0.065 |
| c   | 0.38 TYP.   |       | 0.015 TYP. |       |
| c2  | 1.14        | 1.40  | 0.045      | 0.055 |
| D   | 8.64        | 9.65  | 0.340      | 0.380 |
| E   | 9.65        | 10.54 | 0.380      | 0.415 |
| L   | 14.60       | 15.88 | 0.575      | 0.625 |
| L1  | 2.24        | 2.84  | 0.090      | 0.110 |
| L2  | 1.02        | 2.92  | 0.040      | 0.112 |
| L3  | 1.20        | 1.78  | 0.050      | 0.070 |



## Package Information Cont.

TO-220 ( Reference JEDEC Registration TO-220)



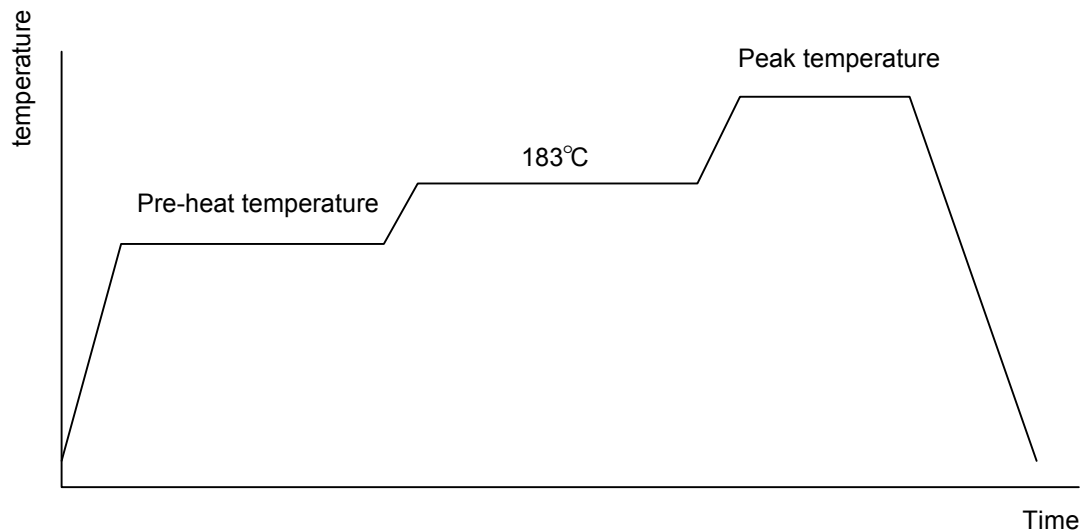
| Dim | Millimeters |       | Inches |       |
|-----|-------------|-------|--------|-------|
|     | Min.        | Max.  | Min.   | Max.  |
| A   | 3.56        | 4.83  | 0.140  | 0.190 |
| b1  | 1.14        | 1.78  | 0.045  | 0.070 |
| b   | 0.51        | 1.14  | 0.020  | 0.045 |
| c   | 0.31        | 1.14  | 0.012  | 0.045 |
| D   | 14.23       | 16.51 | 0.560  | 0.650 |
| e   | 2.29        | 2.79  | 0.090  | 0.110 |
| e1  | 4.83        | 5.33  | 0.190  | 0.210 |
| E   | 9.65        | 10.67 | 0.380  | 0.420 |
| F   | 0.51        | 1.40  | 0.020  | 0.055 |
| H1  | 5.84        | 6.86  | 0.230  | 0.270 |
| J1  | 2.03        | 2.92  | 0.080  | 0.115 |
| L   | 12.7        | 14.73 | 0.500  | 0.580 |
| L1  | 3.65        | 6.35  | 0.143  | 0.250 |
| R   | 3.53        | 4.09  | 0.139  | 0.161 |
| Q   | 2.54        | 3.43  | 0.100  | 0.135 |

## Physical Specifications

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

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

Reference JEDEC Standard J-STD-020A APRIL 1999



## Classification Reflow Profiles

|                                            | Convection or IR/<br>Convection | VPR                       |
|--------------------------------------------|---------------------------------|---------------------------|
| Average ramp-up rate(183°C to Peak)        | 3°C/second max.                 | 10°C /second max.         |
| Preheat temperature 125 ± 25°C)            | 120 seconds max.                |                           |
| Temperature maintained above 183°C         | 60 ~ 150 seconds                |                           |
| Time within 5°C of actual peak temperature | 10 ~ 20 seconds                 | 60 seconds                |
| Peak temperature range                     | 220 +5/-0°C or 235 +5/-0°C      | 215~ 219°C or 235 +5/-0°C |
| Ramp-down rate                             | 6°C /second max.                | 10°C /second max.         |
| Time 25°C to peak temperature              | 6 minutes max.                  |                           |

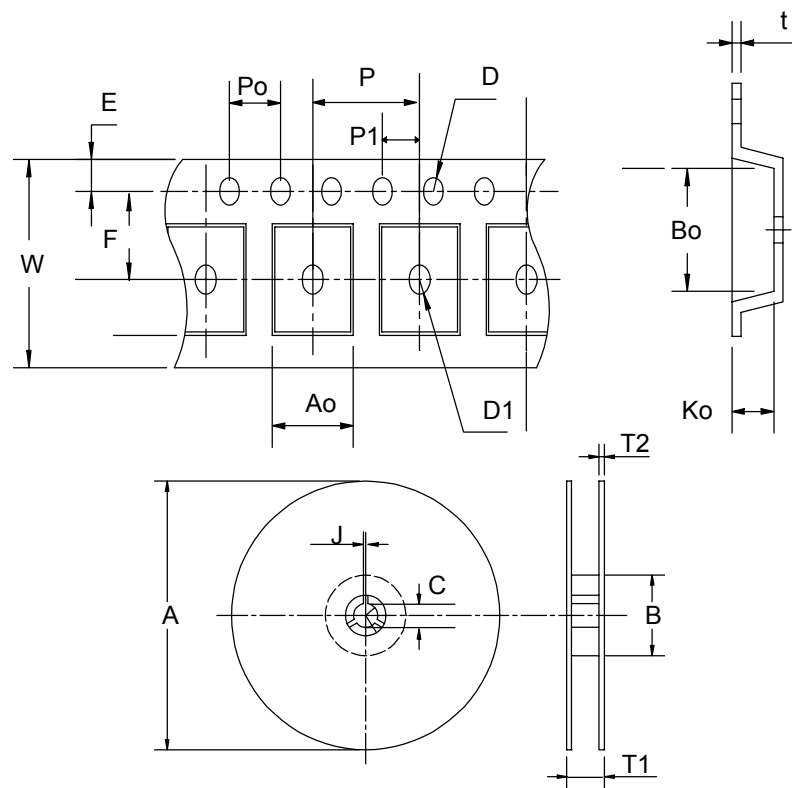
## Package Reflow Conditions

| pkg. thickness ≥ 2.5mm<br>and all bags | pkg. thickness < 2.5mm and<br>pkg. volume ≥ 350 mm | pkg. thickness < 2.5mm and pkg.<br>volume < |
|----------------------------------------|----------------------------------------------------|---------------------------------------------|
| 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 235 +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 Dimension



| 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>16 - 0.1 | 8 ± 0.1  | 1.75± 0.1  |
| Application | F          | D        | D1        | Po        | P1                | Ao         | Bo                   | Ko       | t          |
| TO-252      | 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   |
| Application | A          | B        | C         | J         | T1                | T2         | W                    | P        | E          |
| TO-263      | 380±3      | 80 ± 2   | 13 ± 0.5  | 2 ± 0.5   | 24 ± 4            | 2± 0.3     | 24 + 0.3<br>- 0.1    | 16 ± 0.1 | 1.75± 0.1  |
| Application | F          | D        | D1        | Po        | P1                | Ao         | Bo                   | Ko       | t          |
| TO-263      | 11.5 ± 0.1 | 1.5 +0.1 | 1.5± 0.25 | 4.0 ± 0.1 | 2.0 ± 0.1         | 10.8 ± 0.1 | 16.1± 0.1            | 5.2± 0.1 | 0.35±0.013 |

(mm)

## Cover Tape Dimensions

| Application | Carrier Width | Cover Tape Width | Devices Per Reel |
|-------------|---------------|------------------|------------------|
| TO- 252     | 16            | 13.3             | 2500             |
| TO- 263     | 24            | 21.3             | 1000             |

## Customer Service

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