

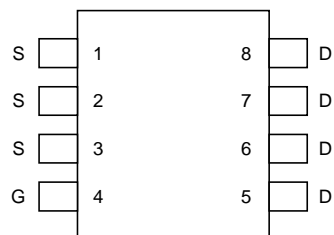
## N-Channel Enhancement Mode MOSFET

### Features

- 30V/8A ,  $R_{DS(ON)}=15m\Omega(\text{typ.}) @ V_{GS}=10V$   
 $R_{DS(ON)}=22m\Omega(\text{typ.}) @ V_{GS}=4.5V$
- Super High Dense Cell Design for Extremely Low  $R_{DS(ON)}$
- Reliable and Rugged
- SO-8 Package

### Pin Description

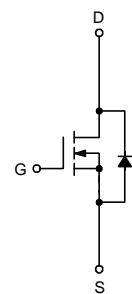
SO-8



Top View

### Applications

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



N-Channel MOSFET

### Ordering and Marking Information

|                                                                                                  |                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>APM4416 □□-□□</p> <p>Handling Code</p> <p>Temp. Range</p> <p>Package Code</p>                 | <p>Package Code<br/>K : SO-8</p> <p>Operating Junction Temp. Range<br/>C : -55 to 150°C</p> <p>Handling Code<br/>TU : Tube<br/>TR : Tape &amp; Reel</p> |
| <p>APM4416 K : <span style="border: 1px solid black; padding: 2px;">APM4416<br/>XXXXX</span></p> | <p>XXXXX - Date Code</p>                                                                                                                                |

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

| Symbol    | Parameter                          | Rating   | Unit |
|-----------|------------------------------------|----------|------|
| $V_{DSS}$ | Drain-Source Voltage               | 30       | V    |
| $V_{GSS}$ | Gate-Source Voltage                | $\pm 20$ |      |
| $I_D^*$   | Maximum Drain Current – Continuous | 8        | A    |
| $I_{DM}$  | Maximum Drain Current – Pulsed     | 32       |      |

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

ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

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

| Symbol          | Parameter                                | Rating                  | Unit               |
|-----------------|------------------------------------------|-------------------------|--------------------|
| $P_D$           | Maximum Power Dissipation                | $T_A=25^\circ\text{C}$  | 2.5                |
|                 |                                          | $T_A=100^\circ\text{C}$ | 1.0                |
| $T_J$           | Maximum Junction Temperature             | 150                     | $^\circ\text{C}$   |
| $T_{STG}$       | Storage Temperature Range                | -55 to 150              | $^\circ\text{C}$   |
| $R_{\theta JA}$ | Thermal Resistance – Junction to Ambient | 50                      | $^\circ\text{C/W}$ |

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

| Symbol                     | Parameter                        | Test Condition                                         | APM4416 |      |           | Unit          |
|----------------------------|----------------------------------|--------------------------------------------------------|---------|------|-----------|---------------|
|                            |                                  |                                                        | Min.    | Typ. | Max.      |               |
| <b>Static</b>              |                                  |                                                        |         |      |           |               |
| $BV_{DSS}$                 | Drain-Source Breakdown Voltage   | $V_{GS}=0V, I_{DS}=250\mu\text{A}$                     | 30      |      |           | V             |
| $I_{DSS}$                  | Zero Gate Voltage Drain Current  | $V_{DS}=24V, V_{GS}=0V$                                |         |      | 1         | $\mu\text{A}$ |
|                            |                                  | $V_{DS}=24V, V_{GS}=0V, T_J=55^\circ\text{C}$          |         |      | 5         |               |
| $V_{GS(th)}$               | Gate Threshold Voltage           | $V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$                 | 1       |      | 3         | V             |
| $I_{GSS}$                  | Gate Leakage Current             | $V_{GS}=\pm 20V, V_{DS}=0V$                            |         |      | $\pm 100$ | nA            |
| $R_{DS(ON)}^a$             | Drain-Source On-state Resistance | $V_{GS}=10V, I_{DS}=4A$                                |         | 15   | 18        | m $\Omega$    |
|                            |                                  | $V_{GS}=4.5V, I_{DS}=2A$                               |         | 22   | 30        |               |
| $V_{SD}^a$                 | Diode Forward Voltage            | $I_{SD}=2A, V_{GS}=0V$                                 | 0.6     |      | 1.3       | V             |
| <b>Dynamic<sup>b</sup></b> |                                  |                                                        |         |      |           |               |
| $Q_g$                      | Total Gate Charge                | $V_{DS}=15V, I_{DS}=10A$<br>$V_{GS}=5V$                |         | 15   | 20        | nC            |
| $Q_{gs}$                   | Gate-Source Charge               |                                                        |         | 5.8  |           |               |
| $Q_{gd}$                   | Gate-Drain Charge                |                                                        |         | 3.8  |           |               |
| $t_{d(ON)}$                | Turn-on Delay Time               | $V_{DD}=15V, I_{DS}=2A,$<br>$V_{GEN}=10V, R_G=6\Omega$ |         | 11   | 18        | ns            |
| $T_r$                      | Turn-on Rise Time                |                                                        |         | 17   | 26        |               |
| $t_{d(OFF)}$               | Turn-off Delay Time              |                                                        |         | 37   | 54        |               |
| $T_f$                      | Turn-off Fall Time               |                                                        |         | 20   | 30        |               |
| $C_{iss}$                  | Input Capacitance                | $V_{GS}=0V$                                            |         | 1150 |           | pF            |
| $C_{oss}$                  | Output Capacitance               | $V_{DS}=15V$                                           |         | 230  |           |               |
| $C_{rss}$                  | Reverse Transfer Capacitance     | Frequency=1.0MHz                                       |         | 100  |           |               |

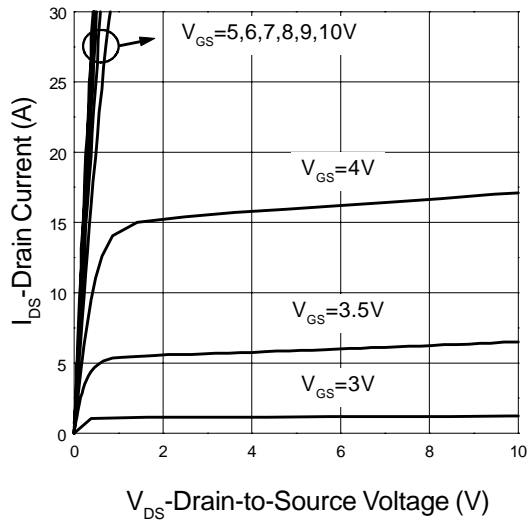
**Notes**

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

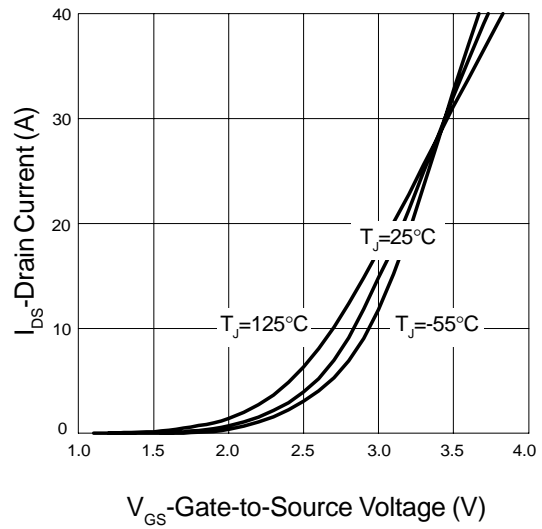
<sup>b</sup> : Guaranteed by design, not subject to production testing

## Typical Characteristics

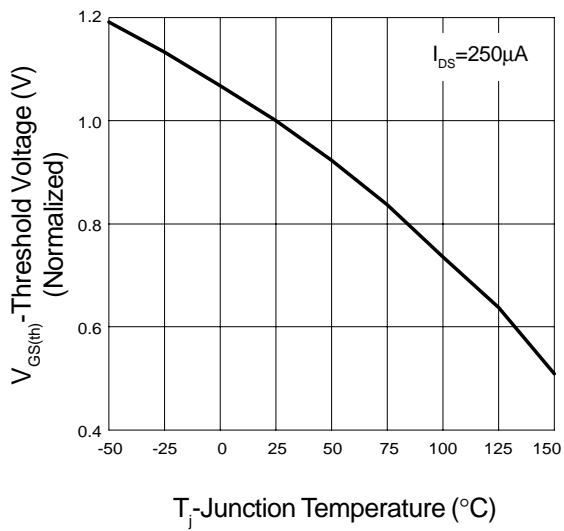
Output Characteristics



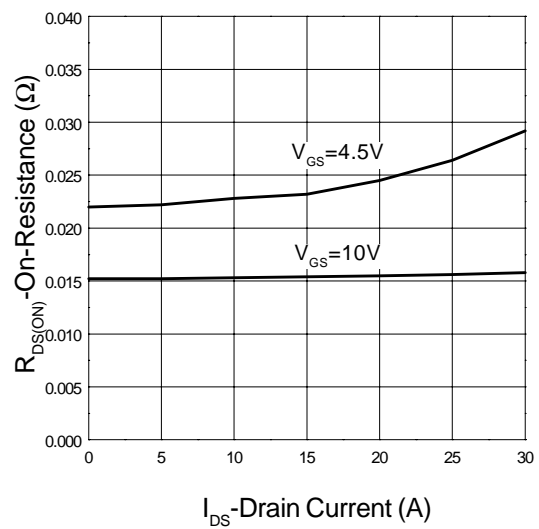
Transfer Characteristics



Threshold Voltage vs. Junction Temperature

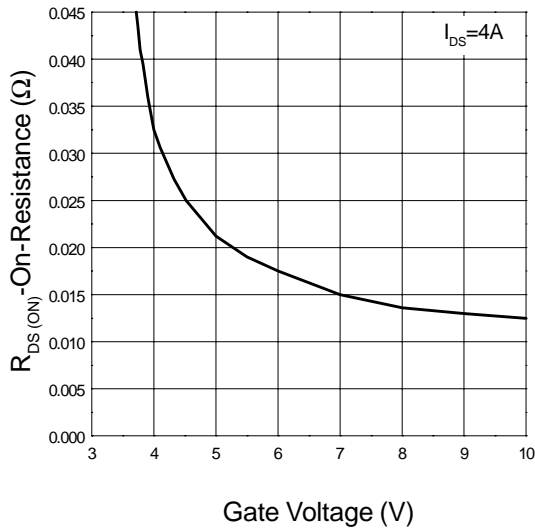


On-Resistance vs. Drain Current

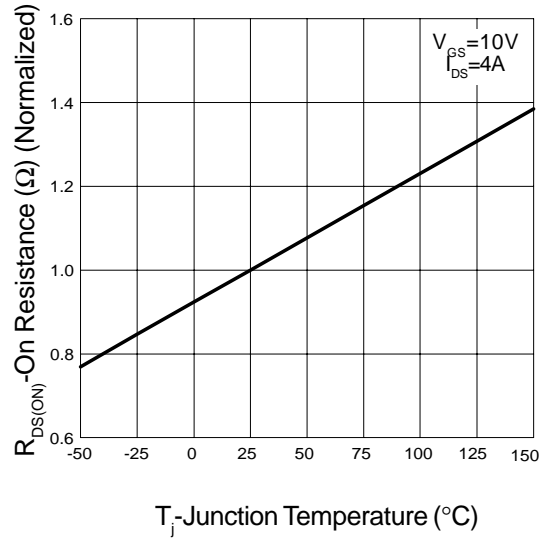


Typical Characteristics Cont.

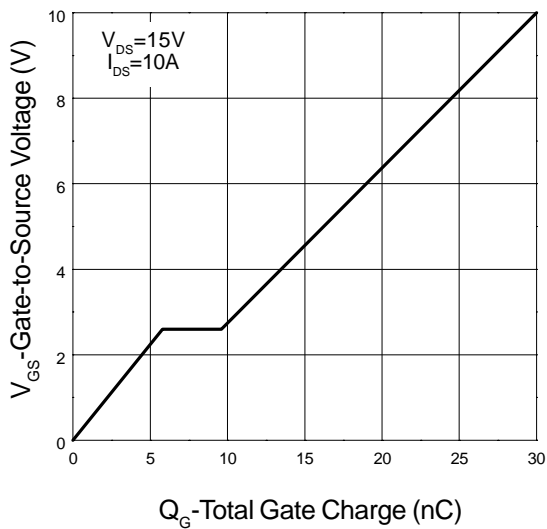
On-Resistance vs. Gate-to-Source Voltage



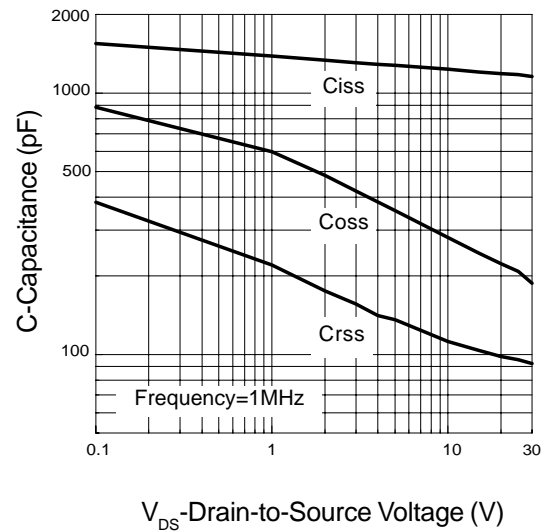
On-Resistance vs. Junction Temperature



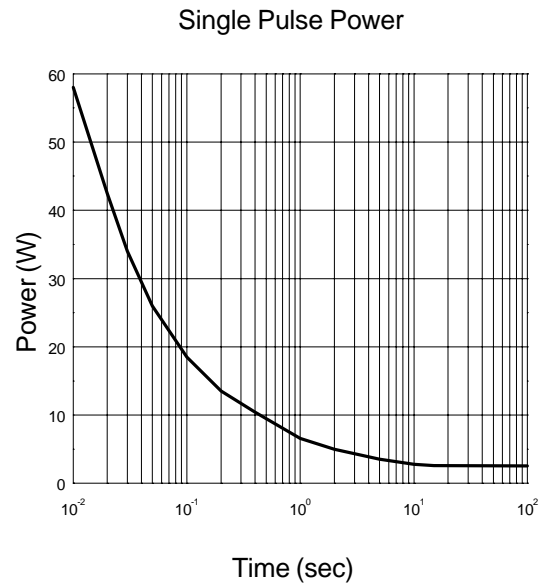
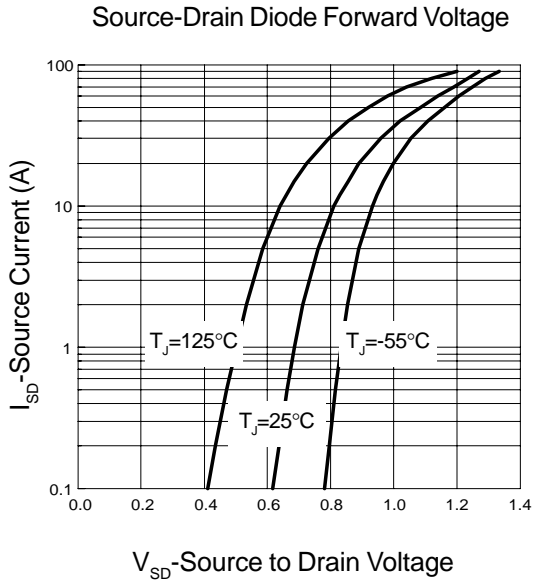
Gate Charge



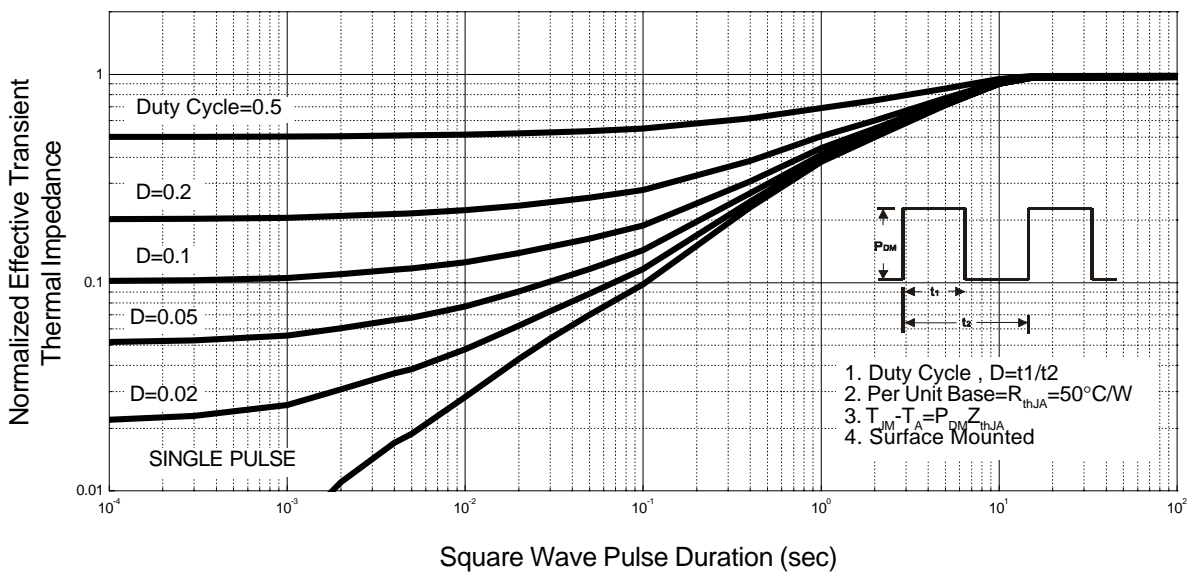
Capacitance Characteristics



Typical Characteristics Cont.

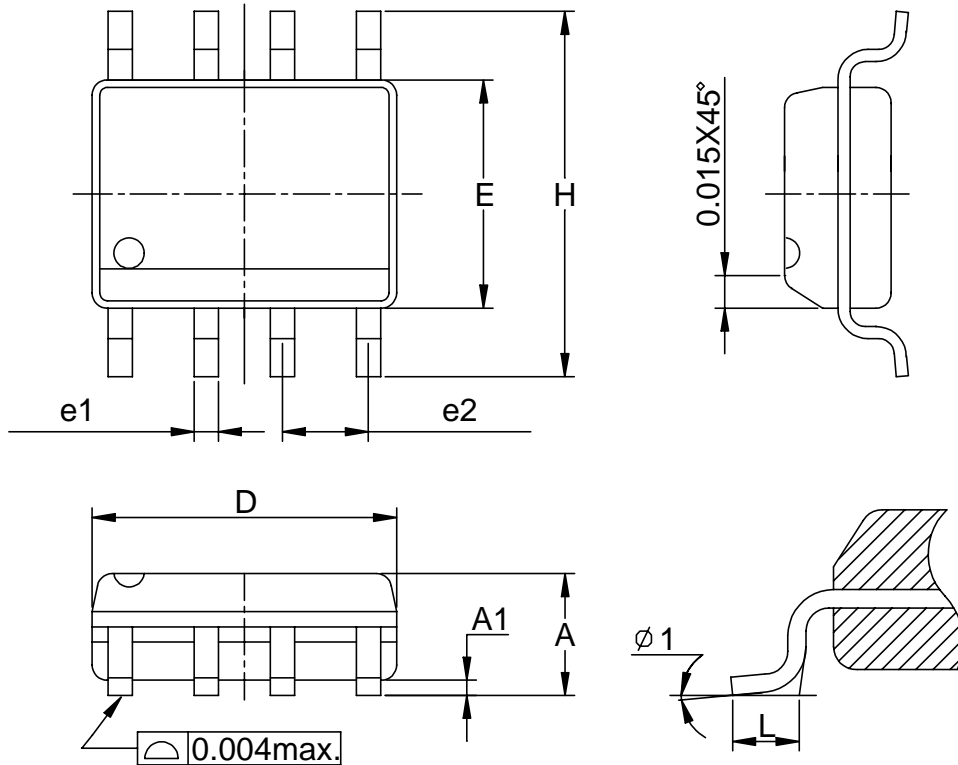


Normalized Transient Thermal Impedance, Junction to Ambient



## Packaging Information

SOP-8 pin ( Reference JEDEC Registration MS-012)



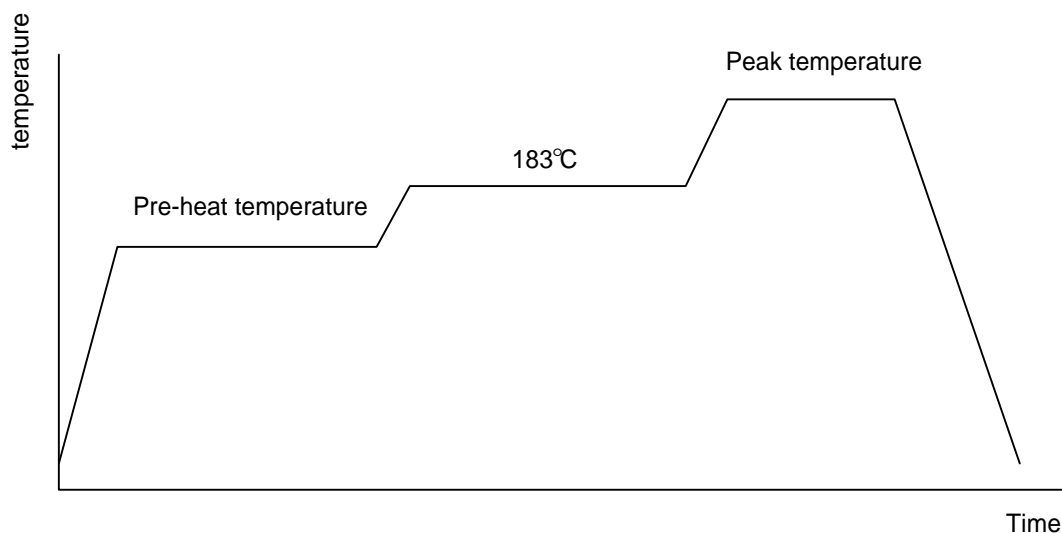
| Dim | Millimeters |      | Inches  |       |
|-----|-------------|------|---------|-------|
|     | Min.        | Max. | Min.    | Max.  |
| A   | 1.35        | 1.75 | 0.053   | 0.069 |
| A1  | 0.10        | 0.25 | 0.004   | 0.010 |
| D   | 4.80        | 5.00 | 0.189   | 0.197 |
| E   | 3.80        | 4.00 | 0.150   | 0.157 |
| H   | 5.80        | 6.20 | 0.228   | 0.244 |
| L   | 0.40        | 1.27 | 0.016   | 0.050 |
| e1  | 0.33        | 0.51 | 0.013   | 0.020 |
| e2  | 1.27BSC     |      | 0.50BSC |       |
| φ 1 | 8°          |      | 8°      |       |

## Physical Specifications

|                    |                                                              |
|--------------------|--------------------------------------------------------------|
| Terminal Material  | Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb) |
| Lead Solderability | Meets EIA Specification RS186-91, ANSI/J-STD-002 Category 3. |

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

Reference JEDEC Standard J-STD-020A APRIL 1999



### Classification Reflow Profiles

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

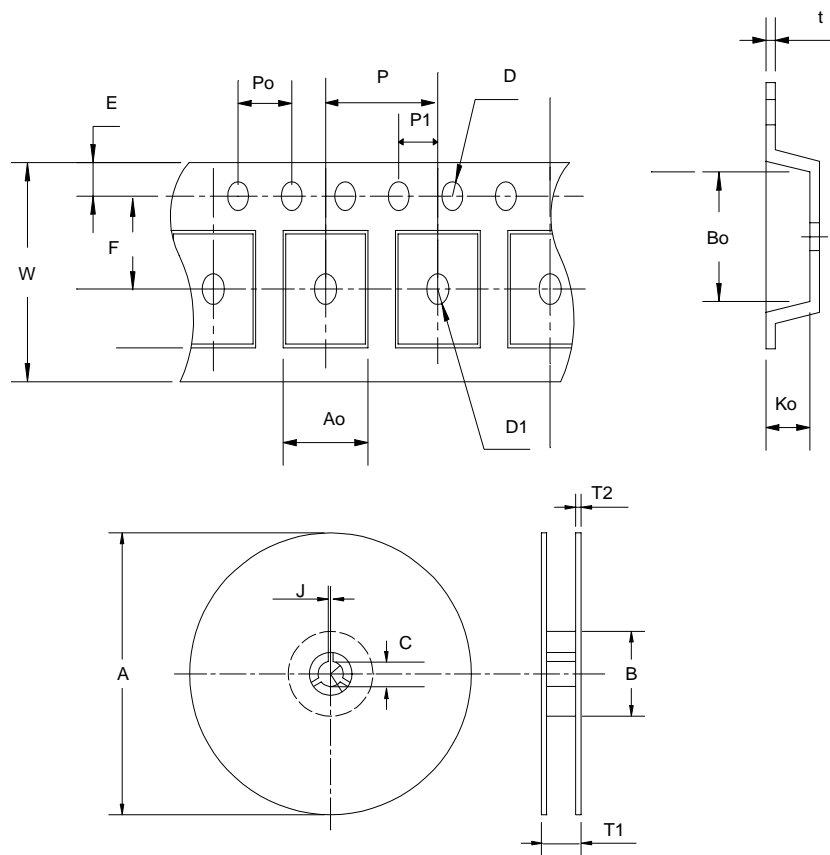
### Package Reflow Conditions

| pkg. thickness ≥ 2.5mm<br>and all bgas | pkg. thickness < 2.5mm and<br>pkg. volume ≥ 350 mm <sup>3</sup> | pkg. thickness < 2.5mm and pkg.<br>volume < 350mm <sup>3</sup> |
|----------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------|
| Convection 220 +5/-0 °C                |                                                                 | Convection 235 +5/-0 °C                                        |
| VPR 215-219 °C                         |                                                                 | VPR 235 +5/-0 °C                                               |
| IR/Convection 220 +5/-0 °C             |                                                                 | IR/Convection 235 +5/-0 °C                                     |

## Reliability test program

| Test item     | Method              | Description               |
|---------------|---------------------|---------------------------|
| SOLDERABILITY | MIL-STD-883D-2003   | 245°C, 5 SEC              |
| HOLT          | MIL-STD 883D-1005.7 | 1000 Hrs Bias @ 125°C     |
| PCT           | JESD-22-B, A102     | 168 Hrs, 100% RH, 121°C   |
| TST           | MIL-STD 883D-1011.9 | -65°C ~ 150°C, 200 Cycles |

## Carrier Tape & Reel Dimensions



| Application | A       | B         | C              | J         | T1         | T2        | W         | P         | E           |
|-------------|---------|-----------|----------------|-----------|------------|-----------|-----------|-----------|-------------|
| SOP-8       | 330 ± 1 | 62 +1.5   | 12.75+<br>0.15 | 2 ± 0.5   | 12.4 ± 0.2 | 2 ± 0.2   | 12 ± 0.3  | 8 ± 0.1   | 1.75 ± 0.1  |
|             | F       | D         | D1             | Po        | P1         | Ao        | Bo        | Ko        | t           |
|             | 5.5 ± 1 | 1.55 +0.1 | 1.55+ 0.25     | 4.0 ± 0.1 | 2.0 ± 0.1  | 6.4 ± 0.1 | 5.2 ± 0.1 | 2.1 ± 0.1 | 0.3 ± 0.013 |



## Cover Tape Dimensions

| Application | Carrier Width | Cover Tape Width | Devices Per Reel |
|-------------|---------------|------------------|------------------|
| SOP- 8      | 12            | 9.3              | 2500             |

## Customer Service

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