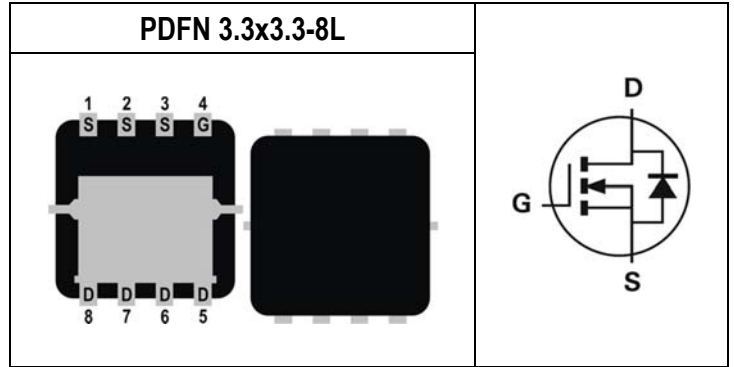


Parameter	Value	Unit
$V_{DSS}$	40	V
$R_{DS(ON)}$ max. $V_{GS}=10V$	11	m $\Omega$
$R_{DS(ON)}$ max. $V_{GS}=4.5V$	16	m $\Omega$
$I_D$	38	A



Features	Application
<ul style="list-style-type: none"> <li>• Low On-Resistance</li> <li>• Low Input Capacitance</li> <li>• Low Miller Charge</li> <li>• Low Input / Output Leakage</li> <li>• Pb-free lead plating; RoHS compliant</li> </ul>	<ul style="list-style-type: none"> <li>• Motor / Body Load Control</li> <li>• Automotive Systems</li> <li>• Load Switch</li> <li>• DC-DC converters and Off-line UPS</li> </ul>

### Ordering Information

Ordering Code	RoHS Status	Package	Package Code	Packing	Quantity
SG40N04E	Halogen-Free	PDFN 3.3x3.3-8L	E	Tape & Reel	5,000

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	40	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	$T_C=25^\circ\text{C}$	38
		$T_C=100^\circ\text{C}$	24
		$T_A=25^\circ\text{C}$	10
		$T_A=70^\circ\text{C}$	6
Drain Current-Pulsed <sup>Note 1</sup>	$I_{DM}$	100	A
Avalanche Current	$I_{AS}$	20	A
Avalanche Energy, $L=0.1\text{mH}$	$E_{AS}$	20	mJ
Maximum Power Dissipation	$P_D$	$T_C=25^\circ\text{C}$	23.1
		$T_C=100^\circ\text{C}$	9.3
		$T_C=25^\circ\text{C}$	1.7
		$T_C=70^\circ\text{C}$	0.7
Storage Temperature Range	$T_{STG}$	-55 to +150	$^\circ\text{C}$
Operating Junction Temperature Range	$T_J$	-55 to +150	$^\circ\text{C}$

### Thermal Resistance Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Maximum Junction-to-Ambient	$R_{\theta JA}$	Steady State	-	-	75	$^\circ\text{C}/\text{W}$
Maximum Junction-to-Case	$R_{\theta JC}$	Steady State	-	-	5.4	$^\circ\text{C}/\text{W}$

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

OFF CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA	40	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA

ON 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	-	2.5	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>DS</sub> =9A	-	13	14.5	mΩ
Drain-Source On-State Resistance		V <sub>GS</sub> =4.5V, I <sub>DS</sub> =5A	-	17.5	20	mΩ
Forward Transconductance <sup>Note 1</sup>	g <sub>fs</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =20A	-	35	-	S

DYNAMIC CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, f=1MHz	-	1248	-	pF
Output Capacitance	C <sub>oss</sub>		-	114	-	
Reverse Transfer Capacitance	C <sub>rss</sub>		-	84	-	
Gate Resistance	R <sub>g</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz	-	2	-	Ω

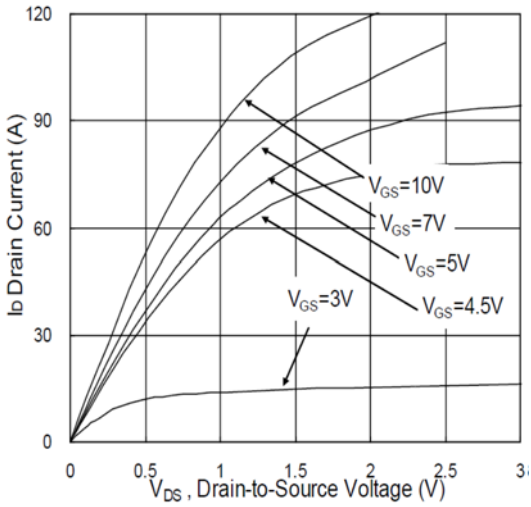
SWITCHING CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Turn-On Delay Time	T <sub>d(on)</sub>	V <sub>DD</sub> =20V, I <sub>D</sub> =20A, V <sub>GS</sub> =10V, R <sub>g</sub> =3.3Ω	-	8.17	-	ns
Rise Time	t <sub>r</sub>		-	3.23	-	
Turn-Off Delay Time	T <sub>d(off)</sub>		-	23.75	-	
Fall Time	t <sub>f</sub>		-	2.09	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =20V, I <sub>DS</sub> =20A, V <sub>GS</sub> =4.5V	-	10.16	-	nC
Gate to Source Gate Charge	Q <sub>gs</sub>		-	3.13	-	
Gate to Drain "Miller" Charge	Q <sub>gd</sub>		-	3.99	-	

DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Maximum Body-Diode Continuous Current	I <sub>S</sub>	V <sub>G</sub> =V <sub>D</sub> =0V, Force Current	-	-	38	A
Pulsed Source Current	I <sub>SM</sub>	V <sub>G</sub> =V <sub>D</sub> =0V, Force Current	-	-	100	A
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =20A	-	-	1.2	V

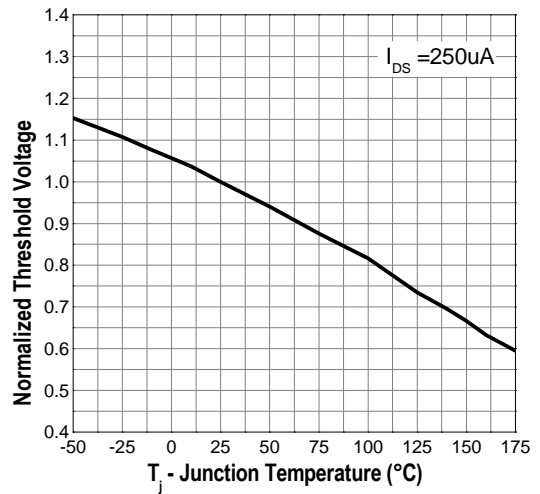
- Notes:**
1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
  2. R<sub>θJA</sub> is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. R<sub>θJC</sub> is guaranteed by design while R<sub>θJA</sub> is determined by the user's board design. R<sub>θJA</sub> shown below for single device operation on FR-4 in still air.

**Typical Operating Characteristics**

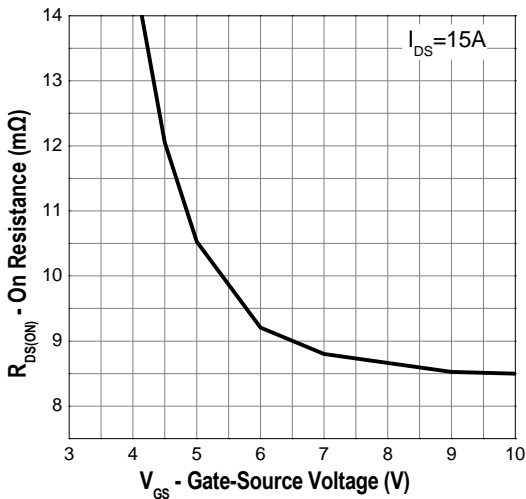
**Output Characteristics**



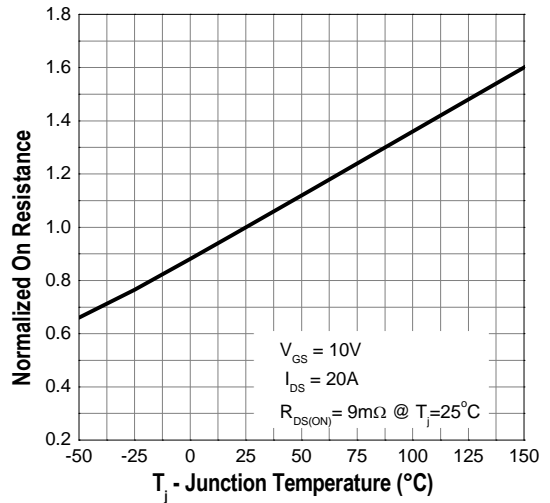
**Gate Threshold Voltage**



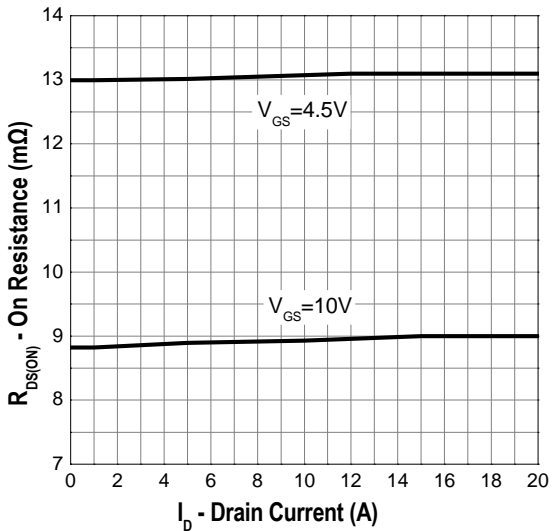
**Gate-Source On Resistance**



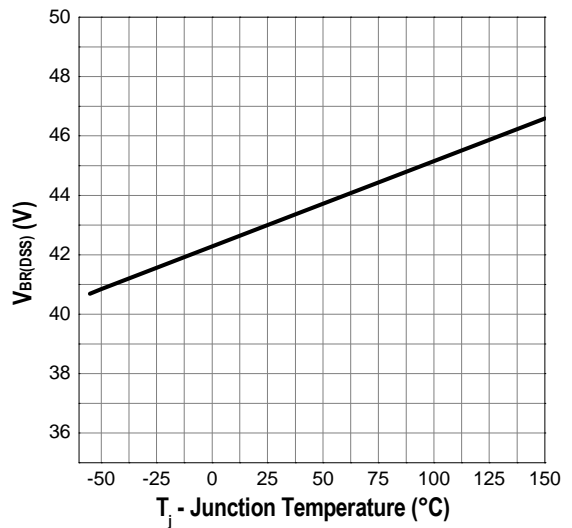
**Drain-Source On Resistance**



**Drain-Source On Resistance**

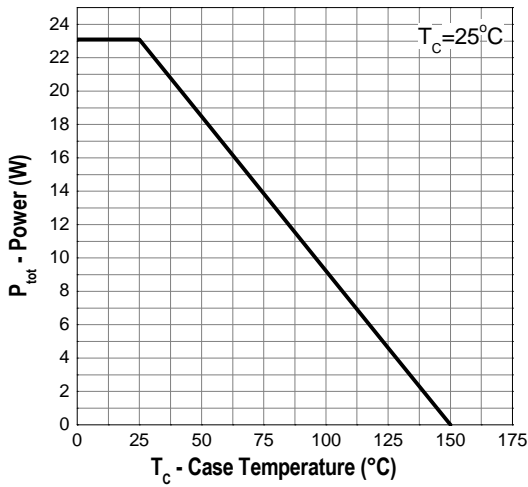


**Drain-source Breakdown Voltage**

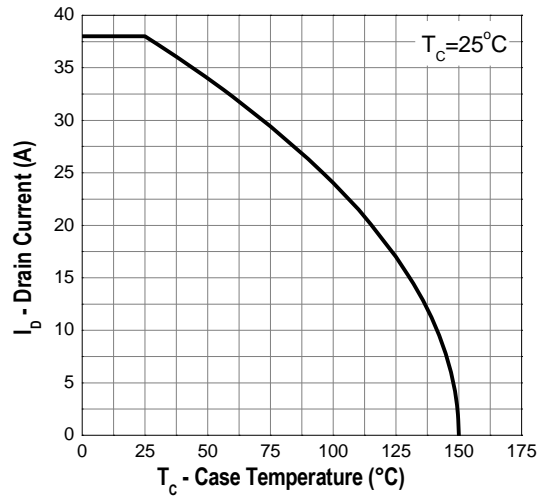


Typical Operating Characteristics (Cont.)

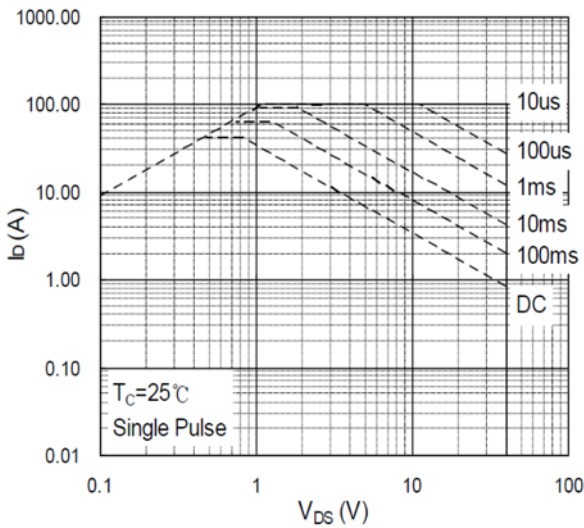
Power Dissipation



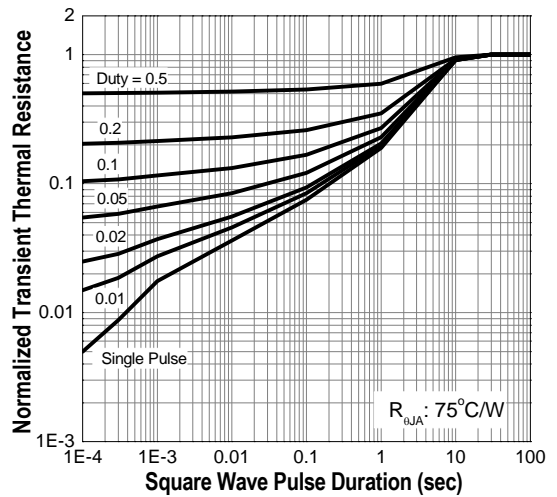
Drain Current



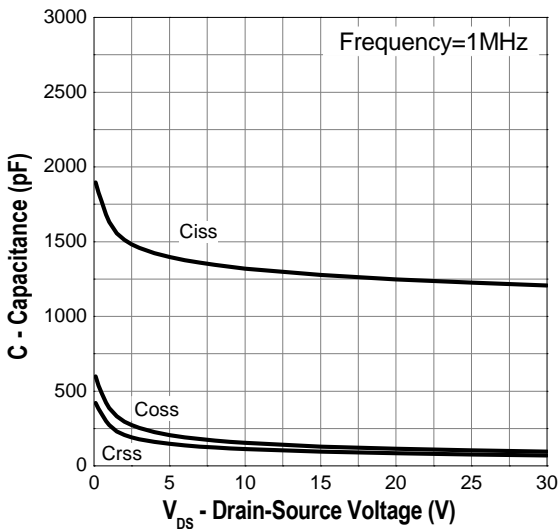
Safe Operation Area



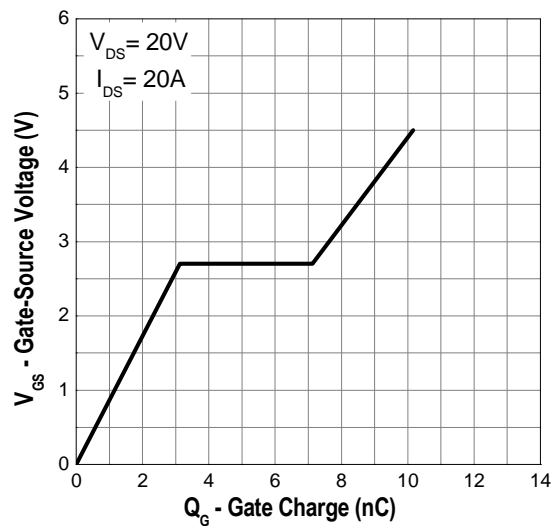
Transient Thermal Impedance




Capacitance



Gate Charge



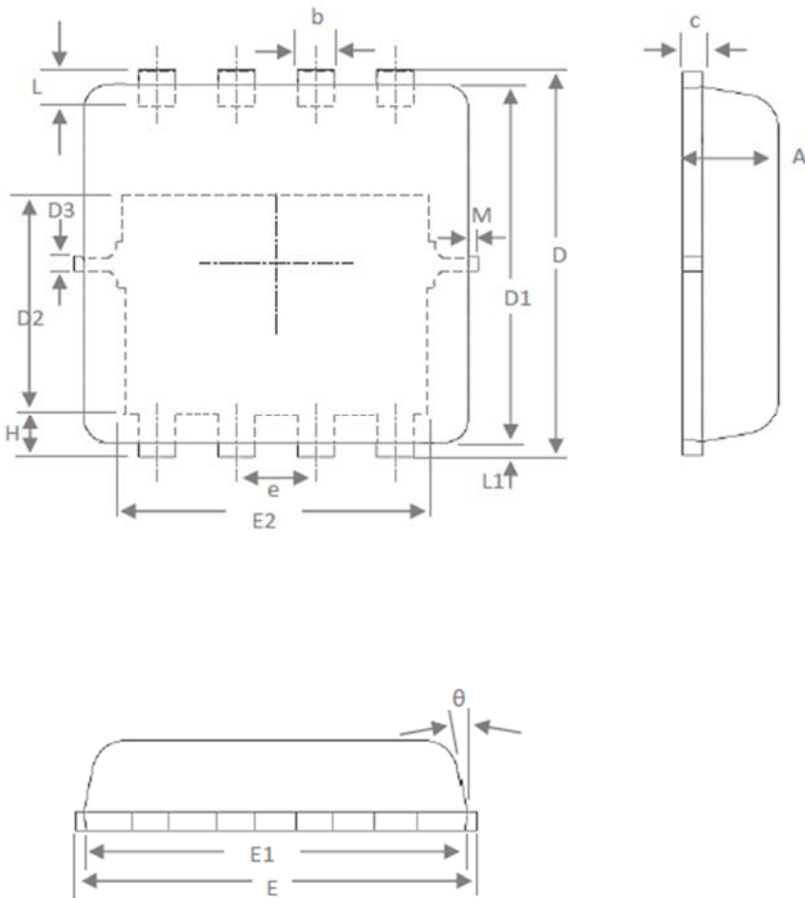
## Marking Information

PDFN 3.3x3.3-8L (E)	Marking Rule
<p><a href="#">Laser Marking</a></p> 	<p><u>Line 1</u> : Device 40N04E</p> <p><u>Line 2</u> : Date Code YMMXXX</p> <p>Y : Year Code MM : Month Code XXX : Serial Number</p> <p>Year Code Description As Below</p>

### Year Code Description

Year Code	Year	
0	2010	2020
1	2011	2021
2	2012	2022
3	2013	2023
4	2014	2024
5	2015	2025
6	2016	2026
7	2017	2027
8	2018	2028
9	2019	2029

Package of Dimension

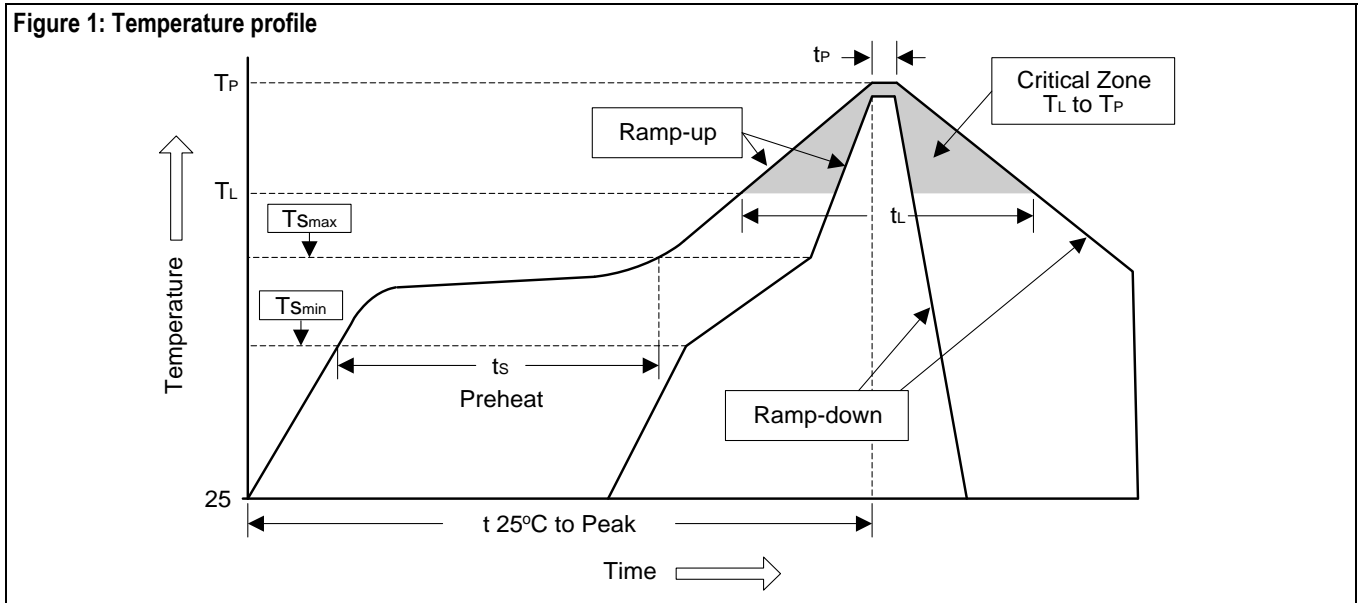


Symbol	Min	Nor	Max
A	0.70	0.75	0.80
b	0.25	0.30	0.35
c	0.10	0.15	0.25
D	3.25	3.35	3.45
D1	3.00	3.10	3.20
D2	1.48	1.58	1.68
D3	-	0.13	-
E	3.00	3.30	3.40
E1	3.00	3.15	3.20
E2	2.39	2.49	2.59
e	0.65BSC		
H	0.30	0.39	0.50
L	0.30	0.40	0.50
L1	-	0.13	-
θ	-	10°	12°
M	-	-	0.15

## Soldering Methods for Silicongear's Products

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

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