

# A N P E C

## MOSFET TRANSISTORS

### N+P-CHANNEL MOSFET

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## Dual Enhancement Mode MOSFET (N- and P-Channel)

### Features

- N-Channel  
20V/3A,  
 $R_{DS(ON)} = 50m\Omega(\text{typ.}) @ V_{GS} = 4.5V$   
 $R_{DS(ON)} = 90m\Omega(\text{typ.}) @ V_{GS} = 2.5V$
- P-Channel  
-20V/-1.5A,  
 $R_{DS(ON)} = 145m\Omega(\text{typ.}) @ V_{GS} = -4.5V$   
 $R_{DS(ON)} = 180m\Omega(\text{typ.}) @ V_{GS} = -2.5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

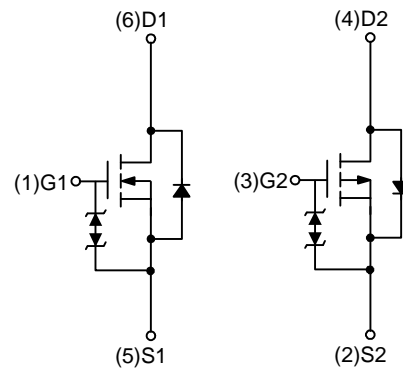
### Applications

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

### Pin Description



Top View of JSOT-6



N-Channel MOSFET

P-Channel MOSFET

### Ordering and Marking Information

|  |   |
|--|---|
| <p>APM2701 <span style="font-family: monospace;">□□□-□□□</span></p> <div style="margin-left: 40px;"> <p>└─ Assembly Material</p> <p>└─ Handling Code</p> <p>└─ Temperature Range</p> <p>└─ Package Code</p> </div> | <p>Package Code<br/>CG : JSOT-6</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/>G : Halogen and Lead Free Device</p> |
| <p>APM2701 CG : <span style="border: 1px solid black; padding: 2px;">M2701<br/>XXXXX</span></p>  | <p>XXXXX - 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                      |
|-------------------|--|-------------------------|-----------|---------------------------|
|                   |  | N Channel               | P Channel |                           |
| $V_{DSS}$         | Drain-Source Voltage                   | 20                      | -20       | V                         |
| $V_{GSS}$         | Gate-Source Voltage                    | $\pm 10$                | $\pm 10$  |                           |
| $I_D^*$           | Continuous Drain Current               | 3                       | -1.5      | A                         |
| $I_{DM}^*$        | 300 $\mu\text{s}$ Pulsed Drain Current |                         |           |                           |
| $I_S^*$           | Diode Continuous Forward Current       | 1                       | -1        | A                         |
| $T_J$             | Maximum Junction Temperature           | 150                     |           | $^\circ\text{C}$          |
| $T_{STG}$         | Storage Temperature Range              | -55 to 150              |           |                           |
| $P_D^*$           | Power Dissipation                      | $T_A=25^\circ\text{C}$  | 0.83      | W                         |
|                   |  | $T_A=100^\circ\text{C}$ | 0.3       |                           |
| $R_{\theta JA}^*$ | Thermal Resistance-Junction to Ambient | 150                     |           | $^\circ\text{C}/\text{W}$ |

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  | APM2701CG |       |      | Unit     |               |
|-------------------------------|----------------------------------|--|-----------|-------|------|----------|---------------|
|                               |                                  |  | Min.      | Typ.  | Max. |          |               |
| <b>Static Characteristics</b> |                                  |  |           |       |      |          |               |
| $BV_{DSS}$                    | Drain-Source Breakdown Voltage   | $V_{GS}=0\text{V}, I_{DS}=250\mu\text{A}$                        | N-Ch      | 20    | -    | -        | V             |
|                               |                                  | $V_{GS}=0\text{V}, I_{DS}=-250\mu\text{A}$                       | P-Ch      | -20   | -    | -        |               |
| $I_{DSS}$                     | Zero Gate Voltage Drain Current  | $V_{DS}=16\text{V}, V_{GS}=0\text{V}$<br>$T_J=85^\circ\text{C}$  | N-Ch      | -     | -    | 1        | $\mu\text{A}$ |
|                               |                                  |  | P-Ch      | -     | -    | 30       |               |
|                               |                                  | $V_{DS}=-16\text{V}, V_{GS}=0\text{V}$<br>$T_J=85^\circ\text{C}$ | N-Ch      | -     | -    | -1       |               |
|                               |                                  |  | P-Ch      | -     | -    | -30      |               |
| $V_{GS(th)}$                  | Gate Threshold Voltage           | $V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$                           | N-Ch      | 0.45  | 0.6  | 1        | V             |
|                               |                                  | $V_{DS}=V_{GS}, I_{DS}=-250\mu\text{A}$                          | P-Ch      | -0.45 | -0.6 | -1       |               |
| $I_{GSS}$                     | Gate Leakage Current             | $V_{GS}=\pm 10\text{V}, V_{DS}=0\text{V}$                        | N-Ch      | -     | -    | $\pm 10$ | $\mu\text{A}$ |
|                               |                                  |  | P-Ch      | -     | -    | $\pm 10$ |               |
| $R_{DS(ON)}^a$                | Drain-Source On-State Resistance | $V_{GS}=4.5\text{V}, I_{DS}=3\text{A}$                           | N-Ch      | -     | 50   | 70       | m $\Omega$    |
|                               |                                  | $V_{GS}=-4.5\text{V}, I_{DS}=-1.5\text{A}$                       | P-Ch      | -     | 145  | 190      |               |
|                               |                                  | $V_{GS}=2.5\text{V}, I_{DS}=1.7\text{A}$                         | N-Ch      | -     | 90   | 110      |               |
|                               |                                  | $V_{GS}=-2.5\text{V}, I_{DS}=-1\text{A}$                         | P-Ch      | -     | 180  | 235      |               |

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

| Symbol  | Parameter                    | Test Conditions  | APM2701CG   |      |      | Unit |     |    |
|---|------------------------------|--|---|------|------|------|-----|----|
|   |                              |  | Min.  | Typ. | Max. |      |     |    |
| <b>Static Characteristics (Cont.)</b>           |                              |  |   |      |      |      |     |    |
| $V_{SD}^a$                                      | Diode Forward Voltage        | $I_{SD}=0.5\text{A}, V_{GS}=0\text{V}$   | N-Ch  | -    | 0.7  | 1.3  | V   |    |
|   |                              | $I_{SD}=-0.5\text{A}, V_{GS}=0\text{V}$  | P-Ch  | -    | -0.7 | -1.3 |     |    |
| <b>Dynamic Characteristics <sup>b</sup></b>     |                              |  |   |      |      |      |     |    |
| $C_{iss}$                                       | Input Capacitance            | N-Channel<br>$V_{GS}=0\text{V},$<br>$V_{DS}=10\text{V},$<br>Frequency=1.0MHz                                 | N-Ch  | -    | 270  | -    | pF  |    |
|   |                              |  | P-Ch  | -    | 300  | -    |     |    |
| $C_{oss}$                                       | Output Capacitance           |  | N-Ch  | -    | 70   | -    |     |    |
|   |                              |  | P-Ch  | -    | 50   | -    |     |    |
| $C_{rss}$                                       | Reverse Transfer Capacitance |  | P-Channel<br>$V_{GS}=0\text{V},$<br>$V_{DS}=-10\text{V},$<br>Frequency=1.0MHz                                   | N-Ch | -    | 50   |     | -  |
|   |                              |  |   | P-Ch | -    | 30   |     | -  |
| $t_{d(ON)}$                                     | Turn-on Delay Time           | N-Channel<br>$V_{DD}=10\text{V}, R_L=10\Omega,$<br>$I_{DS}=1\text{A}, V_{GEN}=4.5\text{V},$<br>$R_G=6\Omega$ |   | N-Ch | -    | 6    | 12  | ns |
|   |                              |  |   | P-Ch | -    | 6    | 10  |    |
| $T_r$   | Turn-on Rise Time            |  |   | N-Ch | -    | 5    | 10  |    |
|   |                              |  |   | P-Ch | -    | 8    | 12  |    |
| $t_{d(OFF)}$                                    | Turn-off Delay Time          |  | P-Channel<br>$V_{DD}=-10\text{V}, R_L=10\Omega,$<br>$I_{DS}=-1\text{A}, V_{GEN}=-4.5\text{V},$<br>$R_G=6\Omega$ | N-Ch | -    | 12   | 23  |    |
|   |                              |  |   | P-Ch | -    | 10   | 15  |    |
| $T_f$   | Turn-off Fall Time           | N-Ch   |   | -    | 6    | 12   |     |    |
|   |                              | P-Ch   |   | -    | 5    | 10   |     |    |
| <b>Gate Charge Characteristics <sup>b</sup></b> |                              |  |   |      |      |      |     |    |
| $Q_g$   | Total Gate Charge            | N-Channel<br>$V_{DS}=10\text{V}, V_{GS}=4.5\text{V},$<br>$I_{DS}=3\text{A}$                                  |   | N-Ch | -    | 5    | 6.5 | nC |
|   |                              |  | P-Ch  | -    | 4    | 6    |     |    |
| $Q_{gs}$  | Gate-Source Charge           |  | P-Channel<br>$V_{DS}=-10\text{V}, V_{GS}=-4.5\text{V},$<br>$I_{DS}=-1.5\text{A}$                                | N-Ch | -    | 0.5  | -   |    |
|   |                              |  |   | P-Ch | -    | 0.6  | -   |    |
| $Q_{gd}$  | Gate-Drain Charge            |  |   | N-Ch | -    | 1.6  | -   |    |
|   |                              |  |   | P-Ch | -    | 1    | -   |    |

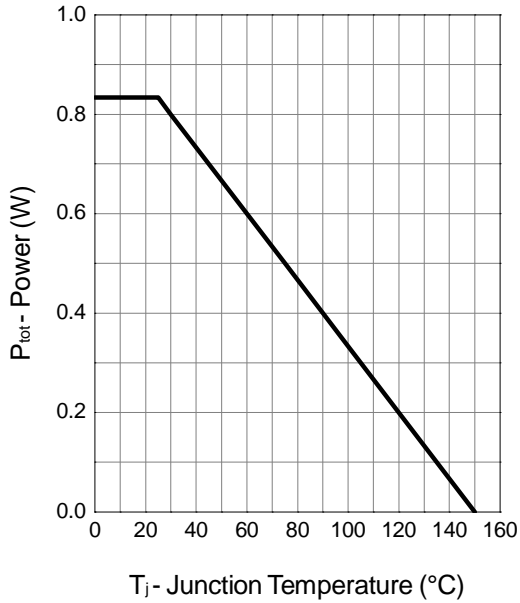
Note a : Pulse test ; pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .

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

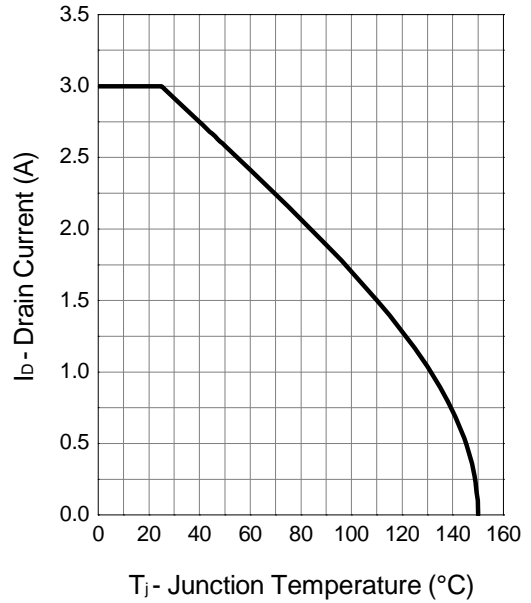
## Typical Operating Characteristics

### N-Channel

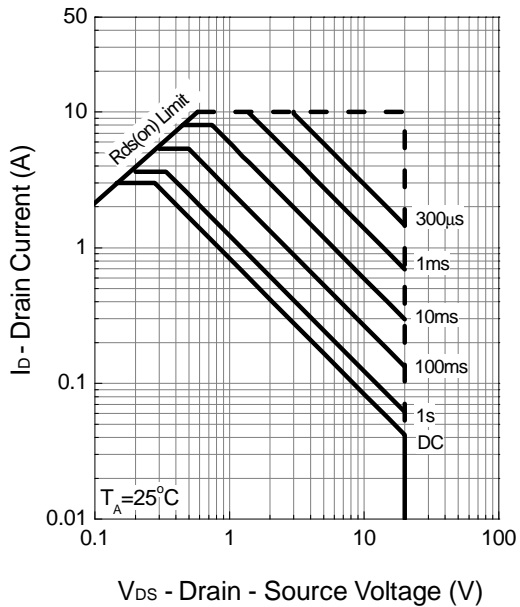
Power Dissipation



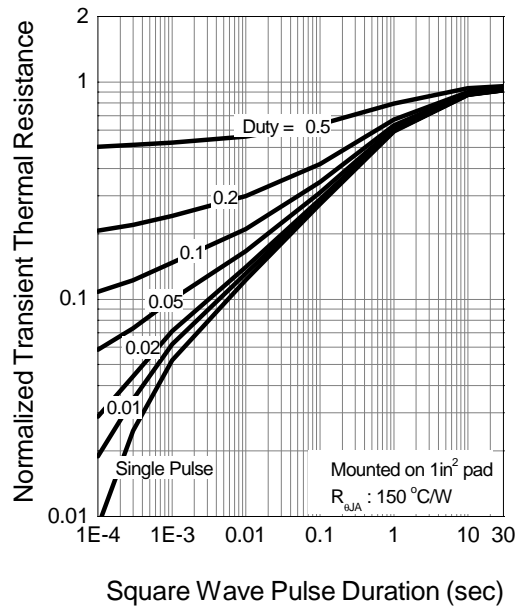
Drain Current



Safe Operation Area



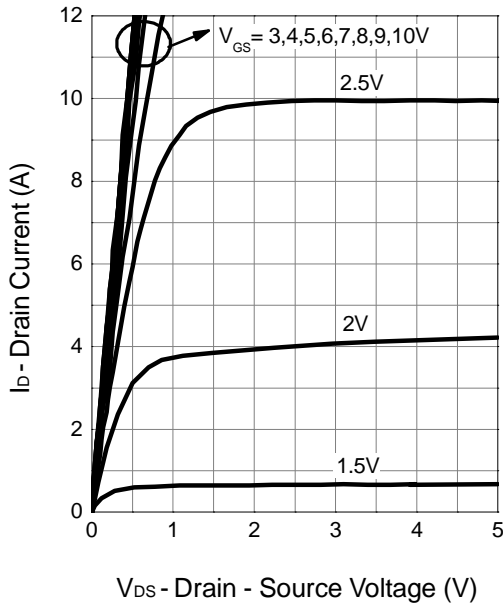
Thermal Transient Impedance



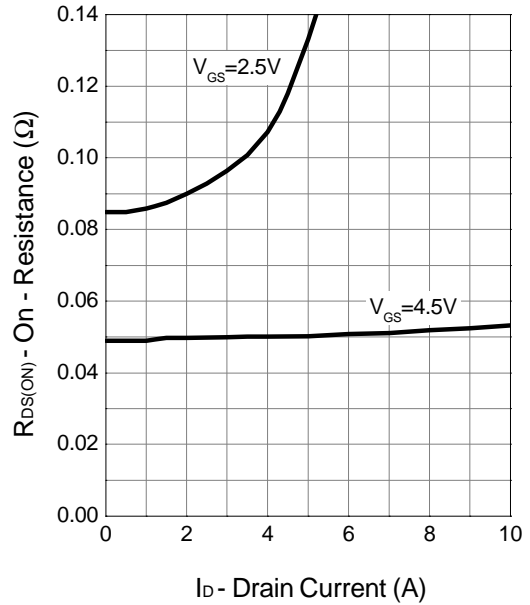
Typical Operating Characteristics (Cont.)

N-Channel

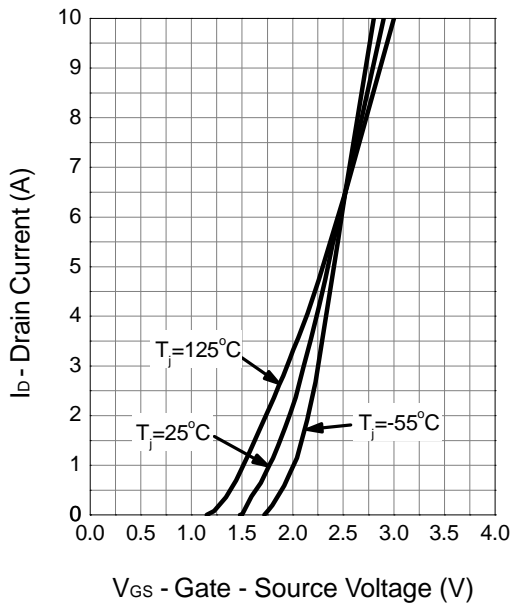
Output Characteristics



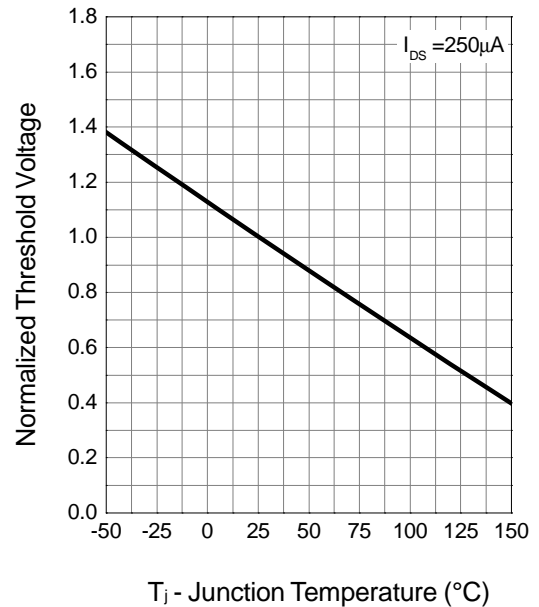
Drain-Source On Resistance



Transfer Characteristics



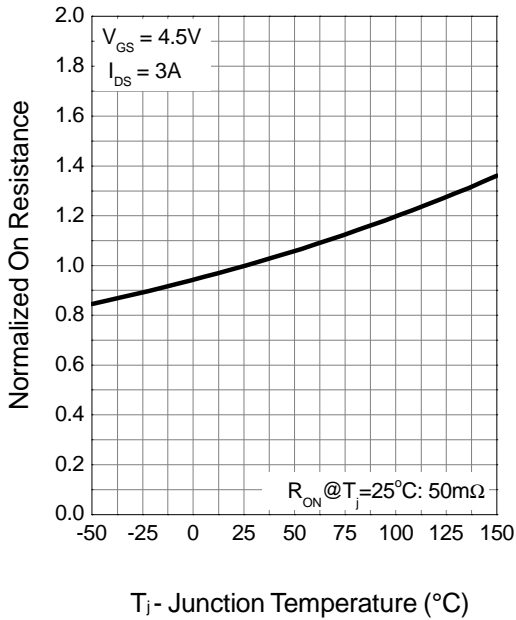
Gate Threshold Voltage



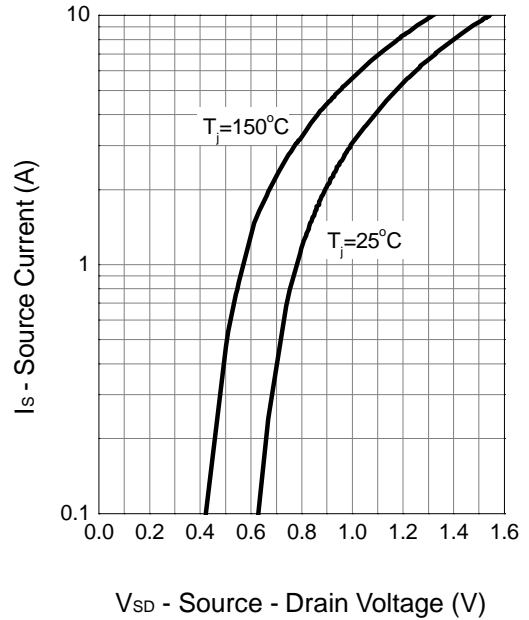
Typical Operating Characteristics (Cont.)

N-Channel

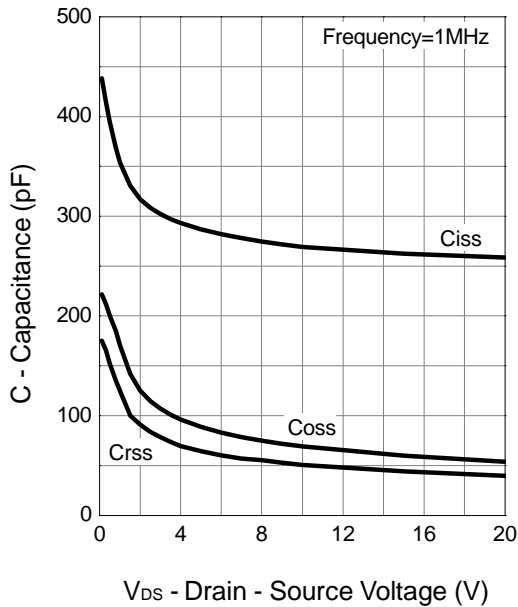
Drain-Source On Resistance



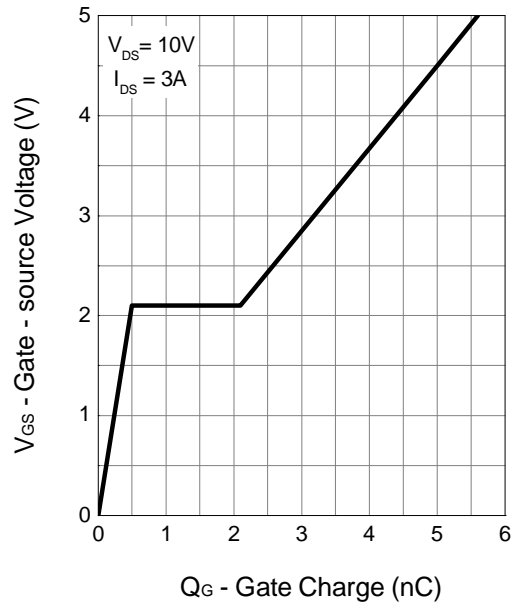
Source-Drain Diode Forward



Capacitance



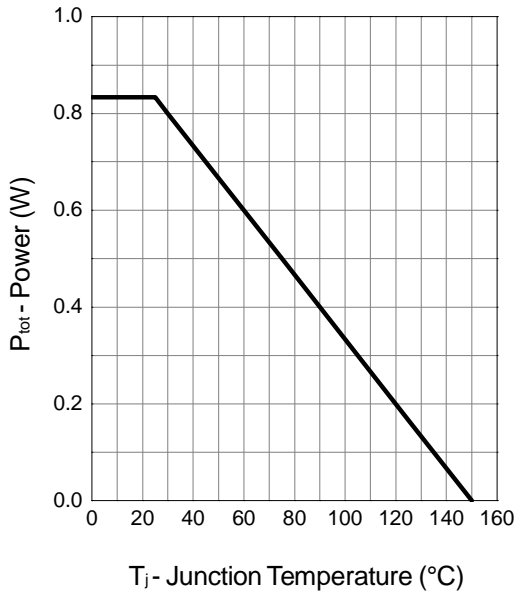
Gate Charge



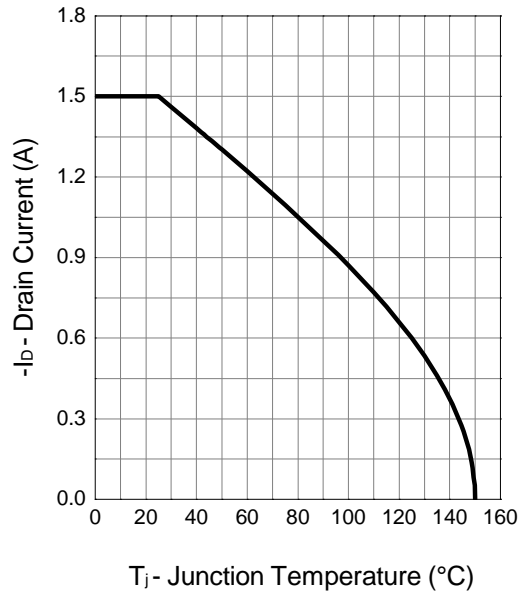
Typical Operating Characteristics (Cont.)

P-Channel

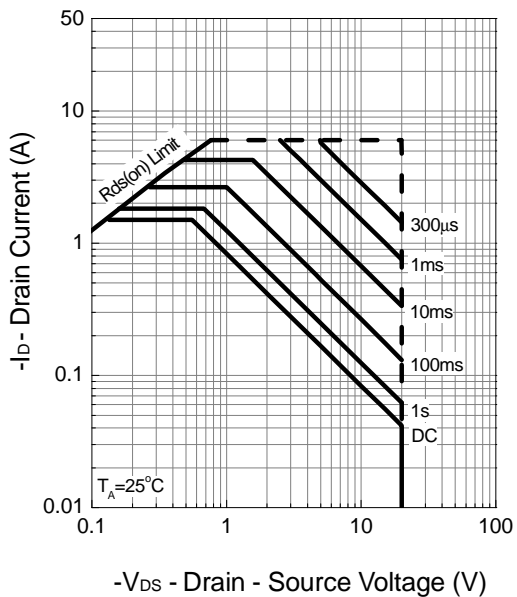
Power Dissipation



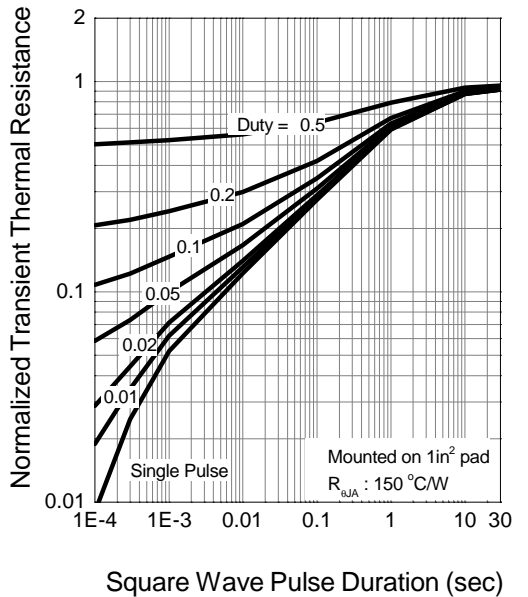
Drain Current



Safe Operation Area



Thermal Transient Impedance

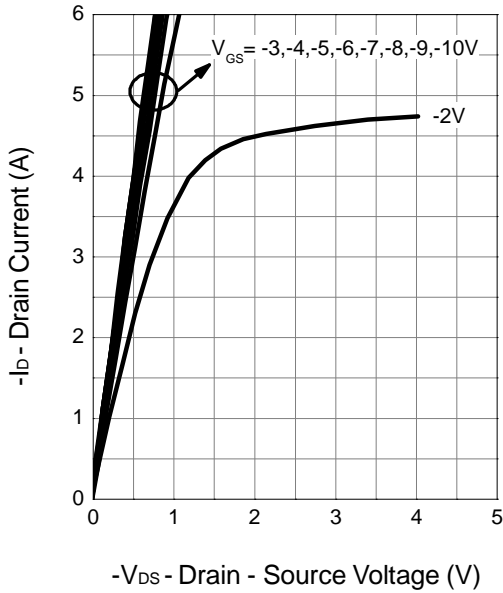




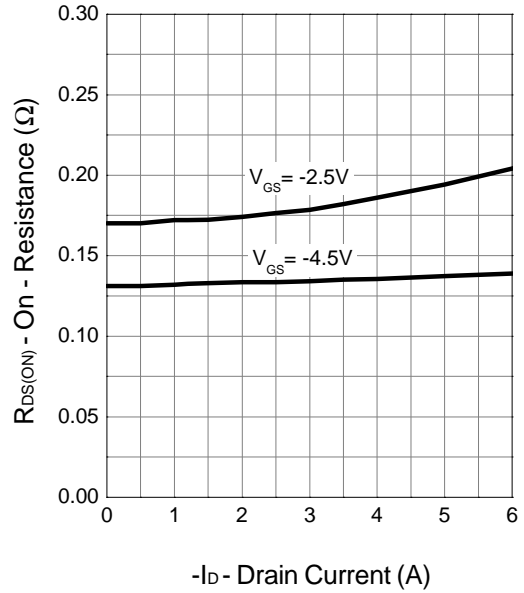
## Typical Operating Characteristics (Cont.)

### P-Channel

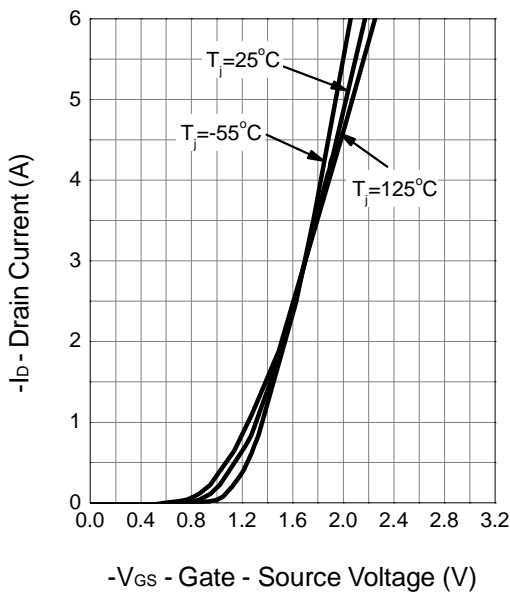
Output Characteristics



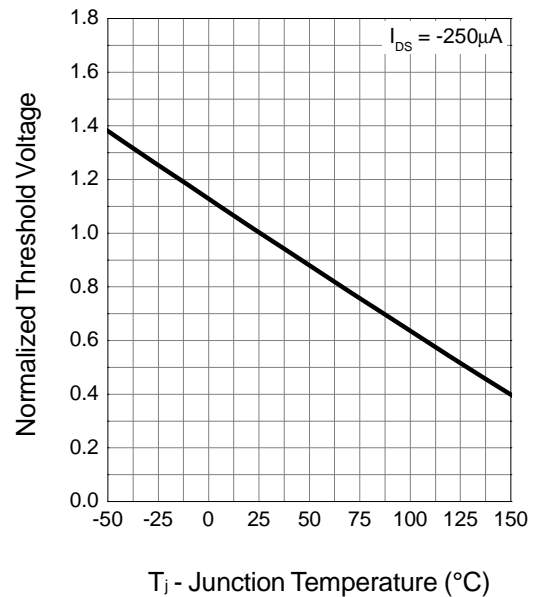
Drain-Source On Resistance



Transfer Characteristics



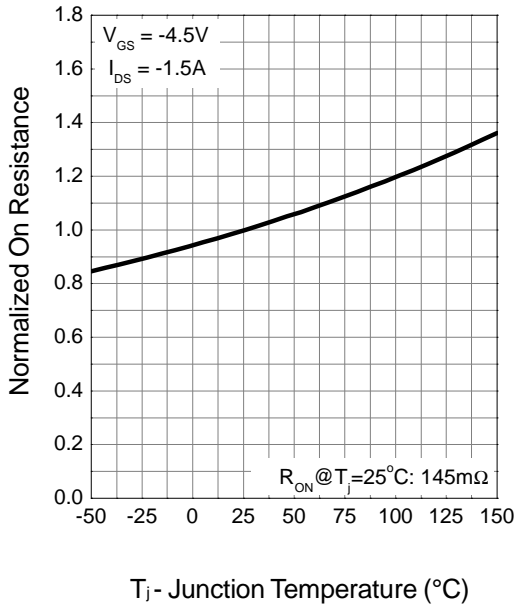
Gate Threshold Voltage



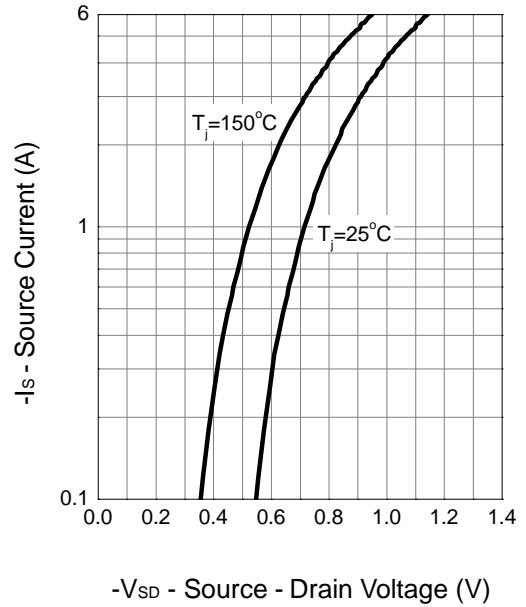
Typical Operating Characteristics (Cont.)

P-Channel

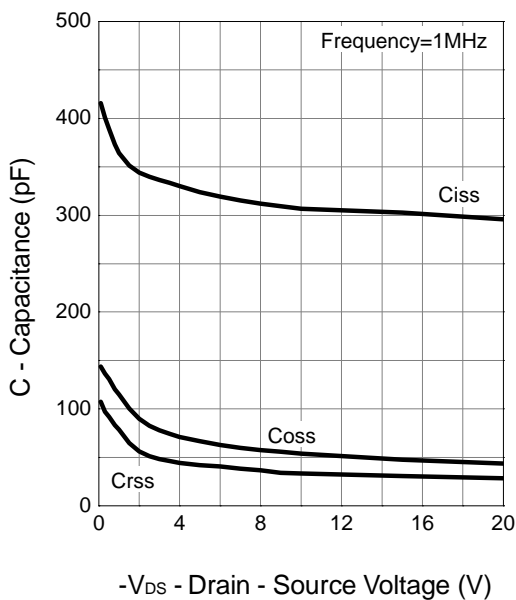
Drain-Source On Resistance



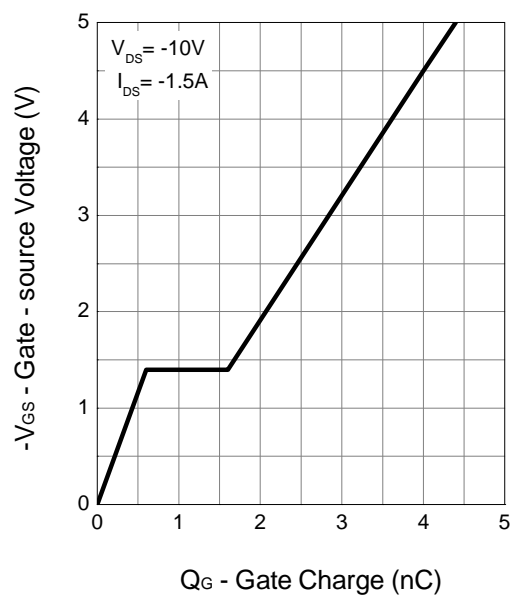
Source-Drain Diode Forward



Capacitance

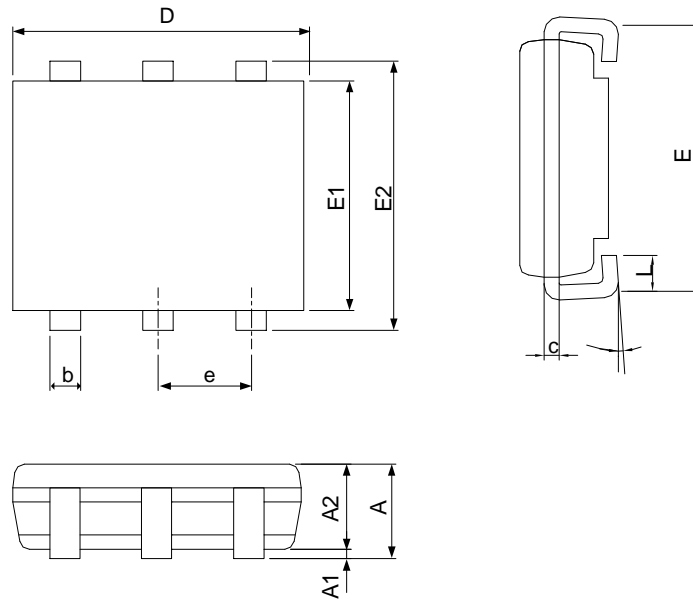


Gate Charge



Package Information

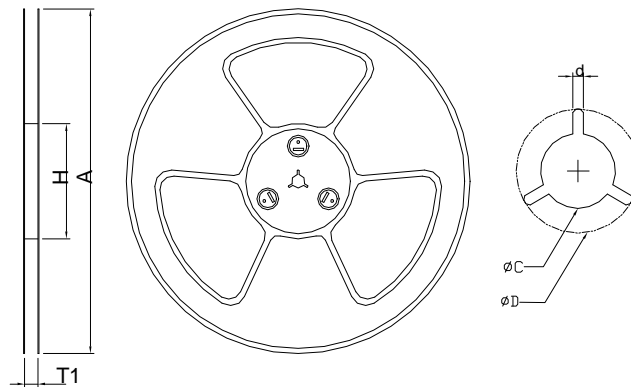
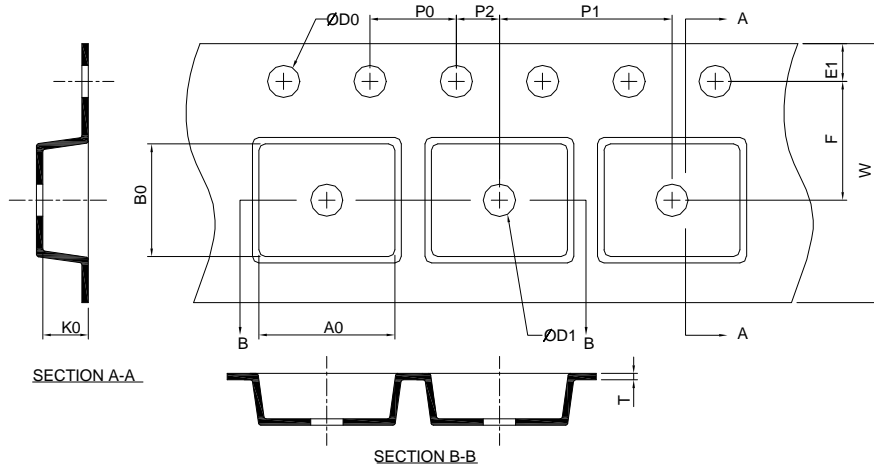
JSOT-6



| DIMENSIONS | JSOT-6      |      |           |       |
|------------|-------------|------|-----------|-------|
|            | MILLIMETERS |      | INCHES    |       |
|            | MIN.        | MAX. | MIN.      | MAX.  |
| A          | 0.93        | 1.10 | 0.037     | 0.043 |
| A1         | 0.01        | 0.10 | 0.000     | 0.004 |
| A2         | 0.92        | 1.00 | 0.036     | 0.039 |
| b          | 0.25        | 0.40 | 0.010     | 0.016 |
| c          | 0.10        | 0.20 | 0.004     | 0.008 |
| D          | 2.95        | 3.10 | 0.116     | 0.122 |
| E          | 2.50        | 3.00 | 0.098     | 0.118 |
| E1         | 2.30        | 2.50 | 0.091     | 0.098 |
| E2         | 2.65        | 3.05 | 0.104     | 0.120 |
| e          | 0.95 BSC    |      | 0.037 BSC |       |
| θ          | 0°          | 8°   | 0°        | 8°    |
| L          | 0.30        | 0.60 | 0.012     | 0.024 |

Note : 1. Follow GEM 2928 6J.  
 2. Dimension D, D1, and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 10 mil.

### Carrier Tape & Reel Dimensions



| Application | A           | H         | T1                | C                  | d        | D                 | W          | E1         | F          |
|-------------|-------------|-----------|-------------------|--------------------|----------|-------------------|------------|------------|------------|
| JSOT-6      | 178.0 ±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 ±0.30  | 1.75 ±0.10 | 3.5 ±0.05  |
|             | P0          | P1        | P2                | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 4.0 ±0.10 | 2.0 ±0.05         | 1.5+0.10<br>-0.00  | 1.0 MIN. | 0.6+0.00<br>-0.40 | 3.20 ±0.20 | 3.10 ±0.20 | 1.50 ±0.20 |

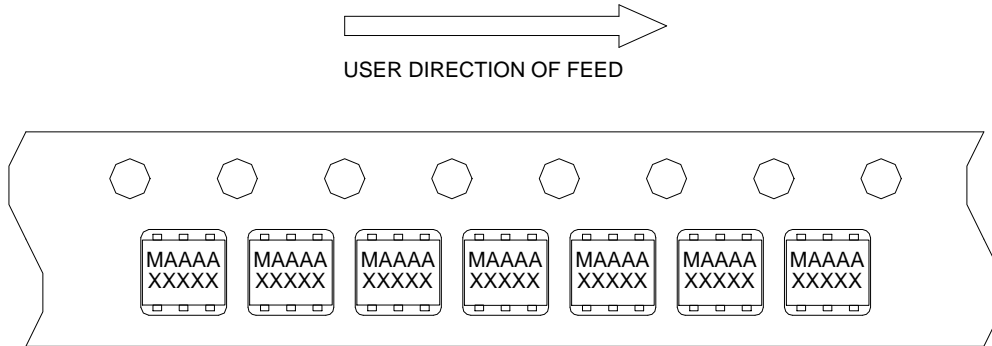
(mm)

### Devices Per Unit

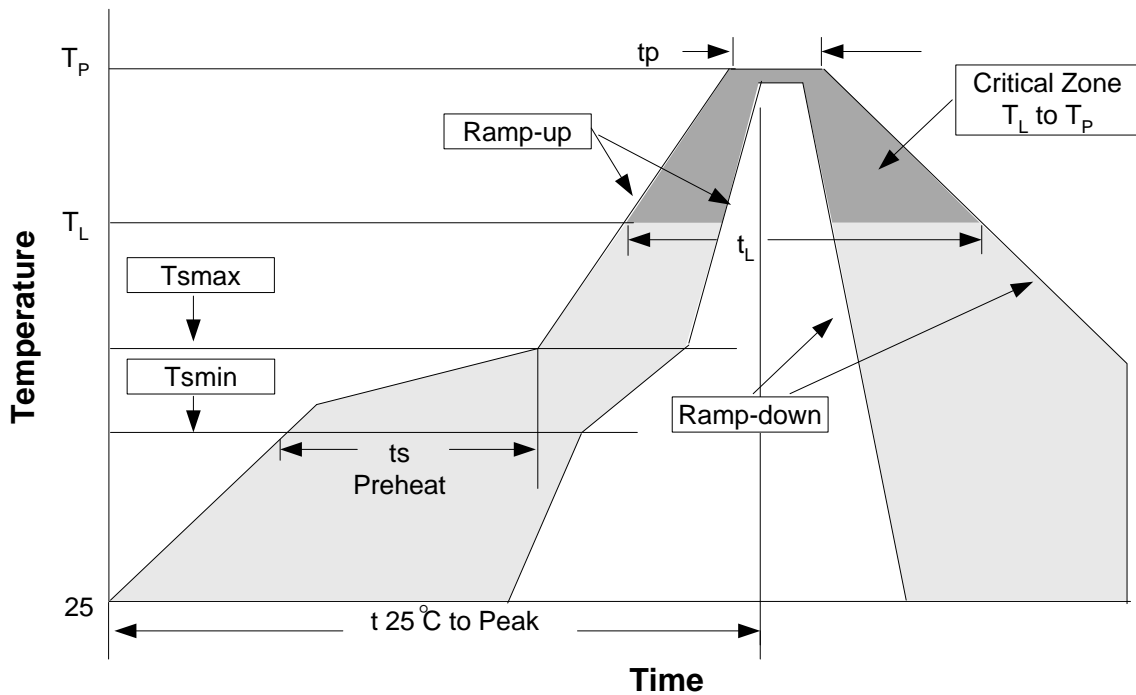
| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| JSOT-6       | Tape & Reel | 3000     |

## Taping Direction Information

JSOT-6



## 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>smin</sub> )<br>- Temperature Max (T <sub>smax</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.

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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Tel : 886-2-2910-3838

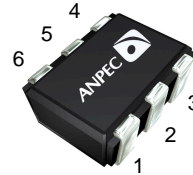
Fax : 886-2-2917-3838

## Dual Enhancement Mode MOSFET (N- and P-Channel)

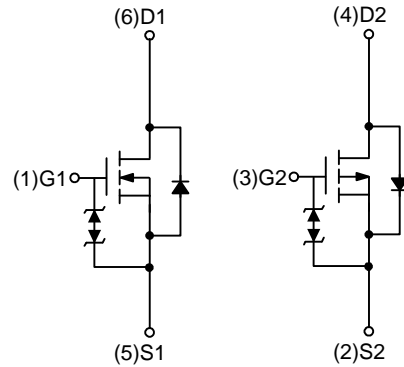
### Features

- N-Channel  
20V/4A,  
 $R_{DS(ON)} = 30m\Omega$  (typ.) @  $V_{GS} = 4.5V$   
 $R_{DS(ON)} = 40m\Omega$  (typ.) @  $V_{GS} = 2.5V$   
 $R_{DS(ON)} = 67m\Omega$  (typ.) @  $V_{GS} = 1.8V$
- P-Channel  
-20V/-3A,  
 $R_{DS(ON)} = 56m\Omega$  (typ.) @  $V_{GS} = -4.5V$   
 $R_{DS(ON)} = 85m\Omega$  (typ.) @  $V_{GS} = -2.5V$   
 $R_{DS(ON)} = 135m\Omega$  (typ.) @  $V_{GS} = -1.8V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

### Pin Description



Top View of JSOT-6



N-Channel MOSFET

P-Channel MOSFET

### Applications

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

### Ordering and Marking Information

|   |   |
|---|---|
| <p>APM2704 <span style="font-family: monospace;">□□□-□□□</span></p> <p style="margin-left: 20px;"> <span style="font-family: monospace;">□□□</span> — Assembly Material<br/> <span style="font-family: monospace;">□□</span> — Handling Code<br/> <span style="font-family: monospace;">□□</span> — Temperature Range<br/> <span style="font-family: monospace;">□</span> — Package Code         </p> | <p>Package Code<br/>CG : JSOT-6</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/>G : Halogen and Lead Free Device</p> |
| <p>APM2704 CG : <span style="border: 1px solid black; padding: 2px 5px; font-family: monospace;">M2704<br/>XXXXX</span></p>   | <p style="text-align: right;">XXXXX - 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               |
|-------------------|--|---|------------|-----------|--------------------|
|                   |  |   | N Channel  | P Channel |                    |
| $V_{DSS}$         | Drain-Source Voltage                   |   | 20         | -20       | V                  |
| $V_{GSS}$         | Gate-Source Voltage                    |   | $\pm 10$   | $\pm 10$  |                    |
| $I_D^*$           | Continuous Drain Current               | $V_{GS}=4.5\text{V (N)}$<br>$V_{GS}=-4.5\text{V (P)}$ | 4          | -3        | A                  |
| $I_{DM}^*$        | Pulsed Drain Current                   |   | 15         | -10       |                    |
| $I_S^*$           | Diode Continuous Forward Current       |   | 1          | -0.6      | A                  |
| $T_J$             | Maximum Junction Temperature           |   | 150        |           | $^\circ\text{C}$   |
| $T_{STG}$         | Storage Temperature Range              |   | -55 to 150 |           |                    |
| $P_D^*$           | Power Dissipation                      | $T_A=25^\circ\text{C}$                                | 1          |           | W                  |
|                   |  | $T_A=100^\circ\text{C}$                               | 0.4        |           |                    |
| $R_{\theta JA}^*$ | Thermal Resistance-Junction to Ambient |   | 125        |           | $^\circ\text{C/W}$ |

Note : \*Surface Mounted on 1in<sup>2</sup> pad area, t ≤ 10sec.

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

| Symbol                        | Parameter                       | Test Conditions  | APM2704CG |      |       | Unit     |               |
|-------------------------------|---------------------------------|--|-----------|------|-------|----------|---------------|
|                               |                                 |  | Min.      | Typ. | Max.  |          |               |
| <b>Static Characteristics</b> |                                 |  |           |      |       |          |               |
| $BV_{DSS}$                    | Drain-Source Breakdown Voltage  | $V_{GS}=0\text{V}, I_{DS}=250\mu\text{A}$                        | N-Ch      | 20   | -     | -        | V             |
|                               |                                 | $V_{GS}=0\text{V}, I_{DS}=-250\mu\text{A}$                       | P-Ch      | -20  | -     | -        |               |
| $I_{DSS}$                     | Zero Gate Voltage Drain Current | $V_{DS}=16\text{V}, V_{GS}=0\text{V}$<br>$T_J=85^\circ\text{C}$  | N-Ch      | -    | -     | 1        | $\mu\text{A}$ |
|                               |                                 |  | P-Ch      | -    | -     | 30       |               |
|                               |                                 | $V_{DS}=-16\text{V}, V_{GS}=0\text{V}$<br>$T_J=85^\circ\text{C}$ | N-Ch      | -    | -     | -1       |               |
|                               |                                 |  | P-Ch      | -    | -     | -30      |               |
| $V_{GS(th)}$                  | Gate Threshold Voltage          | $V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$                           | N-Ch      | 0.5  | 0.75  | 1        | V             |
|                               |                                 | $V_{DS}=V_{GS}, I_{DS}=-250\mu\text{A}$                          | P-Ch      | -0.5 | -0.75 | -1       |               |
| $I_{GSS}$                     | Gate Leakage Current            | $V_{GS}=\pm 10\text{V}, V_{DS}=0\text{V}$                        | N-Ch      | -    | -     | $\pm 10$ | $\mu\text{A}$ |
|                               |                                 | $V_{GS}=\pm 10\text{V}, V_{DS}=0\text{V}$                        | P-Ch      | -    | -     | $\pm 10$ |               |
| $V_{SD}^a$                    | Diode Forward Voltage           | $I_{SD}=1\text{A}, V_{GS}=0\text{V}$                             | N-Ch      | -    | 0.6   | 1.3      | V             |
|                               |                                 | $I_{SD}=-0.6\text{A}, V_{GS}=0\text{V}$                          | P-Ch      | -    | -0.6  | -1.3     |               |



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

| Symbol                                     | Parameter                        | Test Conditions   | APM2704CG   |      |      | Unit |            |   |    |
|--|----------------------------------|---|---|------|------|------|------------|---|----|
|  |                                  |   | Min.  | Typ. | Max. |      |            |   |    |
| <b>Static Characteristics (Cont.)</b>      |                                  |   |   |      |      |      |            |   |    |
| $R_{DS(ON)}$ <sup>a</sup>                  | Drain-Source On-State Resistance | $V_{GS}=4.5V, I_{DS}=4A$  | N-Ch  | -    | 30   | 38   | m $\Omega$ |   |    |
|  |                                  | $V_{GS}=-4.5V, I_{DS}=-3A$  | P-Ch  | -    | 56   | 70   |            |   |    |
|  |                                  | $V_{GS}=2.5V, I_{DS}=2.5A$  | N-Ch  | -    | 40   | 55   |            |   |    |
|  |                                  | $V_{GS}=-2.5V, I_{DS}=-1.5A$  | P-Ch  | -    | 85   | 115  |            |   |    |
|  |                                  | $V_{GS}=1.8V, I_{DS}=1.5A$  | N-Ch  | -    | 67   | 105  |            |   |    |
|  |                                  | $V_{GS}=-1.8V, I_{DS}=-1A$  | P-Ch  | -    | 135  | 200  |            |   |    |
| <b>Dynamic Characteristics<sup>b</sup></b> |                                  |   |   |      |      |      |            |   |    |
| $R_G$                                      | Gate Resistance                  | $V_{GS}=0V, V_{DS}=0V, F=1MHz$  | N-Ch  | -    | 5    | -    | $\Omega$   |   |    |
|  |                                  |   | P-Ch  | -    | 10   | -    |            |   |    |
| $C_{ISS}$                                  | Input Capacitance                | N-Channel<br>$V_{GS}=0V,$<br>$V_{DS}=10V,$<br>Frequency=1.0MHz<br>P-Channel<br>$V_{GS}=0V,$<br>$V_{DS}=-10V,$<br>Frequency=1.0MHz   | N-Ch  | -    | 600  | -    | pF         |   |    |
| $C_{OSS}$                                  | Output Capacitance               |   | P-Ch  | -    | 790  | -    |            |   |    |
|  |                                  |   | N-Ch  | -    | 110  | -    |            |   |    |
| $C_{RSS}$                                  | Reverse Transfer Capacitance     |   | P-Ch  | -    | 110  | -    |            |   |    |
|  |                                  |   | N-Ch  | -    | 80   | -    |            |   |    |
| $t_{d(ON)}$                                | Turn-on Delay Time               | N-Channel<br>$V_{DD}=10V, R_L=10\Omega,$<br>$I_{DS}=1A, V_{GEN}=4.5V,$<br>$R_G=6\Omega$<br><br>P-Channel<br>$V_{DD}=-10V, R_L=10\Omega,$<br>$I_{DS}=-1A, V_{GEN}=-4.5V,$<br>$R_G=6\Omega$ | N-Ch  | -    | 12   | 23   | ns         |   |    |
|  |                                  |   | P-Ch  | -    | 10   | 19   |            |   |    |
| $t_r$                                      | Turn-on Rise Time                |   | N-Ch  | -    | 30   | 55   |            |   |    |
|  |                                  |   | P-Ch  | -    | 26   | 48   |            |   |    |
| $t_{d(OFF)}$                               | Turn-off Delay Time              |   | N-Ch  | -    | 38   | 69   |            |   |    |
|  |                                  |   | P-Ch  | -    | 50   | 91   |            |   |    |
| $t_f$                                      | Turn-off Fall Time               |   | N-Ch  | -    | 6    | 12   |            |   |    |
|  |                                  |   | P-Ch  | -    | 45   | 82   |            |   |    |
| $t_{rr}$                                   | Reverse Recovery Time            |   | N-Channel<br>$I_{DS}=4A, di_{SD}/dt = 100A/\mu s$ | N-Ch | -    | 21   |            | - | ns |
|  |                                  |   |   | P-Ch | -    | 25   |            | - |    |
| $Q_{rr}$                                   | Reverse Recovery Charge          | P-Channel<br>$I_{DS}=-3A, di_{SD}/dt = 100A/\mu s$  | N-Ch  | -    | 10   | -    | nC         |   |    |
|  |                                  |   | P-Ch  | -    | 7    | -    |            |   |    |

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

| Symbol   | Parameter          | Test Conditions   | APM2704CG |      |      | Unit |    |
|--|--------------------|---|-----------|------|------|------|----|
|  |                    |   | Min.      | Typ. | Max. |      |    |
| <b>Gate Charge Characteristics<sup>b</sup></b> |                    |   |           |      |      |      |    |
| Q <sub>g</sub>                                 | Total Gate Charge  | N-Channel<br>V <sub>DS</sub> =10V, V <sub>GS</sub> =4.5V,<br>I <sub>DS</sub> =4A    | N-Ch      | -    | 10   | 14   | nC |
|  |                    |   | P-Ch      | -    | 8    | 11   |    |
| Q <sub>gs</sub>                                | Gate-Source Charge | P-Channel<br>V <sub>DS</sub> =-10V, V <sub>GS</sub> =-4.5V,<br>I <sub>DS</sub> =-3A | N-Ch      | -    | 1.2  | -    |    |
|  |                    |   | P-Ch      | -    | 1.3  | -    |    |
| Q <sub>gd</sub>                                | Gate-Drain Charge  |   | N-Ch      | -    | 3    | -    |    |
|  |                    |   | P-Ch      | -    | 2.7  | -    |    |

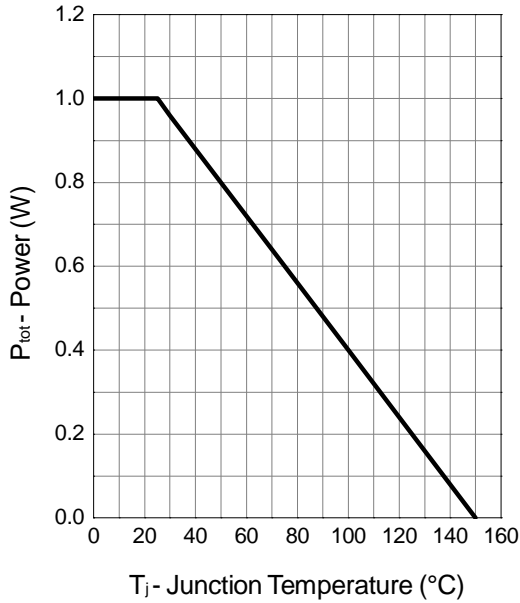
Note a : Pulse test ; pulse width ≤ 300μs, duty cycle ≤ 2%.

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

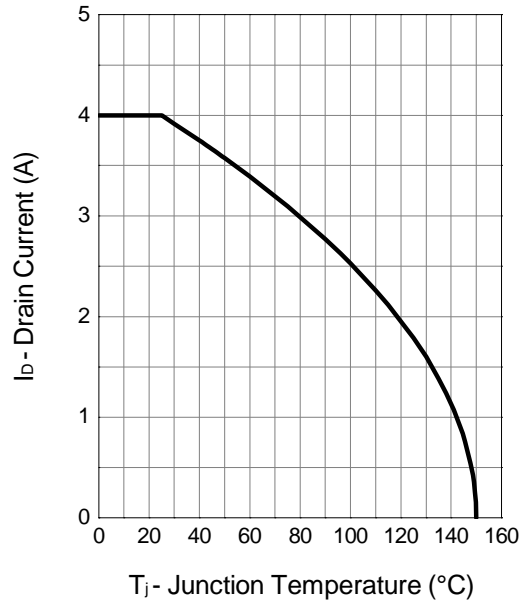
## Typical Operating Characteristics

### N-Channel

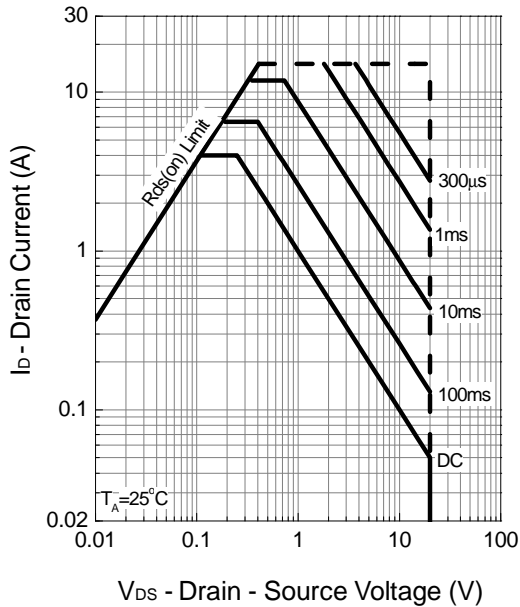
Power Dissipation



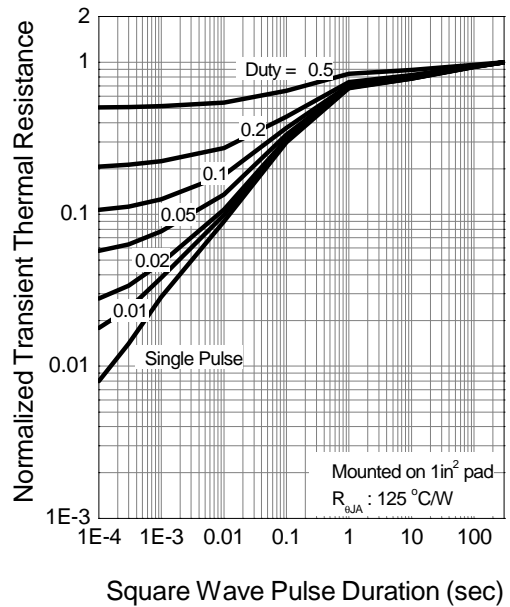
Drain Current



Safe Operation Area



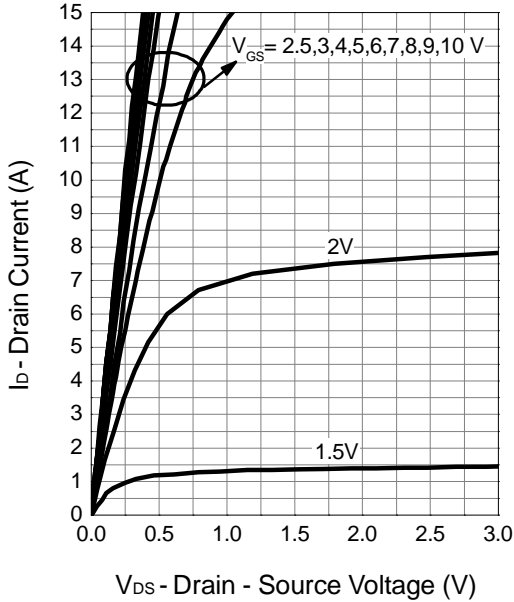
Thermal Transient Impedance



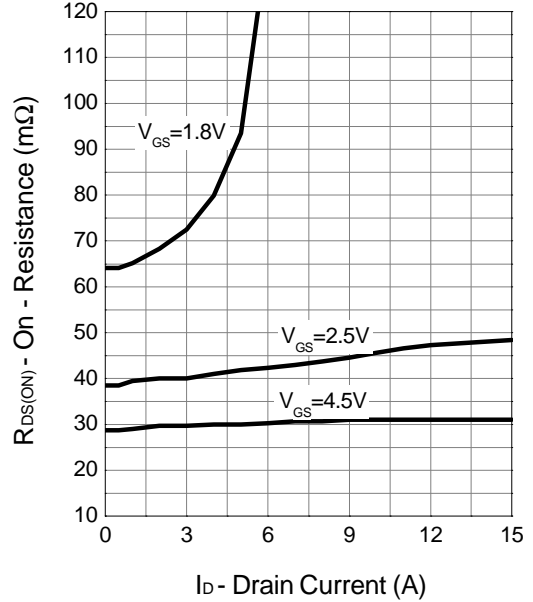
## Typical Operating Characteristics (Cont.)

N-Channel

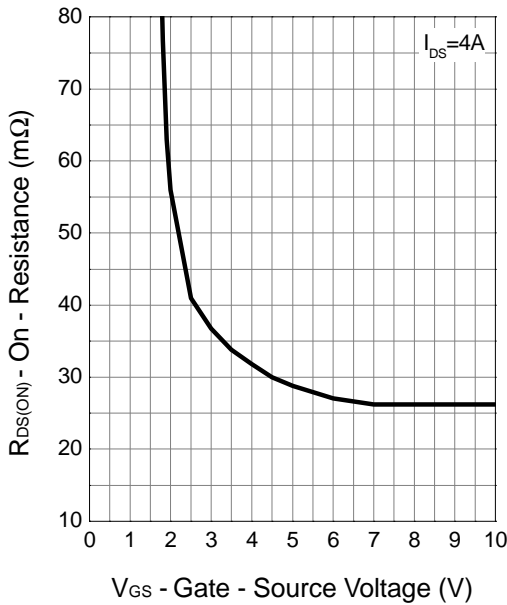
Output Characteristics



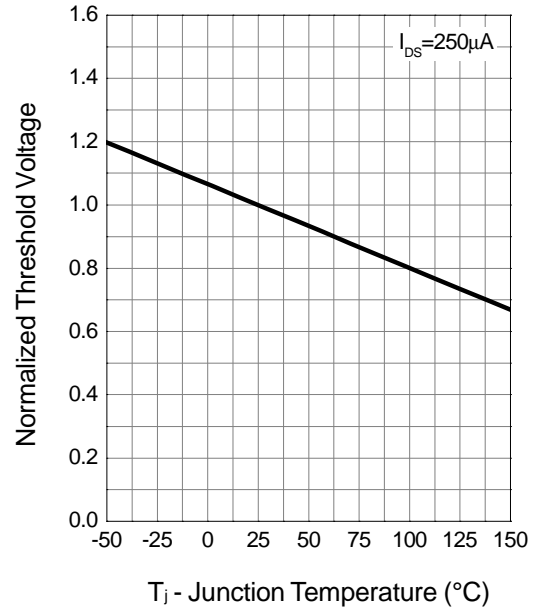
Drain-Source On Resistance



Drain-Source On Resistance



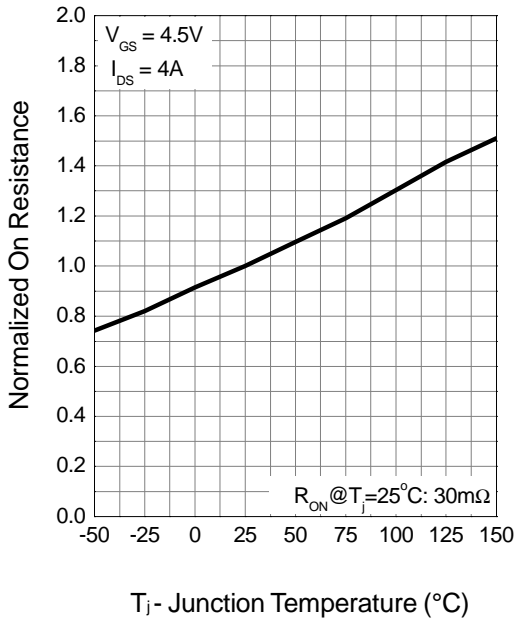
Gate Threshold Voltage



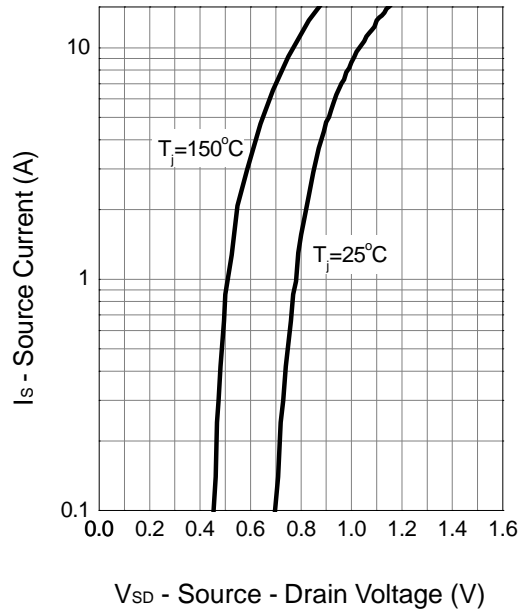
Typical Operating Characteristics (Cont.)

N-Channel

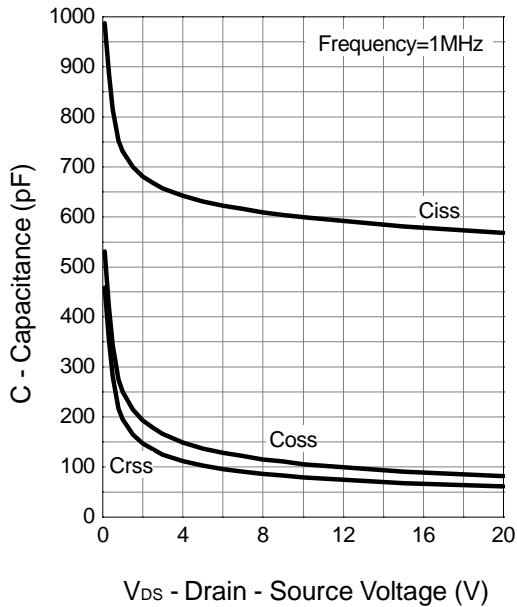
Drain-Source On Resistance



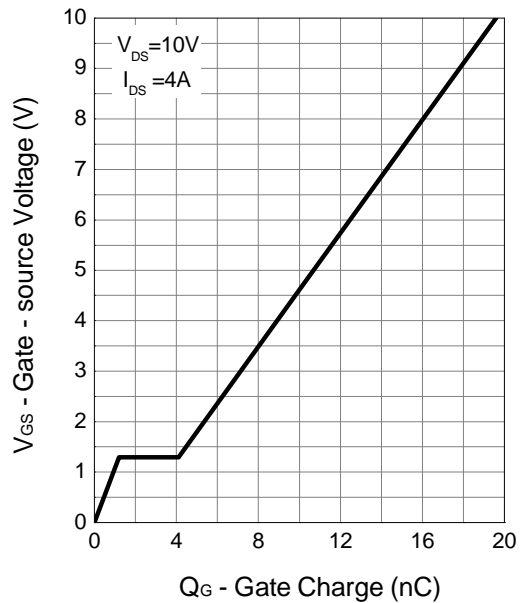
Source-Drain Diode Forward



Capacitance



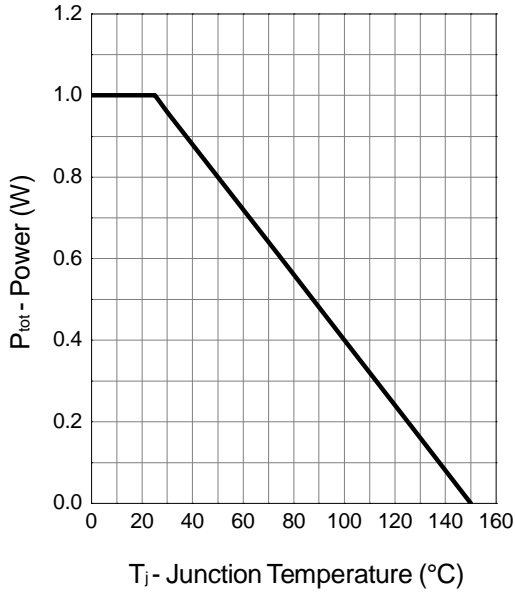
Gate Charge



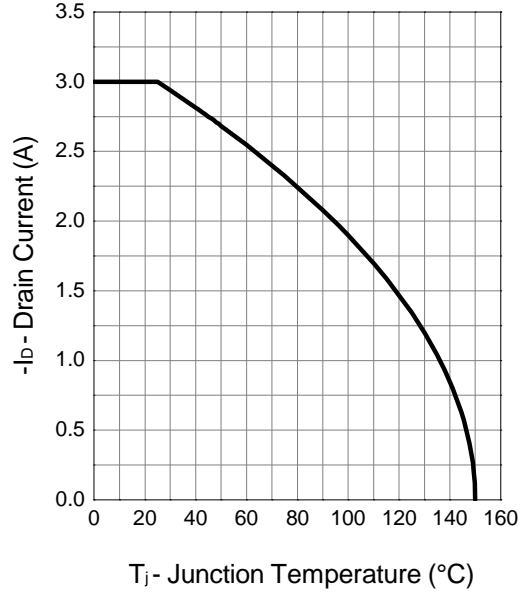
Typical Operating Characteristics (Cont.)

P-Channel

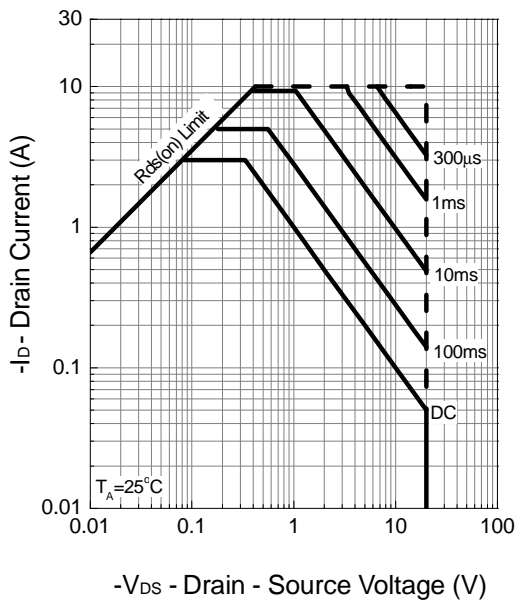
Power Dissipation



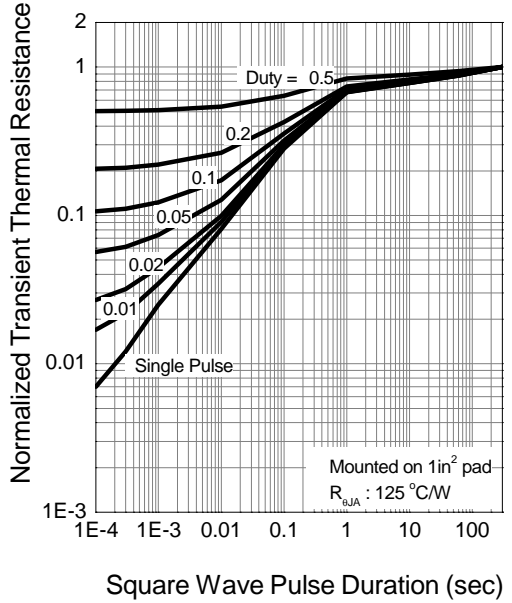
Drain Current



Safe Operation Area



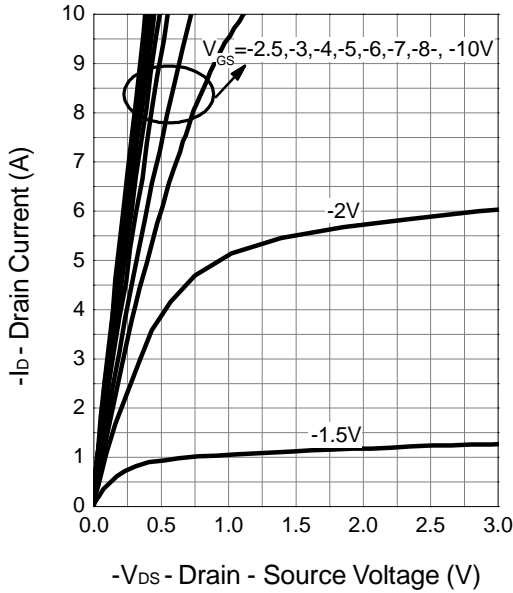
Thermal Transient Impedance



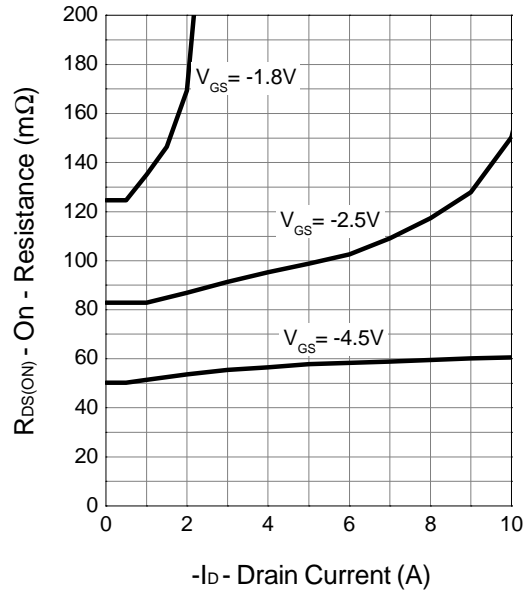
Typical Operating Characteristics (Cont.)

P-Channel

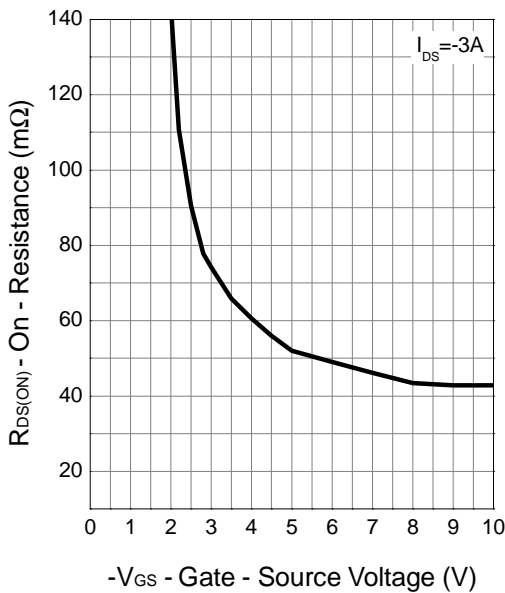
Output Characteristics



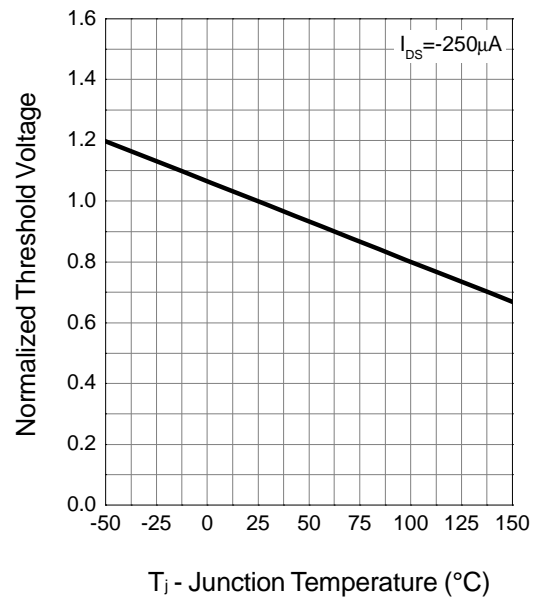
Drain-Source On Resistance



Drain-Source On Resistance



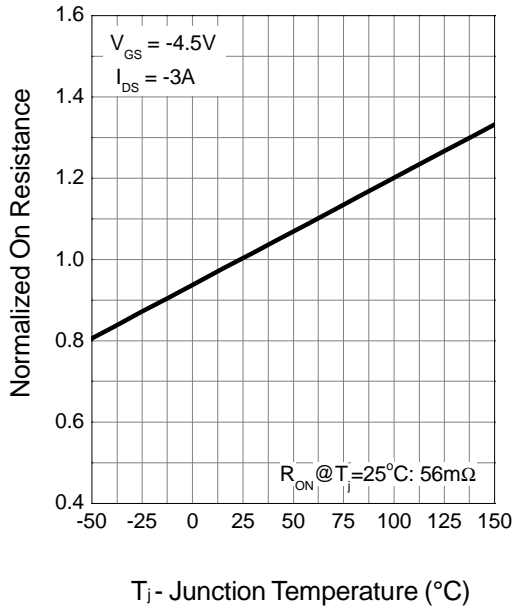
Gate Threshold Voltage



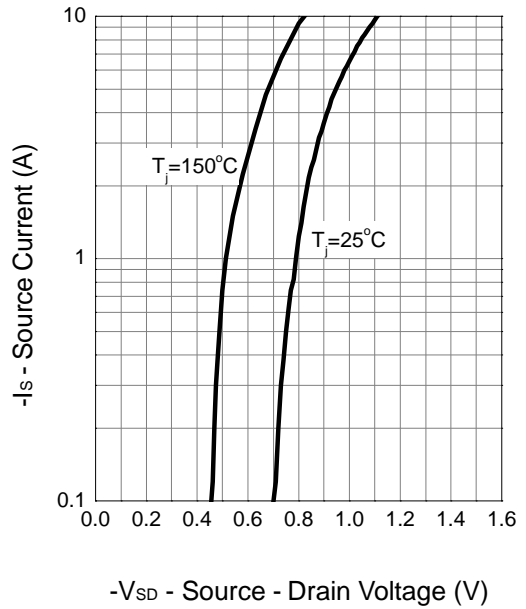
## Typical Operating Characteristics (Cont.)

### P-Channel

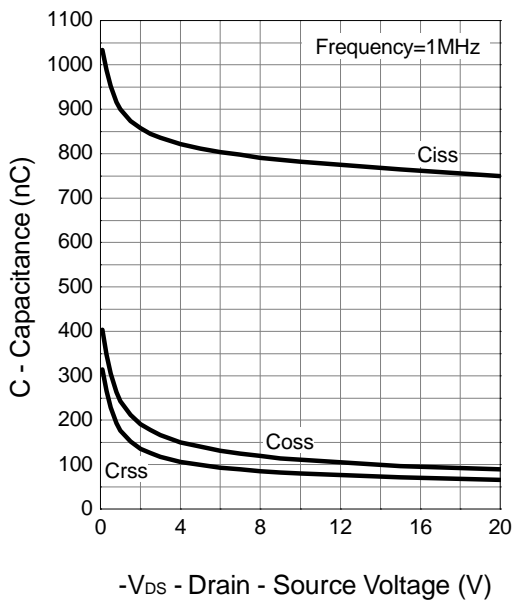
Drain-Source On Resistance



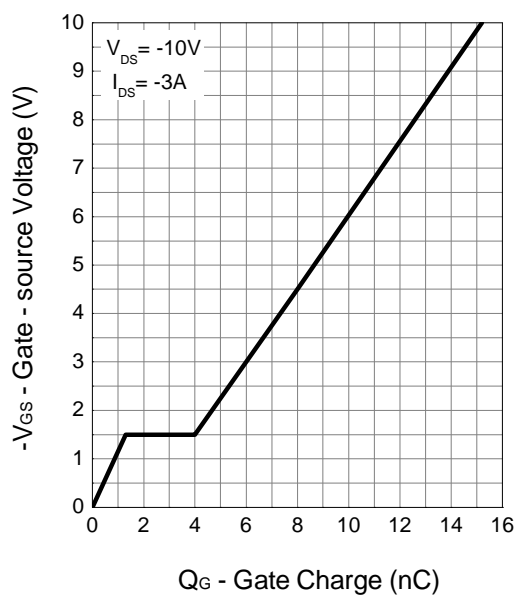
Source-Drain Diode Forward



Capacitance



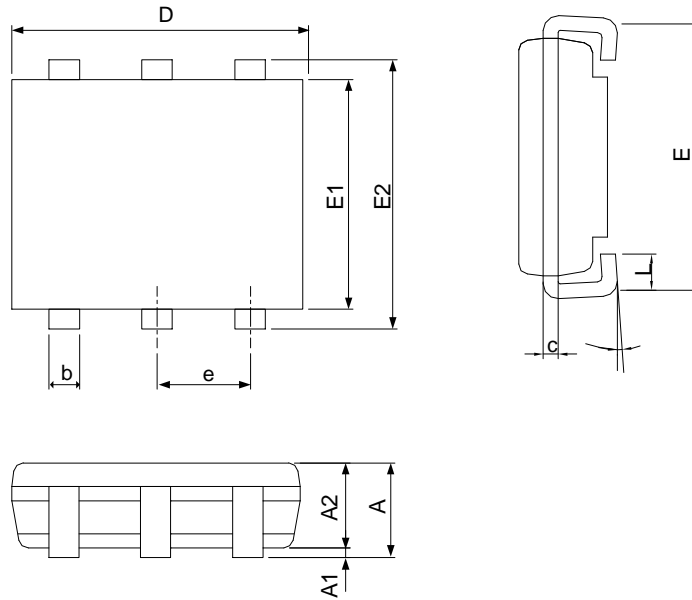
Gate Charge





Package Information

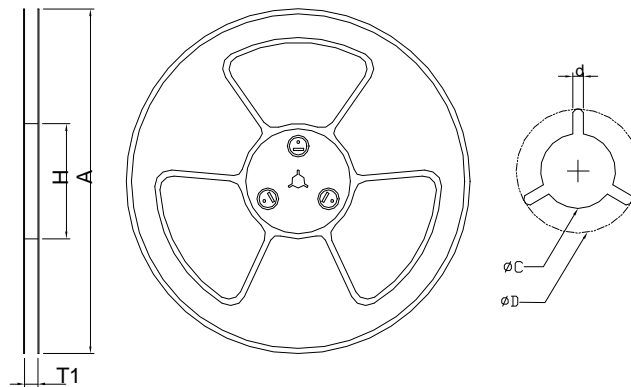
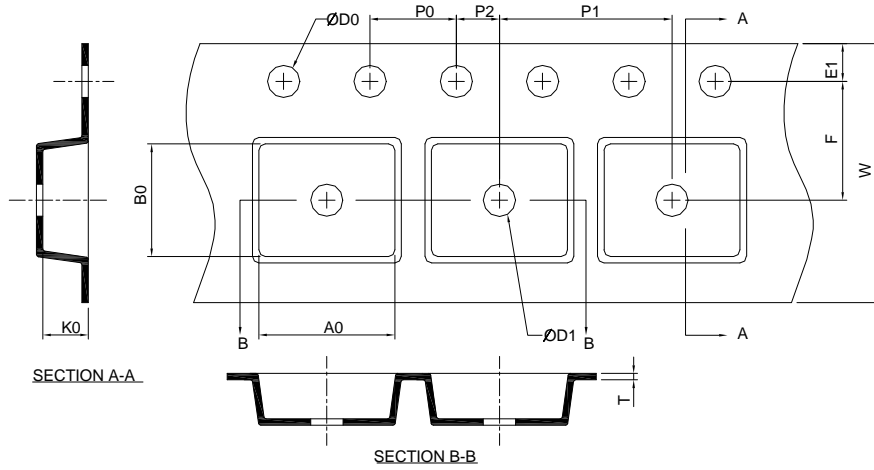
JSOT-6



| DIMENSIONS | JSOT-6      |      |           |       |
|------------|-------------|------|-----------|-------|
|            | MILLIMETERS |      | INCHES    |       |
|            | MIN.        | MAX. | MIN.      | MAX.  |
| A          | 0.93        | 1.10 | 0.037     | 0.043 |
| A1         | 0.01        | 0.10 | 0.000     | 0.004 |
| A2         | 0.92        | 1.00 | 0.036     | 0.039 |
| b          | 0.25        | 0.40 | 0.010     | 0.016 |
| c          | 0.10        | 0.20 | 0.004     | 0.008 |
| D          | 2.95        | 3.10 | 0.116     | 0.122 |
| E          | 2.50        | 3.00 | 0.098     | 0.118 |
| E1         | 2.30        | 2.50 | 0.091     | 0.098 |
| E2         | 2.65        | 3.05 | 0.104     | 0.120 |
| e          | 0.95 BSC    |      | 0.037 BSC |       |
| θ          | 0°          | 8°   | 0°        | 8°    |
| L          | 0.30        | 0.60 | 0.012     | 0.024 |

Note : 1. Follow GEM 2928 6J.  
 2. Dimension D, D1, and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 10 mil.

### Carrier Tape & Reel Dimensions



| Application | A           | H         | T1                | C                  | d        | D                 | W          | E1         | F          |
|-------------|-------------|-----------|-------------------|--------------------|----------|-------------------|------------|------------|------------|
| JSOT-6      | 178.0 ±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 ±0.30  | 1.75 ±0.10 | 3.5 ±0.05  |
|             | P0          | P1        | P2                | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 4.0 ±0.10 | 2.0 ±0.05         | 1.5+0.10<br>-0.00  | 1.0 MIN. | 0.6+0.00<br>-0.40 | 3.20 ±0.20 | 3.10 ±0.20 | 1.50 ±0.20 |

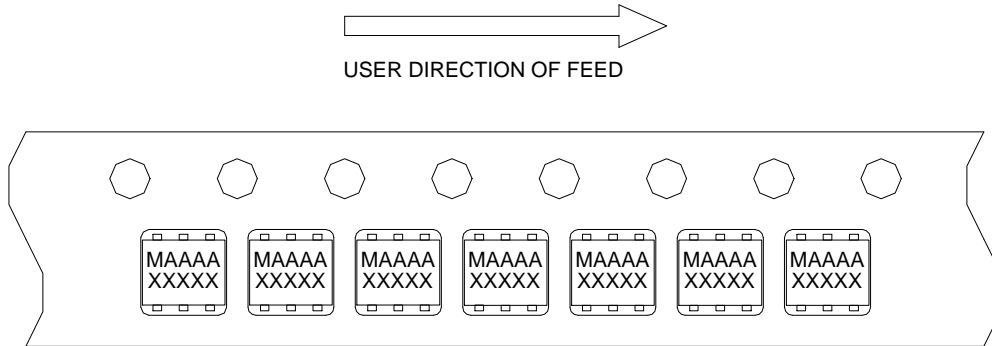
(mm)

### Devices Per Unit

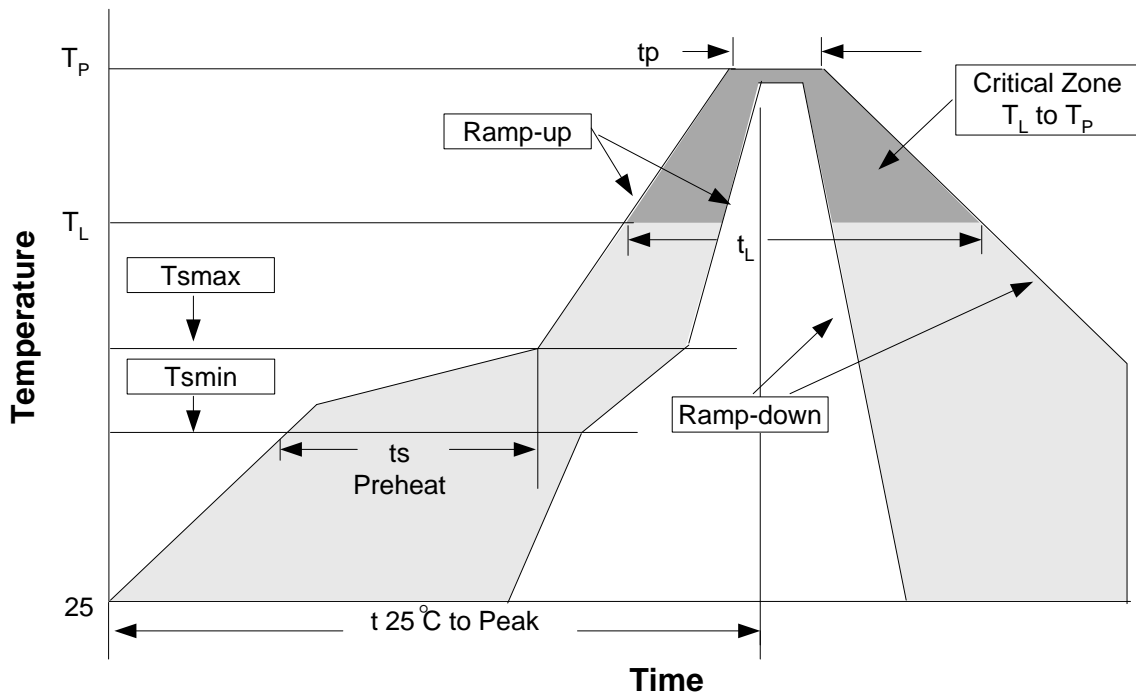
| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| JSOT-6       | Tape & Reel | 3000     |

### Taping Direction Information

JSOT-6



### 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>smin</sub> )<br>- Temperature Max (T <sub>smax</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.

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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Sindain City, Taipei County 23146, Taiwan

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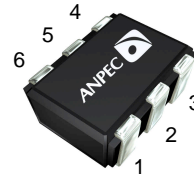
Fax : 886-2-2917-3838

Load Switch with Level-Shift

**Features**

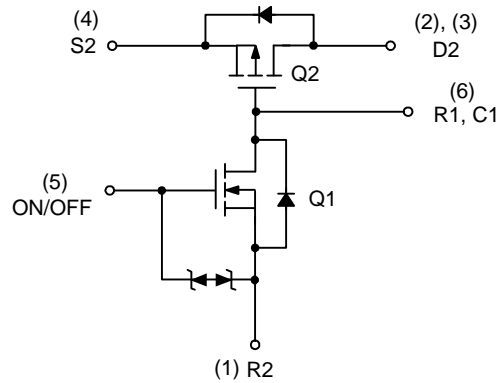
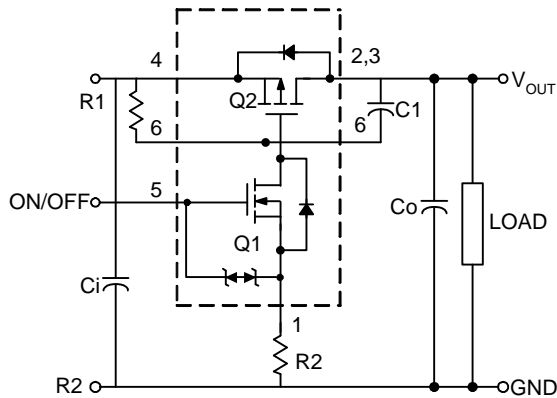
- -12V/±3A,  
 $R_{DS(ON)} = 45m\Omega$  (typ.) @  $V_{GS} = -4.5V$   
 $R_{DS(ON)} = 60m\Omega$  (typ.) @  $V_{GS} = -2.5V$   
 $R_{DS(ON)} = 82m\Omega$  (typ.) @  $V_{GS} = -1.8V$
- Low Forward Voltage
- Lead Free and Green Devices Available  
 (RoHS Compliant)

**Pin Description**



Top View of JSOT-6

**Application Circuits**



**Ordering and Marking Information**

|  |   |
|--|---|
| <p>APM2702 <span style="font-family: monospace;">□□□-□□□</span></p> <div style="margin-left: 20px;"> <p>└─ Assembly Material</p> <p>└─ Handling Code</p> <p>└─ Temperature Range</p> <p>└─ Package Code</p> </div> | <p>Package Code<br/>CG : JSOT-6</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/>G : Halogen and Lead Free Device</p> |
|--|---|

|             |   |                    |
|-------------|---|--------------------|
| APM2702 CG: | <div style="border: 1px solid black; padding: 2px; display: inline-block;">             M2702<br/>XXXXXX         </div> | XXXXXX - Date Code |
|-------------|---|--------------------|

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    |   |
|-----------------|---|----------------------------|---------|---|
| $V_{IN}$        | Input Voltage                                 | 12                         | V       |   |
| $V_{ON/OFF}$    | ON/OFF Voltage                                | 8                          |         |   |
| $I_L$           | Load Current                                  | Continuous <sup>a, b</sup> | $\pm 3$ | A |
|                 |   | Pulsed <sup>b, c</sup>     | $\pm 8$ |   |
| $I_S$           | Diode Continuous Forward Current <sup>a</sup> | -1                         |         |   |
| $T_J$           | Maximum Junction Temperature <sup>a</sup>     | 150                        | °C      |   |
| $T_{STG}$       | Storage Temperature Range                     | -55 to 150                 |         |   |
| $P_D$           | Maximum Power Dissipation <sup>a</sup>        | $T_A=25^\circ\text{C}$     | 0.83    | W |
|                 |   | $T_A=100^\circ\text{C}$    | 0.3     |   |
| $R_{\theta JA}$ | Thermal Resistance-Junction to Ambient        | 150                        | °C/W    |   |

Note a : Surface Mounted on FR4 Board.

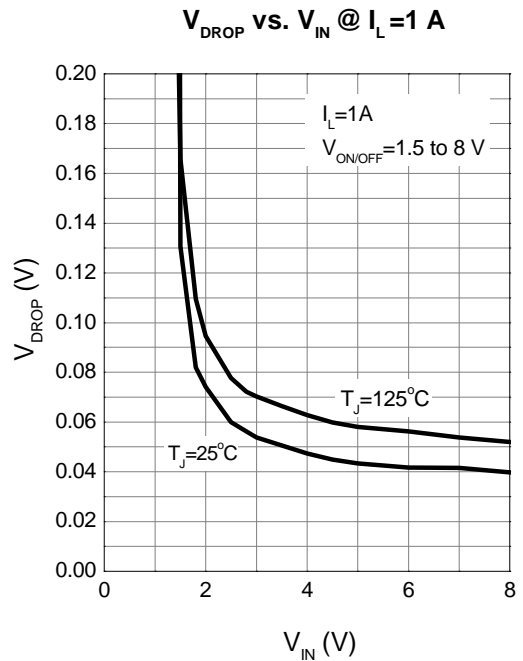
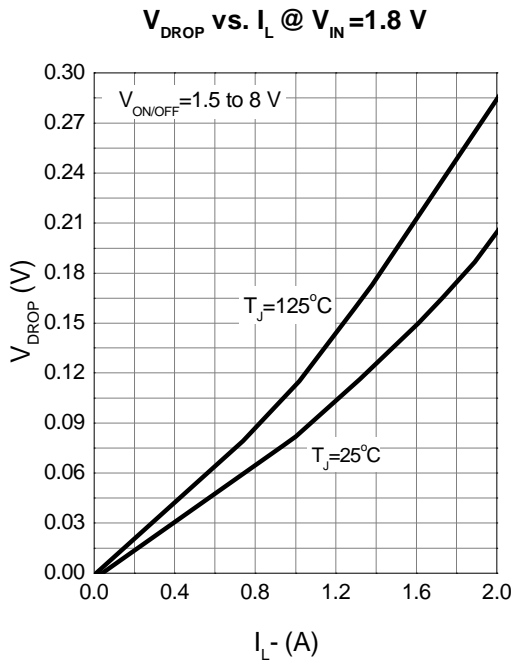
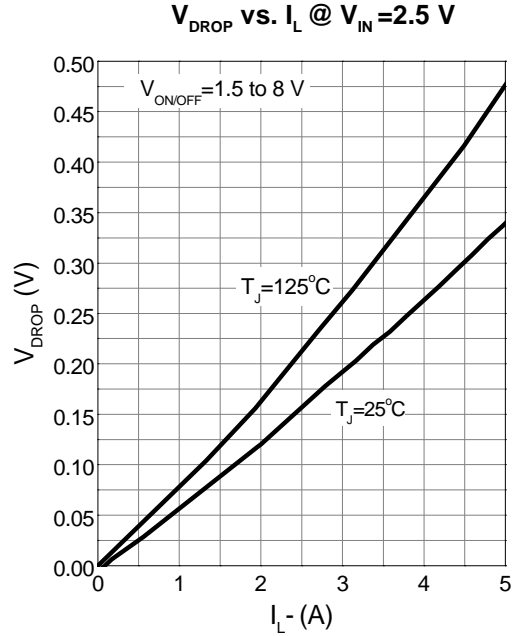
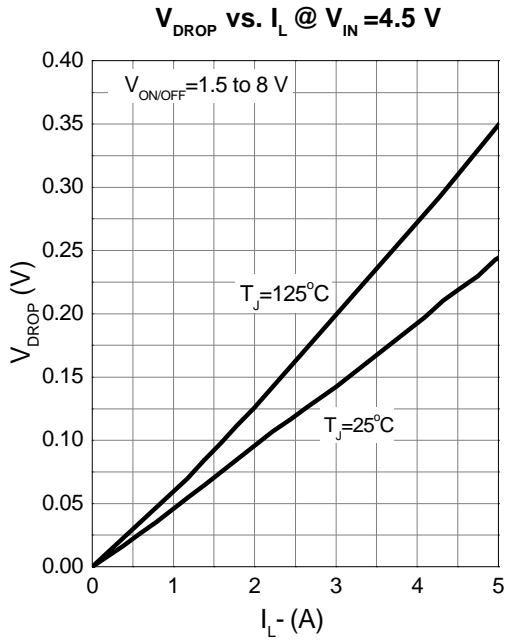
Note b :  $V_{IN}=8\text{V}$ ,  $V_{ON/OFF}=8\text{V}$ ,  $T_A=25^\circ\text{C}$ .

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

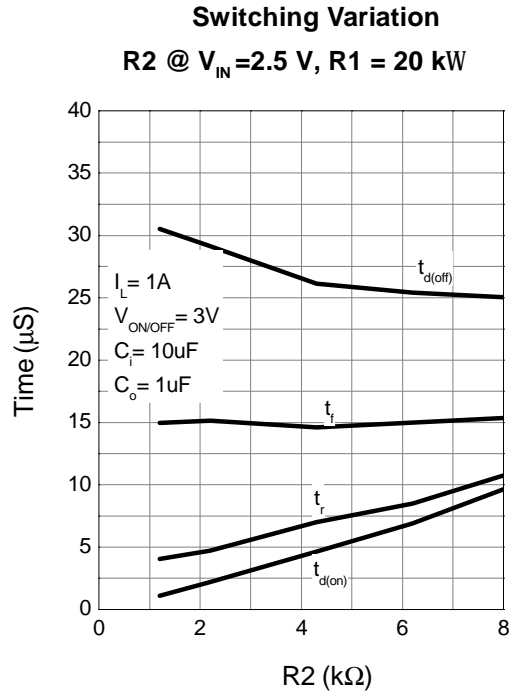
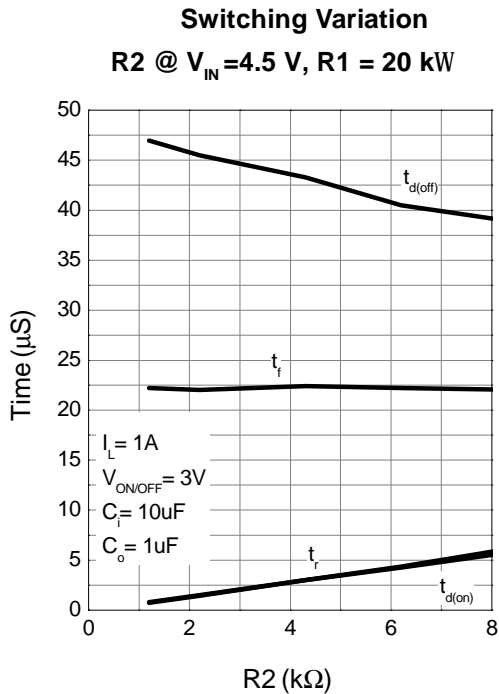
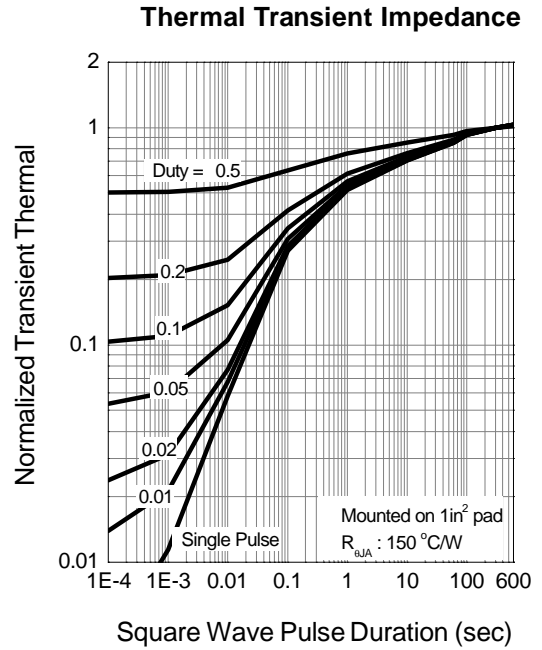
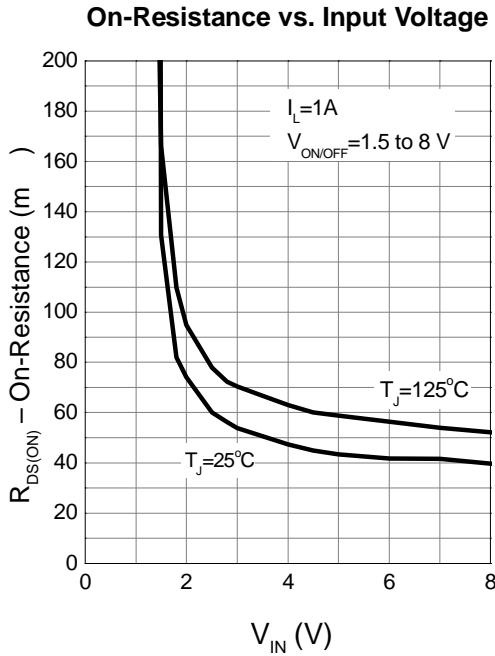
## Electrical Characteristics ( $T_A = 25^\circ\text{C}$ Unless Otherwise Noted)

| Symbol                     | Parameter                          | Test Conditions  | APM2702CG |      |      | Unit          |
|----------------------------|------------------------------------|--|-----------|------|------|---------------|
|                            |                                    |  | Min.      | Typ. | Max. |               |
| <b>OFF Characteristics</b> |                                    |  |           |      |      |               |
| $I_{FL}$                   | Reverse Leakage Current            | $V_{IN}=8\text{V}, V_{ON/OFF}=0\text{V}$                           | -         | -    | 1    | $\mu\text{A}$ |
| $V_{SD}$                   | Diode Forward Voltage              | $I_S=-1\text{A}$   | -         | -0.7 | -1.3 | V             |
| <b>ON Characteristics</b>  |                                    |  |           |      |      |               |
| $V_{IN}$                   | Input Voltage Range                |  | 1.8       | -    | 12   | V             |
| $R_{DS(ON)}$               | On-Resistance (p-channel)          | $V_{IN}=-4.5\text{V}, I_{DS}=-3\text{A}$                           | -         | 45   | 60   | m $\Omega$    |
|                            |                                    | $V_{IN}=-2.5\text{V}, I_{DS}=-2\text{A}$                           | -         | 60   | 85   |               |
|                            |                                    | $V_{IN}=-1.8\text{V}, I_{DS}=-1\text{A}$                           | -         | 82   | 150  |               |
| $I_{D(ON)}$                | On-State (p-channel) Drain-Current | $V_{IN-OUT} 0.2\text{V}, V_{IN}=5\text{V}, V_{ON/OFF}=1.5\text{V}$ | 1         | -    | -    | A             |
|                            |                                    | $V_{IN-OUT} 0.3\text{V}, V_{IN}=3\text{V}, V_{ON/OFF}=1.5\text{V}$ | 1         | -    | -    |               |

### Typical Operating Characteristics



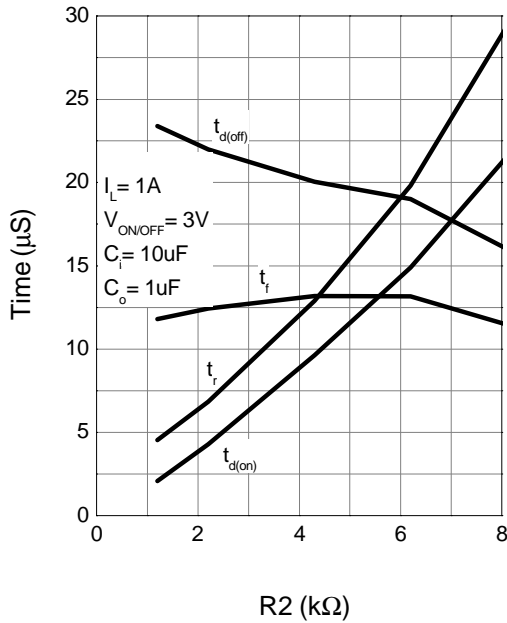
Typical Operating Characteristics (Cont.)



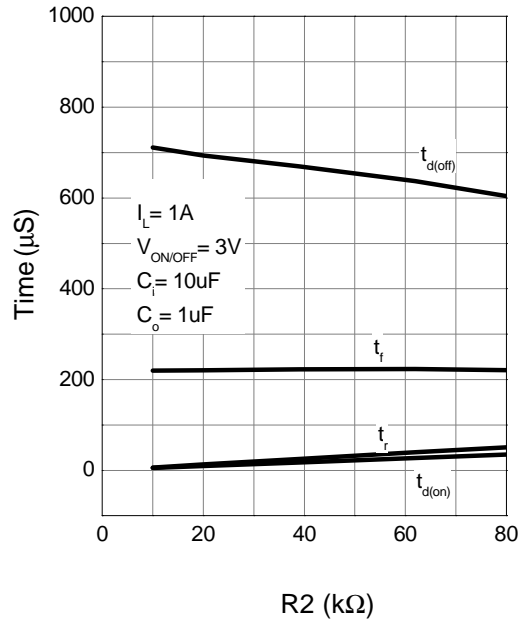


Typical Operating Characteristics (Cont.)

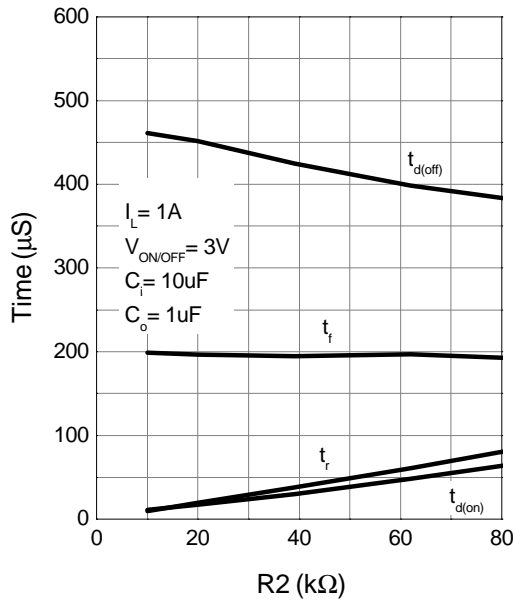
Switching Variation  
R2 @  $V_{IN}=1.8\text{ V}$ , R1 = 20 kW



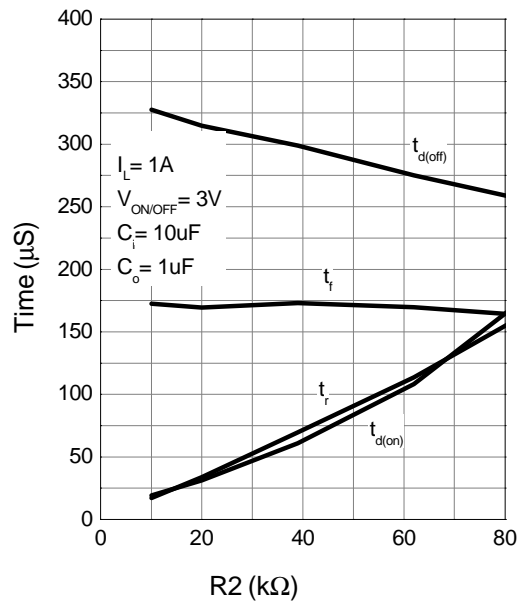
Switching Variation  
R2 @  $V_{IN}=4.5\text{ V}$ , R1 = 300 kW



Switching Variation  
R2 @  $V_{IN}=2.5\text{ V}$ , R1 = 300 kW

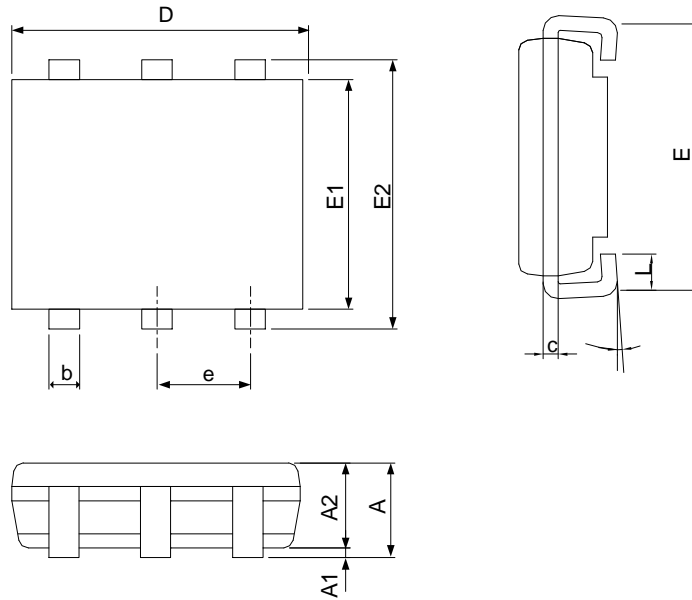


Switching Variation  
R2 @  $V_{IN}=1.8\text{ V}$ , R1 = 300 kW



## Package Information

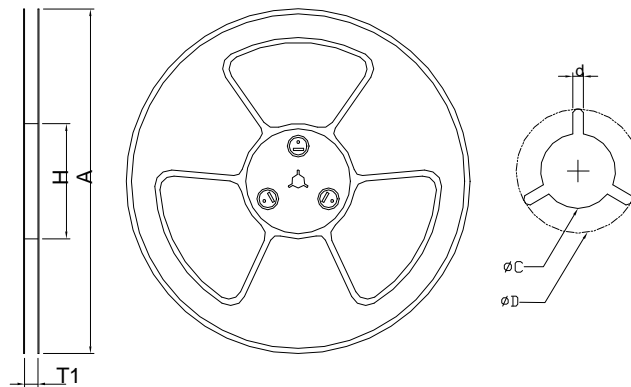
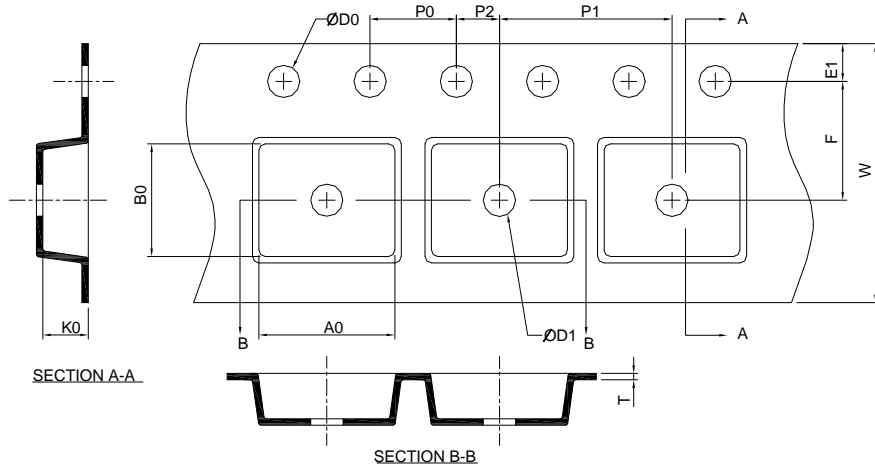
JSOT-6



| DIMENSIONS | JSOT-6      |      |           |       |
|------------|-------------|------|-----------|-------|
|            | MILLIMETERS |      | INCHES    |       |
|            | MIN.        | MAX. | MIN.      | MAX.  |
| A          | 0.93        | 1.10 | 0.037     | 0.043 |
| A1         | 0.01        | 0.10 | 0.000     | 0.004 |
| A2         | 0.92        | 1.00 | 0.036     | 0.039 |
| b          | 0.25        | 0.40 | 0.010     | 0.016 |
| c          | 0.10        | 0.20 | 0.004     | 0.008 |
| D          | 2.95        | 3.10 | 0.116     | 0.122 |
| E          | 2.50        | 3.00 | 0.098     | 0.118 |
| E1         | 2.30        | 2.50 | 0.091     | 0.098 |
| E2         | 2.65        | 3.05 | 0.104     | 0.120 |
| e          | 0.95 BSC    |      | 0.037 BSC |       |
| θ          | 0°          | 8°   | 0°        | 8°    |
| L          | 0.30        | 0.60 | 0.012     | 0.024 |

Note : 1. Follow GEM 2928 6J.  
 2. Dimension D, D1, and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 10 mil.

### Carrier Tape & Reel Dimensions



| Application | A           | H         | T1                | C                  | d        | D                 | W          | E1         | F          |
|-------------|-------------|-----------|-------------------|--------------------|----------|-------------------|------------|------------|------------|
| JSOT-6      | 178.0 ±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 ±0.30  | 1.75 ±0.10 | 3.5 ±0.05  |
|             | P0          | P1        | P2                | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 4.0 ±0.10 | 2.0 ±0.05         | 1.5+0.10<br>-0.00  | 1.0 MIN. | 0.6+0.00<br>-0.40 | 3.20 ±0.20 | 3.10 ±0.20 | 1.50 ±0.20 |

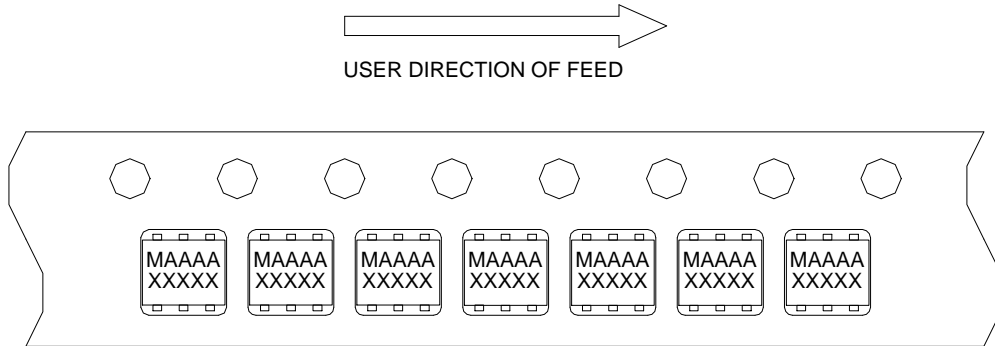
(mm)

### Devices Per Unit

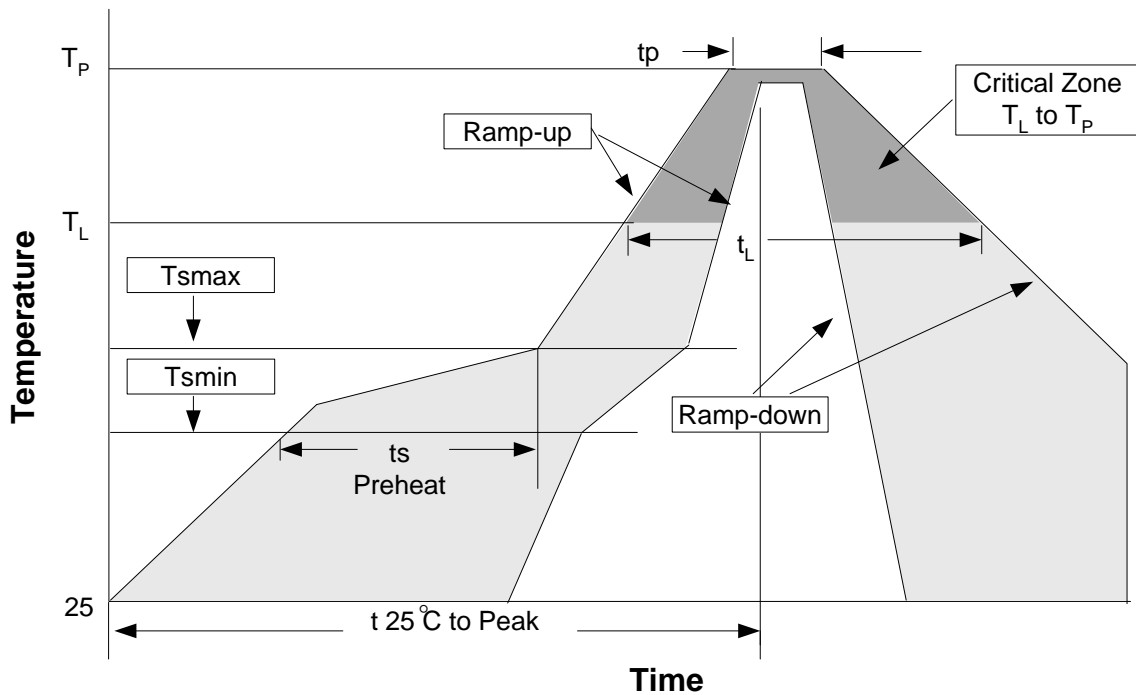
| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| JSOT-6       | Tape & Reel | 3000     |

## Taping Direction Information

JSOT-6



## 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) (ts) | 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 (tp)   | 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.

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## N-Channel Enhancement Mode MOSFET with Schottky Diode

### Features

#### MOSFET

- 20V/3A,  
 $R_{DS(ON)} = 50m\Omega (typ.) @ V_{GS} = 4.5V$   
 $R_{DS(ON)} = 80m\Omega (typ.) @ V_{GS} = 2.5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

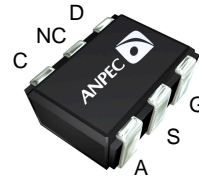
#### SBD

- Low Forward Voltage

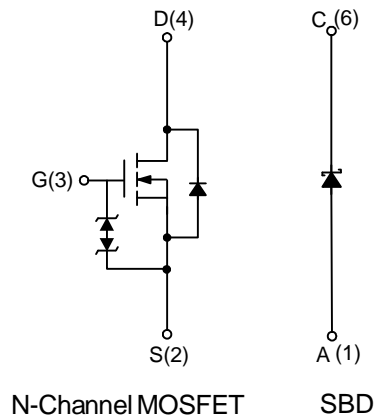
### Applications

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

### Pin Description



Top View of JSOT-6



### Ordering and Marking Information

|   |   |
|---|---|
| <p>APM2802 □□□-□□□</p> <div style="margin-left: 20px;"> <p>└─ Assembly Material</p> <p>└─ Handling Code</p> <p>└─ Temperature Range</p> <p>└─ Package Code</p> </div> | <p>Package Code<br/>CG : JSOT-6</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/>G : Halogen and Lead Free Device</p> |
| <p>APM2802 CG : <span style="border: 1px solid black; padding: 2px 5px;">M2802<br/>XXXXX</span></p>   | <p style="text-align: center;">XXXXX - 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                      |
|-------------------|--|-------------------------|---------------------------|
| <b>MOSFET</b>     |  |                         |                           |
| $V_{DSS}$         | Drain-Source Voltage                   | 20                      | V                         |
| $V_{GSS}$         | Gate-Source Voltage                    | $\pm 10$                |                           |
| $I_D^*$           | Continuous Drain Current               | 3                       | A                         |
| $I_{DM}^*$        | 300 $\mu\text{s}$ Pulsed Drain Current |                         |                           |
| $I_S^*$           | Diode Continuous Forward Current       | 1                       | A                         |
| $T_J$             | Maximum Junction Temperature           | 150                     | $^\circ\text{C}$          |
| $T_{STG}$         | Storage Temperature Range              | -55 to 150              |                           |
| $P_D^*$           | Maximum Power Dissipation              | $T_A=25^\circ\text{C}$  | 0.83                      |
|                   |  | $T_A=100^\circ\text{C}$ | 0.3                       |
| $R_{\theta JA}^*$ | Thermal Resistance-Junction to Ambient | 150                     | $^\circ\text{C}/\text{W}$ |
| <b>SBD</b>        |  |                         |                           |
| $V_{RRM}$         | Repetitive Peak Reverse Voltage        | 20                      | V                         |
| $I_{FSM}$         | Maximum Peak Forward Surge Current     | 5.5                     | A                         |

Note : \*Surface Mounted on 1in<sup>2</sup> pad area, t ≤ 10sec.

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

| Symbol                        | Parameter                        | Test Conditions   | APM2802CG |      |          | Unit          |
|-------------------------------|----------------------------------|---|-----------|------|----------|---------------|
|                               |                                  |   | Min.      | Typ. | Max.     |               |
| <b>MOSFET</b>                 |                                  |   |           |      |          |               |
| <b>Static Characteristics</b> |                                  |   |           |      |          |               |
| $BV_{DSS}$                    | Drain-Source Breakdown Voltage   | $V_{GS}=0\text{V}, I_{DS}=250\mu\text{A}$                       | 20        | -    | -        | V             |
| $I_{DSS}$                     | Zero Gate Voltage Drain Current  | $V_{DS}=16\text{V}, V_{GS}=0\text{V}$<br>$T_J=85^\circ\text{C}$ | -         | -    | 1        | $\mu\text{A}$ |
|                               |                                  |   | -         | -    | 30       |               |
| $V_{GS(th)}$                  | Gate Threshold Voltage           | $V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$                          | 0.45      | 0.6  | 1        | V             |
| $I_{GSS}$                     | Gate Leakage Current             | $V_{GS}=\pm 10\text{V}, V_{DS}=0\text{V}$                       | -         | -    | $\pm 10$ | $\mu\text{A}$ |
| $R_{DS(ON)}^a$                | Drain-Source On-state Resistance | $V_{GS}=4.5\text{V}, I_{DS}=3\text{A}$                          | -         | 50   | 70       | m $\Omega$    |
|                               |                                  | $V_{GS}=2.5\text{V}, I_{DS}=1.7\text{A}$                        | -         | 80   | 110      |               |
| $V_{SD}^a$                    | Diode Forward Voltage            | $I_{SD}=0.5\text{A}, V_{GS}=0\text{V}$                          | -         | 0.7  | 1.3      | V             |

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

| Symbol   | Parameter                    | Test Conditions  | APM2802CG |      |      | Unit    |
|--|------------------------------|--|-----------|------|------|---------|
|  |                              |  | Min.      | Typ. | Max. |         |
| <b>MOSFET</b>                                  |                              |  |           |      |      |         |
| <b>Dynamic Characteristics<sup>b</sup></b>     |                              |  |           |      |      |         |
| $C_{iss}$                                      | Input Capacitance            | $V_{GS}=0V,$<br>$V_{DS}=10V,$<br>Frequency=1.0MHz                          | -         | 270  | -    | pF      |
| $C_{oss}$                                      | Output Capacitance           |  | -         | 80   | -    |         |
| $C_{rss}$                                      | Reverse Transfer Capacitance |  | -         | 50   | -    |         |
| $t_{d(ON)}$                                    | Turn-on Delay Time           | $V_{DD}=10V, R_L=10\Omega,$<br>$I_{DS}=1A, V_{GEN}=4.5V,$<br>$R_G=6\Omega$ | -         | 4    | 8    | ns      |
| $T_r$  | Turn-on Rise Time            |  | -         | 10   | 19   |         |
| $t_{d(OFF)}$                                   | Turn-off Delay Time          |  | -         | 20   | 37   |         |
| $T_f$  | Turn-off Fall Time           |  | -         | 4    | 8    |         |
| $t_{rr}$                                       | Reverse Recovery Time        | $I_{DS}=3A, di_{SD}/dt=100A/\mu s$   | -         | 17   | -    | ns      |
| Qrr  | Reverse Recovery Charge      |  | -         | 7    | -    | nC      |
| <b>Gate Charge Characteristics<sup>b</sup></b> |                              |  |           |      |      |         |
| $Q_g$  | Total Gate Charge            | $V_{DS}=10V, V_{GS}=4.5V,$<br>$I_{DS}=3A$                                  | -         | 4    | 6    | nC      |
| $Q_{gs}$                                       | Gate-Source Charge           |  | -         | 0.6  | -    |         |
| $Q_{gd}$                                       | Gate-Drain Charge            |  | -         | 1.6  | -    |         |
| <b>SBD</b>                                     |                              |  |           |      |      |         |
| $V_R$  | Reverse Voltage              | $I_R=0.5mA$  | 20        | -    | -    | V       |
| $V_{F1}$                                       | Forward Voltage              | $I_F=10mA$   | -         | -    | 0.4  | V       |
| $V_{F2}$                                       |                              | $I_F=500mA$  | -         | -    | 0.5  | V       |
| $I_R$  | Reverse Current              | $V_R=15V$  | -         | -    | 200  | $\mu A$ |
| $C^b$  | Junction Capacitance         | $V_R=10V,$<br>Frequency=1.0MHz   | -         | 45   | -    | pF      |

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

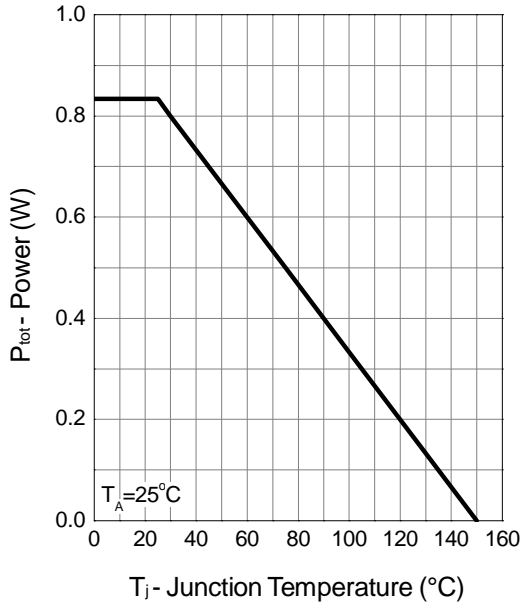
Note b : Guaranteed by design, not subject to production testing.



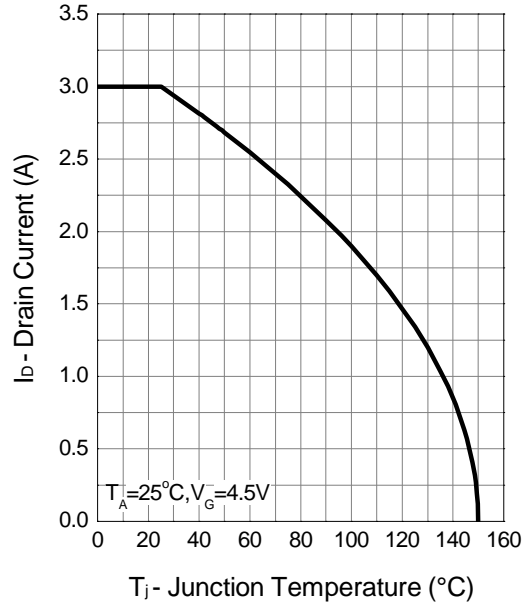
## Typical Operating Characteristics

### N-Channel MOSFET

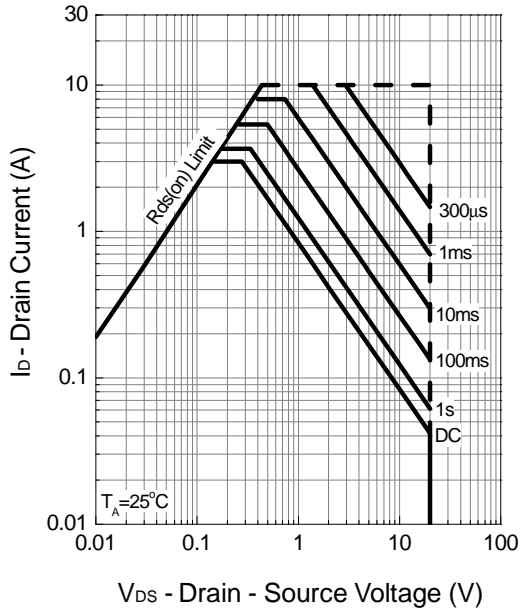
Power Dissipation



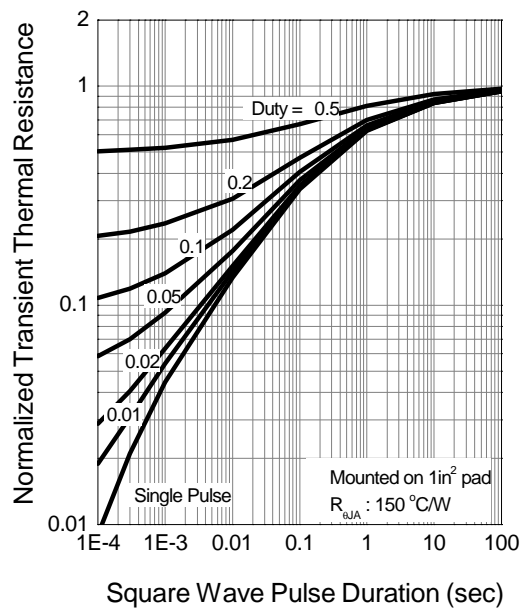
Drain Current



Safe Operation Area



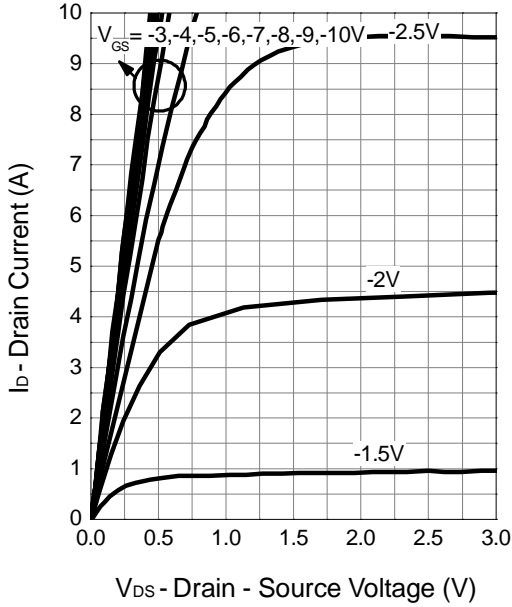
Thermal Transient Impedance



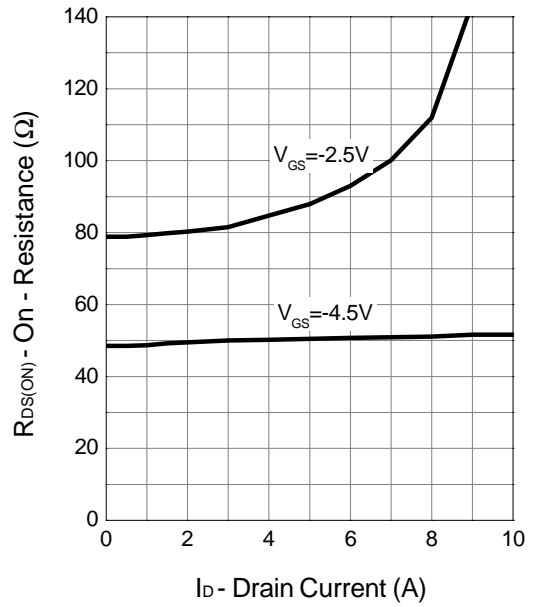
Typical Operating Characteristics (Cont.)

N-Channel MOSFET

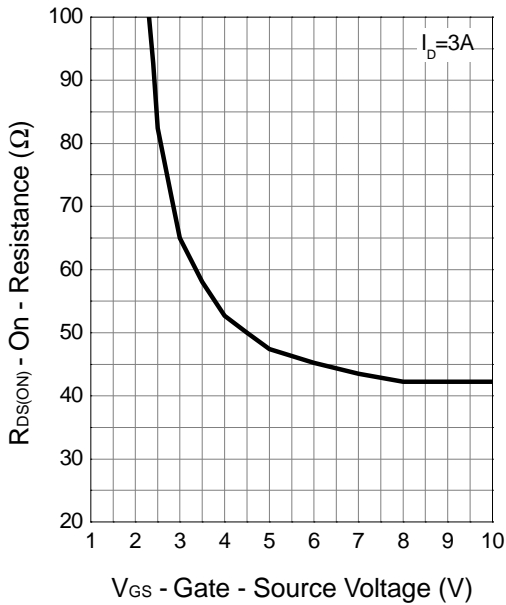
Output Characteristics



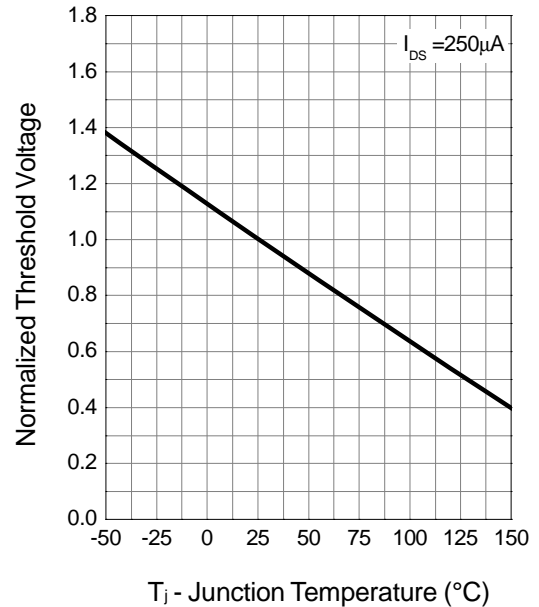
Drain-Source On Resistance



Drain-Source On Resistance



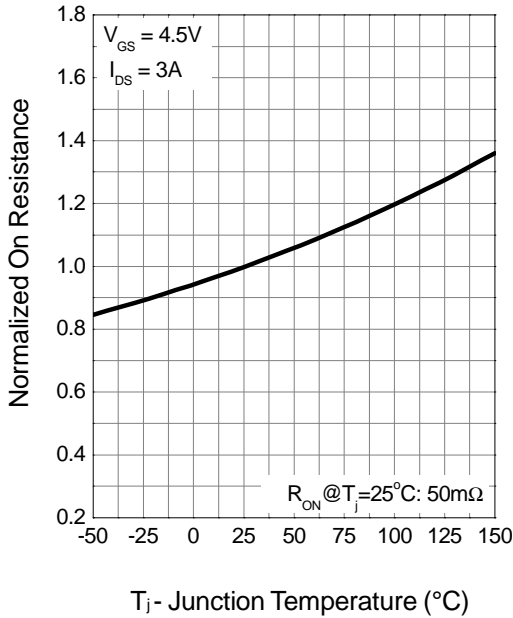
Gate Threshold Voltage



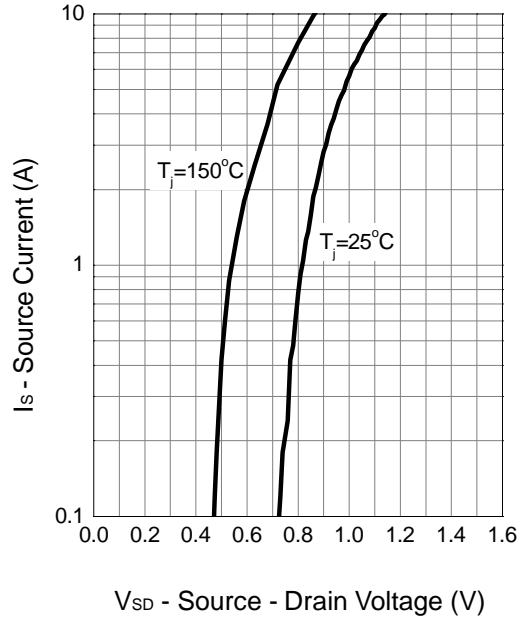
## Typical Operating Characteristics (Cont.)

### N-Channel MOSFET

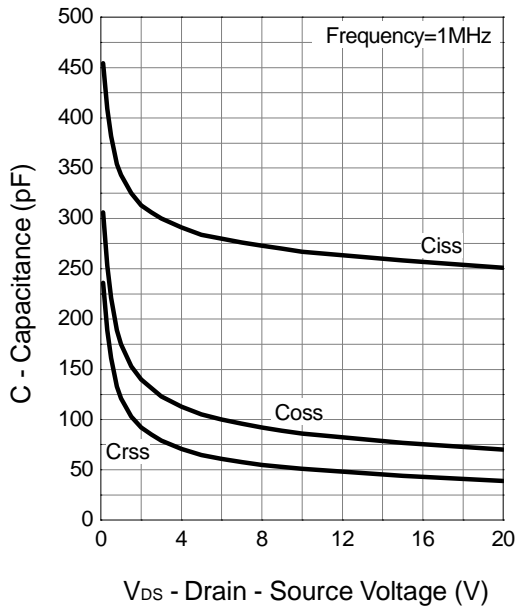
Drain-Source On Resistance



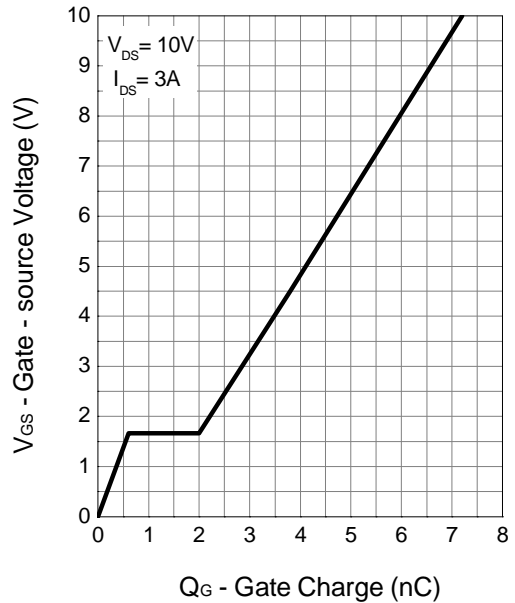
Source-Drain Diode Forward



Capacitance

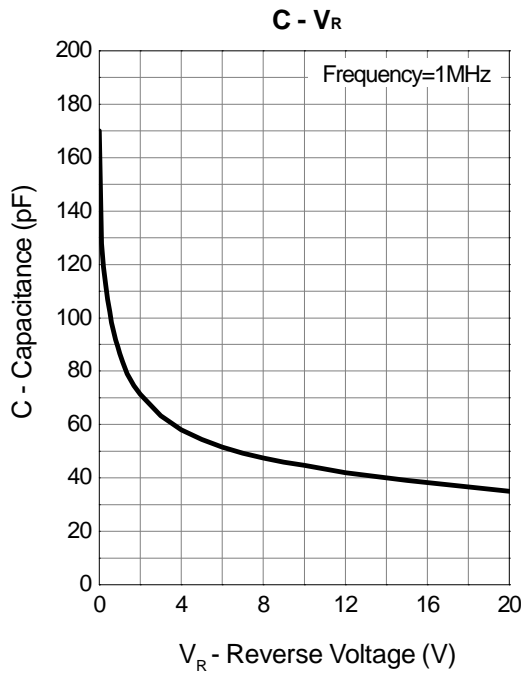
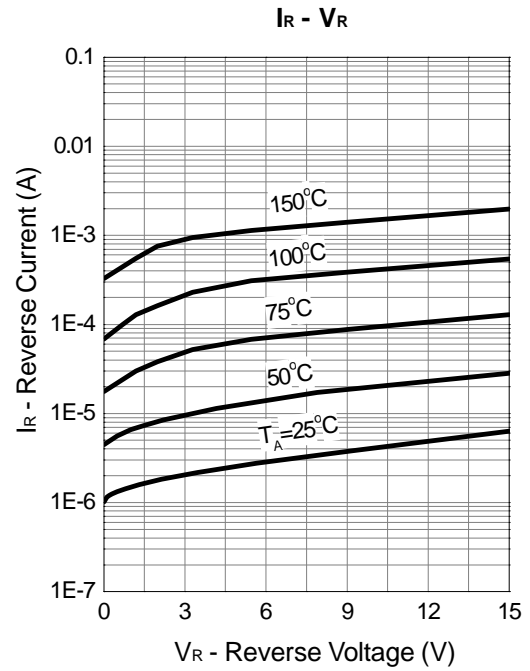
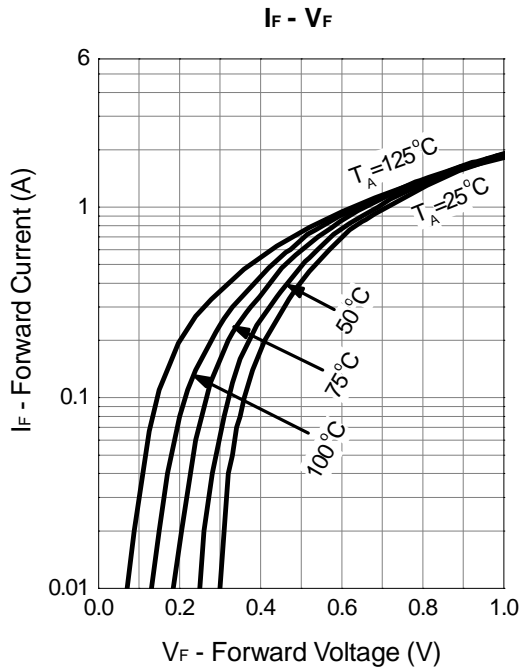


Gate Charge



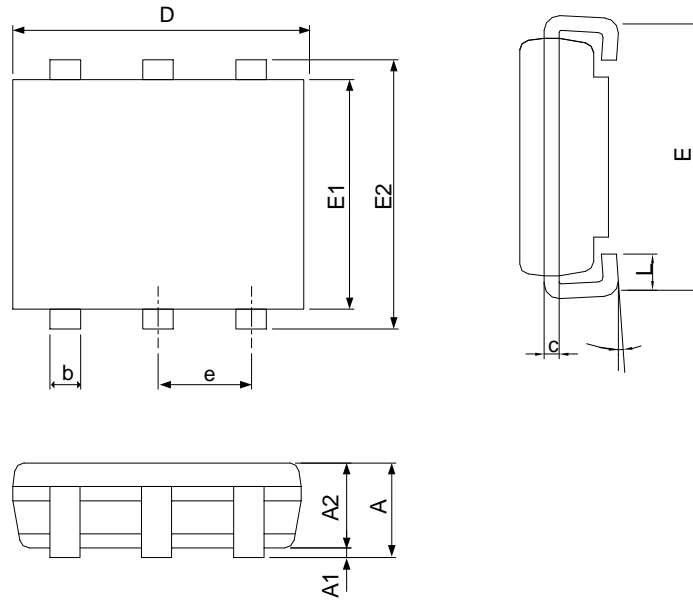
Typical Operating Characteristics (Cont.)

SBD



Package Information

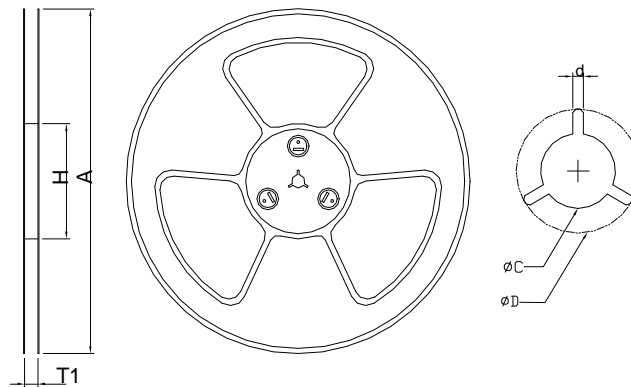
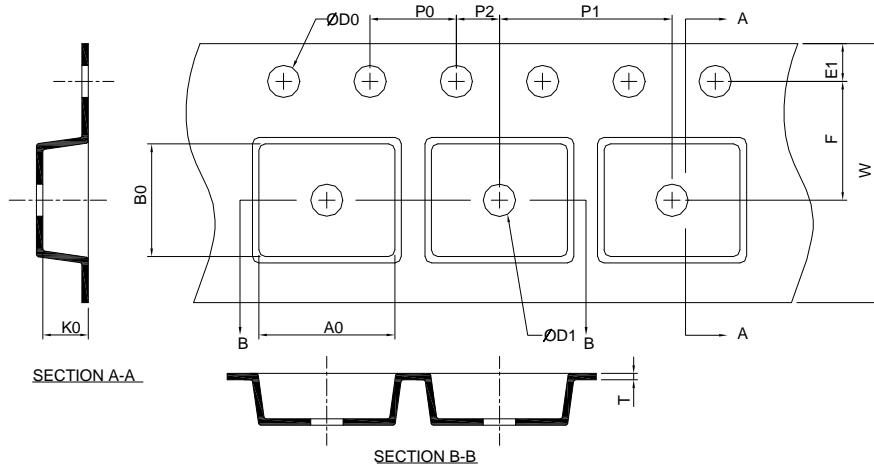
JSOT-6



| DIMENSIONS | JSOT-6      |      |           |       |
|------------|-------------|------|-----------|-------|
|            | MILLIMETERS |      | INCHES    |       |
|            | MIN.        | MAX. | MIN.      | MAX.  |
| A          | 0.93        | 1.10 | 0.037     | 0.043 |
| A1         | 0.01        | 0.10 | 0.000     | 0.004 |
| A2         | 0.92        | 1.00 | 0.036     | 0.039 |
| b          | 0.25        | 0.40 | 0.010     | 0.016 |
| c          | 0.10        | 0.20 | 0.004     | 0.008 |
| D          | 2.95        | 3.10 | 0.116     | 0.122 |
| E          | 2.50        | 3.00 | 0.098     | 0.118 |
| E1         | 2.30        | 2.50 | 0.091     | 0.098 |
| E2         | 2.65        | 3.05 | 0.104     | 0.120 |
| e          | 0.95 BSC    |      | 0.037 BSC |       |
| θ          | 0°          | 8°   | 0°        | 8°    |
| L          | 0.30        | 0.60 | 0.012     | 0.024 |

Note : 1. Follow GEM 2928 6J.  
 2. Dimension D, D1, and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 10 mil.

### Carrier Tape & Reel Dimensions



| Application | A           | H         | T1                | C                  | d        | D                 | W          | E1         | F          |
|-------------|-------------|-----------|-------------------|--------------------|----------|-------------------|------------|------------|------------|
| JSOT-6      | 178.0 ±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 ±0.30  | 1.75 ±0.10 | 3.5 ±0.05  |
|             | P0          | P1        | P2                | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10   | 4.0 ±0.10 | 2.0 ±0.05         | 1.5+0.10<br>-0.00  | 1.0 MIN. | 0.6+0.00<br>-0.40 | 3.20 ±0.20 | 3.10 ±0.20 | 1.50 ±0.20 |

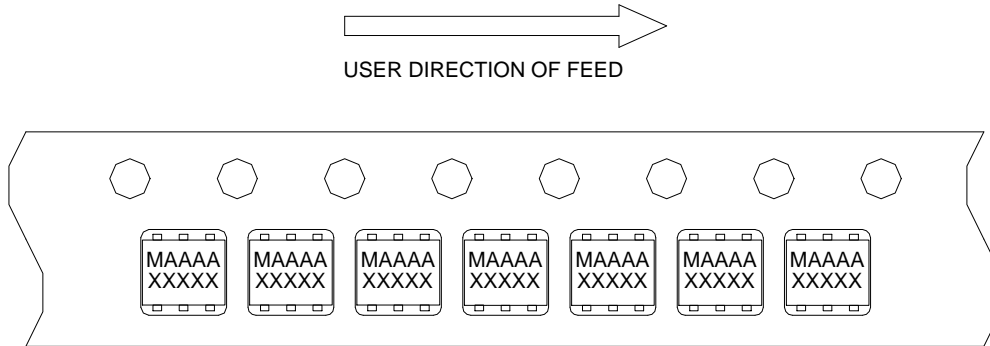
(mm)

### Devices Per Unit

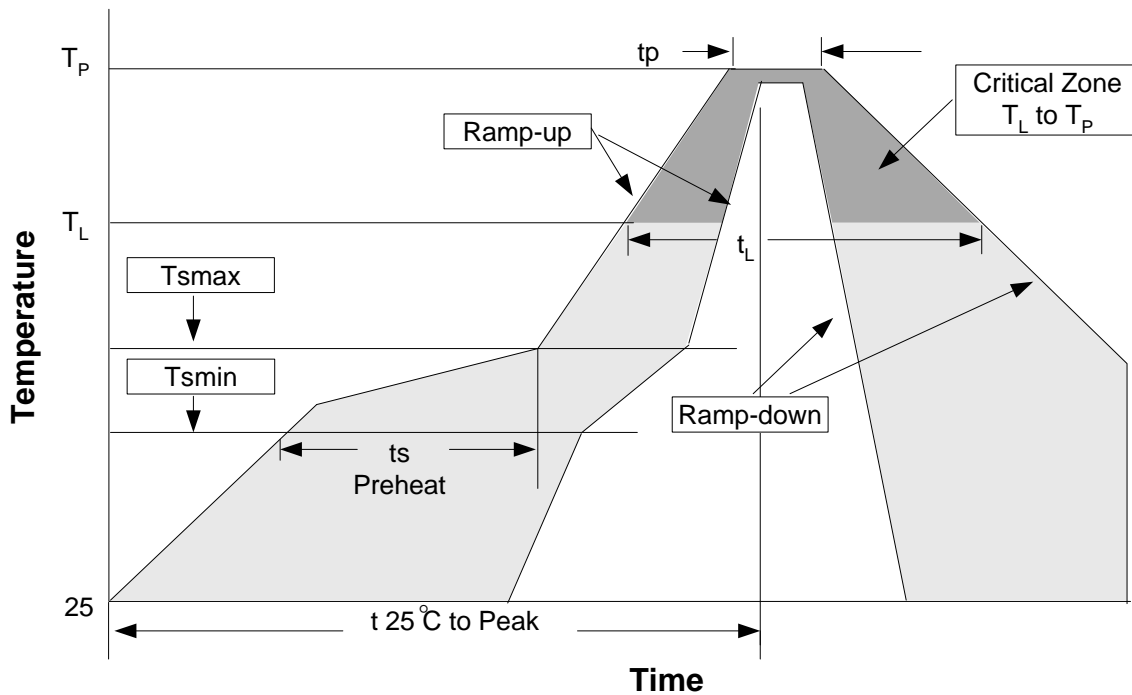
| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| JSOT-6       | Tape & Reel | 3000     |

## Taping Direction Information

JSOT-6



## 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>smin</sub> )<br>- Temperature Max (T <sub>smax</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.

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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P-Channel Enhancement Mode MOSFET with Schottky Diode

## Features

### MOSFET

- 20V/-1.5A,  
 $R_{DS(ON)} = 145m\Omega(\text{typ.}) @ V_{GS} = -4.5V$   
 $R_{DS(ON)} = 180m\Omega(\text{typ.}) @ V_{GS} = -2.5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free Available (RoHS Compliant)

### SBD

- Low Forward Voltage

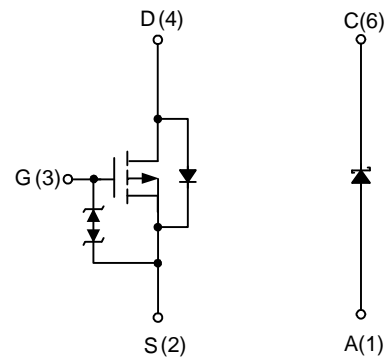
## Applications

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

## Pin Description



Top View of JSOT-6



P-Channel MOSFET

SBD

## Ordering and Marking Information

|  |   |
|--|---|
| <p>APM2803    □□□-□□□</p> <ul style="list-style-type: none"> <li>└─ Lead Free Code</li> <li>└─ Handling Code</li> <li>└─ Temp. Range</li> <li>└─ Package Code</li> </ul> | <p>Package Code<br/>CG : JSOT-6</p> <p>Operating Junction Temp. Range<br/>C : -55 to 150°C</p> <p>Handling Code<br/>TR : Tape &amp; Reel</p> <p>Lead Free Code<br/>L : Lead Free Device</p> |
| <p>APM2803 CG :    <span style="border: 1px solid black; padding: 2px;">M2803<br/>XXXXX</span></p>   | <p>XXXXX - Date Code</p>  |

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte in plate termination finish; which are fully compliant with RoHS and compatible with both SnPb and lead-free soldering operations. 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 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                      |
|-------------------|--|---------------------------|---------------------------|
| <b>MOSFET</b>     |  |                           |                           |
| $V_{DSS}$         | Drain-Source Voltage                   | -20                       | V                         |
| $V_{GSS}$         | Gate-Source Voltage                    | $\pm 10$                  |                           |
| $I_D^*$           | Continuous Drain Current               | $V_{GS} = -4.5V$          | A                         |
| $I_{DM}^*$        | 300 $\mu\text{s}$ Pulsed Drain Current |                           |                           |
| $I_S^*$           | Diode Continuous Forward Current       | -1                        | A                         |
| $T_J$             | Maximum Junction Temperature           | 150                       | $^\circ\text{C}$          |
| $T_{STG}$         | Storage Temperature Range              | -55 to 150                |                           |
| $P_D^*$           | Maximum Power Dissipation              | $T_A = 25^\circ\text{C}$  | 0.83                      |
|                   |  | $T_A = 100^\circ\text{C}$ | 0.3                       |
| $R_{\theta JA}^*$ | Thermal Resistance-Junction to Ambient | 150                       | $^\circ\text{C}/\text{W}$ |
| <b>SBD</b>        |  |                           |                           |
| $V_{RRM}$         | Repetitive Peak Reverse Voltage        | 20                        | V                         |
| $I_{FSM}$         | Maximum Peak Forward Surge Current     | 5.5                       | A                         |

Notes:

\*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 Condition   | APM2803CG |      |          | Unit          |
|-------------------------------|----------------------------------|--|-----------|------|----------|---------------|
|                               |                                  |  | Min.      | Typ. | Max.     |               |
| <b>MOSFET</b>                 |                                  |  |           |      |          |               |
| <b>Static Characteristics</b> |                                  |  |           |      |          |               |
| $BV_{DSS}$                    | Drain-Source Breakdown Voltage   | $V_{GS} = 0V, I_{DS} = -250\mu\text{A}$                  | -20       |      |          | V             |
| $I_{DSS}$                     | Zero Gate Voltage Drain Current  | $V_{DS} = -16V, V_{GS} = 0V$<br>$T_J = 85^\circ\text{C}$ |           |      | -1       | $\mu\text{A}$ |
|                               |                                  |  |           |      | -30      |               |
| $V_{GS(th)}$                  | Gate Threshold Voltage           | $V_{DS} = V_{GS}, I_{DS} = -250\mu\text{A}$              | -0.45     | -0.6 | -1       | V             |
| $I_{GSS}$                     | Gate Leakage Current             | $V_{GS} = \pm 10V, V_{DS} = 0V$                          |           |      | $\pm 10$ | $\mu\text{A}$ |
| $R_{DS(ON)}^a$                | Drain-Source On-state Resistance | $V_{GS} = -4.5V, I_{DS} = -1.5A$                         |           | 145  | 185      | m $\Omega$    |
|                               |                                  | $V_{GS} = -2.5V, I_{DS} = -1A$                           |           | 180  | 235      |               |
| $V_{SD}^a$                    | Diode Forward Voltage            | $I_{SD} = -0.5A, V_{GS} = 0V$                            |           | -0.7 | -1.3     | V             |

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

| Symbol   | Parameter                    | Test Condition  | APM2803CG |      |      | Unit    |
|--|------------------------------|---|-----------|------|------|---------|
|  |                              |   | Min.      | Typ. | Max. |         |
| <b>MOSFET</b>                                  |                              |   |           |      |      |         |
| <b>Dynamic Characteristics<sup>b</sup></b>     |                              |   |           |      |      |         |
| $C_{iss}$                                      | Input Capacitance            | $V_{GS}=0V,$<br>$V_{DS}=-10V,$<br>Frequency=1.0MHz                            |           | 375  |      | pF      |
| $C_{oss}$                                      | Output Capacitance           |   |           | 90   |      |         |
| $C_{rss}$                                      | Reverse Transfer Capacitance |   |           | 40   |      |         |
| $t_{d(ON)}$                                    | Turn-on Delay Time           | $V_{DD}=-10V, R_L=10\Omega,$<br>$I_{DS}=-1A, V_{GEN}=-4.5V,$<br>$R_G=6\Omega$ |           | 8    | 15   | ns      |
| $T_r$  | Turn-on Rise Time            |   |           | 22   | 41   |         |
| $t_{d(OFF)}$                                   | Turn-off Delay Time          |   |           | 29   | 53   |         |
| $T_f$  | Turn-off Fall Time           |   |           | 35   | 64   |         |
| $t_{rr}$                                       | Reverse Recovery Time        | $I_{DS}=-1.5A, di_{SD}/dt=100A/\mu s$   |           | 14   |      | ns      |
| $Q_{rr}$                                       | Reverse Recovery Charge      |   |           | 6    |      | nC      |
| <b>Gate Charge Characteristics<sup>b</sup></b> |                              |   |           |      |      |         |
| $Q_g$  | Total Gate Charge            | $V_{DS}=-10V, V_{GS}=-4.5V,$<br>$I_{DS}=-1.5A$                                |           | 4    | 6    | nC      |
| $Q_{gs}$                                       | Gate-Source Charge           |   |           | 0.8  |      |         |
| $Q_{gd}$                                       | Gate-Drain Charge            |   |           | 1    |      |         |
| <b>SBD</b>                                     |                              |   |           |      |      |         |
| $V_R$  | Reverse Voltage              | $I_R=0.5mA$   | 20        |      |      | V       |
| $V_{F1}$                                       | Forward Voltage              | $I_F=10mA$  |           |      | 0.4  | V       |
| $V_{F2}$                                       |                              | $I_F=500mA$   |           |      | 0.5  | V       |
| $I_R$  | Reverse Current              | $V_R=15V$   |           |      | 200  | $\mu A$ |
| $C^b$  | Junction Capacitance         | $V_R=10V,$<br>Frequency=1.0MHz  |           | 45   |      | pF      |

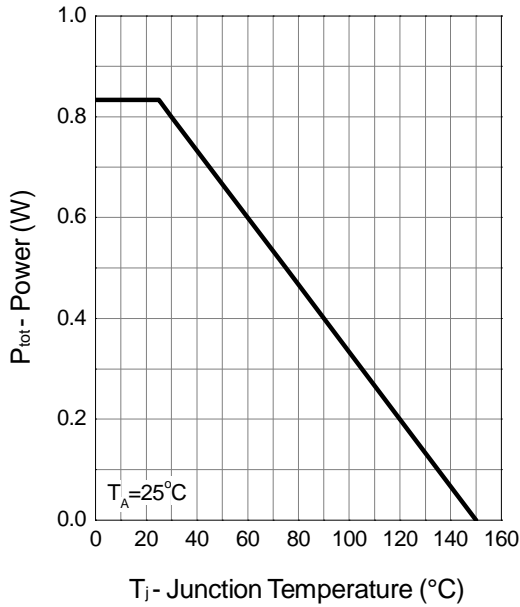
Notes:

- a : Pulse test ; pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$ .
- b : Guaranteed by design, not subject to production testing.

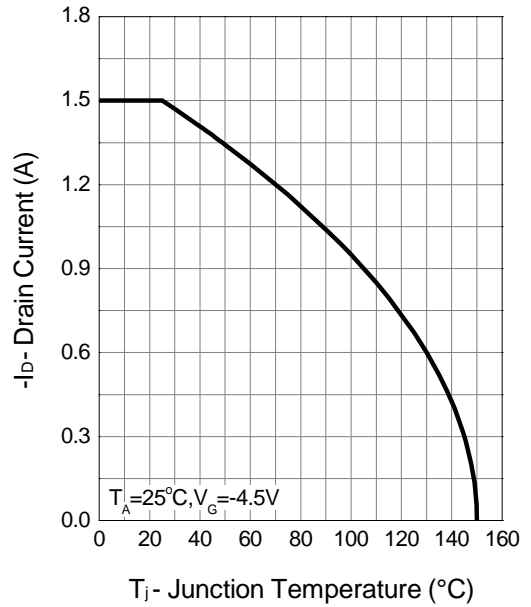
## Typical Characteristics

### P-Channel MOSFET

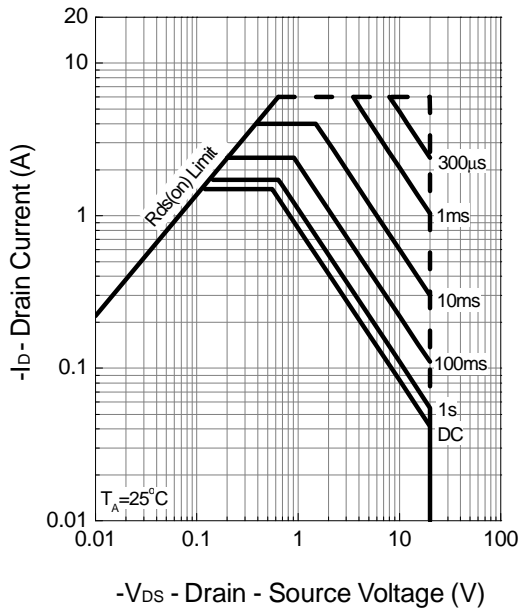
Power Dissipation



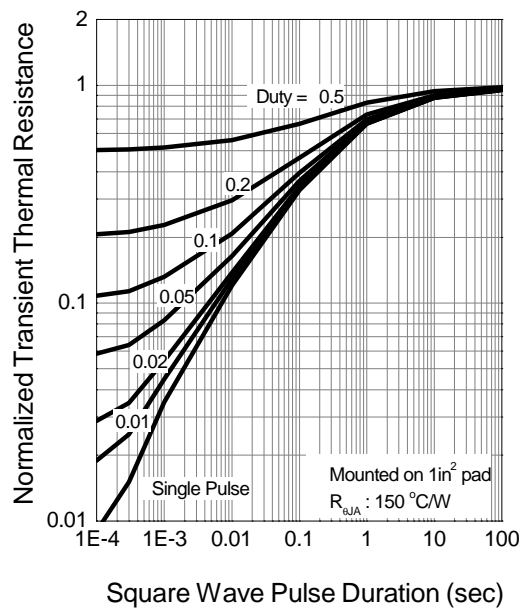
Drain Current



Safe Operation Area

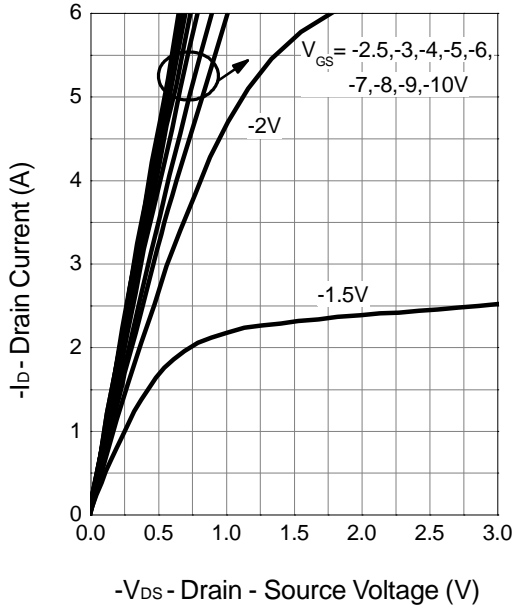


Thermal Transient Impedance

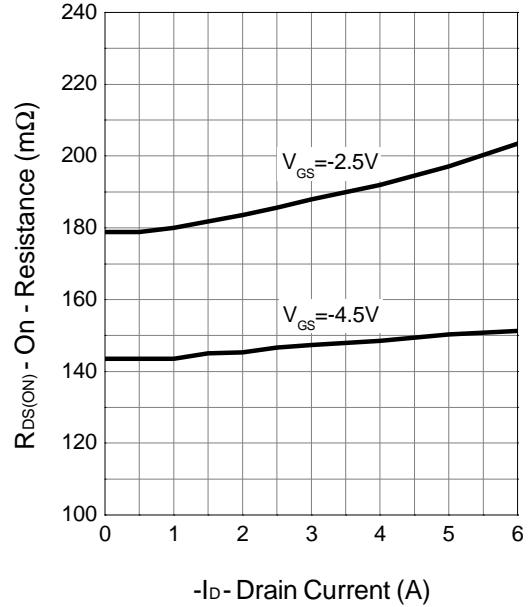


Typical Characteristics (Cont.)

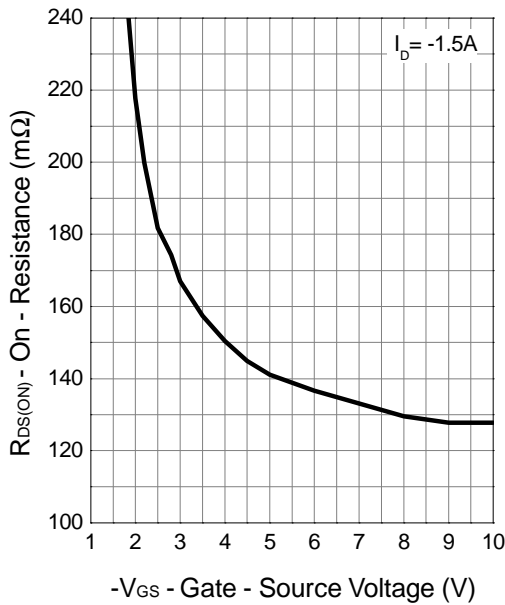
Output Characteristics



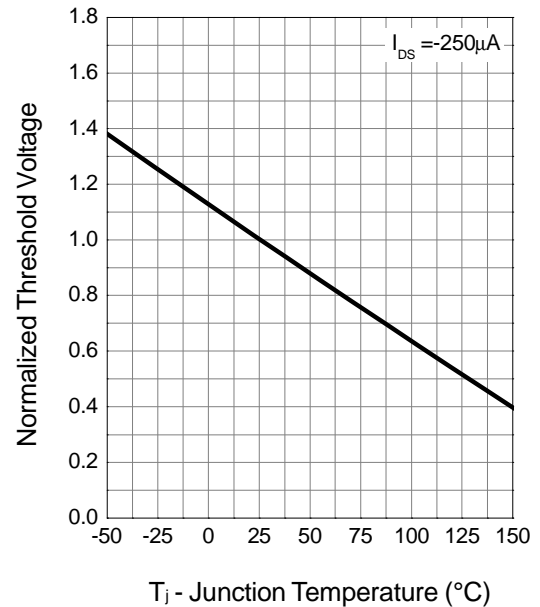
Drain-Source On Resistance



Drain-Source On Resistance

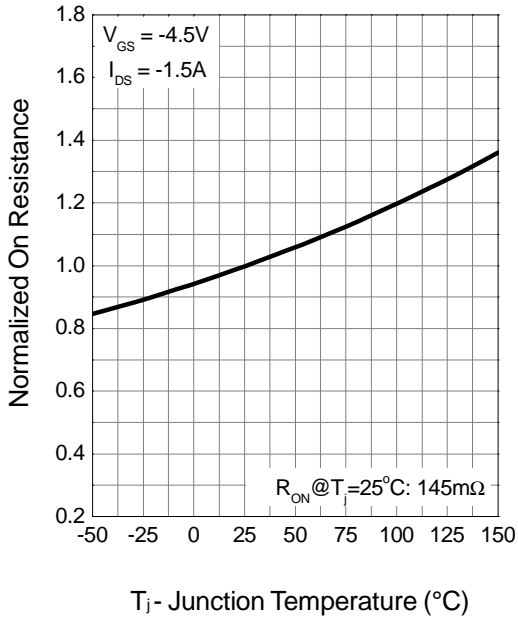


Gate Threshold Voltage

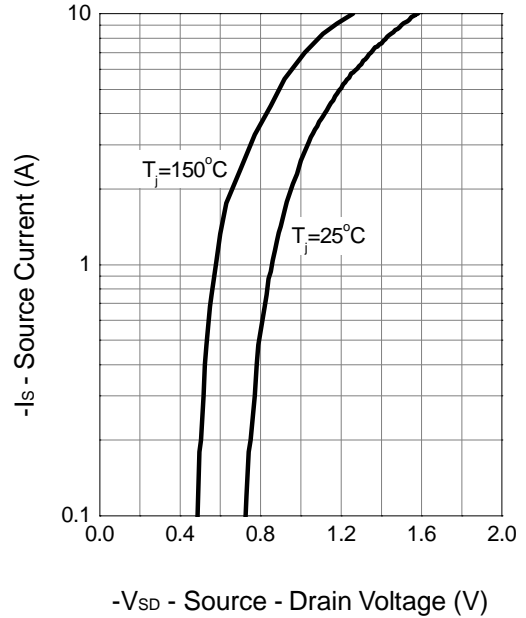


Typical Characteristics (Cont.)

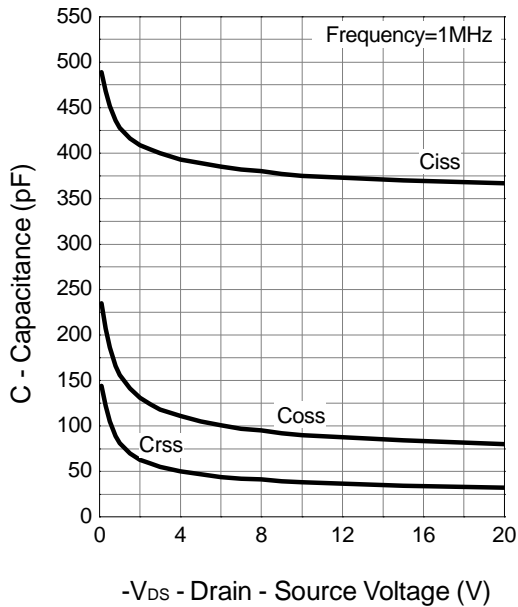
Drain-Source On Resistance



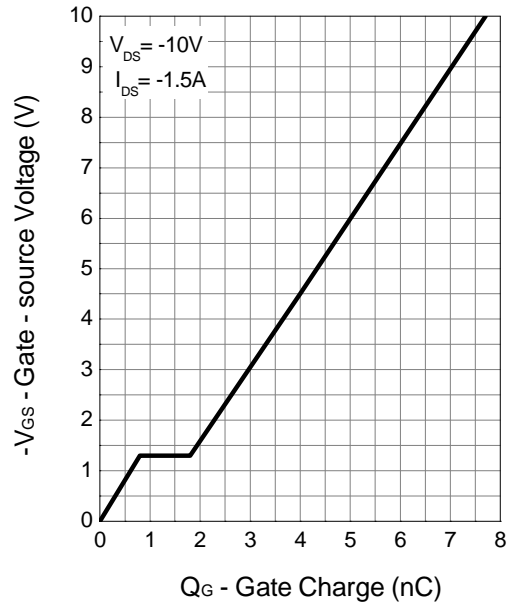
Source-Drain Diode Forward



Capacitance

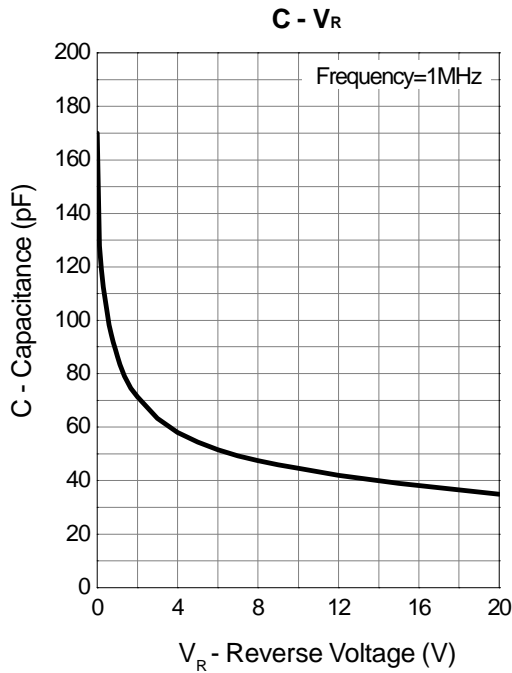
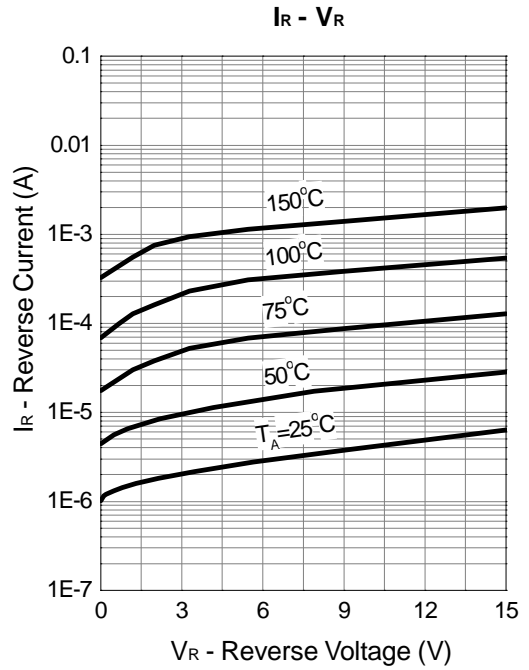
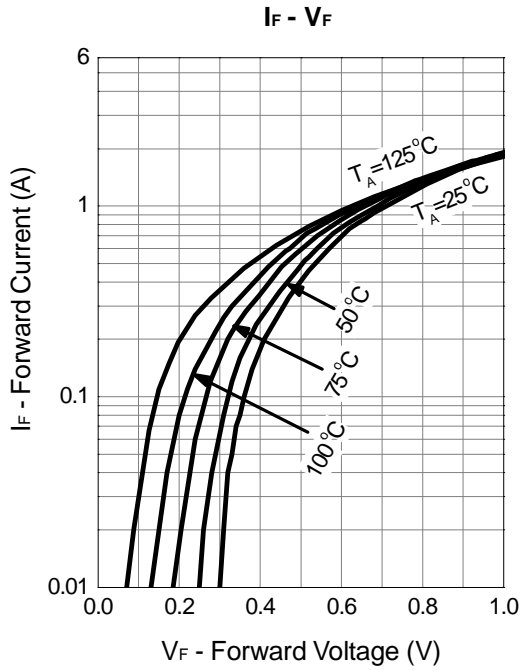


Gate Charge



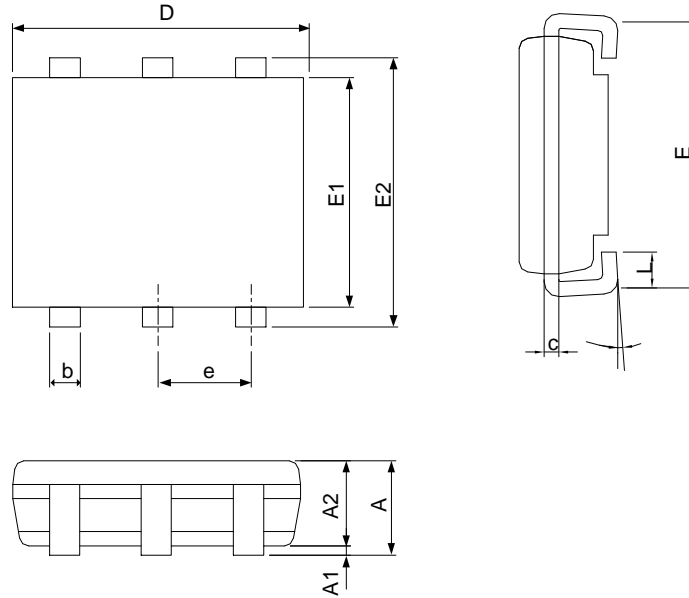
Typical Characteristics (Cont.)

SBD



## Package Information

JSOT-6

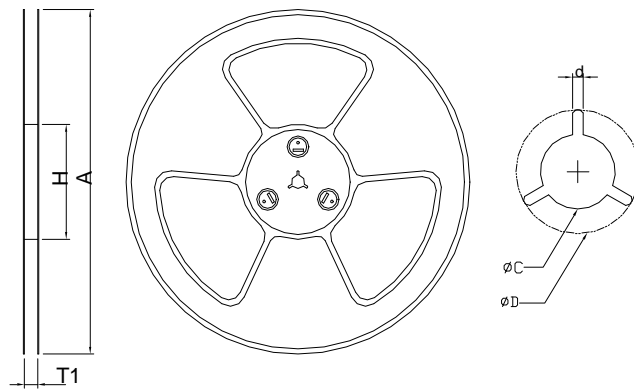
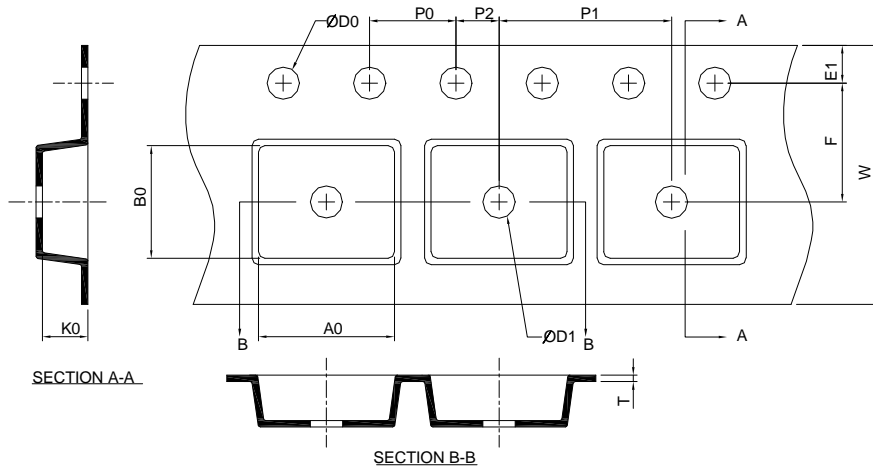


| DIMENSIONS | JSOT-6      |      |           |       |
|------------|-------------|------|-----------|-------|
|            | MILLIMETERS |      | INCHES    |       |
|            | MIN.        | MAX. | MIN.      | MAX.  |
| A          | 0.93        | 1.10 | 0.037     | 0.043 |
| A1         | 0.01        | 0.10 | 0.000     | 0.004 |
| A2         | 0.92        | 1.00 | 0.036     | 0.039 |
| b          | 0.25        | 0.40 | 0.010     | 0.016 |
| c          | 0.10        | 0.20 | 0.004     | 0.008 |
| D          | 2.95        | 3.10 | 0.116     | 0.122 |
| E          | 2.50        | 3.00 | 0.098     | 0.118 |
| E1         | 2.30        | 2.50 | 0.091     | 0.098 |
| E2         | 2.65        | 3.05 | 0.104     | 0.120 |
| e          | 0.95 BSC    |      | 0.037 BSC |       |
| θ          | 0°          | 8°   | 0°        | 8°    |
| L          | 0.30        | 0.60 | 0.012     | 0.024 |

Note : 1. Follow GEM 2928 6J.  
 2. Dimension D, D1 and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 10 mil.



### Carrier Tape & Reel Dimensions



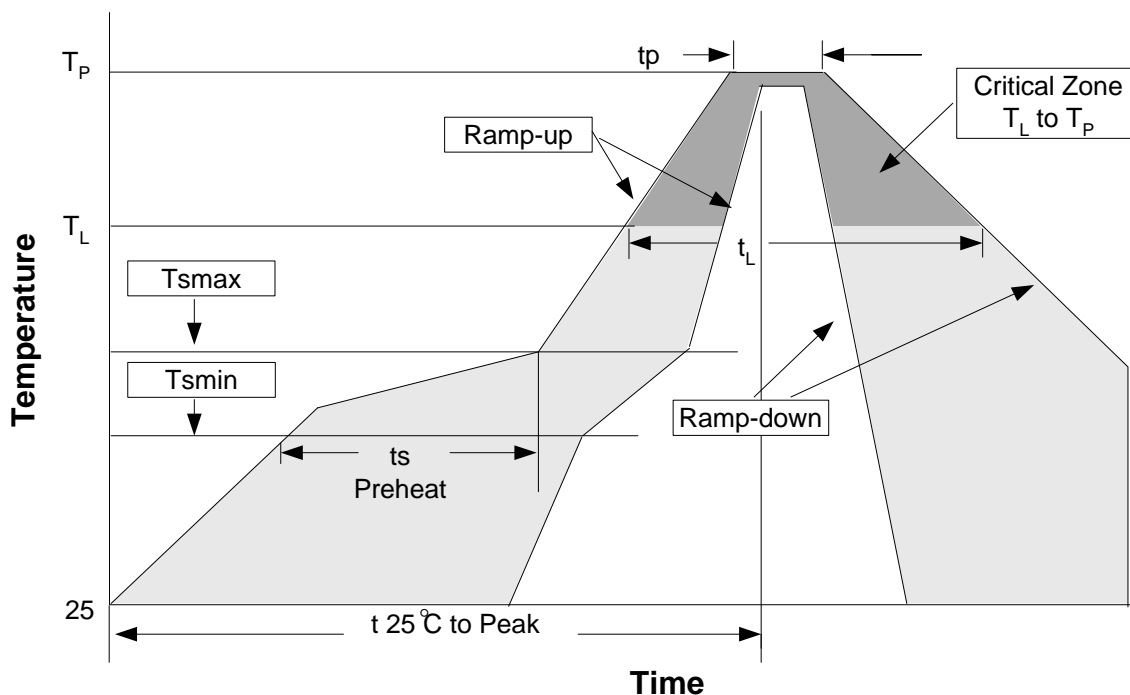
| Application | A            | H         | T1                | C                  | d        | D                 | W          | E1         | F          |
|-------------|--------------|-----------|-------------------|--------------------|----------|-------------------|------------|------------|------------|
| JSOT-6      | 178.0 ± 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 ±0.30  | 1.75 ±0.10 | 3.5 ±0.05  |
|             | P0           | P1        | P2                | D0                 | D1       | T                 | A0         | B0         | K0         |
|             | 4.0 ±0.10    | 4.0 ±0.10 | 2.0 ±0.10         | 1.5+0.10<br>-0.00  | 1.5 MIN. | 0.6+0.00<br>-0.40 | 3.20 ±0.20 | 3.10 ±0.20 | 1.50 ±0.20 |

(mm)

### Devices Per Unit

| Package Type | Unit        | Quantity |
|--------------|-------------|----------|
| JSOT-6       | Tape & Reel | 3000     |

### 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  |                         |                  |
| - Temperature Min (T <sub>smmin</sub> )                      | 100°C                   | 150°C            |
| - Temperature Max (T <sub>smmax</sub> )                      | 150°C                   | 200°C            |
| - Time (min to max) (t <sub>s</sub> )                        | 60-120 seconds          | 60-180 seconds   |
| Time maintained above:                                       |                         |                  |
| - Temperature (T <sub>L</sub> )                              | 183°C                   | 217°C            |
| - Time (t <sub>L</sub> )                                     | 60-150 seconds          | 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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