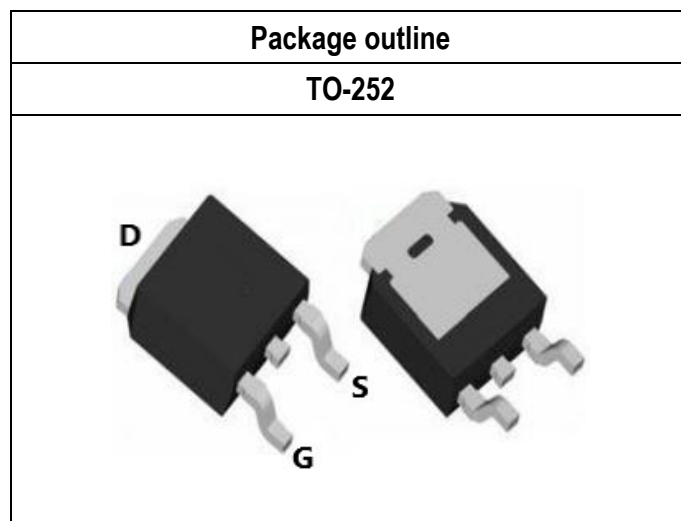


Key parameter	Value	Unit
$V_{(BR)DSS \text{ min.}}$	60	V
$R_{DS(ON) \text{ max. } V_{GS}=10V}$	5.4	m $\Omega$
$I_D$	154.2	A
$V_{GS(TH) \text{ Typ.}}$	2.8	V
$C_{iss \text{ Typ.}}$	4632	pF
$Q_g \text{ 10V Typ.}$	77.2	nC



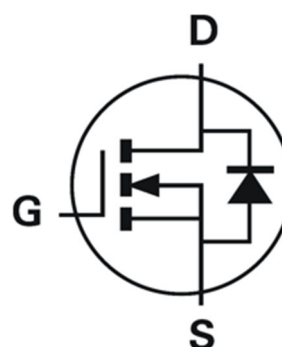
### Description

The 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.

### Features

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

### Symbol and Pin assignment



### Potential application

- Lithium-Ion Secondary Batteries
- Load Switch
- DC-DC converters and Off-line UPS

### Order Information

Item	Description
1. Order Code	SG60N03D
2. Part Number	SG60N03D
3. Package Type	TO-252
4. Package Code	D
5. Packing Type	Tape & Reel
6. Quantity in Pack	2,500
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		$V_{DS}$	60	V
Gate-Source Voltage		$V_{GS}$	$\pm 20$	V
Drain Current-Continuous <sup>Note 1</sup>	$T_C=25^{\circ}\text{C}$	$I_D$	154.2	A
	$T_C=100^{\circ}\text{C}$		97.5	A
Drain Current-Continuous <sup>Note 2</sup>	$T_A=25^{\circ}\text{C}$	$I_D$	19.2	A
	$T_A=70^{\circ}\text{C}$		15.4	A
Drain Current-Pulsed <sup>Note 3</sup>	$T_A=25^{\circ}\text{C}$	$I_{DM}$	200	A
Avalanche Current		$I_{AR}$	51.0	A
Single Pulse Avalanche Energy <sup>Note 4</sup>		$E_{AS}$	130.0	mJ
Maximum Power Dissipation	$T_C=25^{\circ}\text{C}$	$P_D$	208.0	W
	$T_C=100^{\circ}\text{C}$		83.2	W
	$T_A=25^{\circ}\text{C}$		3.2	W
	$T_A=70^{\circ}\text{C}$		2.1	W
	Derate Factor Above $T_C=25^{\circ}\text{C}$		1.6	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	-	-	0.6	$^{\circ}\text{C/W}$
Thermal resistance, Junction-Ambient	$R_{\theta JA}$	Please refer to Note 5	-	-	38.1	$^{\circ}\text{C/W}$

### 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 $\leq$ 100uS, Duty $\leq$ 2%)
- Limited by  $T_{Jmax}$ , starting  $T_J=25^{\circ}\text{C}$ ,  $L=0.1\text{mH}$ ,  $R_g=25\Omega$ ,  $I_D=51\text{A}$ ,  $V_{GS}=10\text{V}$ .
- The value of thermal resistance is measured with the single device put on cooling plate under a still air environment temperature is 25 degree 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	60	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =60V, V <sub>GS</sub> =0V	-	-	1	μA
		V <sub>DS</sub> =60V, 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	2.4	2.8	3.2	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>DS</sub> =20A	-	4.5	5.4	mΩ
Gate Resistance	R <sub>g</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz	-	2.0	-	Ω
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> =-5V, I <sub>DS</sub> =5A	-	18.6	-	S

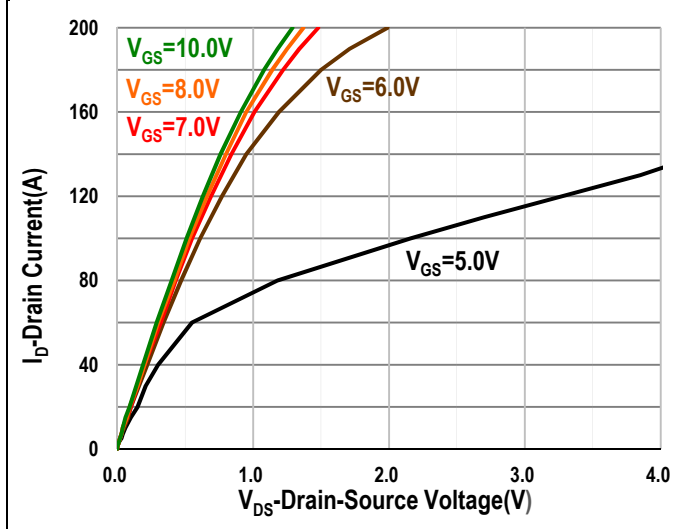
DYNAMIC CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Capacitance	C <sub>iss</sub>	V <sub>DD</sub> =60V, V <sub>DS</sub> =30V, V <sub>GS</sub> =0V, f=1MHz	-	4632	-	pF
Output Capacitance	C <sub>oss</sub>	V <sub>DD</sub> =60V, V <sub>DS</sub> =30V, V <sub>GS</sub> =0V, f=1MHz	-	428.8	-	pF
Reverse Transfer Capacitance	C <sub>rss</sub>	V <sub>DD</sub> =60V, V <sub>DS</sub> =30V, V <sub>GS</sub> =0V, f=1MHz	-	156.2	-	pF
Turn-On Delay Time	T <sub>d(on)</sub>	V <sub>DS</sub> =30V, V <sub>GS</sub> =10V, I <sub>DS</sub> =20A, R <sub>GEN</sub> =3Ω	-	17	-	nS
Rise Time	T <sub>r</sub>	V <sub>DS</sub> =30V, V <sub>GS</sub> =10V, I <sub>DS</sub> =20A, R <sub>GEN</sub> =3Ω	-	44.5	-	nS
Turn-Off Delay Time	T <sub>d(off)</sub>	V <sub>DS</sub> =30V, V <sub>GS</sub> =10V, I <sub>DS</sub> =20A, R <sub>GEN</sub> =3Ω	-	56.6	-	nS
Fall Time	T <sub>f</sub>	V <sub>DS</sub> =30V, V <sub>GS</sub> =10V, I <sub>DS</sub> =20A, R <sub>GEN</sub> =3Ω	-	42.3	-	nS

GATE CHARGE CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Gate to Source Gate Charge	Q <sub>gs</sub>	V <sub>DD</sub> =30V, I <sub>D</sub> =20A, V <sub>GS</sub> =0 to 10V	-	22.5	-	nC
Gate charge at threshold	Q <sub>g(th)</sub>	V <sub>DD</sub> =30V, I <sub>D</sub> =20A, V <sub>GS</sub> =0 to 10V	-	13.2	-	nC
Gate to Drain Charge	Q <sub>gd</sub>	V <sub>DD</sub> =30V, I <sub>D</sub> =20A, V <sub>GS</sub> =0 to 10V	-	16.7	-	nC
Switching charge	Q <sub>sw</sub>	V <sub>DD</sub> =30V, I <sub>D</sub> =20A, V <sub>GS</sub> =0 to 10V	-	26	-	nC
Gate charge total	Q <sub>g 10V</sub>	V <sub>DD</sub> =30V, I <sub>D</sub> =20A, V <sub>GS</sub> =0 to 10V	-	77.2	-	nC
Gate plateau voltage	V <sub>plateau</sub>	V <sub>DD</sub> =30V, I <sub>D</sub> =20A, V <sub>GS</sub> =0 to 10V	-	4.6	-	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	-	60.5	-	nC

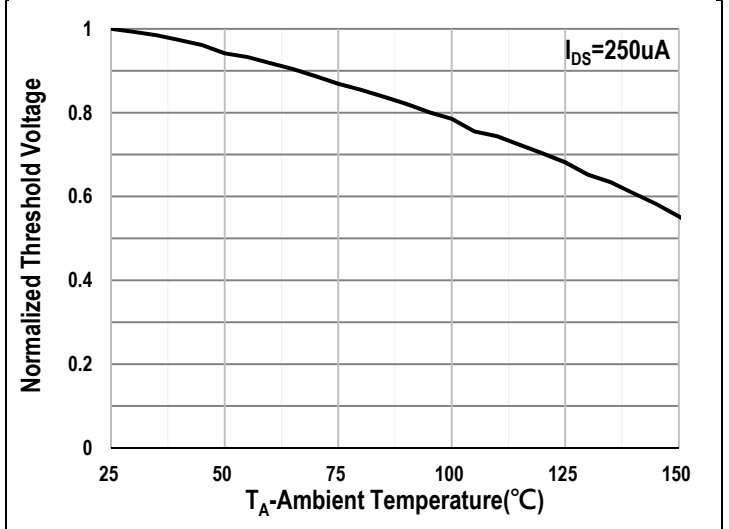
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Body Diode continuous forward current	I <sub>S</sub>	T <sub>C</sub> =25°C	-	-	-	A
Body Diode pulse current	I <sub>SM</sub>	T <sub>C</sub> =25°C	-	-	-	A
Body Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =20A	-	0.8	1.2	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	V <sub>DD</sub> =30V, I <sub>F</sub> =20A, di/dt=100A/μs	-	27.8	-	nS
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>	V <sub>DD</sub> =30V, I <sub>F</sub> =20A, di/dt=100A/μs	-	25.6	-	nC
Body Diode Reverse Recovery Current	I <sub>rm</sub>	V <sub>DD</sub> =30V, I <sub>F</sub> =20A, di/dt=100A/μs	-	-1.7	-	A

#### 4. Typical Operating Characteristics Diagram

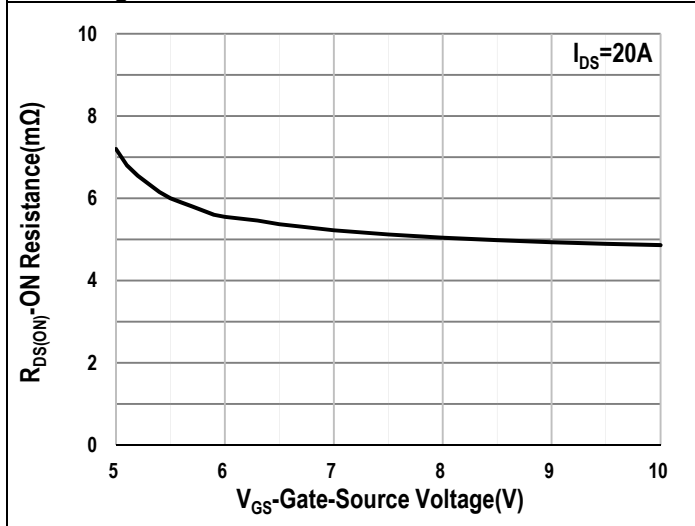
**Fig. 1: Output Characteristics**



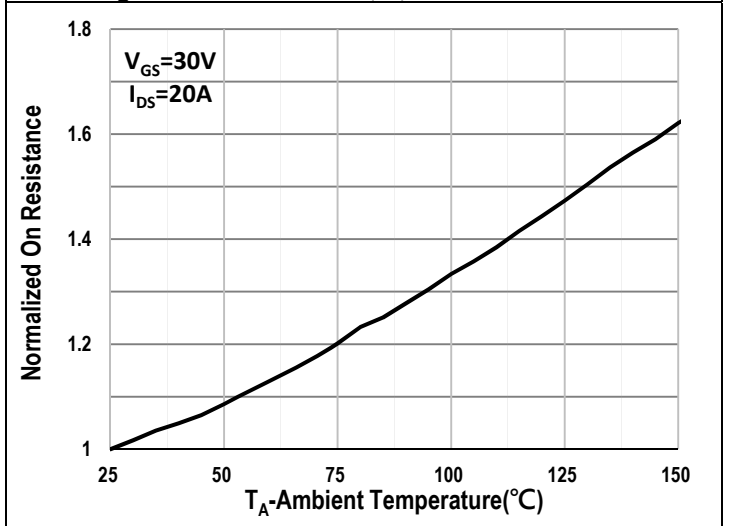
**Fig. 2: Normalized  $V_{(TH)GS}$  Voltage Vs.  $T_A$**



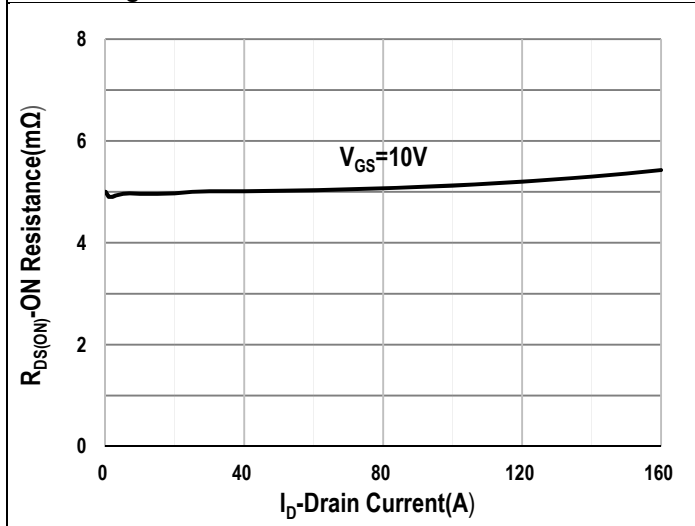
**Fig. 3: Drain-Source On Resistance Vs  $V_{GS}$**



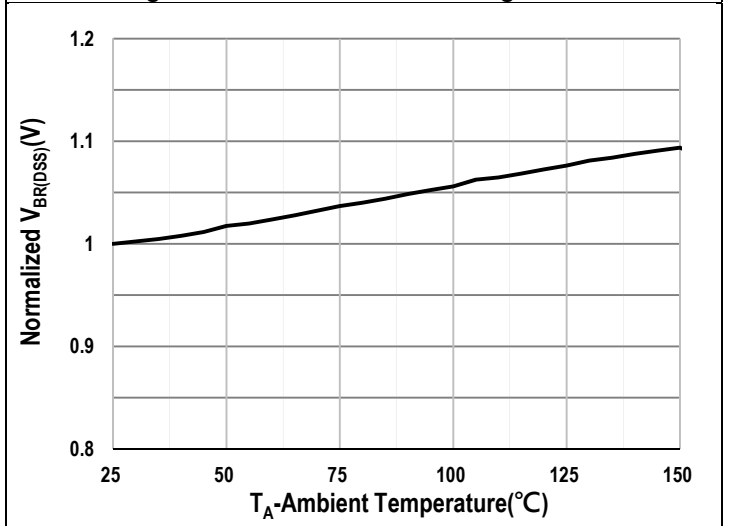
**Fig. 4: Normalized  $R_{DS(ON)}$  Resistance Vs.  $T_A$**



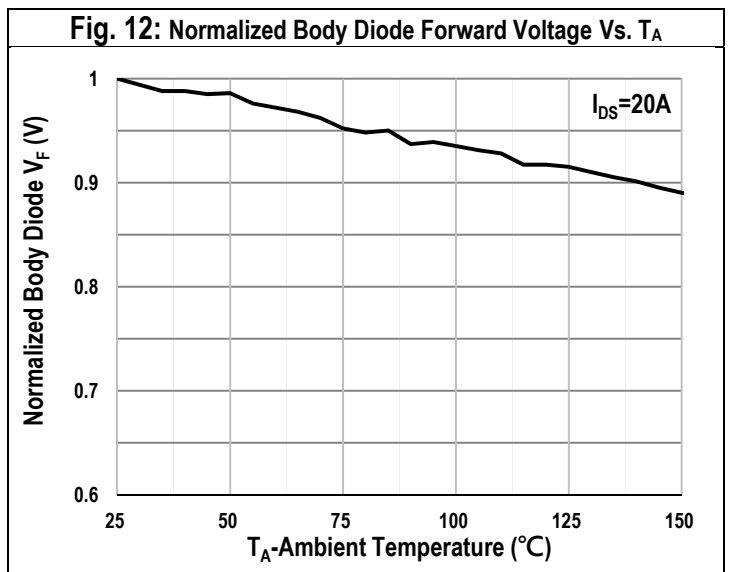
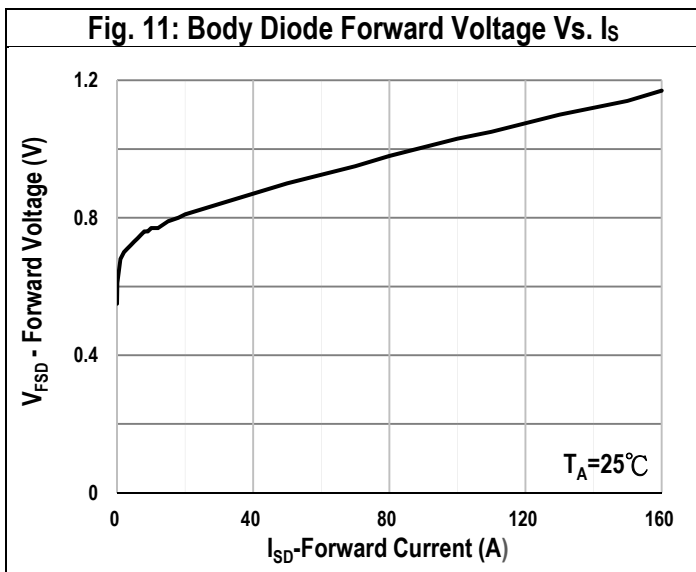
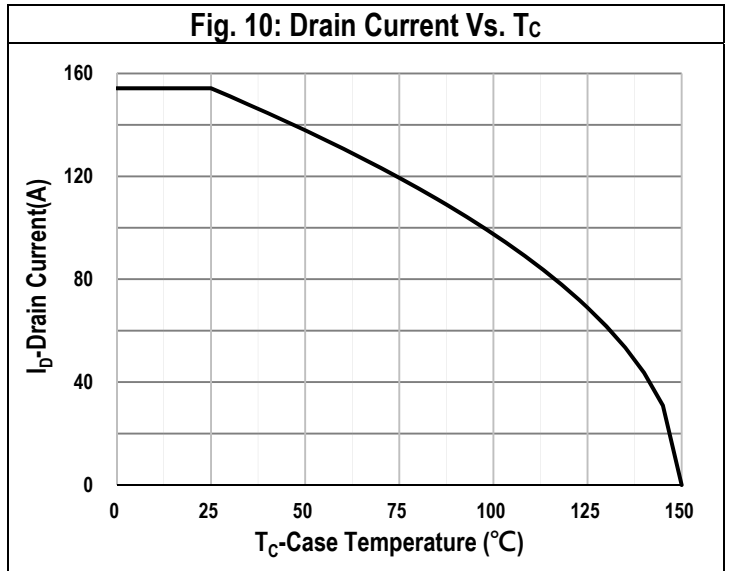
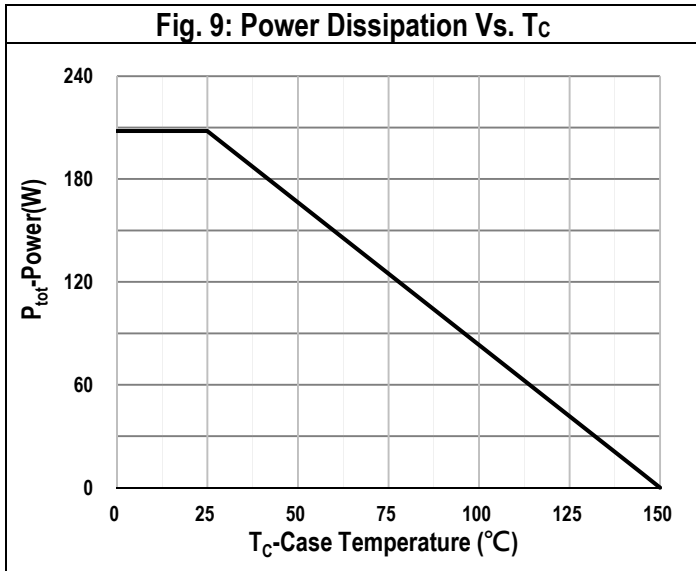
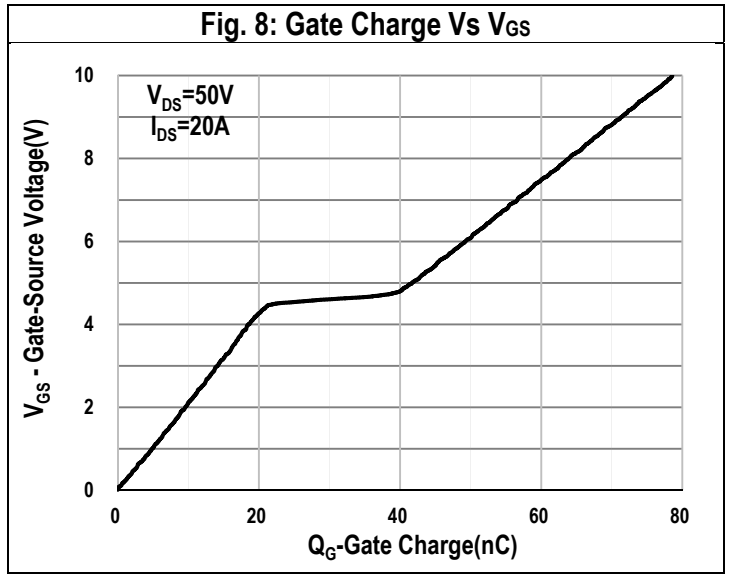
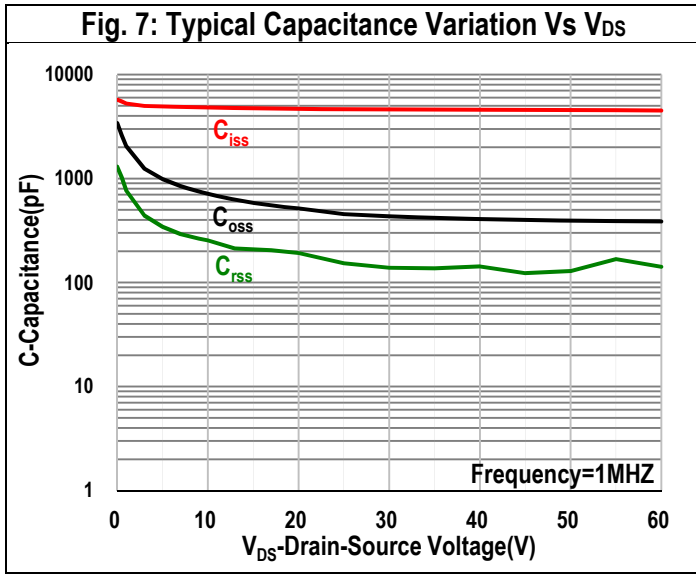
**Fig. 5: Drain-Source On Resistance Vs  $I_D$**



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



#### 4. Typical Operating Characteristics Diagram



#### 4. Typical Operating Characteristics Diagram

Fig. 13: Safe Operation Area

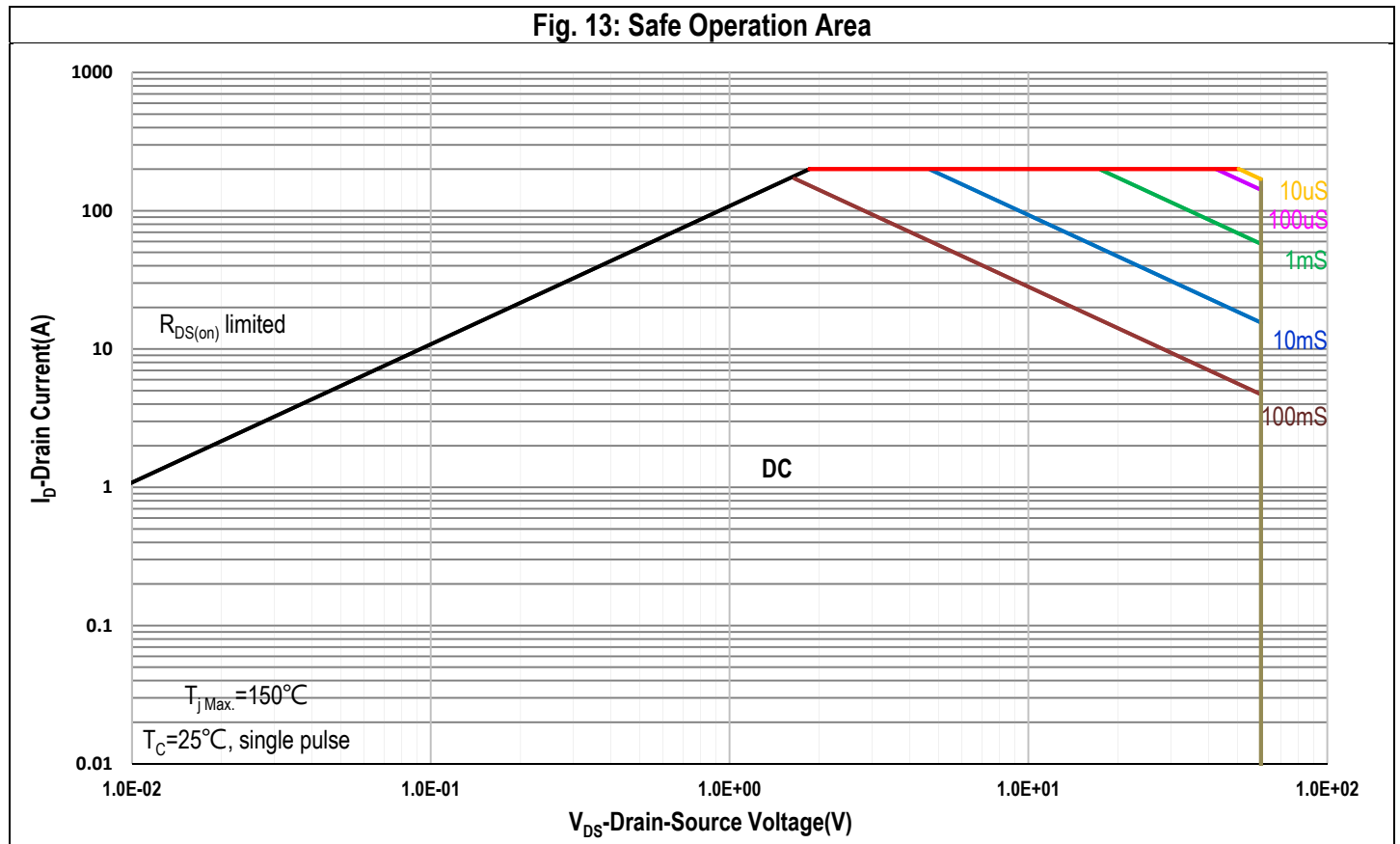
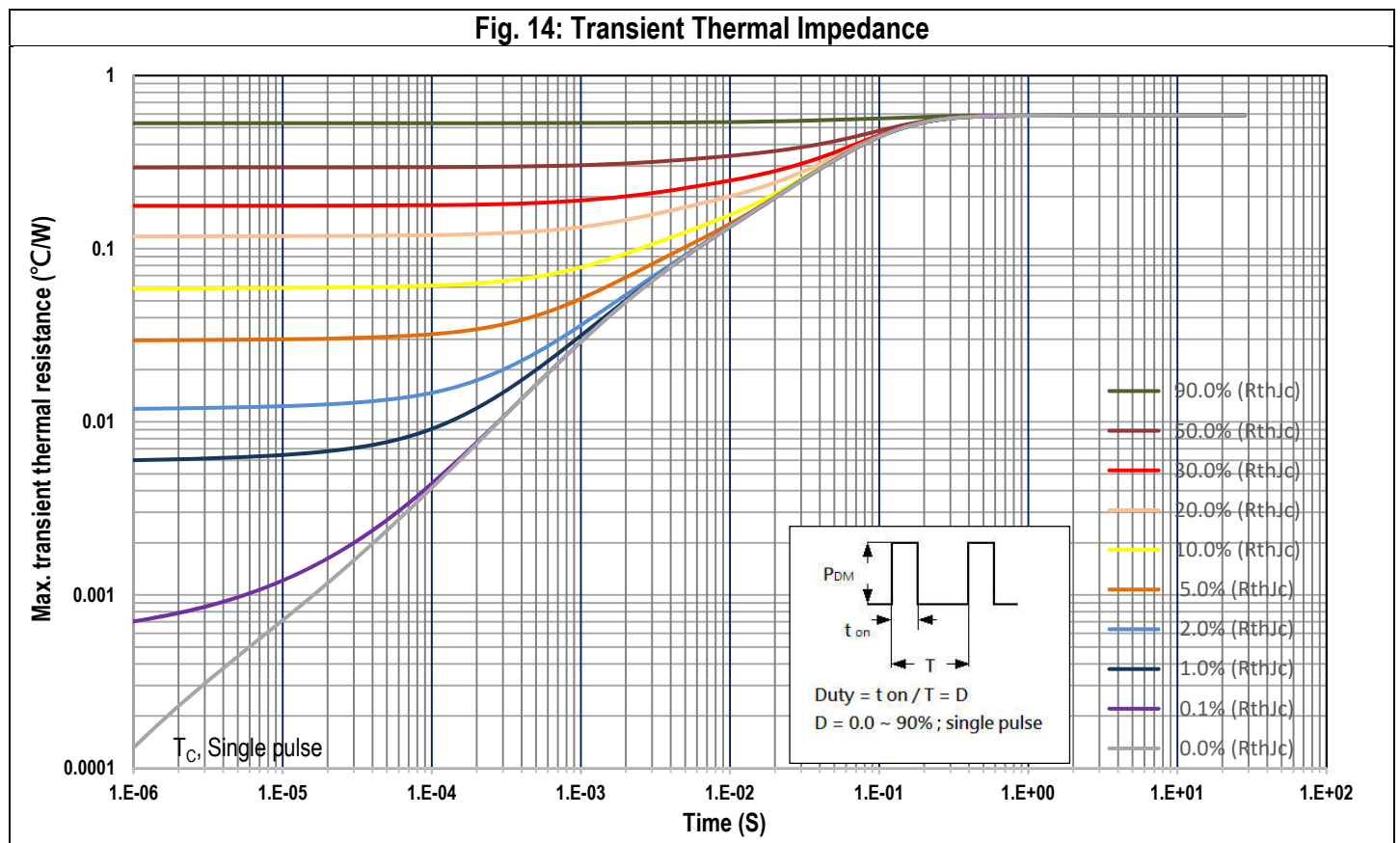
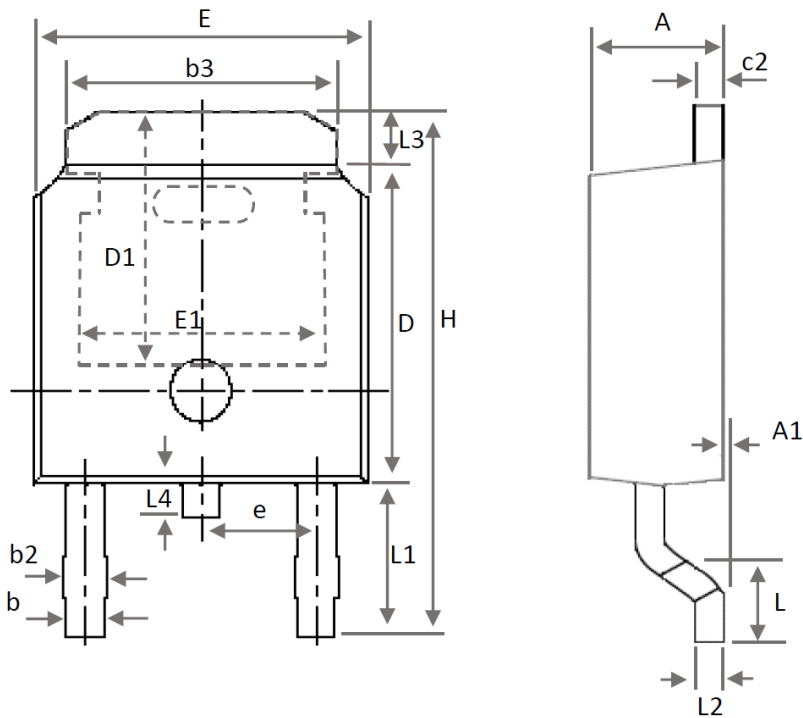


Fig. 14: Transient Thermal Impedance



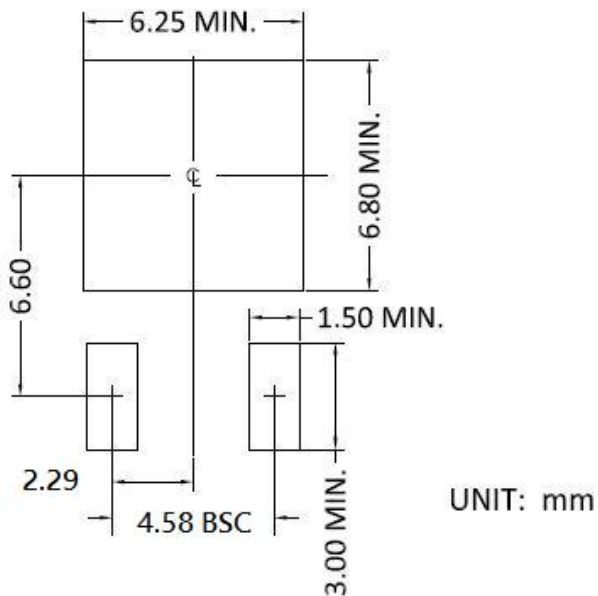
## 5. Package of Dimension



Symbol	Min	Nor	Max
E	6.35	6.54	6.731
L	1.40	1.59	1.78
L1	2.743 Ref.		
L2	0.508 BSC		
L3	0.89	1.08	1.27
L4	0.60	0.81	1.01
D	5.97	6.10	6.223
H	9.40	9.91	10.41
b	0.64	0.77	0.89
b2	0.76	0.95	1.14
b3	4.95	5.21	5.46
e	2.286 BSC		
A	2.18	2.29	2.39
A1	0.00	0.07	0.13
c2	0.46	0.68	0.89
D1	5.21	-	-
E1	4.32	-	-

1. All dimension are in millimeters.
2. Dimension does not include burrs and mold flash/protrusions.

## 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.

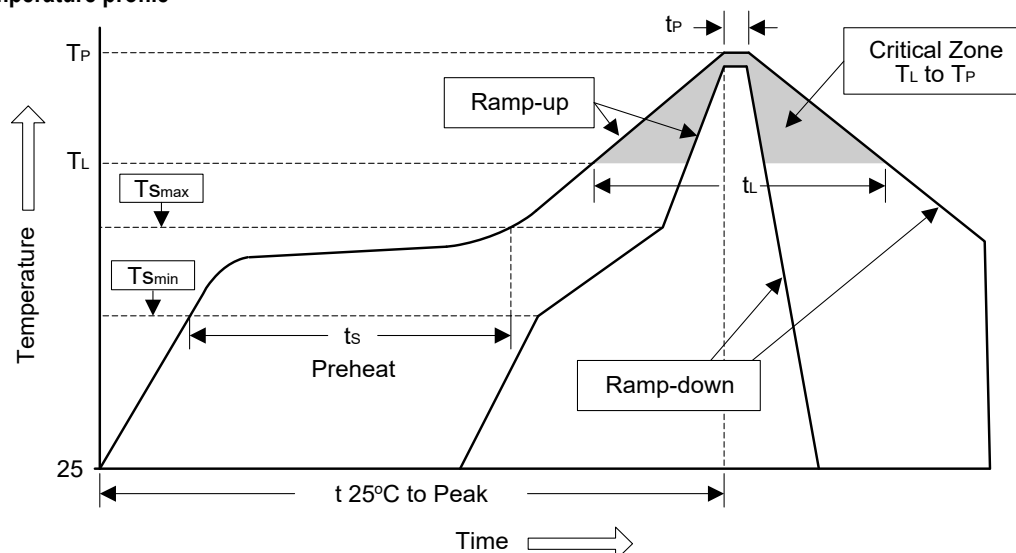
**Note 4:** Tolerance 0.1mm unless otherwise specified.

## 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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