

| Key parameter                    | Value | Unit       |
|----------------------------------|-------|------------|
| $V_{(BR)DSS}$ min.               | -30   | V          |
| $R_{DS(ON)}$ max. $V_{GS}=-10V$  | 14    | m $\Omega$ |
| $R_{DS(ON)}$ max. $V_{GS}=-4.5V$ | 22    | m $\Omega$ |
| $I_D$                            | -24.4 | A          |
| $V_{GS(TH)}$ Typ.                | -1.7  | V          |
| $C_{iss}$ Typ.                   | 2516  | pF         |
| $Q_g$ 10V Typ.                   | 42.8  | nC         |

| Package outline |
|-----------------|
| PDFN 3.3x3.3-8L |
|                 |

### Description

These devices used advanced trench technology of MOSFET to provide excellent electrical parameter. There is high speed switching capability, low  $R_{DS(ON)}$  resistance, stabilizing qualified and characteristics for these devices. Moreover, it is had extreme high cell density in design. These features combine to be an advantage design for use in wide variety of application including small signal control and load switch application.

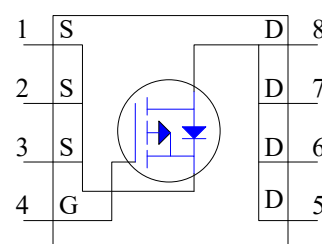
### Features

- ◇ Low On-Resistance
- ◇ Low Input Capacitance
- ◇ Low Miller Charge
- ◇ Low Input / Output Leakage
- ◇ Pb-free lead plating; RoHS compliant

### Potential application

- Motor / Body Load Contro
- Automotive Systems
- Load Switch

### Symbol and Pin assignment



### Order Information

| Item                | Description     |
|---------------------|-----------------|
| 1. Order Code       | SGP3011E        |
| 2. Part Number      | SGP3011E        |
| 3. Package Type     | PDFN 3.3x3.3-8L |
| 4. Package Code     | E               |
| 5. Packing Type     | Tape & Reel     |
| 6. Quantity in Pack | 5,000           |
| 7. RoHS Status      | Halogen-Free    |

**Content**

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

| Parameter                                       |                                              | Symbol         | Value      | Unit                  |
|-------------------------------------------------|----------------------------------------------|----------------|------------|-----------------------|
| Drain-Source Voltage                            |                                              | $V_{DS}$       | -30        | V                     |
| Gate-Source Voltage                             |                                              | $V_{GS}$       | $\pm 20$   | V                     |
| Drain Current-Continuous <sup>Note 1</sup>      | $T_C=25^{\circ}\text{C}$                     | $I_D$          | -24.4      | A                     |
|                                                 | $T_C=100^{\circ}\text{C}$                    |                | -15.4      | A                     |
| Drain Current-Continuous <sup>Note 2</sup>      | $T_A=25^{\circ}\text{C}$                     | $I_D$          | -7.4       | A                     |
|                                                 | $T_A=70^{\circ}\text{C}$                     |                | -5.9       | A                     |
| Drain Current-Pulsed <sup>Note 3</sup>          | $T_A=25^{\circ}\text{C}$                     | $I_{DM}$       | -120       | A                     |
| Avalanche Current                               |                                              | $I_{AR}$       | -26.0      | A                     |
| Single Pulse Avalanche Energy <sup>Note 4</sup> |                                              | $E_{AS}$       | 34.0       | mJ                    |
| Maximum Power Dissipation                       | $T_C=25^{\circ}\text{C}$                     | $P_D$          | 11.9       | W                     |
|                                                 | $T_C=100^{\circ}\text{C}$                    |                | 4.7        | W                     |
|                                                 | $T_A=25^{\circ}\text{C}$                     |                | 1.1        | W                     |
|                                                 | $T_A=70^{\circ}\text{C}$                     |                | 0.7        | W                     |
|                                                 | Derate Factor Above $T_C=25^{\circ}\text{C}$ |                | 0.1        | W/ $^{\circ}\text{C}$ |
| Max. Operating Junction Temperature             |                                              | $T_J$          | 150        | $^{\circ}\text{C}$    |
| Operating and Storage Temperature Range         |                                              | $T_J, T_{STG}$ | -55 to 150 | $^{\circ}\text{C}$    |

## 2. Thermal Resistance Ratings

| Parameter                            | Symbol          | Conditions             | Min. | Typ. | Max. | Unit                        |
|--------------------------------------|-----------------|------------------------|------|------|------|-----------------------------|
| Thermal resistance, Junction-Case    | $R_{\theta JC}$ | Please refer to Note 5 | -    | -    | 10.4 | $^{\circ}\text{C}/\text{W}$ |
| Thermal resistance, Junction-Ambient | $R_{\theta JA}$ | Please refer to Note 5 | -    | -    | 113  | $^{\circ}\text{C}/\text{W}$ |

### Notes:

- Limited by silicon chip capability and  $R_{\theta JC}$  junction-to-case thermal resistance.
- The maximum current rating is limited by package and  $R_{\theta JA}$  junction-to-ambient thermal resistance.
- Must be ensure junction temperature does not exceed 150-degree C. (Pulse Width  $\leq 100\mu\text{s}$ , Duty  $\leq 2\%$ )
- Limited by  $T_{Jmax}$ , starting  $T_J=25^{\circ}\text{C}$ ,  $L=0.1\text{mH}$ ,  $R_g=25\Omega$ ,  $I_D=-26\text{A}$ ,  $V_{GS}=-10\text{V}$ .
- The value of thermal resistance is measured with the single device mounted on 1 inch<sup>2</sup> FR-4 PCB with 2 oz. copper under a still air environment temperature is  $25^{\circ}\text{C}$  based on JEDEC standard JESD51-14 and JESD51-2a. Thermal resistance obtained depends on the user's specific board design and given application.

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

| STATIC CHARACTERISTICS          |                      |                                                                   |      |      |      |      |
|---------------------------------|----------------------|-------------------------------------------------------------------|------|------|------|------|
| Parameter                       | Symbol               | Conditions                                                        | Min. | Typ. | Max. | Unit |
| Drain-Source Breakdown Voltage  | V <sub>(BR)DSS</sub> | V <sub>GS</sub> =0V, I <sub>DS</sub> =-250μA                      | -30  | -    | -    | V    |
| Zero Gate Voltage Drain Current | I <sub>DSS</sub>     | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V                        | -    | -    | -1   | μA   |
|                                 |                      | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V, T <sub>J</sub> =125°C | -    | -    | -100 | μA   |
| Gate-Body Leakage               | I <sub>GSS</sub>     | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                        | -    | -    | ±100 | nA   |

| STATIC CHARACTERISTICS           |                     |                                                            |      |      |      |      |
|----------------------------------|---------------------|------------------------------------------------------------|------|------|------|------|
| Parameter                        | Symbol              | Conditions                                                 | Min. | Typ. | Max. | Unit |
| Gate Threshold Voltage           | V <sub>GS(TH)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =-250μA | -1.5 | -1.7 | -2.0 | V    |
| Drain-Source On-State Resistance | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>DS</sub> =-15A               | -    | 11.6 | 14.0 | mΩ   |
|                                  |                     | V <sub>GS</sub> =-4.5V, I <sub>DS</sub> =-8A               | -    | 18.1 | 22.0 | mΩ   |
| Gate Resistance                  | R <sub>g</sub>      | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz           | -    | 8.1  | -    | Ω    |
| Forward Transconductance         | g <sub>fs</sub>     | V <sub>DS</sub> =-5V, I <sub>DS</sub> =-15A                | -    | 13.4 | -    | S    |

| DYNAMIC CHARACTERISTICS      |                     |                                                                                            |      |       |      |      |
|------------------------------|---------------------|--------------------------------------------------------------------------------------------|------|-------|------|------|
| Parameter                    | Symbol              | Conditions                                                                                 | Min. | Typ.  | Max. | Unit |
| Input Capacitance            | C <sub>iss</sub>    | V <sub>DD</sub> =-30V, V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                  | -    | 2516  | -    | pF   |
| Output Capacitance           | C <sub>oss</sub>    | V <sub>DD</sub> =-30V, V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                  | -    | 282   | -    | pF   |
| Reverse Transfer Capacitance | C <sub>rss</sub>    | V <sub>DD</sub> =-30V, V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                  | -    | 209.4 | -    | pF   |
| Turn-On Delay Time           | T <sub>d(on)</sub>  | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-10V, I <sub>DS</sub> =-15A, R <sub>GEN</sub> =10Ω | -    | 8.1   | -    | nS   |
| Rise Time                    | T <sub>r</sub>      | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-10V, I <sub>DS</sub> =-15A, R <sub>GEN</sub> =10Ω | -    | 44.8  | -    | nS   |
| Turn-Off Delay Time          | T <sub>d(off)</sub> | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-10V, I <sub>DS</sub> =-15A, R <sub>GEN</sub> =10Ω | -    | 106.2 | -    | nS   |
| Fall Time                    | T <sub>f</sub>      | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-10V, I <sub>DS</sub> =-15A, R <sub>GEN</sub> =10Ω | -    | 53.4  | -    | nS   |

| GATE CHARGE CHARACTERISTICS                                      |                      |                                                                          |      |      |      |      |
|------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------|------|------|------|------|
| Parameter                                                        | Symbol               | Conditions                                                               | Min. | Typ. | Max. | Unit |
| Gate to Source Gate Charge                                       | Q <sub>gs</sub>      | V <sub>DD</sub> =-15V, I <sub>D</sub> =-15A, V <sub>GS</sub> =0 to -10V  | -    | 9.1  | -    | nC   |
| Gate charge at threshold                                         | Q <sub>g(th)</sub>   | V <sub>DD</sub> =-15V, I <sub>D</sub> =-15A, V <sub>GS</sub> =0 to -10V  | -    | 4.4  | -    | nC   |
| Gate to Drain Charge                                             | Q <sub>gd</sub>      | V <sub>DD</sub> =-15V, I <sub>D</sub> =-15A, V <sub>GS</sub> =0 to -10V  | -    | 7    | -    | nC   |
| Switching charge                                                 | Q <sub>sw</sub>      | V <sub>DD</sub> =-15V, I <sub>D</sub> =-15A, V <sub>GS</sub> =0 to -10V  | -    | 11.8 | -    | nC   |
| Gate charge total                                                | Q <sub>g 10V</sub>   | V <sub>DD</sub> =-15V, I <sub>D</sub> =-15A, V <sub>GS</sub> =0 to -10V  | -    | 42.8 | -    | nC   |
| Gate charge total                                                | Q <sub>g 4.5V</sub>  | V <sub>DD</sub> =-15V, I <sub>D</sub> =-15A, V <sub>GS</sub> =0 to -4.5V | -    | 20.1 | -    | nC   |
| Gate plateau voltage                                             | V <sub>plateau</sub> | V <sub>DD</sub> =-15V, I <sub>D</sub> =-15A, V <sub>GS</sub> =0 to -10V  | -    | 3.4  | -    | V    |
| Gate charge total, sync. FET (Q <sub>g</sub> - Q <sub>gd</sub> ) | Q <sub>g(sync)</sub> | V <sub>DS</sub> =0.1V, V <sub>GS</sub> =0 to -10V                        | -    | 35.7 | -    | nC   |

| DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS |                 |                                                            |      |      |        |      |
|--------------------------------------------------------|-----------------|------------------------------------------------------------|------|------|--------|------|
| Parameter                                              | Symbol          | Conditions                                                 | Min. | Typ. | Max.   | Unit |
| Body Diode continuous forward current                  | I <sub>S</sub>  | T <sub>C</sub> =25°C                                       | -    | -    | -24.4  | A    |
| Body Diode pulse current                               | I <sub>SM</sub> | T <sub>C</sub> =25°C                                       | -    | -    | -120.0 | A    |
| Body Diode Forward Voltage                             | V <sub>SD</sub> | V <sub>GS</sub> =0V, I <sub>S</sub> =-15A                  | -    | -0.8 | -1.2   | V    |
| Body Diode Reverse Recovery Time                       | t <sub>rr</sub> | V <sub>DD</sub> =-15V, I <sub>F</sub> =-15A, di/dt=100A/μs | -    | 16.2 | -      | nS   |
| Body Diode Reverse Recovery Charge                     | Q <sub>rr</sub> | V <sub>DD</sub> =-15V, I <sub>F</sub> =-15A, di/dt=100A/μs | -    | 7.7  | -      | nC   |
| Body Diode Reverse Recovery Current                    | I <sub>rm</sub> | V <sub>DD</sub> =-15V, I <sub>F</sub> =-15A, di/dt=100A/μs | -    | -0.8 | -      | A    |

## 4. Typical Operating Characteristics Diagram

Fig. 1: Output Characteristics

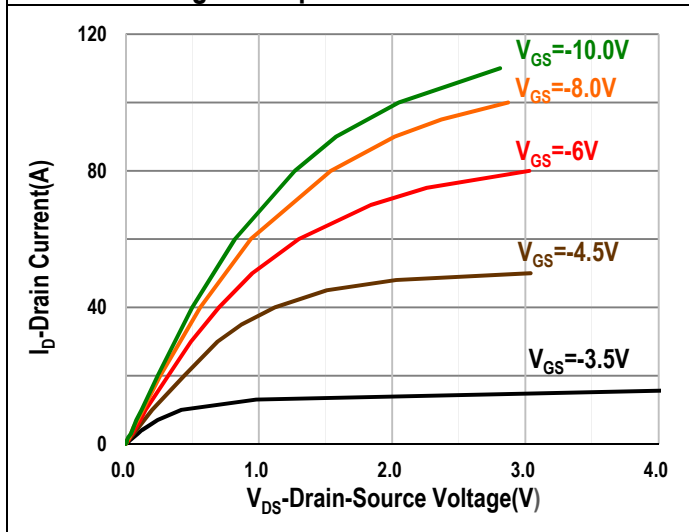


Fig. 2: Normalized  $V_{(TH)GS}$  Voltage Vs.  $T_A$

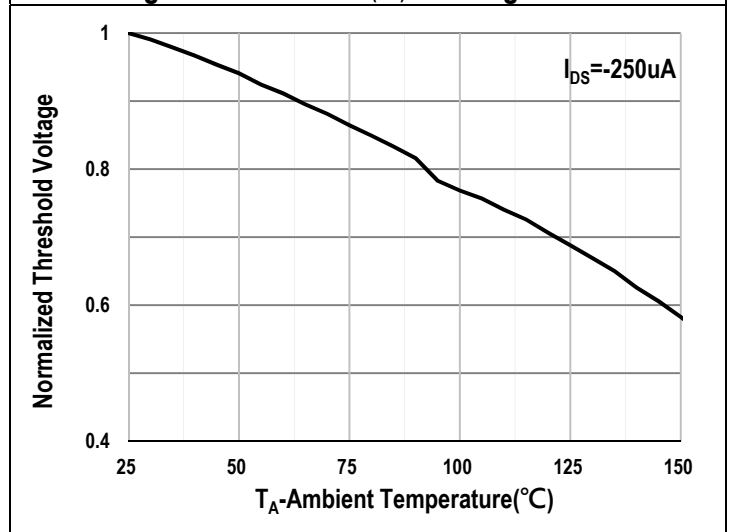


Fig. 3: Drain-Source On Resistance Vs  $V_{GS}$

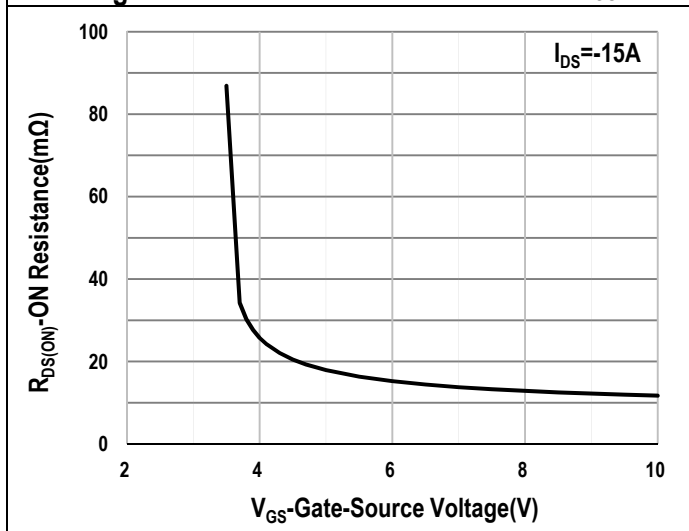


Fig. 4: Normalized  $R_{DS(ON)}$  Resistance Vs.  $T_A$

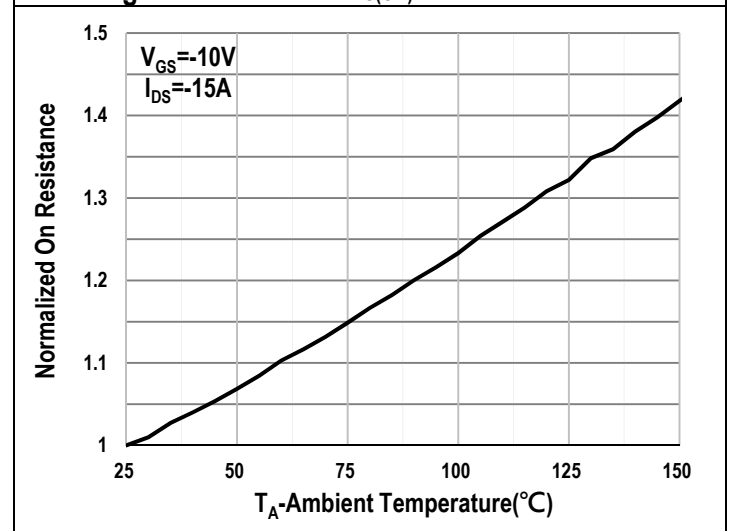


Fig. 5: Drain-Source On Resistance Vs  $I_D$

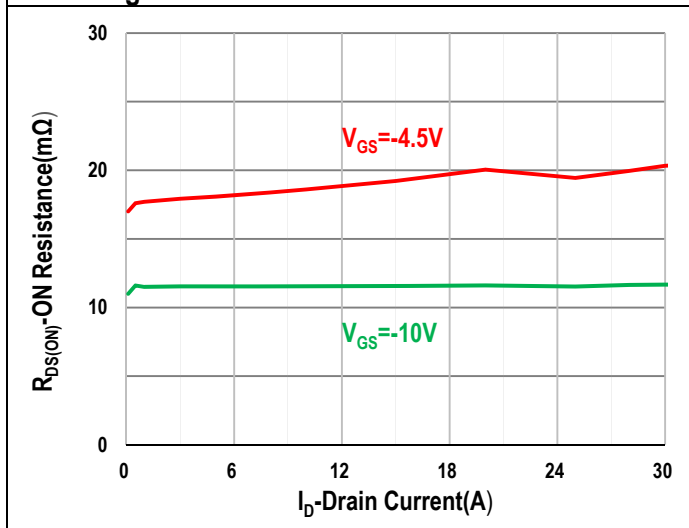
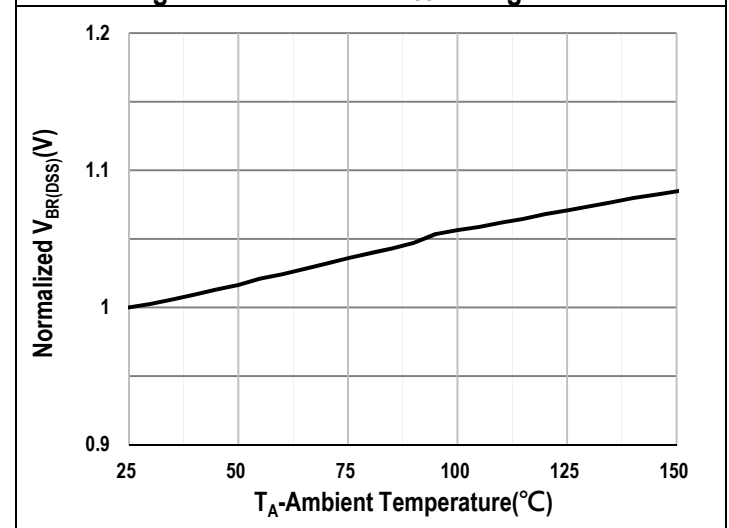
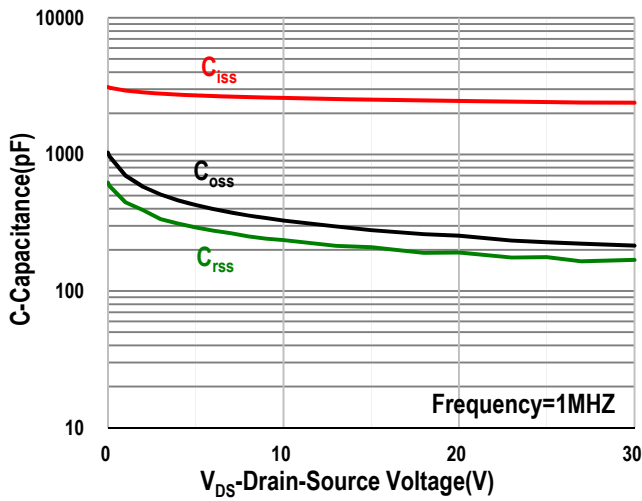


Fig. 6: Normalized  $BV_{DSS}$  Voltage Vs  $T_A$

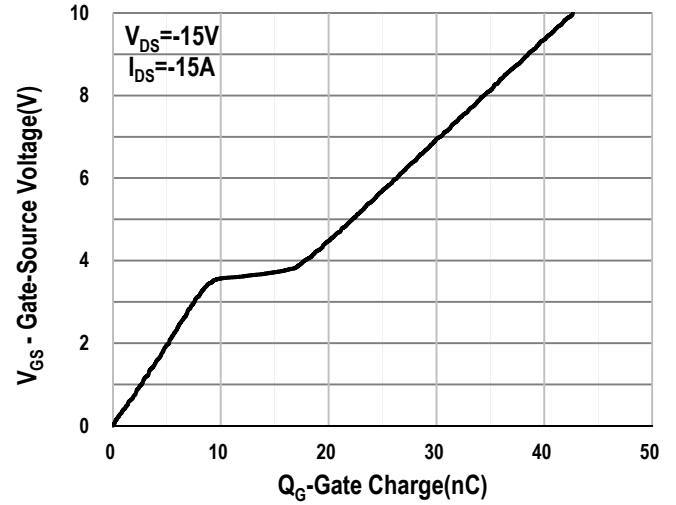


## 4. Typical Operating Characteristics Diagram

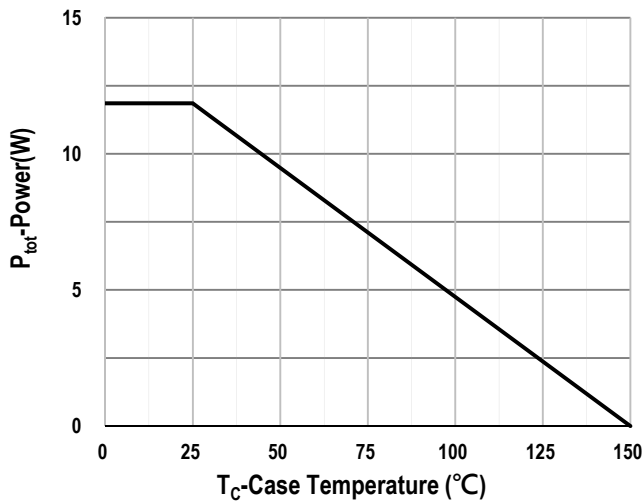
**Fig. 7: Typical Capacitance Variation Vs  $V_{DS}$**



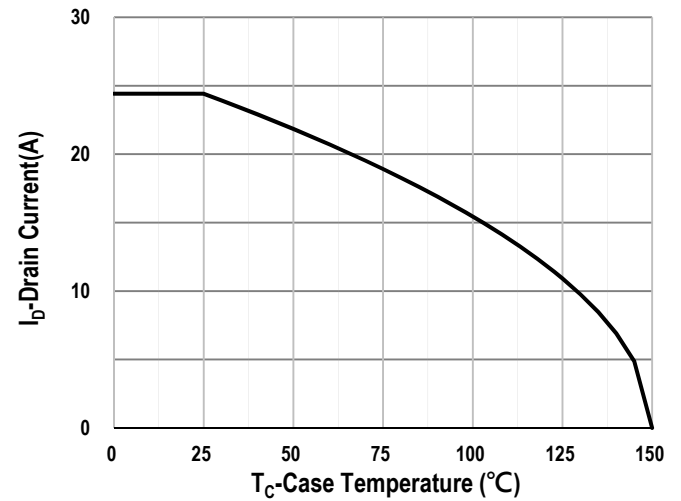
**Fig. 8: Gate Charge Vs  $V_{GS}$**



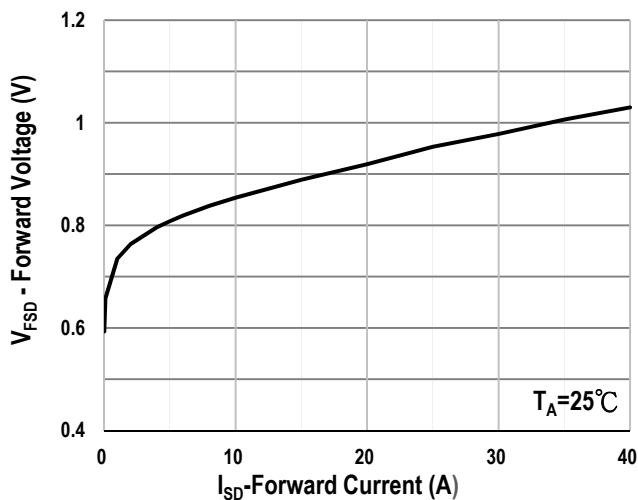
**Fig. 9: Power Dissipation Vs.  $T_C$**



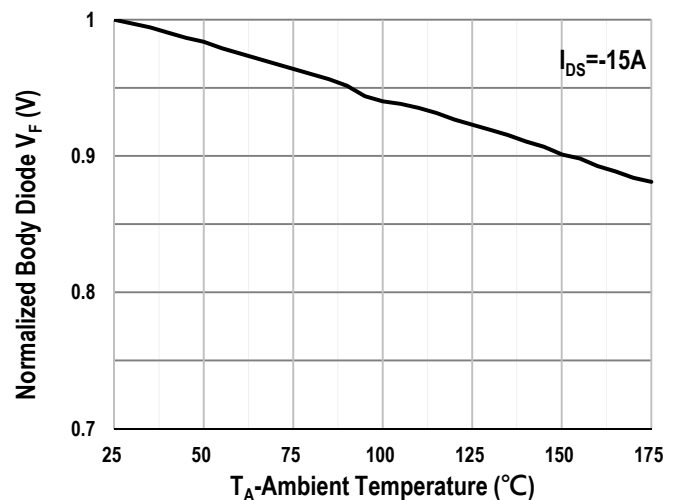
**Fig. 10: Drain Current Vs.  $T_C$**



**Fig. 11: Body Diode Forward Voltage Vs.  $I_{SD}$**

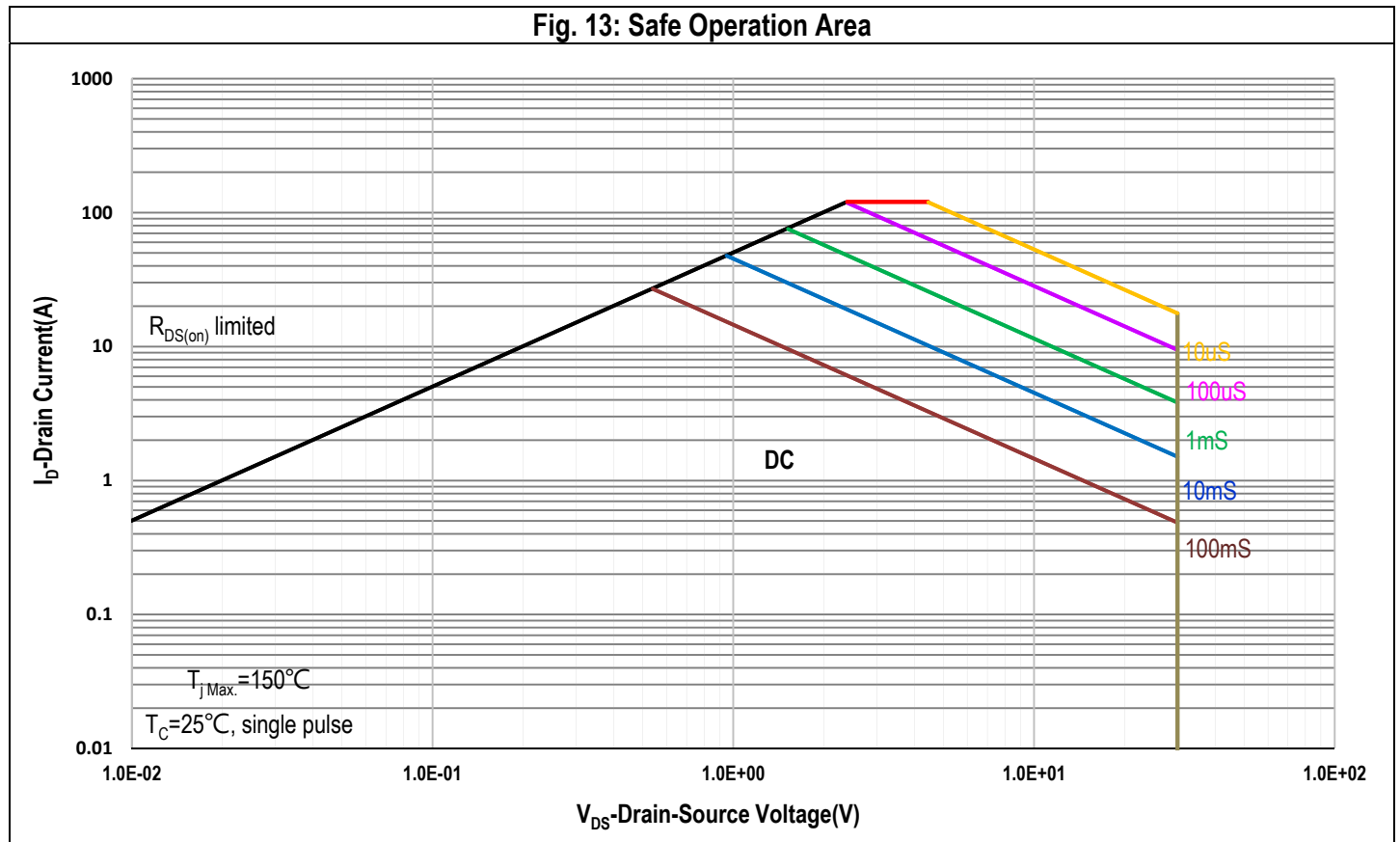


**Fig. 12: Normalized Body Diode Forward Voltage Vs.  $T_A$**

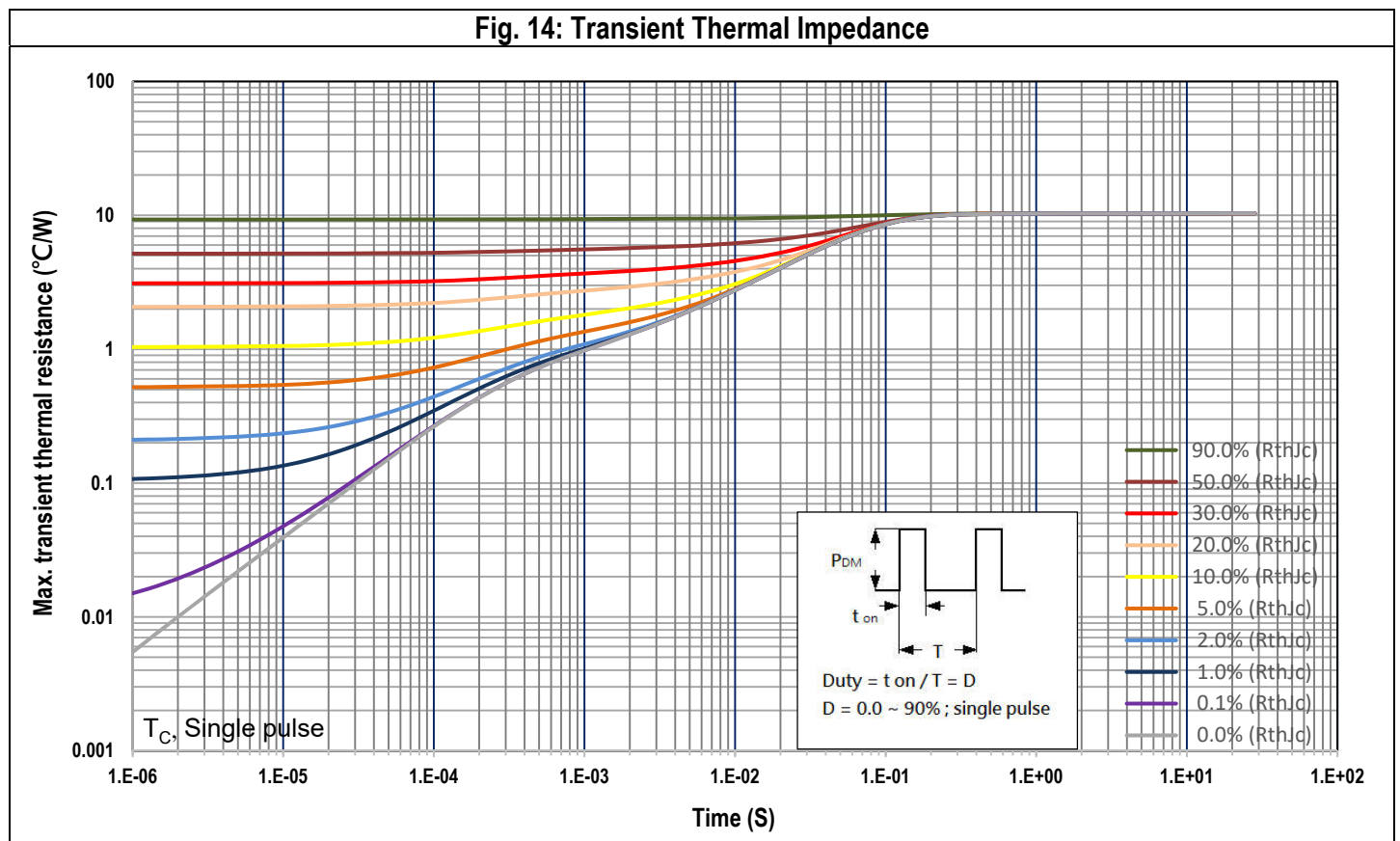


#### 4. Typical Operating Characteristics Diagram

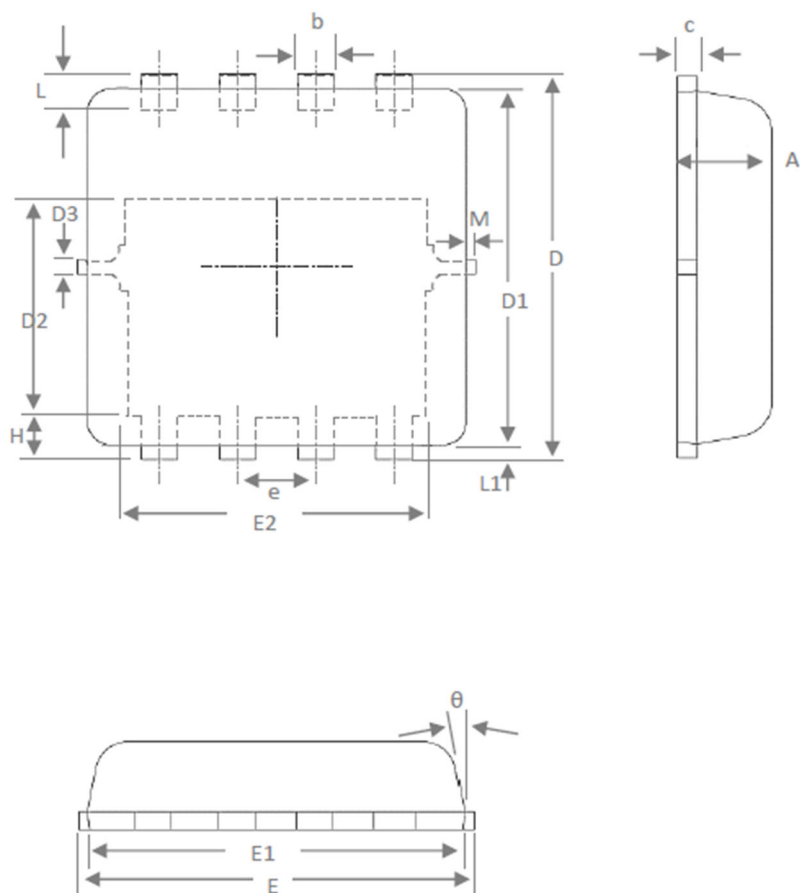
**Fig. 13: Safe Operation Area**



**Fig. 14: Transient Thermal Impedance**



### 5. Package of Dimension



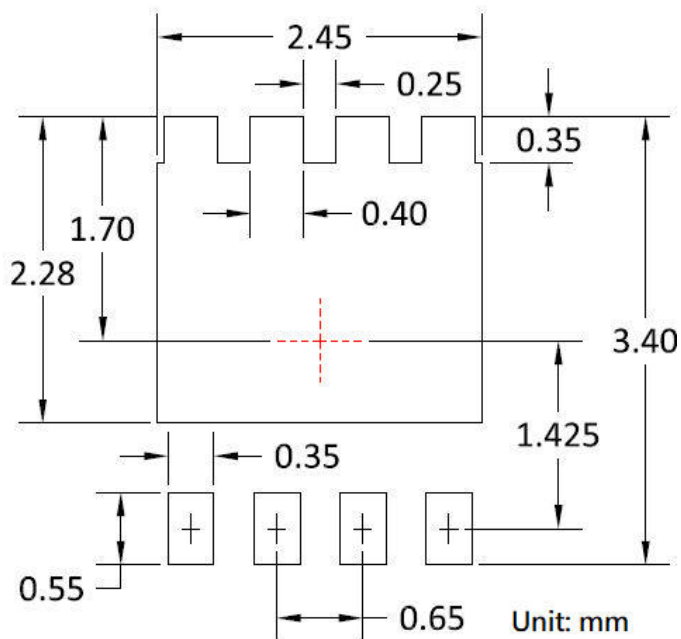
| Symbol | Min     | Nor  | Max  |
|--------|---------|------|------|
| A      | 0.70    | 0.75 | 0.80 |
| b      | 0.25    | 0.30 | 0.35 |
| c      | 0.10    | 0.15 | 0.25 |
| D      | 3.25    | 3.35 | 3.45 |
| D1     | 3.00    | 3.10 | 3.20 |
| D2     | 1.48    | 1.58 | 1.68 |
| D3     | -       | 0.13 | -    |
| E      | 3.00    | 3.30 | 3.40 |
| E1     | 3.00    | 3.15 | 3.20 |
| E2     | 2.39    | 2.49 | 2.59 |
| e      | 0.65BSC |      |      |
| H      | 0.30    | 0.39 | 0.50 |
| L      | 0.30    | 0.40 | 0.50 |
| L1     | -       | 0.13 | -    |
| θ      | -       | 10°  | 12°  |
| M      | -       | -    | 0.15 |

#### Note:

1. All Dimension Are In mm.
2. Package Body Sizes Exclude Mold Flash, Protrusion Or Gate Burrs.  
Mold Flash, Protrusion Or Gate Burrs Shall Not Exceed 0.10 mm Per Side.
3. Package Body Sizes Determined At The Outermost Extremes Of The Plastic Body  
Exclusive Of Mold Flash, Tie Bar Burrs, Gate Burrs And Interlead Flash,  
But Including Any Mismatch Between The Top And Bottom Of The Plastic Body.



## 6.Land pattern (Footprint)



**Note 1: Land pattern (Footprint) design is for reference only.**

**Note 2: Package body sizes exclude mold flash and burrs.**

**Note 3: Dimension is measured in gauge plane.**

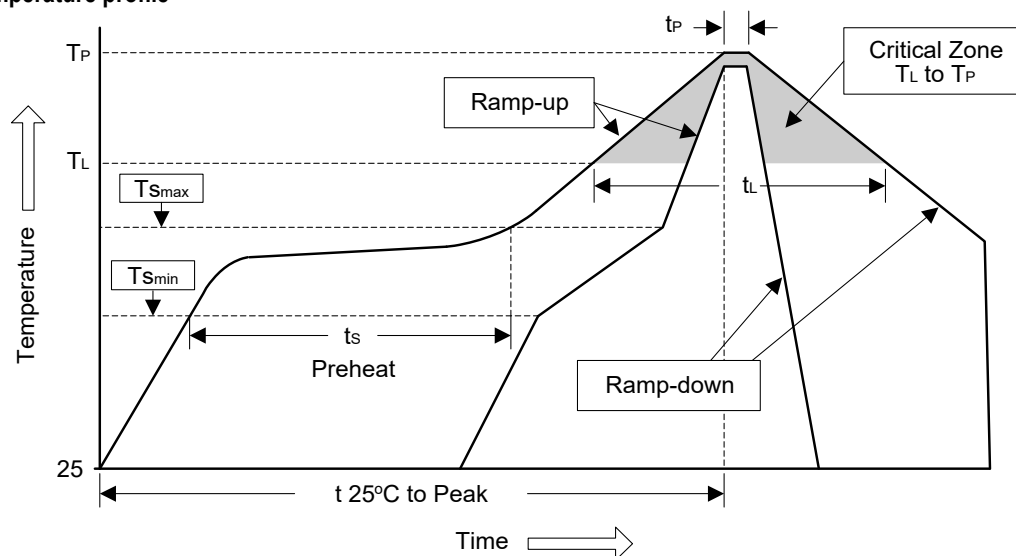
**Note 4: Tolerance 0.1mm unless otherwise specified.**

## 7. Appendix-A

### Soldering Methods for Silicongear's Products (Just for SMD type of device)

1. Storage environment: Temperature=10°C to 35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



| Profile Feature                                      | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|------------------------------------------------------|-------------------------|------------------|
| Average ramp-up rate ( $T_L$ to $T_P$ )              | <3°C/sec                | <3°C/sec         |
| Preheat                                              |                         |                  |
| - Temperature Min ( $T_{smin}$ )                     | 100°C                   | 150°C            |
| - Temperature Max ( $T_{smax}$ )                     | 150°C                   | 200°C            |
| - Time (min to max) ( $t_s$ )                        | 60 to 120 sec           | 60 to 180 sec    |
| $T_{smax}$ to $T_L$                                  |                         |                  |
| - Ramp-up Rate                                       | <3°C/sec                | <3°C/sec         |
| Time maintained above:                               |                         |                  |
| - Temperature ( $T_L$ )                              | 183°C                   | 217°C            |
| - Time ( $t_L$ )                                     | 60 to 150 sec           | 60 to 150 sec    |
| Peak Temperature ( $T_P$ )                           | 240°C +0/-5°C           | 260°C +0/-5°C    |
| Time within 5°C of actual Peak Temperature ( $t_P$ ) | 10 to 30 sec            | 20 to 40 sec     |
| Ramp-down Rate                                       | <6°C/sec                | <6°C/sec         |
| Time 25°C to Peak Temperature                        | <6 minutes              | <8 minutes       |

### 3. Flow (wave) soldering (solder dipping)

| Products         | Peak Temperature | Dipping Time |
|------------------|------------------|--------------|
| Pb devices.      | 245°C ±5°C       | 5sec ±1sec   |
| Pb-Free devices. | 260°C +0/-5°C    | 5sec ±1sec   |

**8. Appendix-B****Important Notice****© Silicongear Corporation**

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