

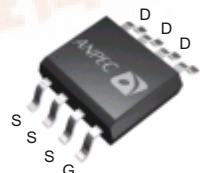
# APM4230K

## N-Channel Enhancement Mode MOSFET

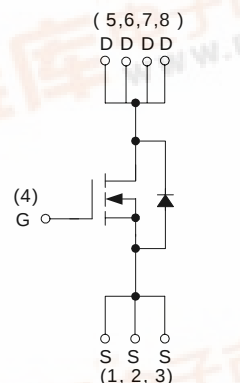
## Features

- 25V/13.5A,  
 $R_{DS(ON)}=6m\Omega(typ.) @ V_{GS}=10V$   
 $R_{DS(ON)}=7.5m\Omega(typ.) @ V_{GS}=4.5V$
- Super High Dense Cell Design
- Avalanche Rated
- Reliable and Rugged
- SOP-8 Package
- Lead Free Available (RoHS Compliant)

## Pin Description



Top View of SOP – 8



### N-Channel MOSFET

## Applications

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

## Ordering and Marking Information

|                                                                                                                                |                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>APM4230 □□-□□ □</p> <p>Lead Free Code</p> <p>Handling Code</p> <p>Temp. Range</p> <p>Package Code</p>                       | <p>Package Code<br/>K : SOP-8</p> <p>Operating Junction Temp. Range<br/>C : -55 to 150°C</p> <p>Handling Code<br/>TU : Tube    TR : Tape &amp; Reel</p> <p>Lead Free Code<br/>L : Lead Free Device    Blank : Original Device</p> |
| <p>APM4230 K :</p> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p>APM4230<br/>XXXXX</p> </div> | <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.

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

| Symbol             | Parameter                              |                       | Rating     | Unit |
|--------------------|----------------------------------------|-----------------------|------------|------|
| V <sub>DSS</sub>   | Drain-Source Voltage                   |                       | 25         | V    |
| V <sub>GSS</sub>   | Gate-Source Voltage                    |                       | ±20        |      |
| I <sub>D</sub> *   | Continuous Drain Current               | V <sub>GS</sub> =10V  | 13.5       | A    |
| I <sub>DM</sub> *  | 300μs Pulsed Drain Current             |                       | 55         |      |
| I <sub>S</sub> *   | Diode Continuous Forward Current       |                       | 3          | A    |
| T <sub>J</sub>     | Maximum Junction Temperature           |                       | 150        | °C   |
| T <sub>STG</sub>   | Storage Temperature Range              |                       | -55 to 150 |      |
| P <sub>D</sub> *   | Maximum Power Dissipation              | T <sub>A</sub> =25°C  | 2          | W    |
|                    |                                        | T <sub>A</sub> =100°C | 0.8        |      |
| R <sub>θJA</sub> * | Thermal Resistance-Junction to Ambient |                       | 62.5       | °C/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 Condition                                                     | APM4230K |      |      | Unit |
|------------------------------------------|----------------------------------|--------------------------------------------------------------------|----------|------|------|------|
|                                          |                                  |                                                                    | Min.     | Typ. | Max. |      |
| Drain-Source Avalanche Ratings           |                                  |                                                                    |          |      |      |      |
| E <sub>AS</sub>                          | Avalanche Energy, Single Pulsed  | I <sub>D</sub> =20A, V <sub>DD</sub> =15V                          |          |      | 45   | mJ   |
| Static Characteristics                   |                                  |                                                                    |          |      |      |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA                        | 25       |      |      | V    |
| I <sub>DSS</sub>                         | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =20V, V <sub>GS</sub> =0V                          |          |      | 1    | μA   |
|                                          |                                  | T <sub>J</sub> =85°C                                               |          |      | 30   |      |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA          | 1.3      | 1.8  | 2.5  | V    |
| I <sub>GSS</sub>                         | Gate Leakage Current             | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                         |          |      | ±100 | nA   |
| R <sub>DS(ON)</sub> <sup>a</sup>         | Drain-Source On-state Resistance | V <sub>GS</sub> =10V, I <sub>DS</sub> =13.5A                       |          | 6    | 7.5  | mΩ   |
|                                          |                                  | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =10A                        |          | 7.5  | 10   |      |
|                                          |                                  | V <sub>GS</sub> =4.5V, I <sub>DS</sub> =10A, T <sub>J</sub> =125°C |          | 9.5  | 13   |      |
| V <sub>SD</sub> <sup>a</sup>             | Diode Forward Voltage            | I <sub>SD</sub> =1A, V <sub>GS</sub> =0V                           |          | 0.7  | 1.3  | V    |
| Gate Charge Characteristics <sup>b</sup> |                                  |                                                                    |          |      |      |      |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =10V, V <sub>GS</sub> =4.5V, I <sub>DS</sub> =16A  |          | 29   | 40   | nC   |
| Q <sub>gs</sub>                          | Gate-Source Charge               |                                                                    |          | 3.6  |      |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge                |                                                                    |          | 12   |      |      |

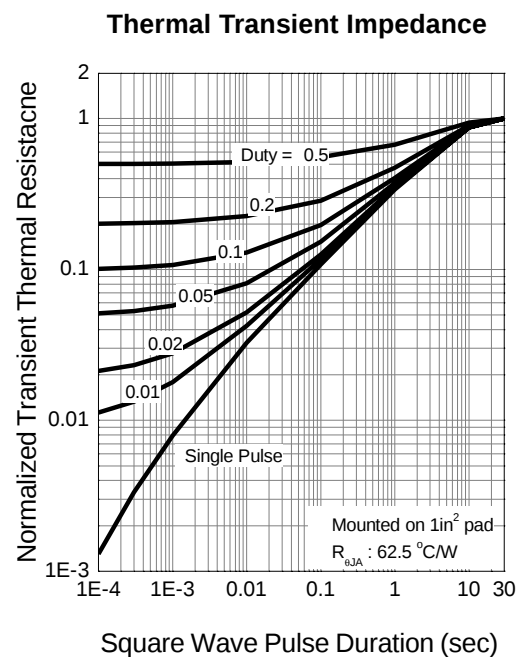
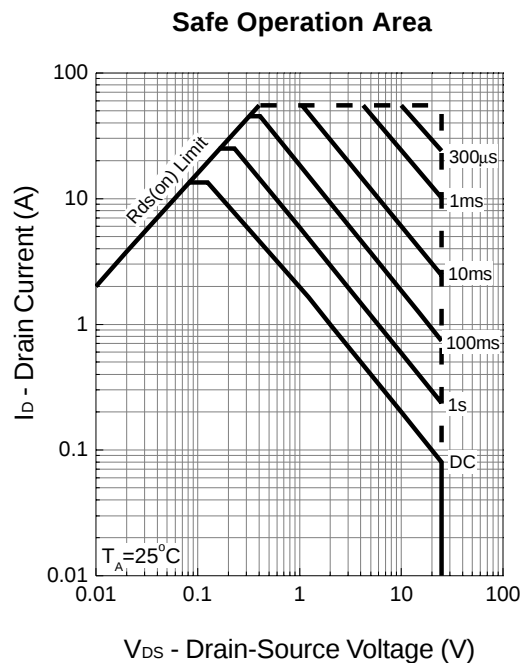
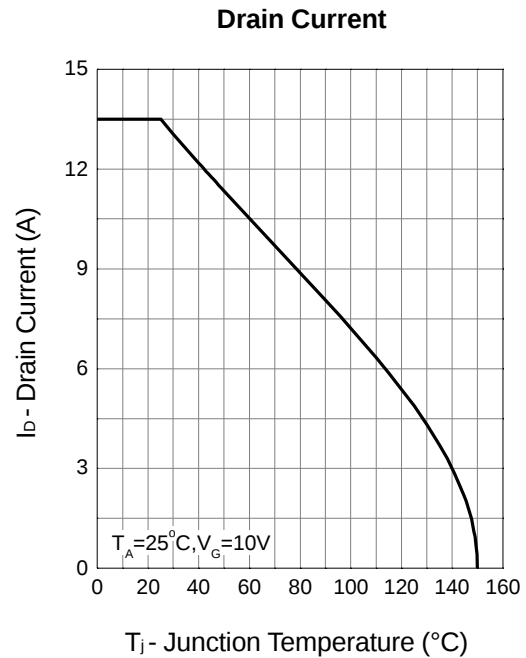
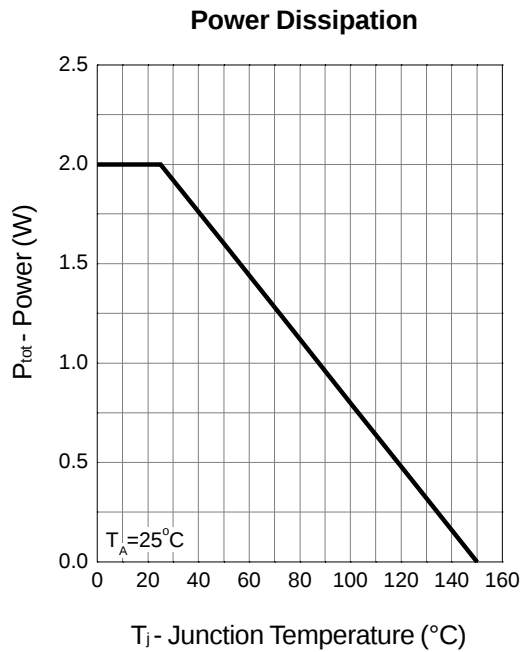
## Electrical Characteristics (Cont.) (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol                               | Parameter                    | Test Condition                                                                                                  | APM4230K |      |      | Unit |
|--------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------|----------|------|------|------|
|                                      |                              |                                                                                                                 | Min.     | Typ. | Max. |      |
| Dynamic Characteristics <sup>b</sup> |                              |                                                                                                                 |          |      |      |      |
| R <sub>G</sub>                       | Gate Resistance              | V <sub>GS</sub> =0V,V <sub>DS</sub> =0V,F=1MHz                                                                  |          | 2.3  |      | Ω    |
| C <sub>iss</sub>                     | Input Capacitance            | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =15V,<br>Frequency=1.0MHz                                               |          | 3300 |      | pF   |
| C <sub>oss</sub>                     | Output Capacitance           |                                                                                                                 |          | 1180 |      |      |
| C <sub>rss</sub>                     | Reverse Transfer Capacitance |                                                                                                                 |          | 790  |      |      |
| t <sub>d(ON)</sub>                   | Turn-on Delay Time           | V <sub>DD</sub> =15V, R <sub>L</sub> =15Ω,<br>I <sub>DS</sub> =1A, V <sub>GEN</sub> =10V,<br>R <sub>G</sub> =6Ω |          | 15   | 28   | ns   |
| T <sub>r</sub>                       | Turn-on Rise Time            |                                                                                                                 |          | 13   | 24   |      |
| t <sub>d(OFF)</sub>                  | Turn-off Delay Time          |                                                                                                                 |          | 122  | 170  |      |
| T <sub>f</sub>                       | Turn-off Fall Time           |                                                                                                                 |          | 53   | 75   |      |

Notes:

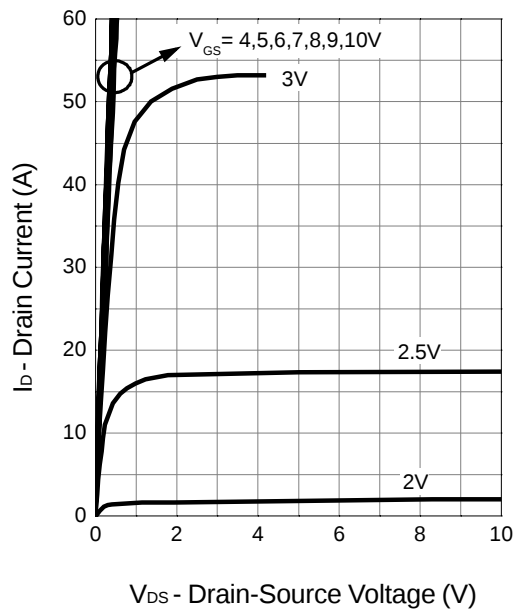
- a : Pulse test ; pulse width≤300μs, duty cycle≤2%.
- b : Guaranteed by design, not subject to production testing.

## Typical Characteristics

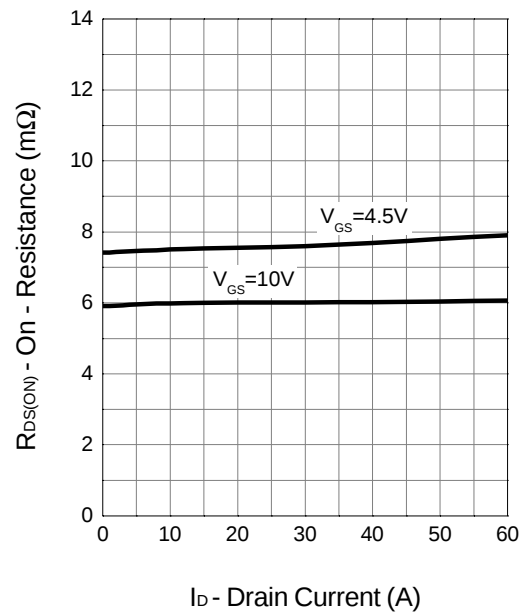


## Typical Characteristics (Cont.)

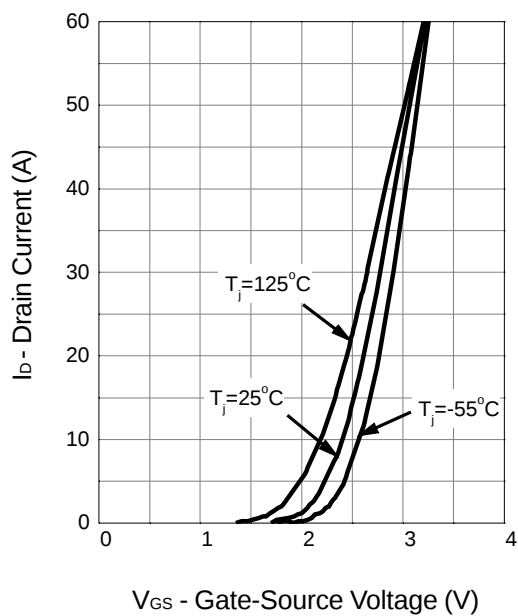
Output Characteristics



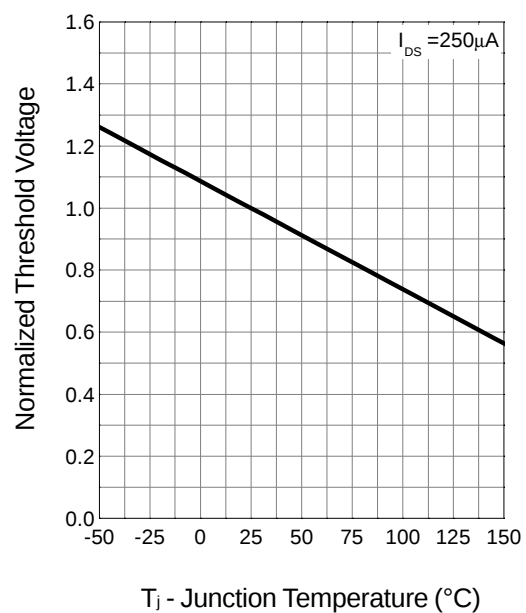
Drain-Source On Resistance



Transfer Characteristics

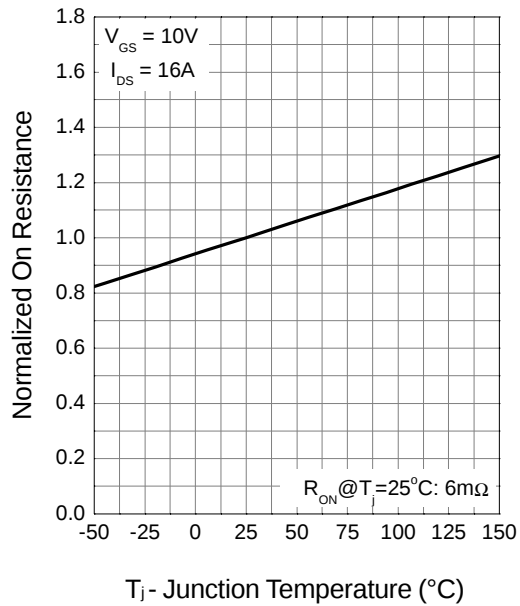


Gate Threshold Voltage

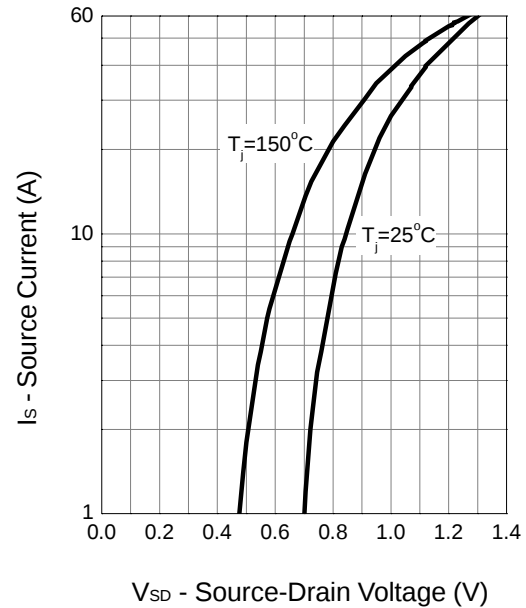


## Typical Characteristics (Cont.)

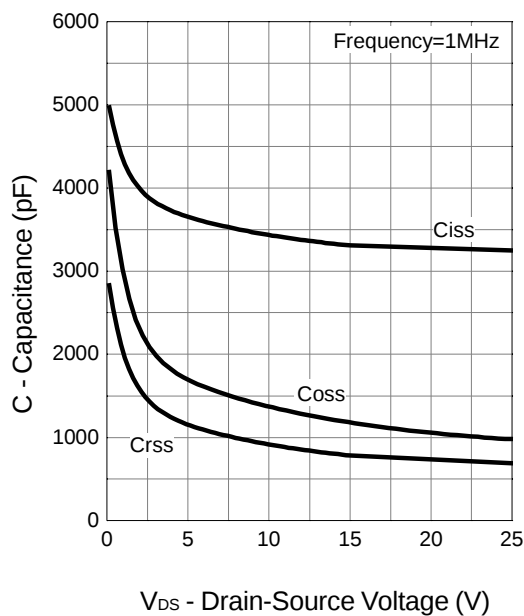
Drain-Source On Resistance



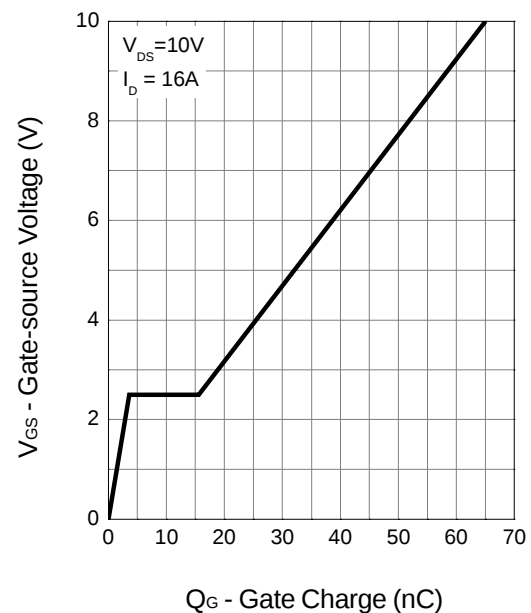
Source-Drain Diode Forward



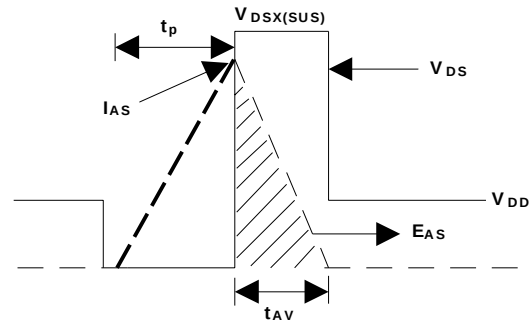
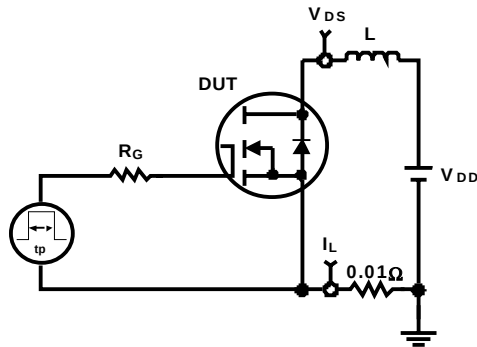
Capacitance



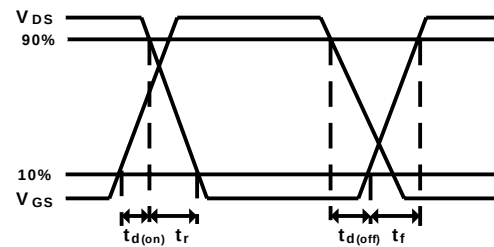
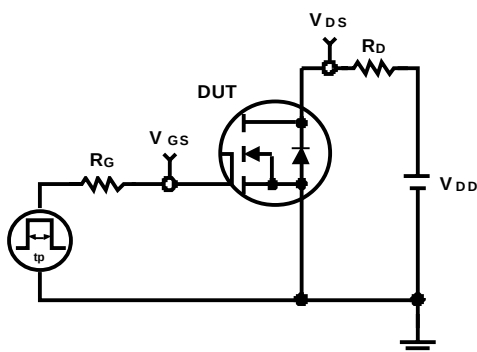
Gate Charge



## Avalanche Test Circuit and Waveforms

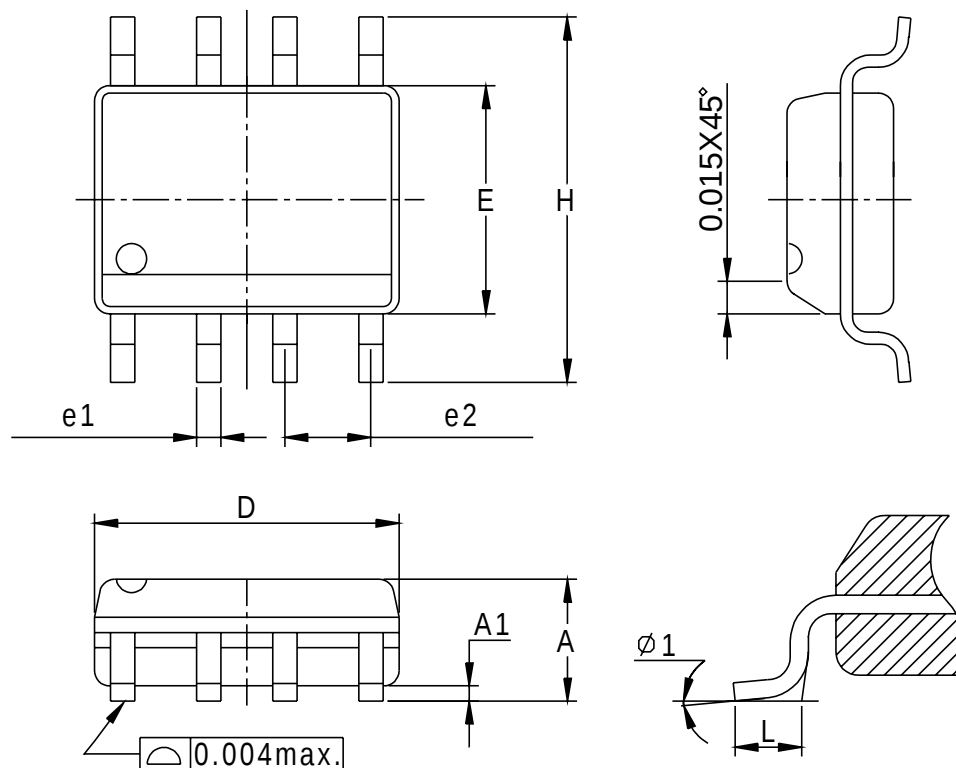


## Switching Time Test Circuit and Waveforms



## Packaging Information

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

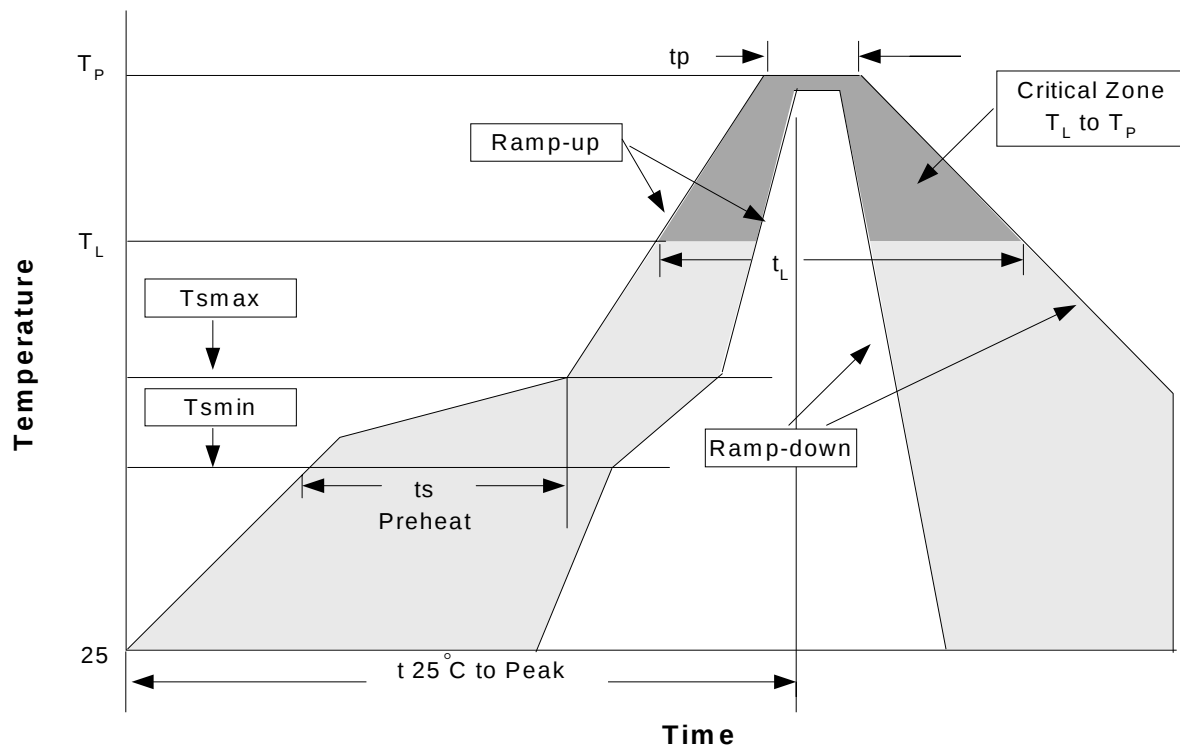


| Dim      | Millimeters |      | Inches  |       |
|----------|-------------|------|---------|-------|
|          | Min.        | Max. | Min.    | Max.  |
| A        | 1.35        | 1.75 | 0.053   | 0.069 |
| A1       | 0.10        | 0.25 | 0.004   | 0.010 |
| D        | 4.80        | 5.00 | 0.189   | 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 |       |
| $\phi 1$ | 8°          |      | 8°      |       |

## Physical Specifications

|                    |                                                                      |
|--------------------|----------------------------------------------------------------------|
| Terminal Material  | Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb), 100%Sn |
| Lead Solderability | Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.         |

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



## Classification Reflow Profiles

| Profile Feature                                          | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|----------------------------------------------------------|-------------------------|------------------|
| Average ramp-up rate (T <sub>L</sub> to T <sub>P</sub> ) | 3°C/second max.         | 3°C/second max.  |
| Preheat                                                  |                         |                  |
| - Temperature Min (Tsmín)                                | 100°C                   | 150°C            |
| - Temperature Max (Tsmáx)                                | 150°C                   | 200°C            |
| - Time (min to max) (ts)                                 | 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 (Tp)                     | 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.   |

Notes: All temperatures refer to topside of the package .Measured on the body surface.

## Classification Reflow Profiles(Cont.)

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>≥350 |
|-------------------|--------------------------------|--------------------------------|
| <2.5 mm           | 240 +0/-5°C                    | 225 +0/-5°C                    |
| ≥2.5 mm           | 225 +0/-5°C                    | 225 +0/-5°C                    |

Table 2. Pb-free Process – Package Classification Reflow Temperatures

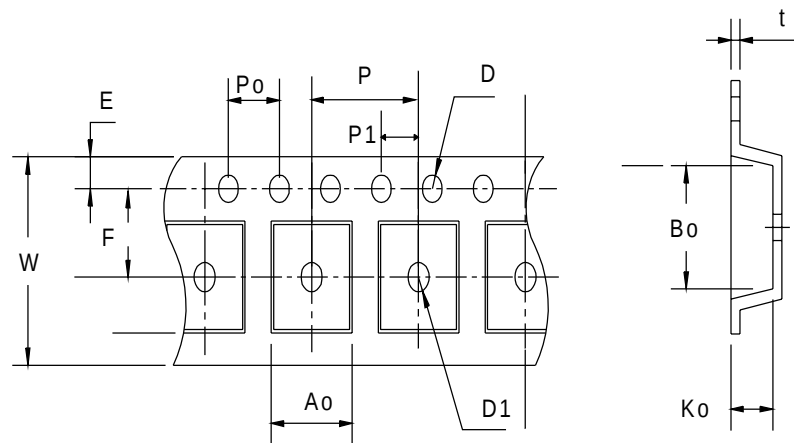
| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>>2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm           | 260 +0°C*                      | 260 +0°C*                          | 260 +0°C*                       |
| 1.6 mm – 2.5 mm   | 260 +0°C*                      | 250 +0°C*                          | 245 +0°C*                       |
| ≥2.5 mm           | 250 +0°C*                      | 245 +0°C*                          | 245 +0°C*                       |

\*Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.

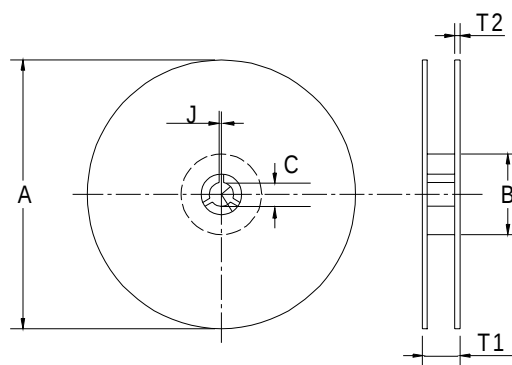
## Reliability Test Program

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

## Carrier Tape & Reel Dimensions



## Carrier Tape & Reel Dimensions(Cont.)



| Application | A         | B        | C            | J         | T1        | T2        | W              | P        | E         |
|-------------|-----------|----------|--------------|-----------|-----------|-----------|----------------|----------|-----------|
| SOP-8       | 330±1     | 62 ± 1.5 | 12.75 + 0.15 | 2 + 0.5   | 12.4 +0.2 | 2± 0.2    | 12 + 0.3 - 0.1 | 8± 0.1   | 1.75± 0.1 |
|             | F         | D        | D1           | Po        | P1        | Ao        | Bo             | Ko       | t         |
|             | 5.5 ± 0.1 | 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 |

(mm)

## Cover Tape Dimensions

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

## Customer Service

### Anpec Electronics Corp.

#### Head Office :

5F, No. 2 Li-Hsin Road, SBIP,

Hsin-Chu, Taiwan, R.O.C.

Tel : 886-3-5642000

Fax : 886-3-5642050

#### Taipei Branch :

7F, No. 137, Lane 235, Pac Chiao Rd.,

Hsin Tien City, Taipei Hsien, Taiwan, R. O. C.

Tel : 886-2-89191368

Fax : 886-2-89191369