## Product Summary

| $V_{(BR)DSS}$ | $R_{DS(on)TYP}$ | $I_D$ |
|---|---|---|
| 30V | 24mΩ@10V | 5A |
| | 39mΩ@4.5V | |
| -30V | 40mΩ@-10V | -5A |
| | 60mΩ@-4.5V | |

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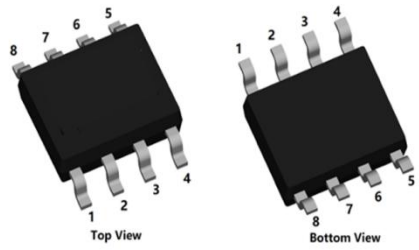
## Feature

- High power and current handing capability
- Lead free product is acquired
- Surface mount package
- 100% Single Pluse avalanche energy Test

## Applications

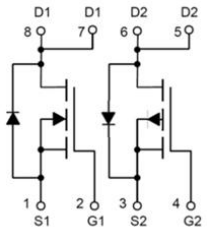
- Battery Protection
- Load Switch
- Power Management

## Package

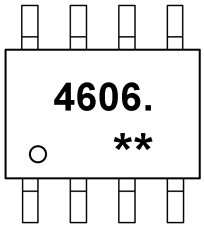



**SOP-8L**

## Circuit diagram




## Marking




**4606.** **:Device Code**
****** **:Week Code**

## Order Information

| Device | Package | Unit/Tape |
|---|---|---|
| SP4606BCP8 | SOP-8L | 4000 |

## Absolute maximum ratings (Ta=25℃,unless otherwise noted)

| Parameter | Symbol | Value | | Units |
|---|---|---|---|---|
| | | N-Channel | P-Channel | |
| Drain-Source Voltage | $V_{DS}$ | 30 | -30 | V |
| Gate-Source Voltage | $V_{GS}$ | ±20 | ±20 | V |
| Continuous Drain Current (Ta=25°C) | $I_D$ | 5 | -5 | A |
| Continuous Drain Current (Ta=100°C) | $I_D$ | 3.3 | -3.3 | A |
| Pulsed Drain Current | $I_{DM}$ | 20 | -20 | A |
| Single Pulse Avalanche Energy[1] | $E_{AS}$ | 10.5 | 19 | mJ |
| Power Dissipation (Ta=25°C) | $P_D$ | 2 | | W |
| Power Dissipation (Ta=100°C) | $P_D$ | 0.8 | | W |
| Thermal Resistance Junction-to-Ambient | $R_{\theta JC}$ | 62.5 | | ℃/W |
| Storage Temperature Range | $T_{STG}$ | -55 to 150 | | ℃ |
| Operating Junction Temperature Range | $T_J$ | -55 to 150 | | ℃ |

## N-Channel Electrical characteristics (Ta=25℃, unless otherwise noted)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | VGS=0V , ID=250uA | 30 | - | - | V |
| Drain-Source Leakage Current | $I_{DSS}$ | VDS=24V , VGS=0V , TJ=25℃ | - | - | 1 | uA |
| Gate-Source Leakage Current | $I_{GSS}$ | VGS=±20V , VDS=0V | - | - | ±100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | VGS=VDS , ID =250uA | 1 | 1.6 | 2.2 | V |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | VGS=10V , ID=1A | - | 24 | 31 | mΩ |
| | | VGS=4.5V , ID=1A | - | 39 | 52 | |
| Gate Resistance | $R_G$ | VDS=15V , VGS=0V , f=1MHz | - | 2.4 | - | Ω |
| **Dynamic characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | VDS=15V , VGS=0V , f=1MHz | - | 416 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 62 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 51 | - | |
| Total Gate Charge | $Q_g$ | VDS=20V , VGS=4.5V , ID=6A | - | 5 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 1.01 | - | |
| Gate-Drain Charge | $Q_{gd}$ | | - | 1.61 | - | |
| Gate Plateau Voltage | $V_{plateau}$ | | - | 3.4 | - | V |
| **Switching Characteristics** | | | | | | |
| Turn-On Delay Time | $T_{d(on)}$ | VDD=12V, VGS=10V , RG=3Ω, ID=6A | - | 7.7 | - | nS |
| Rise Time | $T_r$ | | - | 46 | - | |
| Turn-Off Delay Time | $T_{d(off)}$ | | - | 11 | - | |
| Fall Time | $T_f$ | | - | 3.6 | - | |
| **Diode Characteristics** | | | | | | |
| Diode Forward Voltage | $V_{SD}$ | VGS=0V , IS=1A , TJ=25℃ | - | - | 1.2 | V |
| Maximum Body-Diode Continuous Current | $I_S$ | | - | - | 6 | A |
| Reverse Recovery Time | $T_{rr}$ | IS=10A, di/dt=100A/us, Tj=25℃ | - | 18 | - | nS |
| Reverse Recovery Charge | $Q_{rr}$ | | - | 2 | - | nC |

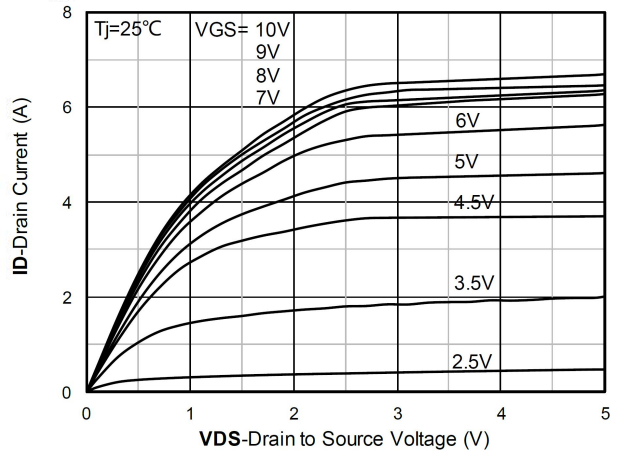
**Note :**
1.The EAS test condition is VDD=15V,VGS=10V,L=0.5mH,RG=25Ω

## P-Channel Electrical characteristics (Ta=25℃, unless otherwise noted)

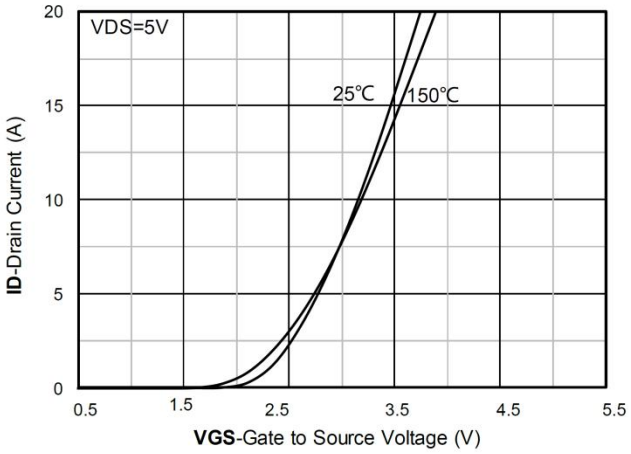
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | VGS=0V , ID=-250uA | -30 | - | - | V |
| Drain-Source Leakage Current | $I_{DSS}$ | VDS=-24V , VGS=0V , TJ=25℃ | - | - | -1 | uA |
| Gate-Source Leakage Current | $I_{GSS}$ | VGS=±20V , VDS=0V | - | - | ±100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | VGS=VDS , ID =-250uA | -1 | -1.6 | -2.2 | V |
| Static Drain-Source On-Resistance | $R_{DS(ON)}$ | VGS=-10V , ID=-4.1A | - | 40 | 50 | mΩ |
| | | VGS=-4.5V , ID=-3A | - | 60 | 80 | |
| Gate Resistance | $R_G$ | VDS=-15V , VGS=0V , f=1MHz | - | 3.3 | - | Ω |
| **Dynamic characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | VDS=-15V , VGS=0V , f=1MHz | - | 501 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 72 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 57 | - | |
| Total Gate Charge | $Q_g$ | VDS=-15V , VGS=-10V , ID=-5A | - | 24 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 2.6 | - | |
| Gate-Drain Charge | $Q_{gd}$ | | - | 5.8 | - | |
| Gate Plateau Voltage | $V_{plateau}$ | | - | -2.9 | - | V |
| **Switching Characteristics** | | | | | | |
| Turn-On Delay Time | $T_{d(on)}$ | VDD=-15V, VGS=-10V , RG=3Ω, ID=-1A | - | 8.6 | - | nS |
| Rise Time | $T_r$ | | - | 5.0 | - | |
| Turn-Off Delay Time | $T_{d(off)}$ | | - | 28.2 | - | |
| Fall Time | $T_f$ | | - | 13.5 | - | |
| **Diode Characteristics** | | | | | | |
| Diode Forward Voltage | $V_{SD}$ | VGS=0V , IS=-1A , TJ=25℃ | - | - | -1.2 | V |
| Maximum Body-Diode Continuous Current | $I_S$ | | - | - | -5 | A |
| Reverse Recovery Time | $T_{rr}$ | $I_S$=-5A, di/dt=100A/us, TJ=25℃ | - | 31 | - | nS |
| Reverse Recovery Charge | $Q_{rr}$ | | - | 10 | | nC |

**Note :**
1.The EAS test condition is VDD=-15V,VGS=-10V,L=0.5mH,RG=25Ω

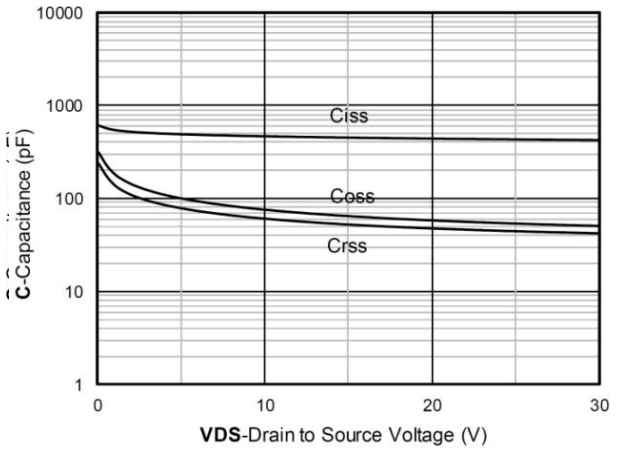
## N-Channel Typical Characteristics



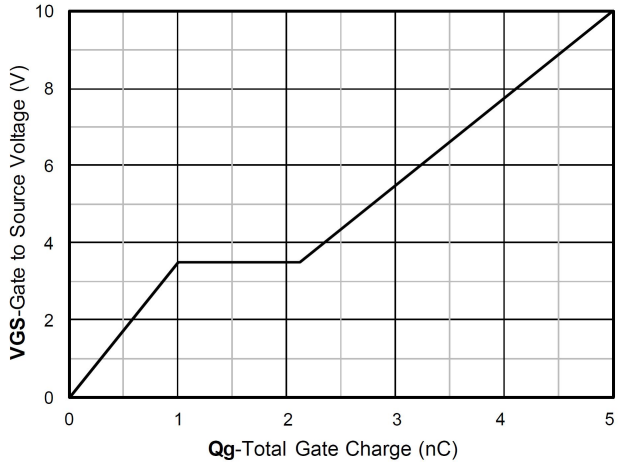

Output Characteristics



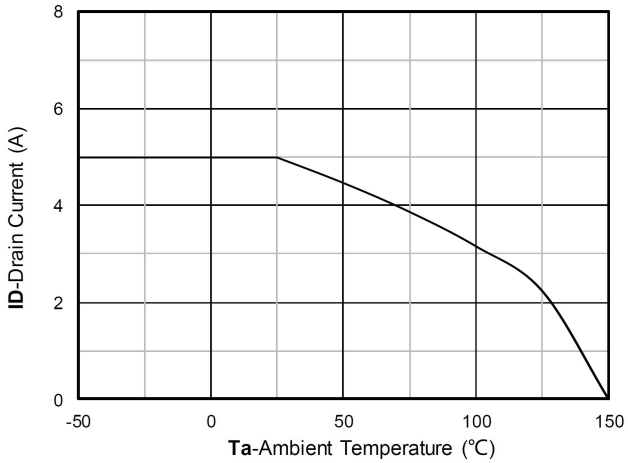

Transfer Characteristics



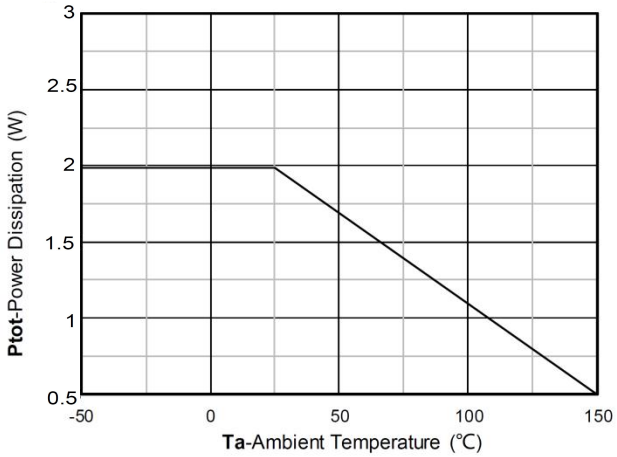

Capacitance Characteristics



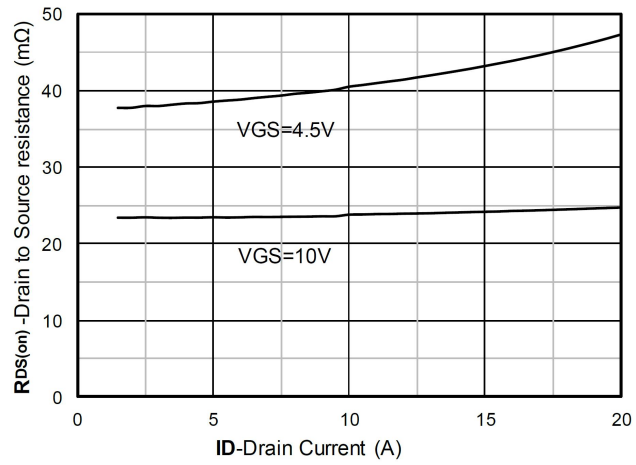

Gate Charge



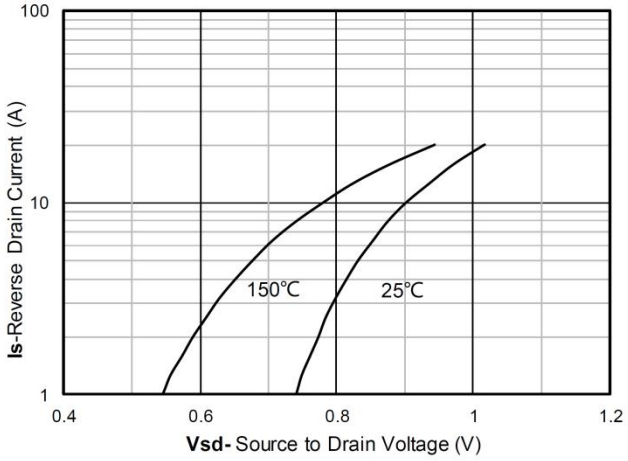

Current dissipation



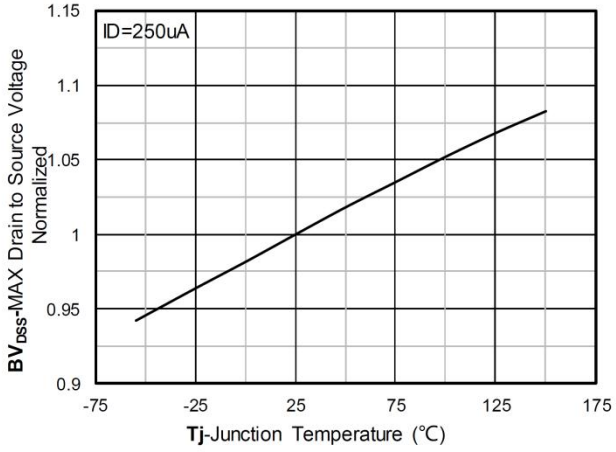

Power dissipation



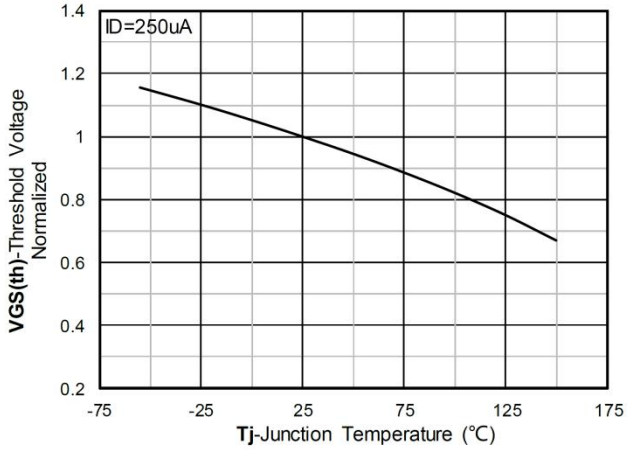

RDS(on) VS Drain Current



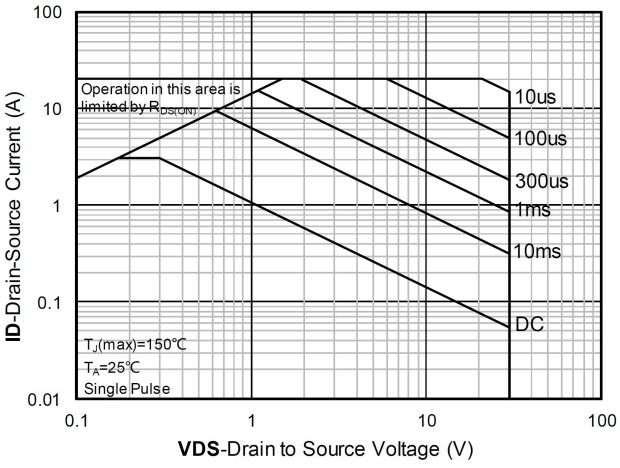

Forward characteristics of reverse diode

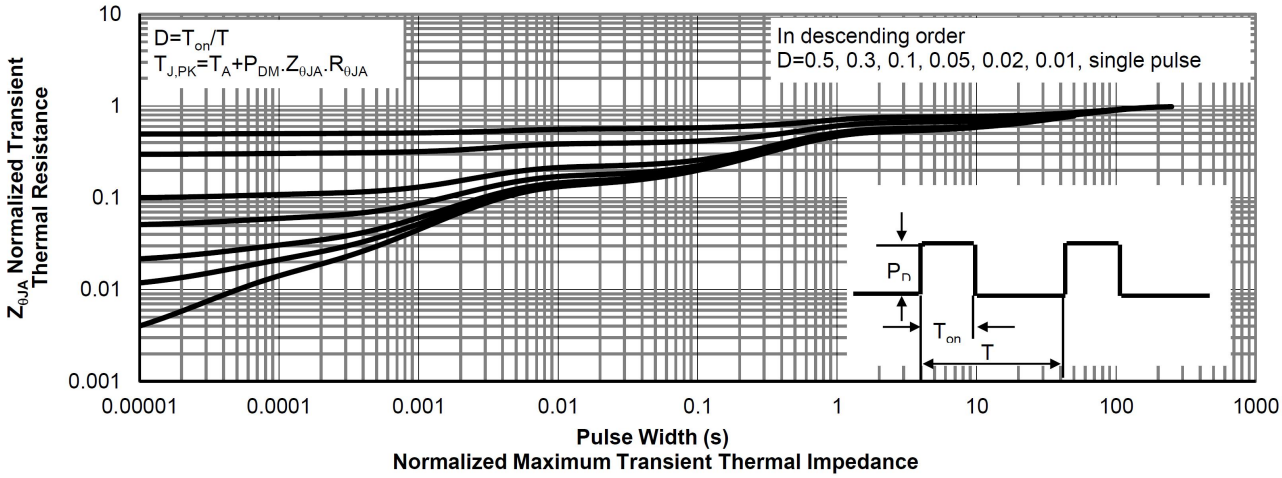



Normalized breakdown voltage



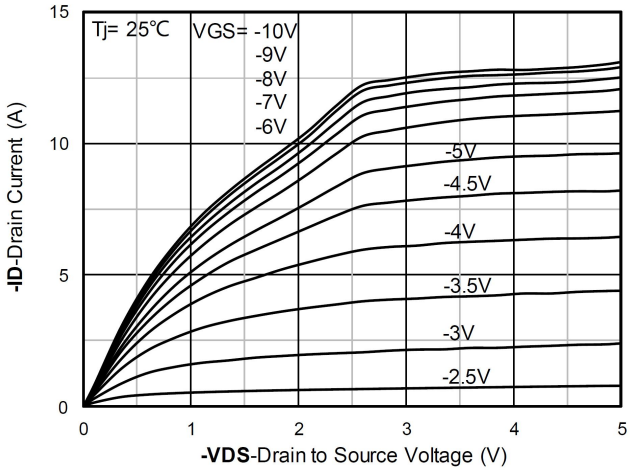

Normalized Threshold voltage



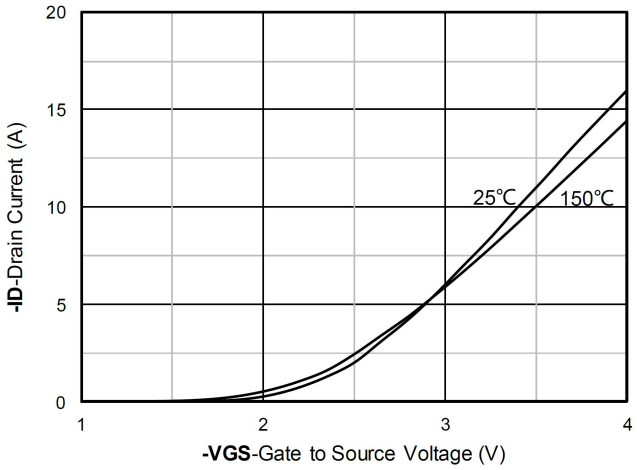



**Normalized Maximum Transient Thermal Impedance**

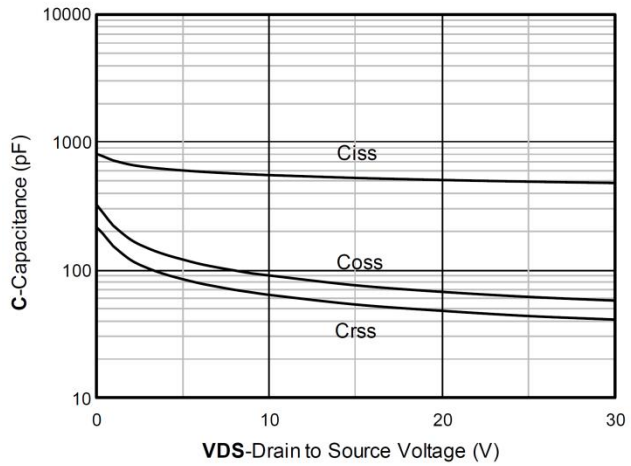
## P-Channel Typical Characteristics



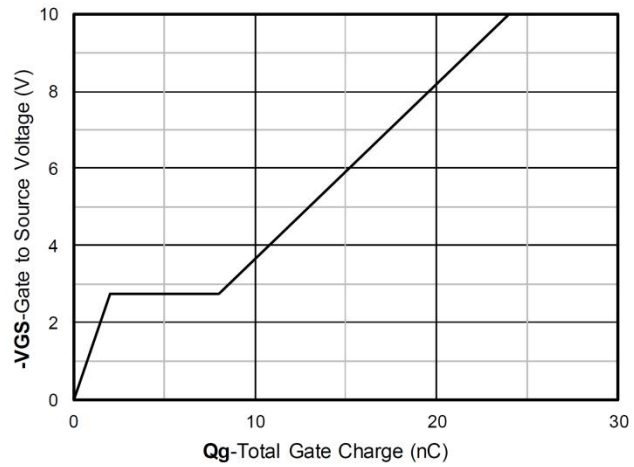

Output Characteristics



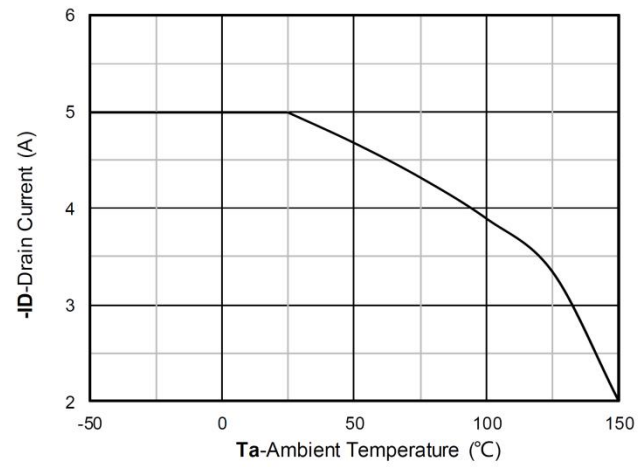

Transfer Characteristics



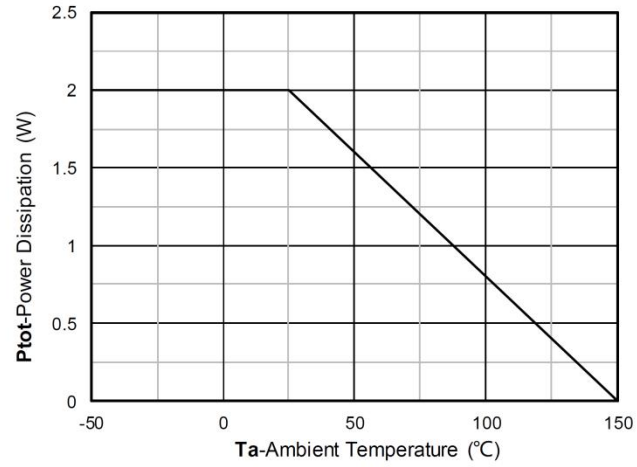

Capacitance Characteristics



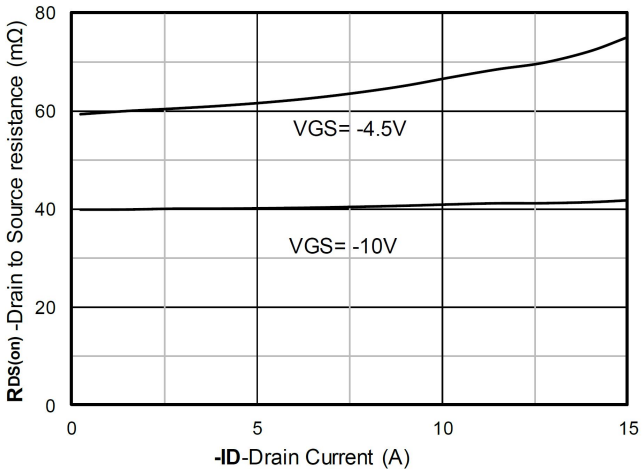

Gate Charge



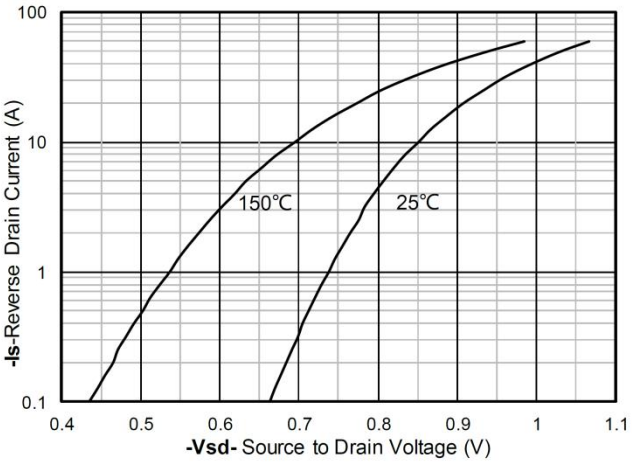

Current dissipation



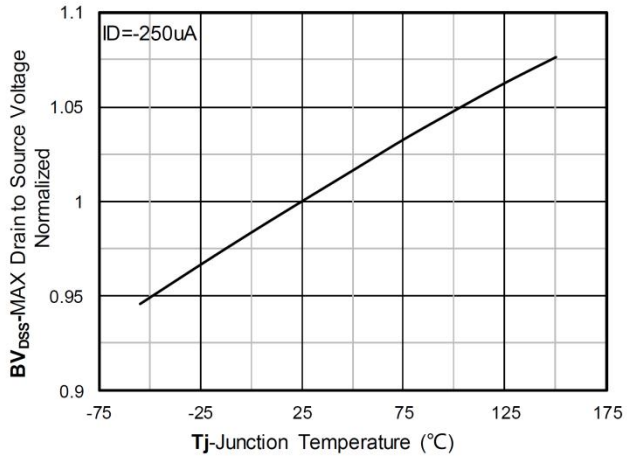

Power dissipation



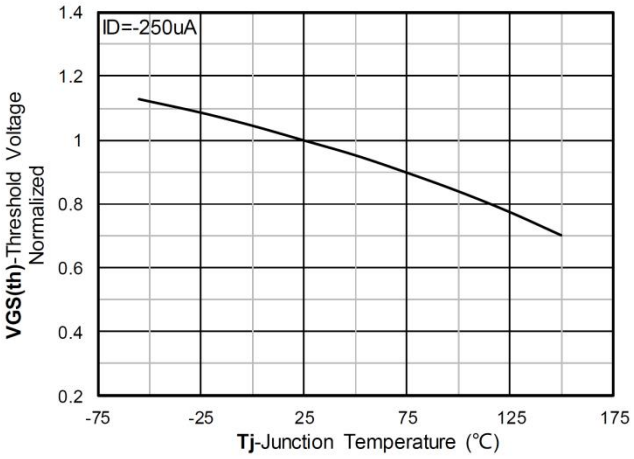

RDS(on) VS Drain Current



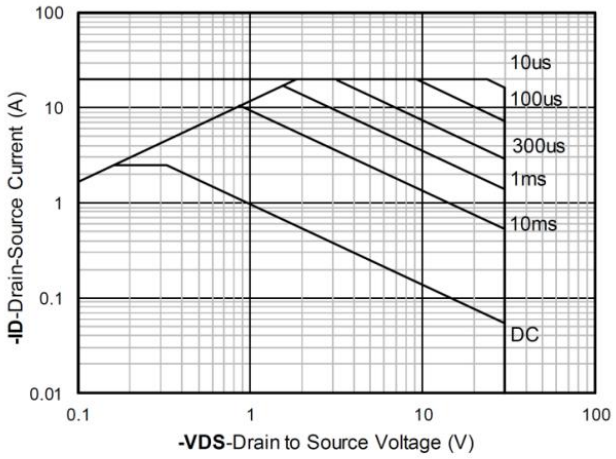

Forward characteristics of reverse diode



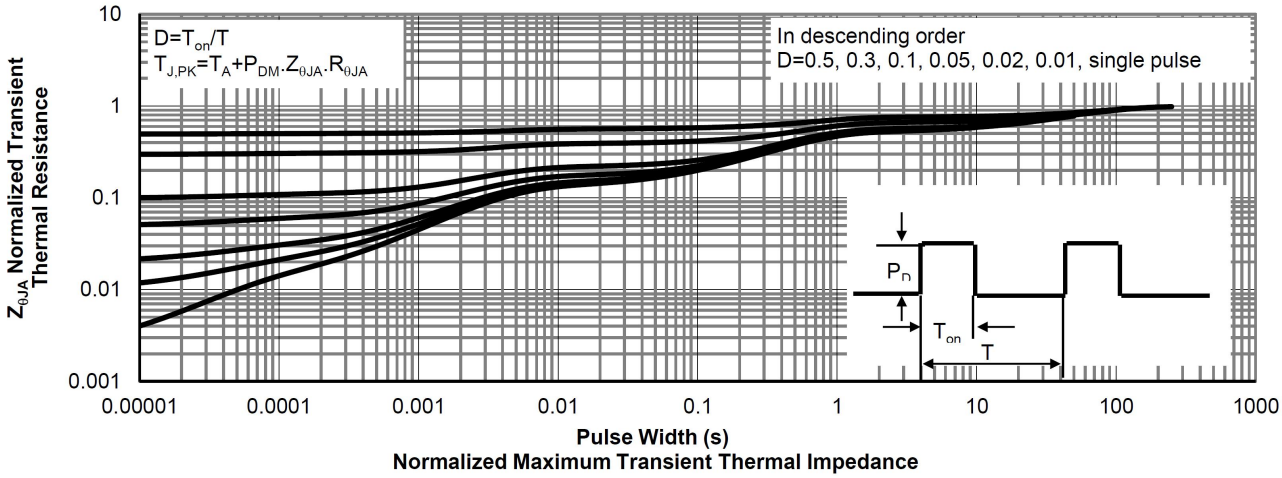

Normalized breakdown voltage




Normalized Threshold voltage



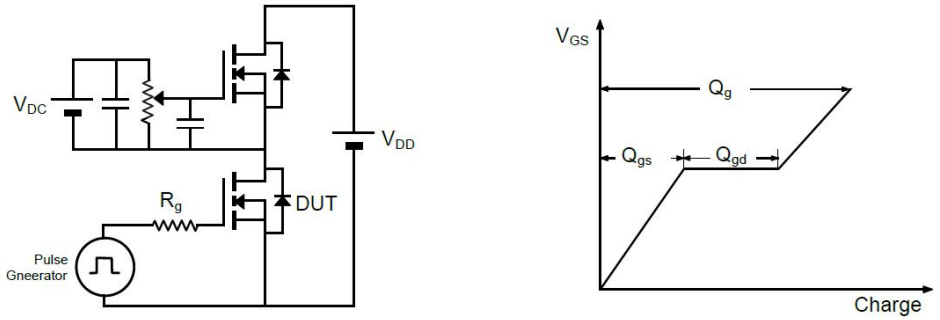

Safe Operation Area



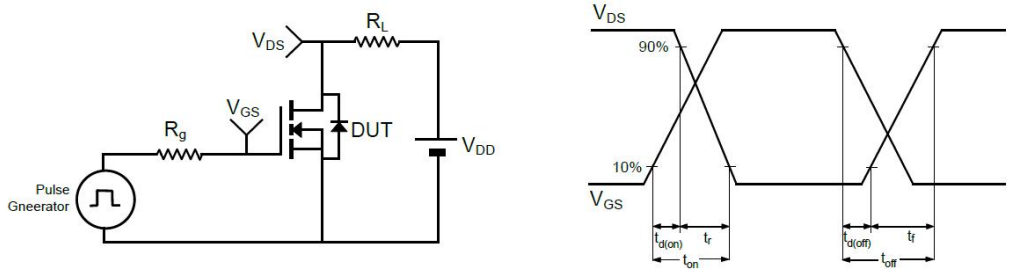

**Normalized Maximum Transient Thermal Impedance**

## Test Circuit

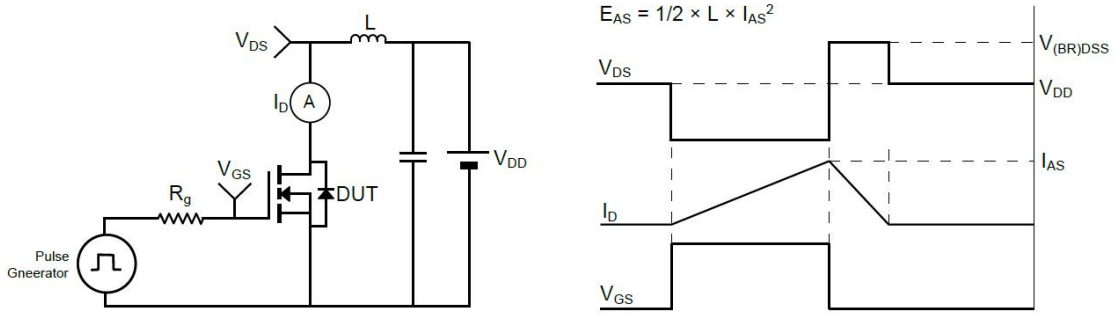
### Gate Charge



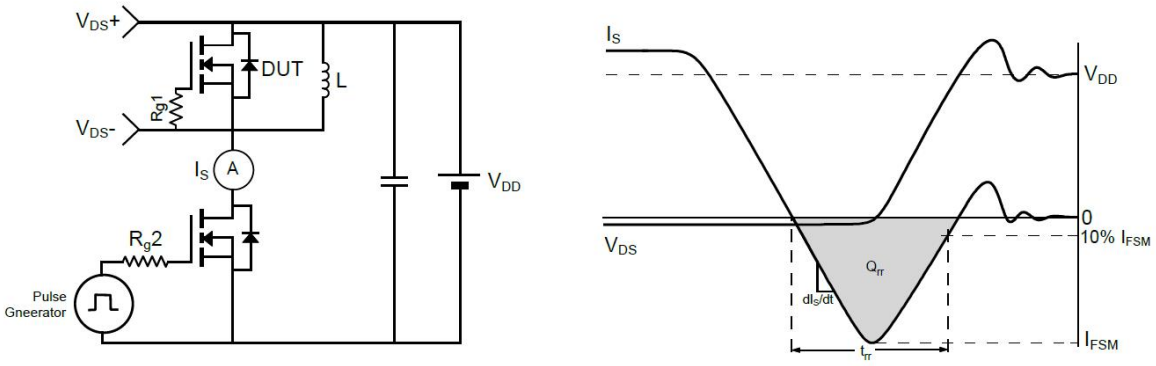

### Resistive Load Switching Time



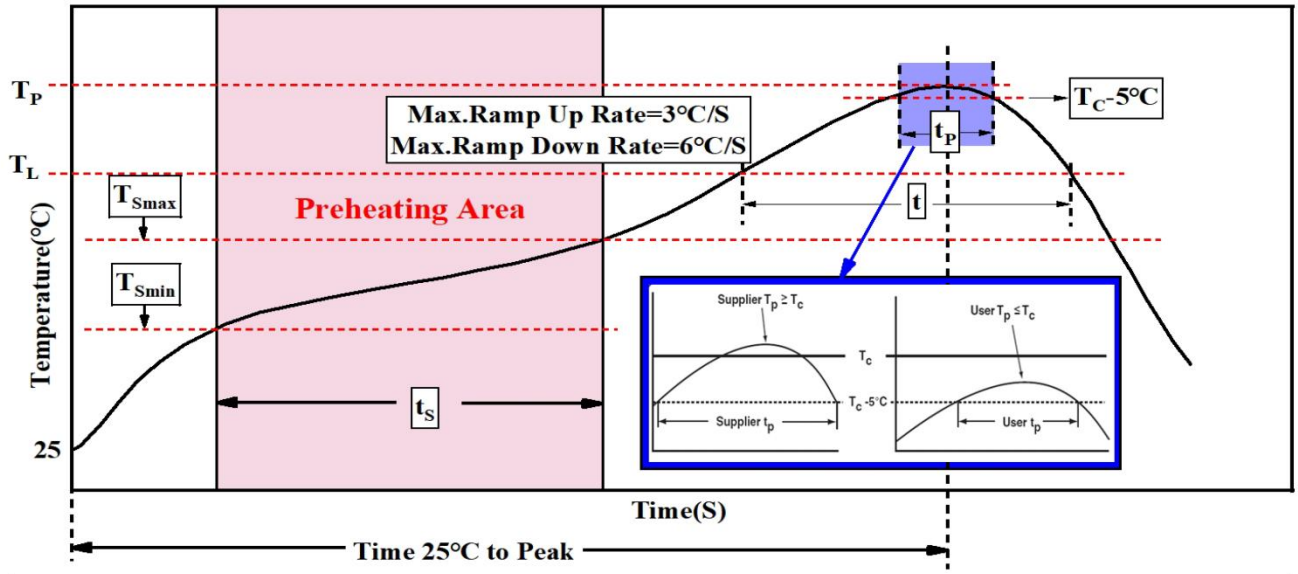

### Un-clamped Inductive Load Switching




### Drain-Source Body Diode Reverse Recovery



## Temperature Profile for IR Reflow Soldering




| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|---|---|---|
| **Preheat & Soak**<br>Temperature min (Tsmin)<br>Temperature max (Tsmax)<br>Time (Tsmin to Tsmax) (ts) | <br>100°C<br>150°C<br>60-120 seconds | <br>150°C<br>200°C<br>60-120 seconds |
| Average ramp-up rate (Tsmax to Tp) | 3 °C/second max. | 3°C/second max. |
| Liquidous temperature (TL)<br>Time at liquidous (tL) | 183 °C<br>60-150 seconds | 217°C<br>60-150 seconds |
| Peak package body Temperature e (Tp)* | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time (tp)** within 5°C of the specified classification temperature (Tc) | 20** seconds | 30** seconds |
| Average ramp-down rate (Tp to Tsmax) | 6 °C/second max. | 6 °C/second max. |
| Time 25°C to peak temperature | 6 minutes max. | 8 minutes max. |
| * Tolerance for peak profile Temperature (Tp) is defined as a supplier minimum and a user maximum.<br>** Tolerance for time at peak profile temperature (tp) is defined as a supplier minimum and a user maximum | | |

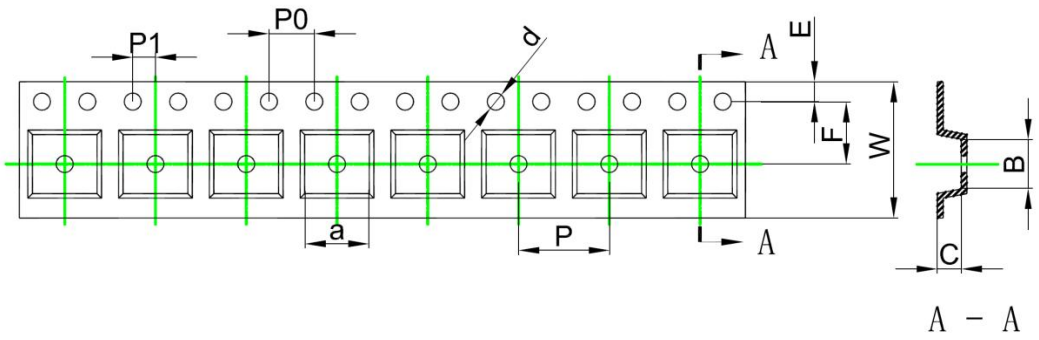
Table 1. SnPb Eutectic Process – Classification Temperatures (Tc)

| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ ≥350 |
|---|---|---|
| <2.5 mm | 235 °C | 220 °C |
| ≥2.5 mm | 220 °C | 220 °C |

Table 2. Pb-free Process – Classification Temperatures (Tc)

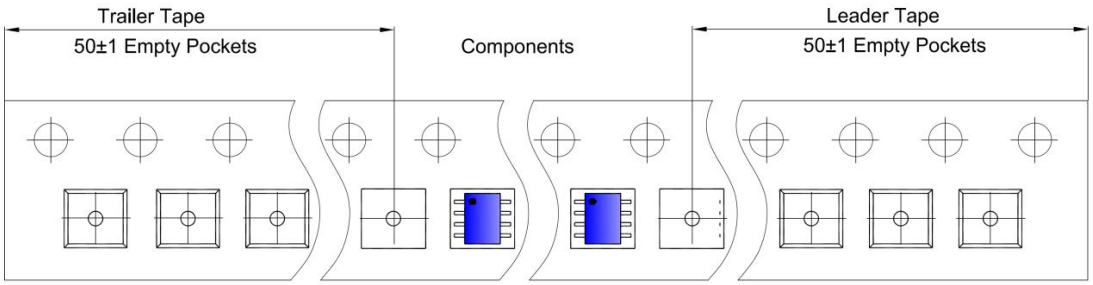
| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ 350-2000 | Volume $mm^3$ >2000 |
|---|---|---|---|
| <1.6 mm | 260 °C | 260 °C | 260 °C |
| 1.6 mm – 2.5 mm | 260 °C | 250 °C | 245 °C |
| ≥2.5 mm | 250 °C | 245 °C | 245 °C |

## SOP8 Embossed Carrier Tape

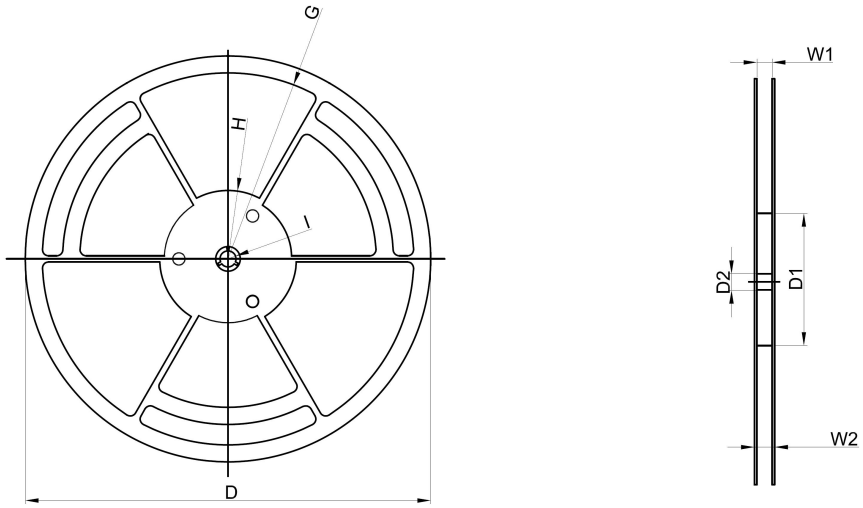



| Dimensions are in millimeter | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pkg type | a | B | c | d | E | F | P0 | P | P1 | W |
| SOP-8 | 6.40 | 5.40 | 2.10 | Φ1.50 | 1.75 | 5.50 | 4.00 | 8.00 | 2.00 | 12.00 |

## SOP8 Tape Leader and Trailer



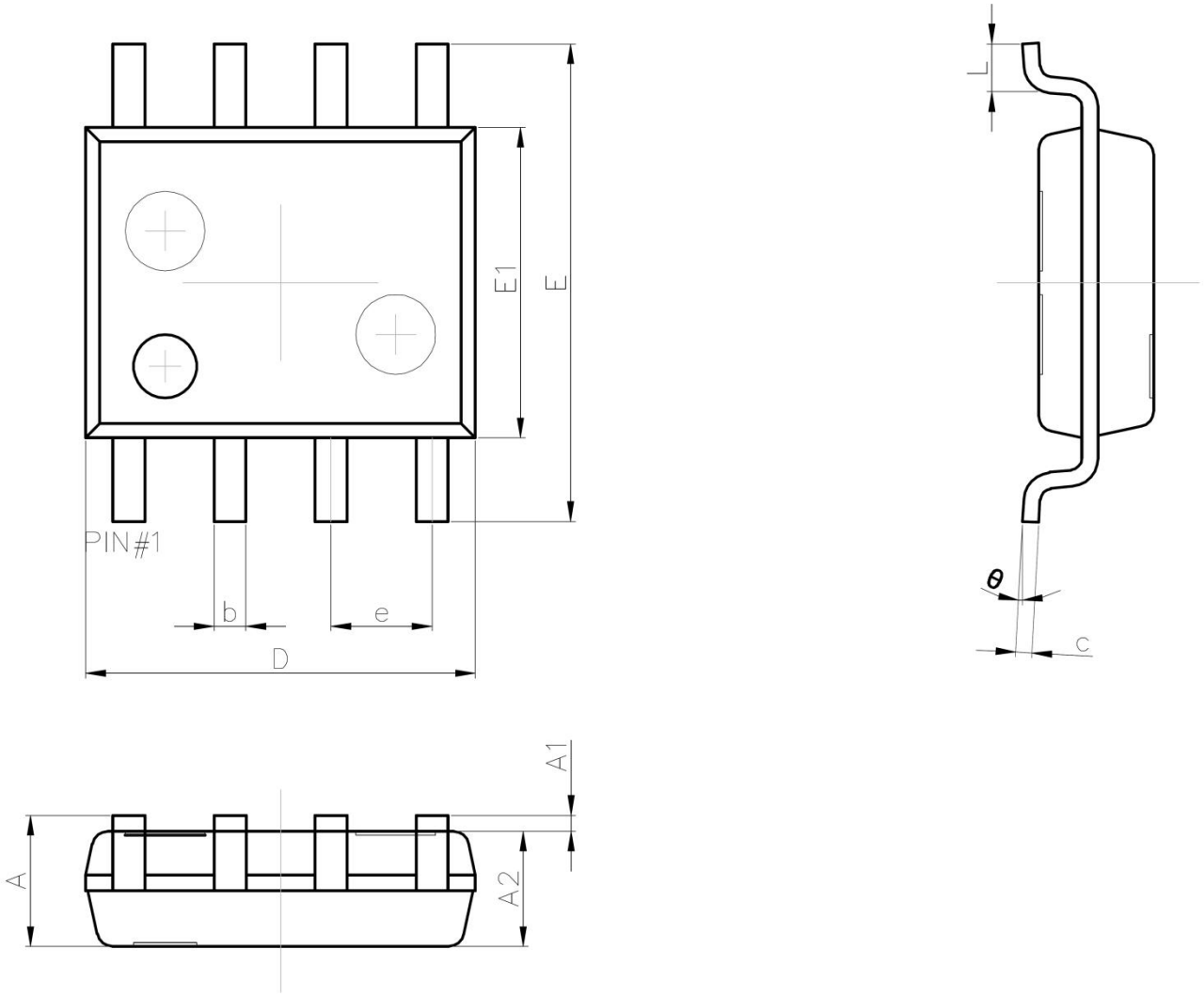

## SOP8 Reel




| Dimensions are in millimeter | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reel Option | D | D1 | D2 | G | H | I | W1 | W2 |
| 13"Dia | Ø330.00 | 100.00 | 13.00 | R151.00 | R56.00 | R6.50 | 12.40 | 17.60 |

| REEL | Reel Size | Box | Box Size(mm) | Carton | Carton Size(mm) | G.W.(kg) |
|---|---|---|---|---|---|---|
| 4,000 pcs | 13 inch | 8,000 pcs | 360×360×65 | 40,000 pcs | 565×380×390 | |

## SOP-8L Package Information




| Symbol | Dimensions In Millimeters | |
|---|---|---|
| | Min. | Max. |
| A | 1.35 | 1.75 |
| A1 | 0.10 | 0.25 |
| A2 | 1.35 | 1.55 |
| b | 0.33 | 0.51 |
| c | 0.17 | 0.25 |
| D | 4.80 | 5.00 |
| e | 1.27 REF. | |
| E | 5.80 | 6.20 |
| E1 | 3.80 | 4.00 |
| L | 0.40 | 1.27 |
| θ | 0° | 8° |