

## P-Channel Enhancement Mode Power MOSFET

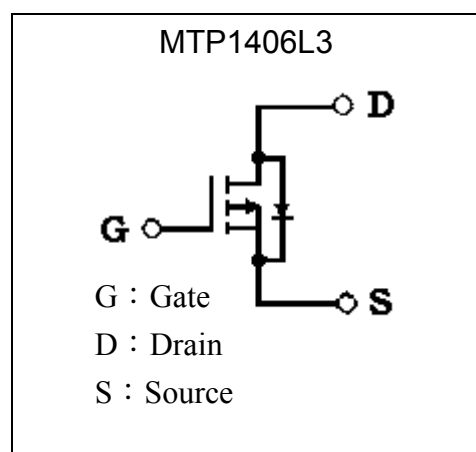
# MTP1406L3

### Features

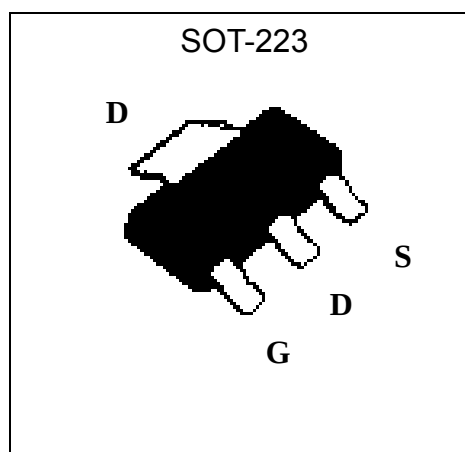
- Simple Drive Requirement
- Low On-resistance
- Fast switching Characteristic
- Pb-free lead plating package

|                                                                    |                    |
|--------------------------------------------------------------------|--------------------|
| <b>BV<sub>DSS</sub></b>                                            | <b>-60V</b>        |
| <b>I<sub>D</sub></b>                                               | <b>-4.8A</b>       |
| <b>R<sub>DS(on)</sub>@V<sub>GS</sub>=-10V, I<sub>D</sub>=-4A</b>   | <b>75mΩ (typ.)</b> |
| <b>R<sub>DS(on)</sub>@V<sub>GS</sub>=-10V, I<sub>D</sub>=-1.5A</b> | <b>74mΩ (typ.)</b> |
| <b>R<sub>DS(on)</sub>@V<sub>GS</sub>=-4.5V, I<sub>D</sub>=-2A</b>  | <b>99mΩ (typ.)</b> |

### Symbol



### Outline



### Absolute Maximum Ratings (T<sub>A</sub>=25°C)

| Parameter                                       | Symbol                            | Limits   | Unit |
|-------------------------------------------------|-----------------------------------|----------|------|
| Drain-Source Voltage                            | V <sub>DS</sub>                   | -60      | V    |
| Gate-Source Voltage                             | V <sub>GS</sub>                   | ±20      | V    |
| Continuous Drain Current @ T <sub>A</sub> =25°C | I <sub>D</sub>                    | -4.8 *1  | A    |
| Continuous Drain Current @ T <sub>A</sub> =70°C | I <sub>D</sub>                    | -3.8 *1  | A    |
| Pulsed Drain Current                            | I <sub>DM</sub>                   | -20 *1   | A    |
| Total Power Dissipation (T <sub>A</sub> =25°C)  | P <sub>d</sub>                    | 2.7 *2   | W    |
| Linear Derating Factor                          |                                   | 0.02     | W/°C |
| Operating Junction and Storage Temperature      | T <sub>j</sub> , T <sub>stg</sub> | -55~+150 | °C   |

Note : \*1. Pulse width limited by maximum junction temperature

\*2. Surface mounted on 1 in<sup>2</sup> copper pad of FR-4 board; 120°C/W when mounted on minimum copper pad

**Thermal Data**

| Parameter                                    | Symbol       | Value     | Unit |
|----------------------------------------------|--------------|-----------|------|
| Thermal Resistance, Junction-to-case, max    | $R_{th,j-c}$ | 14        | °C/W |
| Thermal Resistance, Junction-to-ambient, max | $R_{th,j-a}$ | 45 (Note) | °C/W |

Note : Surface mounted on 1 in<sup>2</sup> copper pad of FR-4 board; 120°C/W when mounted on minimum copper pad

**Characteristics (T<sub>j</sub>=25°C, unless otherwise specified)**

| Symbol                              | Min. | Typ.  | Max. | Unit | Test Conditions                                                                       |
|-------------------------------------|------|-------|------|------|---------------------------------------------------------------------------------------|
| Static                              |      |       |      |      |                                                                                       |
| BV <sub>DSS</sub>                   | -60  | -     | -    | V    | V <sub>GS</sub> =0, I <sub>D</sub> =-250μA                                            |
| ΔBV <sub>DSS</sub> /ΔT <sub>j</sub> | -    | -0.04 | -    | V/°C | Reference to 25°C, I <sub>D</sub> =-1mA                                               |
| V <sub>GS(th)</sub>                 | -1.0 | -1.9  | -2.5 | V    | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> =-250μA                            |
| G <sub>FS</sub>                     | -    | 5     | -    | S    | V <sub>DS</sub> =-10V, I <sub>D</sub> =-3A                                            |
| I <sub>GSS</sub>                    | -    | -     | ±100 | nA   | V <sub>GS</sub> =±20                                                                  |
| I <sub>DSS</sub>                    | -    | -     | -1   | μA   | V <sub>DS</sub> =-48V, V <sub>GS</sub> =0                                             |
| I <sub>DSS</sub>                    | -    | -     | -25  | μA   | V <sub>DS</sub> =-48V, V <sub>GS</sub> =0, T <sub>j</sub> =70°C                       |
| *R <sub>DS(ON)</sub>                | -    | 75    | 90   | mΩ   | V <sub>GS</sub> =-10V, I <sub>D</sub> =-4A                                            |
|                                     | -    | 74    | 90   |      | V <sub>GS</sub> =-10V, I <sub>D</sub> =-2A                                            |
|                                     | -    | 99    | 120  |      | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-2A                                           |
|                                     |      |       |      |      |                                                                                       |
| Dynamic                             |      |       |      |      |                                                                                       |
| *Q <sub>g</sub>                     | -    | 14    | -    | nC   | I <sub>D</sub> =-4.8A, V <sub>DS</sub> =-30V, V <sub>GS</sub> =-10V                   |
| *Q <sub>gs</sub>                    | -    | 3.2   | -    |      |                                                                                       |
| *Q <sub>gd</sub>                    | -    | 5.2   | -    |      |                                                                                       |
| *t <sub>d(ON)</sub>                 | -    | 10    | -    | ns   | V <sub>DS</sub> =-30V, I <sub>D</sub> =-1A, V <sub>GS</sub> =-10V, R <sub>G</sub> =6Ω |
| *t <sub>r</sub>                     | -    | 7     | -    |      |                                                                                       |
| *t <sub>d(OFF)</sub>                | -    | 43    | -    |      |                                                                                       |
| *t <sub>f</sub>                     | -    | 25    | -    |      |                                                                                       |
| C <sub>iss</sub>                    | -    | 939   | -    | pF   | V <sub>GS</sub> =0V, V <sub>DS</sub> =-25V, f=1MHz                                    |
| C <sub>oss</sub>                    | -    | 54    | -    |      |                                                                                       |
| C <sub>rss</sub>                    | -    | 39    | -    |      |                                                                                       |
| Source-Drain Diode                  |      |       |      |      |                                                                                       |
| *V <sub>SD</sub>                    | -    | -     | -1.2 | V    | I <sub>S</sub> =-2A, V <sub>GS</sub> =0V                                              |
| *t <sub>rr</sub>                    | -    | 29    | -    | ns   | I <sub>S</sub> =-4.8A, V <sub>GS</sub> =0, dI/dt=100A/μs                              |
| *Q <sub>rr</sub>                    | -    | 20    | -    | nC   |                                                                                       |

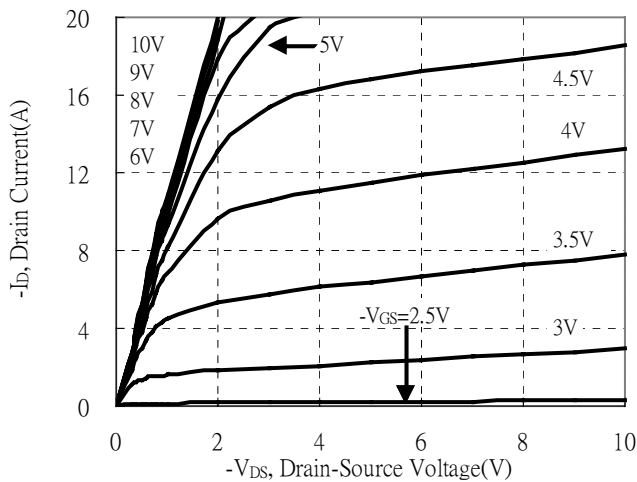
\*Pulse Test : Pulse Width ≤300μs, Duty Cycle≤2%

**Ordering Information**

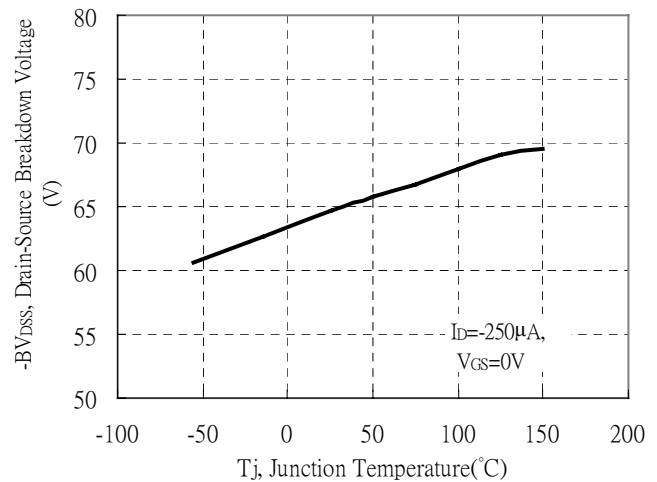
| Device    | Package                                   | Shipping               | Marking |
|-----------|-------------------------------------------|------------------------|---------|
| MTP1406L3 | SOT-223<br>(Pb-free lead plating package) | 2500 pcs / Tape & Reel | 1406    |

## Typical Characteristics

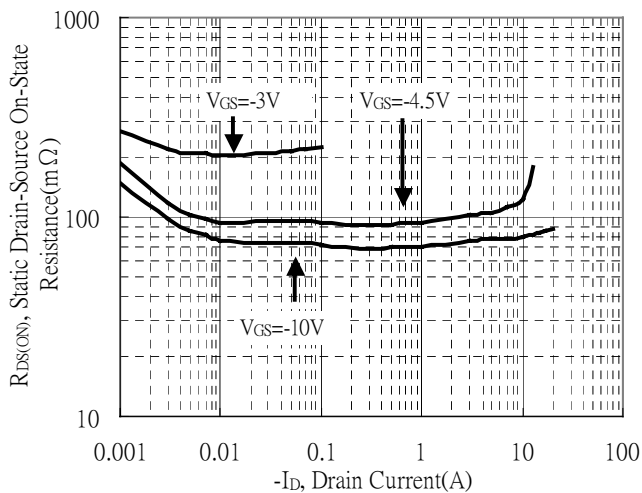
Typical Output Characteristics



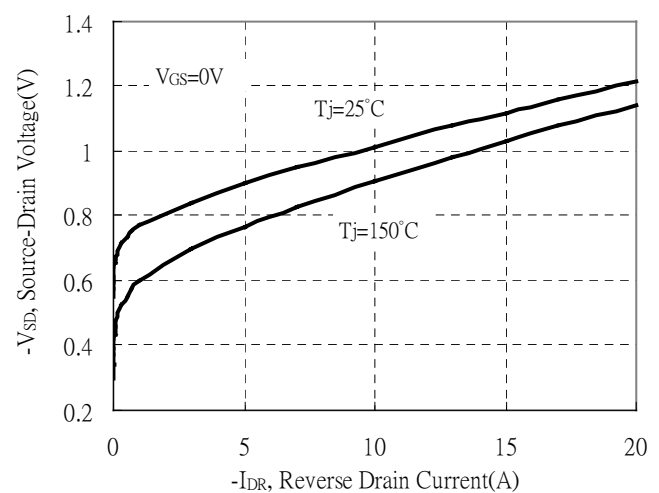
Brekdown Voltage vs Ambient Temperature



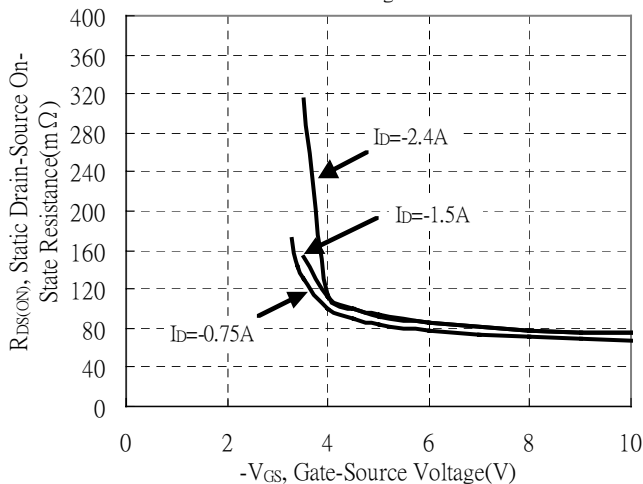
Static Drain-Source On-State resistance vs Drain Current



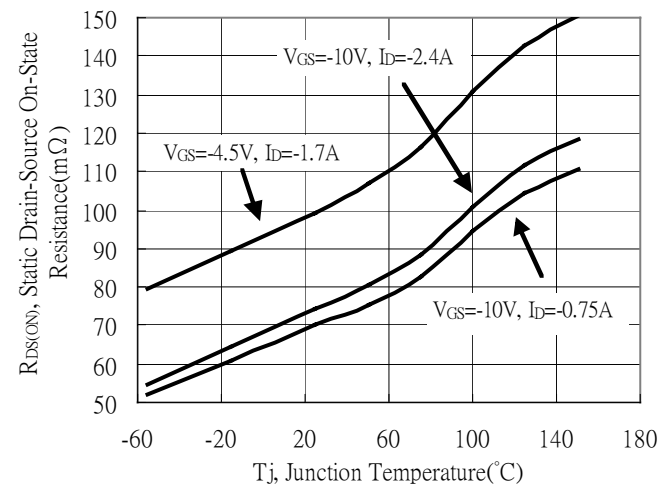
Reverse Drain Current vs Source-Drain Voltage



Static Drain-Source On-State Resistance vs Gate-Source Voltage

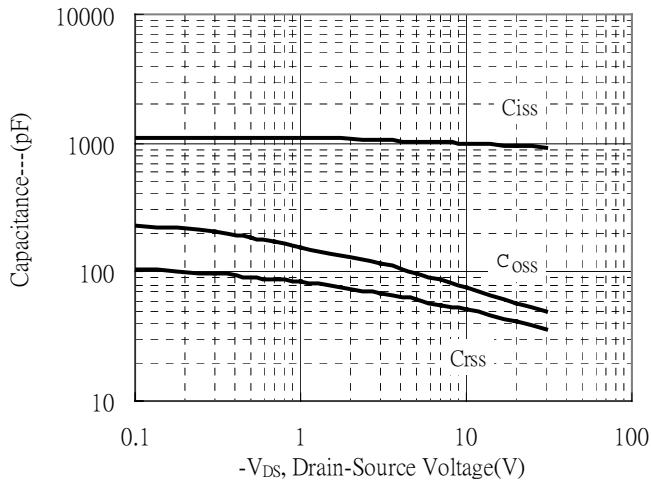


Drain-Source On-State Resistance vs Junction Temperature

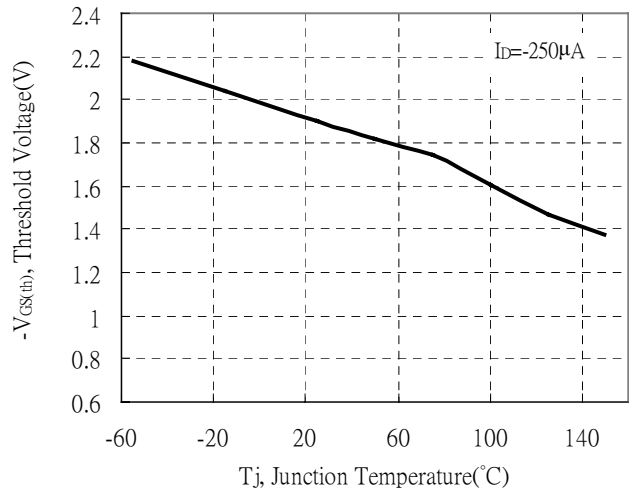


## Typical Characteristics(Cont.)

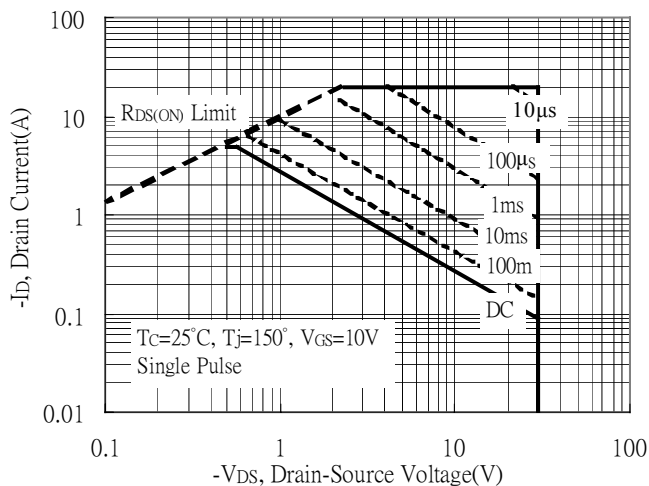
Capacitance vs Drain-to-Source Voltage



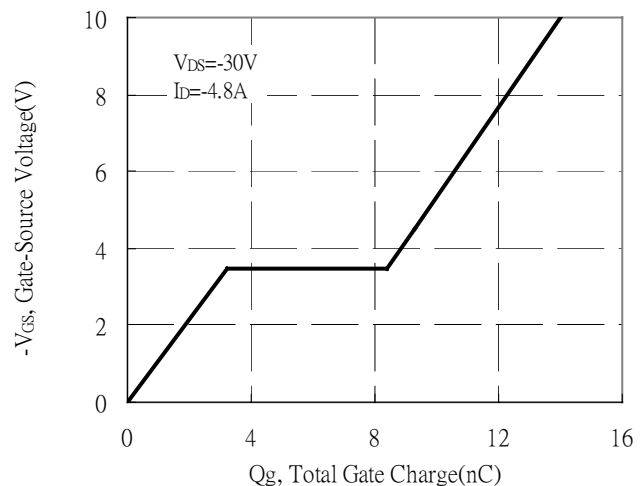
Threshold Voltage vs Junction Temperature



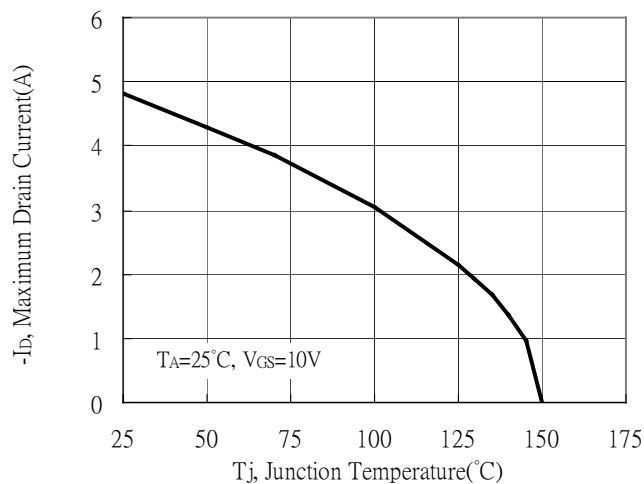
Maximum Safe Operating Area



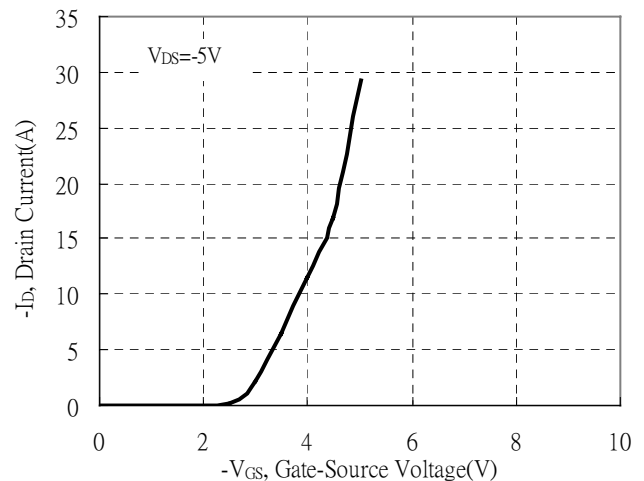
Gate Charge Characteristics



Maximum Drain Current vs Case Temperature

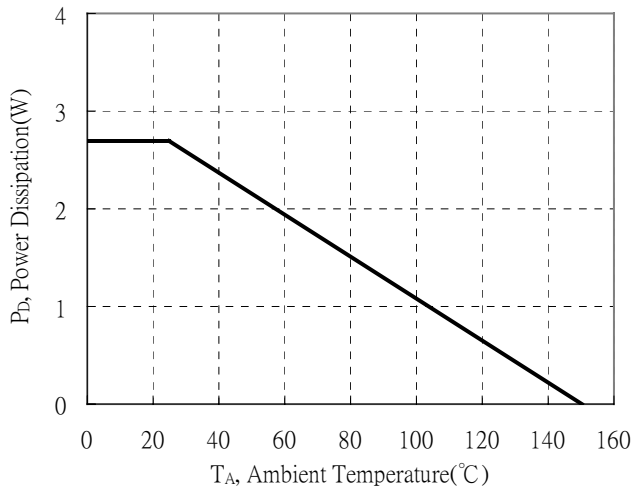


Typical Transfer Characteristics

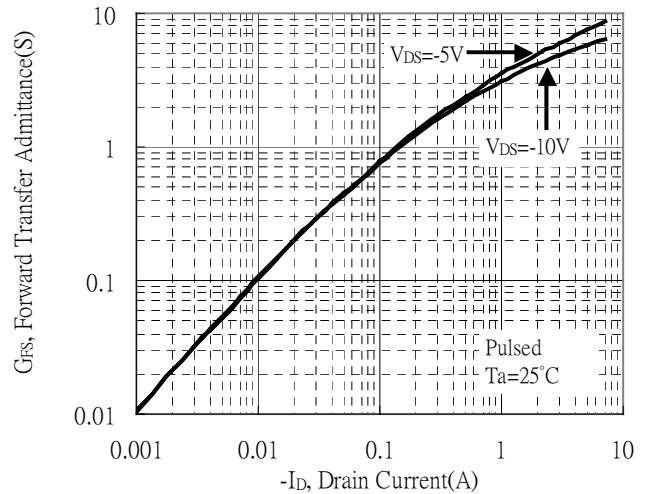


## Typical Characteristics(Cont.)

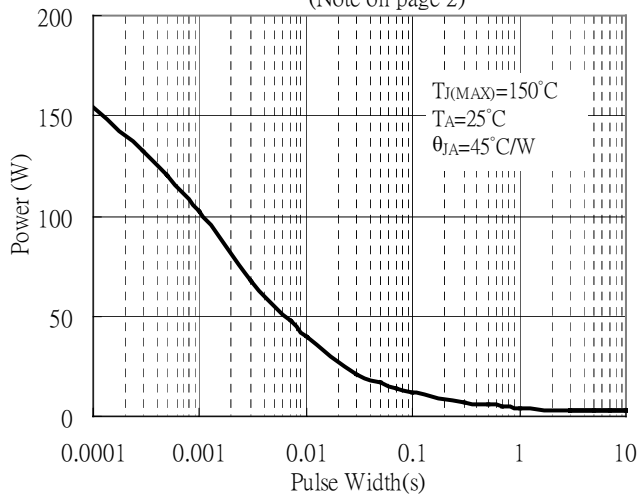
Power Derating Curve



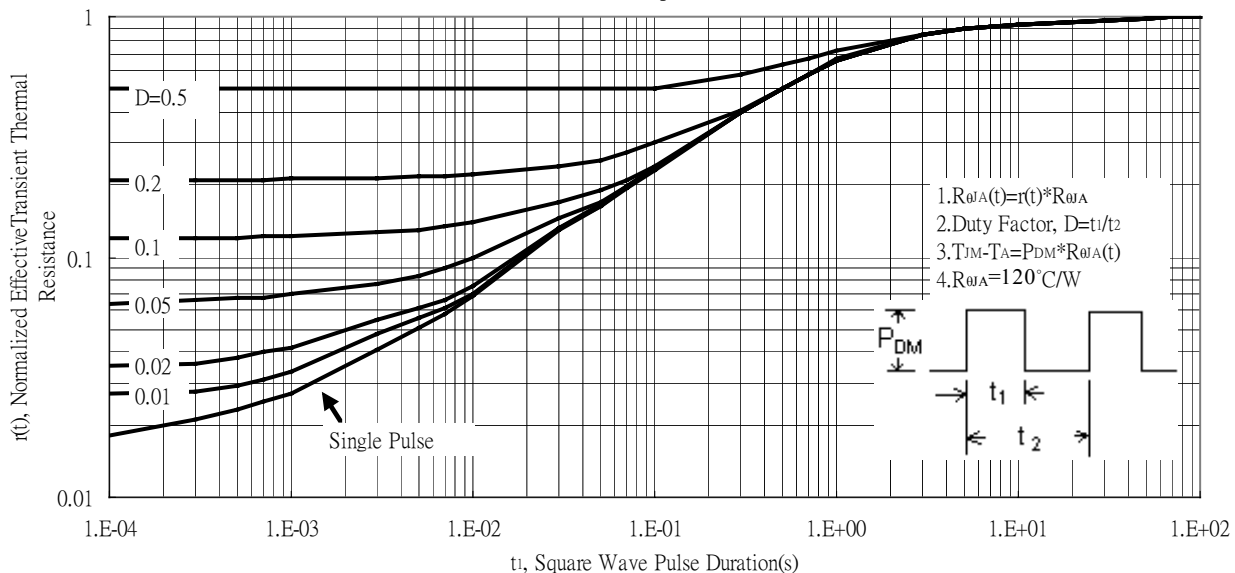
Forward Transfer Admittance vs Drain Current



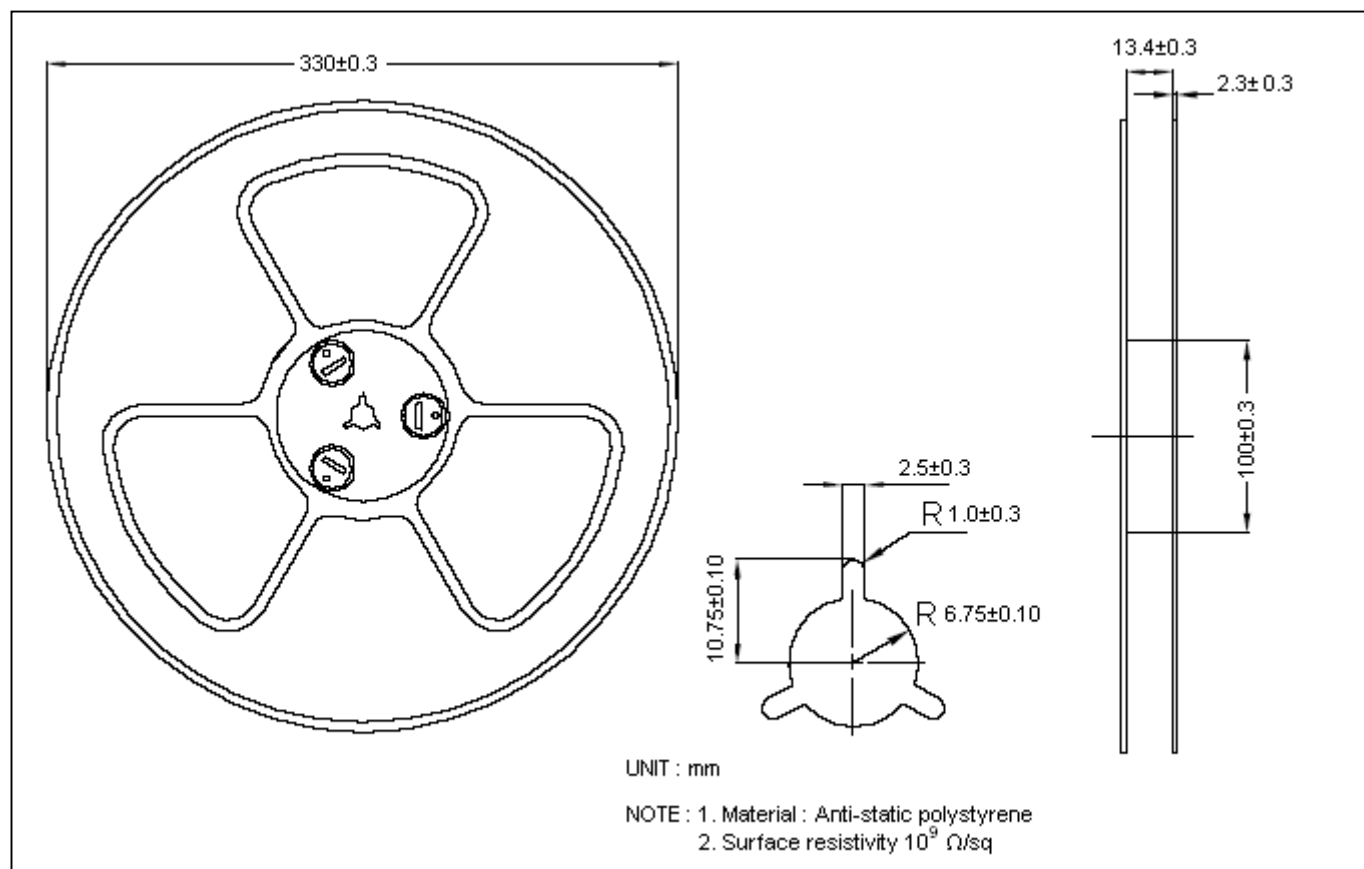
Single Pulse Power Rating, Junction to Ambient  
(Note on page 2)



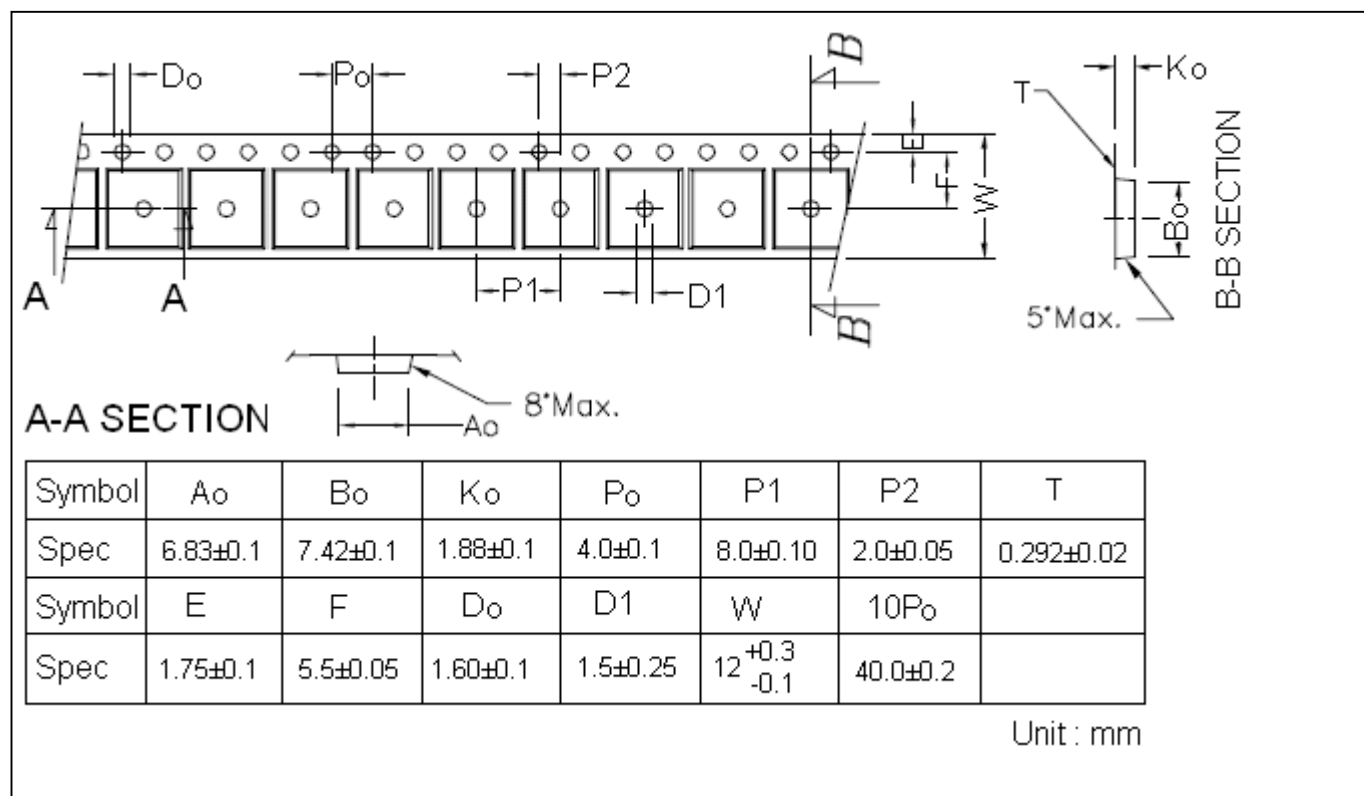
Transient Thermal Response Curves



## Reel Dimension



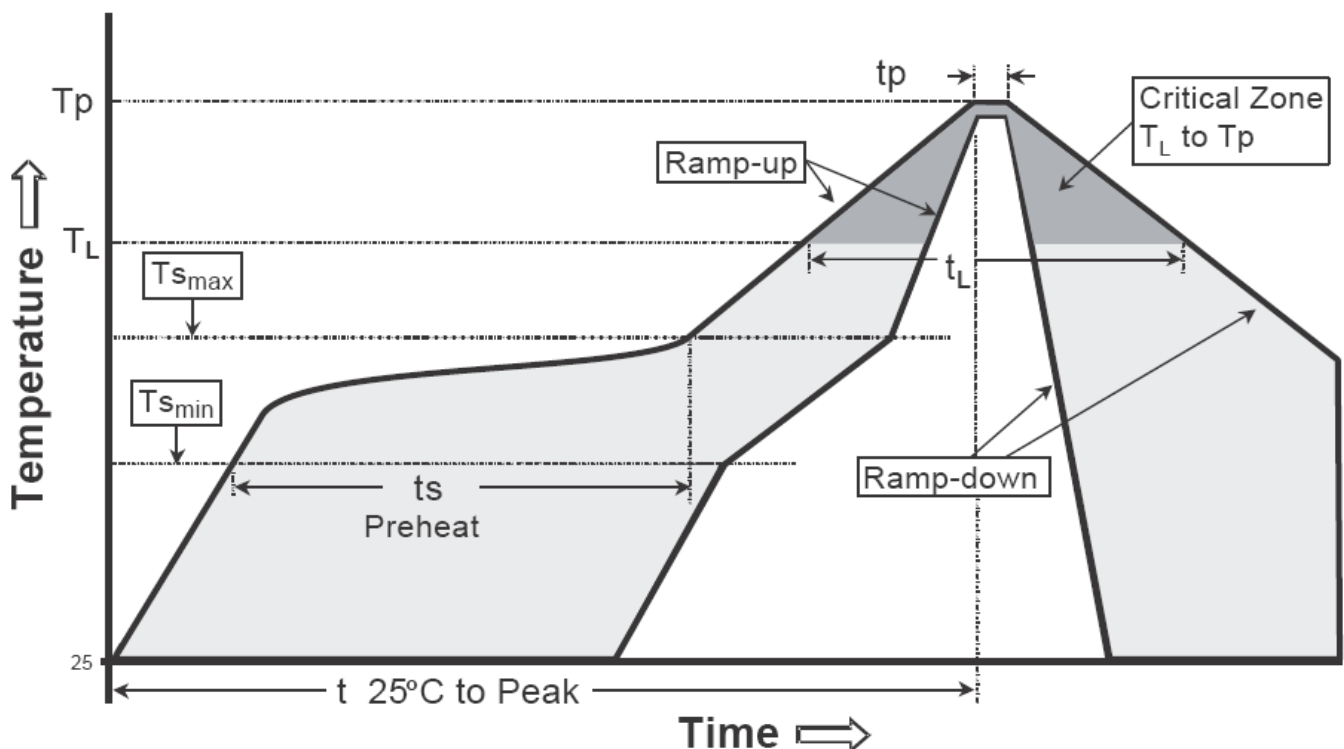
## Carrier Tape Dimension



### Recommended wave soldering condition

|                 |                  |                 |
|-----------------|------------------|-----------------|
| Product         | Peak Temperature | Soldering Time  |
| Pb-free devices | 260 +0/-5 °C     | 5 +1/-1 seconds |

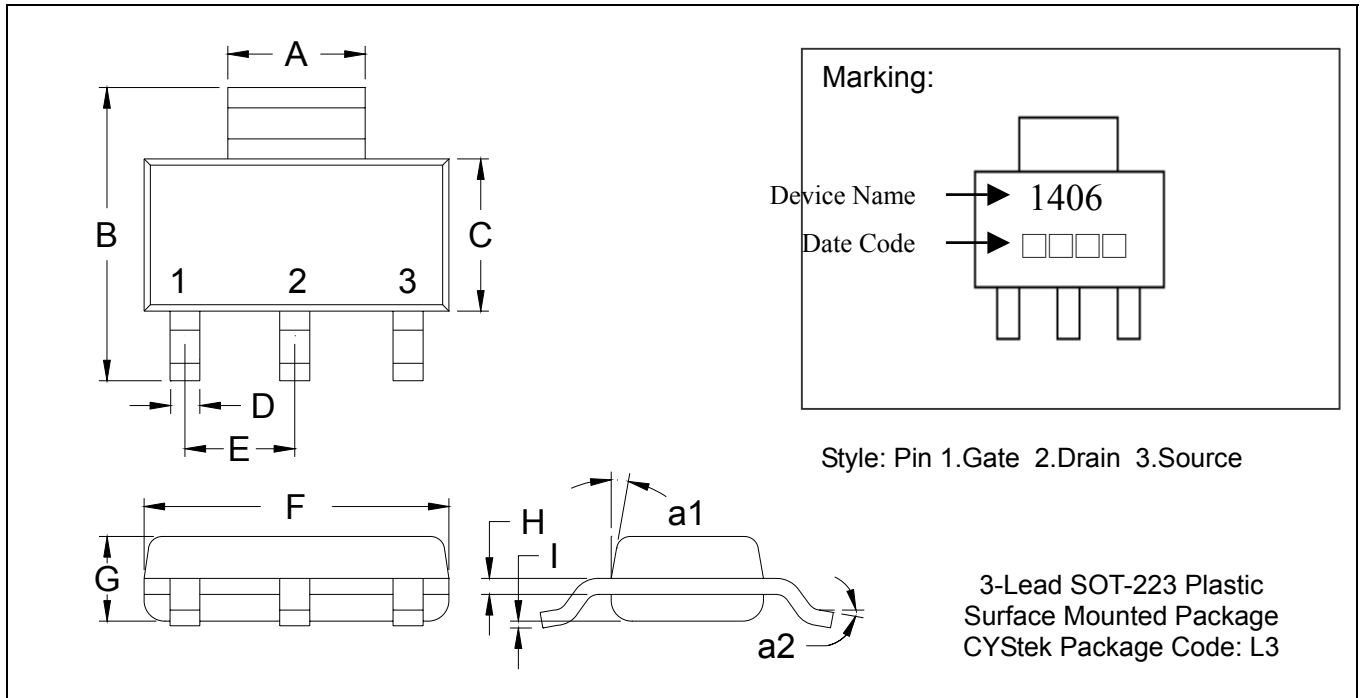
### Recommended temperature profile for IR reflow



| Profile feature                                | Sn-Pb eutectic Assembly | Pb-free Assembly |
|------------------------------------------------|-------------------------|------------------|
| Average ramp-up rate (Tsmax to Tp)             | 3°C/second max.         | 3°C/second max.  |
| Preheat                                        |                         |                  |
| -Temperature Min(Ts min)                       | 100°C                   | 150°C            |
| -Temperature Max(Ts max)                       | 150°C                   | 200°C            |
| -Time(ts min to ts max)                        | 60-120 seconds          | 60-180 seconds   |
| Time maintained above:                         |                         |                  |
| -Temperature (TL)                              | 183°C                   | 217°C            |
| - Time (tL)                                    | 60-150 seconds          | 60-150 seconds   |
| Peak Temperature(Tp)                           | 240 +0/-5 °C            | 260 +0/-5 °C     |
| 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 package body surface.

## SOT-223 Dimension



\*: Typical

| DIM | Inches  |        | Millimeters |      | DIM | Inches |        | Millimeters |      |
|-----|---------|--------|-------------|------|-----|--------|--------|-------------|------|
|     | Min.    | Max.   | Min.        | Max. |     | Min.   | Max.   | Min.        | Max. |
| A   | 0.1142  | 0.1220 | 2.90        | 3.10 | G   | 0.0551 | 0.0709 | 1.40        | 1.80 |
| B   | 0.2638  | 0.2874 | 6.70        | 7.30 | H   | 0.0098 | 0.0138 | 0.25        | 0.35 |
| C   | 0.1299  | 0.1457 | 3.30        | 3.70 | I   | 0.0008 | 0.0039 | 0.02        | 0.10 |
| D   | 0.0236  | 0.0315 | 0.60        | 0.80 | a1  | *13°   | -      | *13°        | -    |
| E   | *0.0906 | -      | *2.30       | -    | a2  | 0°     | 10°    | 0°          | 10°  |
| F   | 0.2480  | 0.2638 | 6.30        | 6.70 |     |        |        |             |      |

Notes: 1.Controlling dimension: millimeters.

2.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.

3.If there is any question with packing specification or packing method, please contact your local CYStek sales office.

### Material:

- Lead: Pure tin plated.
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0.

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