

V_{DSS} , 60V R_{DS(ON)} , 2.2mΩ (max.) @ V_{GS}=10V I_D , 200A (Package Limited)	TO-263 (D²PAK)		

Description	Features
<p>The SG60N04G uses advanced Trench technology and designs to provide excellent R_{DS(ON)} with low gate charge. This device is suitable for use in PWM, load switching and general purpose applications.</p>	<ul style="list-style-type: none"> • Low On-Resistance • Low Input Capacitance • Low Miller Charge • Pb-free lead plating; RoHS compliant
	Applications
	<ul style="list-style-type: none"> • Motor / Body Load Control • Load Switch • Solenoid and Motor Control • DC-DC converters and Off-line UPS

Ordering Information

Ordering Code	RoHS Status	Package	Package Code	Packing	Quantity
SG60N04G	Halogen-Free	TO-263 (D ² PAK)	G	Tape & Reel	800

Absolute Maximum Ratings (T_A=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	60	V
Gate-Source Voltage	V _{GS}	±20	V
Drain Current-Continuous	I _D	T _C =25°C	200
		T _C =100°C	126
Drain Current-Pulsed ^{Note 1}	I _{DM}	680	A
Drain Current-Continuous	I _D	T _A =25°C	18
		T _A =100°C	11.4
Avalanche Current, L=0.5mH, V _D =30V, V _G =20V, V _{DS} =60V	I _{AS}	60	A
Avalanche Energy, L=0.5mH, V _D =30V, V _G =20V, V _{DS} =60V	E _{AS}	900	mJ
Maximum Power Dissipation	P _D	T _C =25°C	250
		T _C =100°C	100
		T _A =25°C	2
		T _A =100°C	0.8
Storage Temperature Range	T _{STG}	-55 to +175	°C
Operating Junction Temperature Range	T _J	-55 to +175	°C

Thermal Resistance Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Maximum Junction-to-Ambient	R _{θJA}	Steady State	-	-	62	°C/W
Maximum Junction-to-Case	R _{θJC}	Steady State	-	-	0.5	°C/W
Case-to-Sink, Flat Greased Surface	R _{θCS}	Steady State	-	-	0.3	°C/W

Electrical Characteristics (T_J=25°C unless otherwise noted)

OFF CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V, I _{DS} =250μA	60	-	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =60V, V _{GS} =0V	-	-	1	μA
Breakdown Voltage Temp. Coefficient	ΔV _{(BR)DSS} /ΔT _J	Reference to 25°C, I _D =5mA	-	0.06	-	V/°C
Gate-Body Leakage	I _{GSS}	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA

ON CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Gate Threshold Voltage	V _{GS(TH)}	V _{DS} =V _{GS} , I _{DS} =250μA	2	3	4	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _{DS} =30A	-	-	2.2	mΩ
Internal Gate Resistance	R _G	-	-	0.9	-	Ω

DYNAMIC CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Capacitance	C _{iss}	V _{DS} =30V, V _{GS} =0V, f=1MHz	-	8499	-	pF
Output Capacitance	C _{oss}		-	818	-	
Reverse Transfer Capacitance	C _{rss}		-	293	-	
Forward Transconductance	g _{fs}	V _{DS} =50V, I _D =30A	250	-	-	S

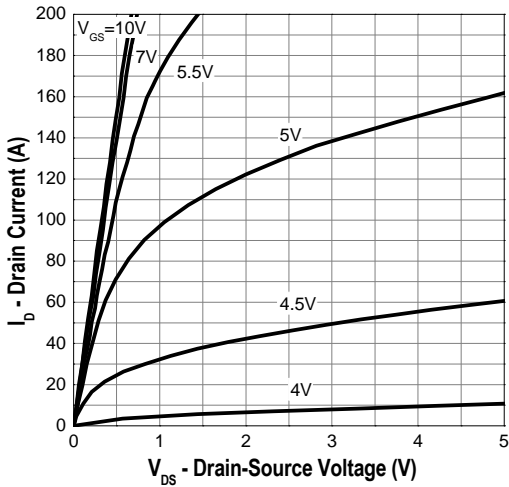
SWITCHING CHARACTERISTICS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Turn-On Delay Time	T _{d(on)}	V _{DD} =30V, R _L =30Ω, I _D =30A, V _{GEN} =10V, R _G =3.3Ω	-	24	-	ns
Rise Time	t _r		-	41	-	
Turn-Off Delay Time	T _{d(off)}		-	92	-	
Fall Time	t _f		-	48	-	
Total Gate Charge at 10V	Q _g	V _{DS} =30V, V _{GS} =10V, I _{DS} =30A	-	190	-	nC
Gate to Source Gate Charge	Q _{gs}		-	42	-	
Gate to Drain "Miller" Charge	Q _{gd}		-	45	-	

DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Drain-Source Diode Forward Voltage	V _{SD}	V _{GS} =0V, I _{DS} =30A	-	-	1.3	V
Body Diode Reverse Recovery Time	t _{rr}	I _F =90A, di/dt=100A/μs	-	120	-	ns
Body Diode Reverse Recovery Charge	Q _{rr}		-	160	-	nC
Continuous Source Current	I _S	-	-	-	200	A
Pulsed Source Current	I _{SM}	-	-	-	680	A

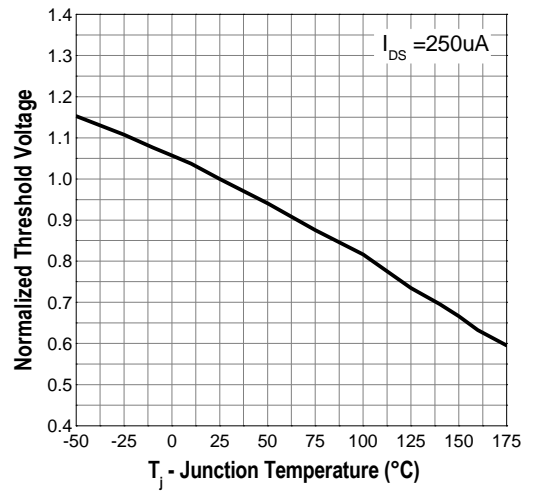
- Notes:**
1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
 2. R_{θJA} is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. R_{θJC} is guaranteed by design while R_{θJA} is determined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

Typical Operating Characteristics

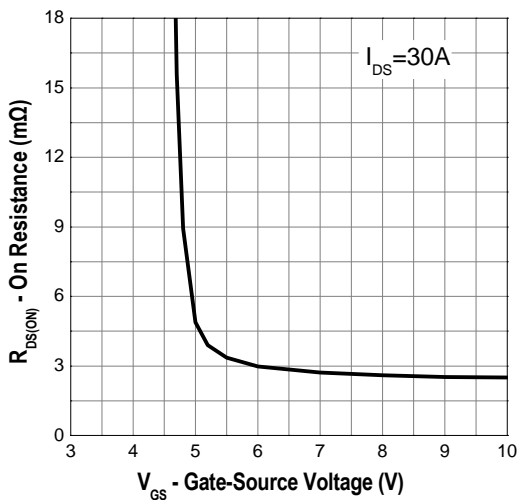
Output Characteristics



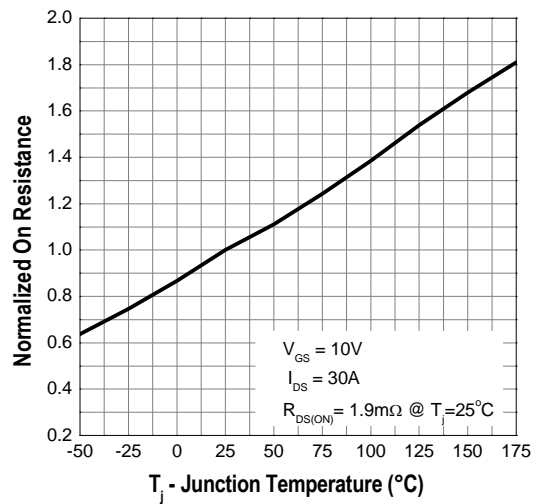
Gate Threshold Voltage



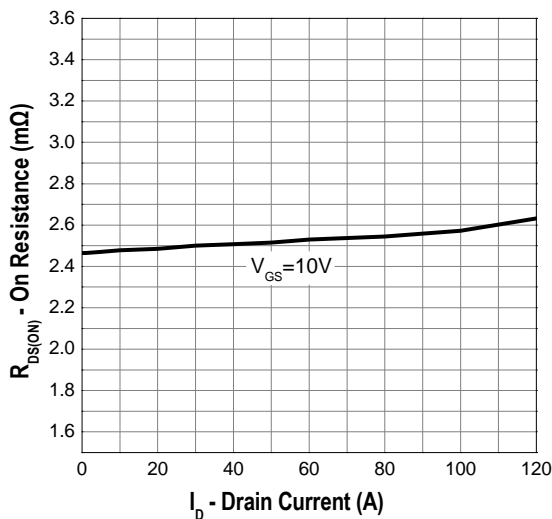
Gate-Source On Resistance



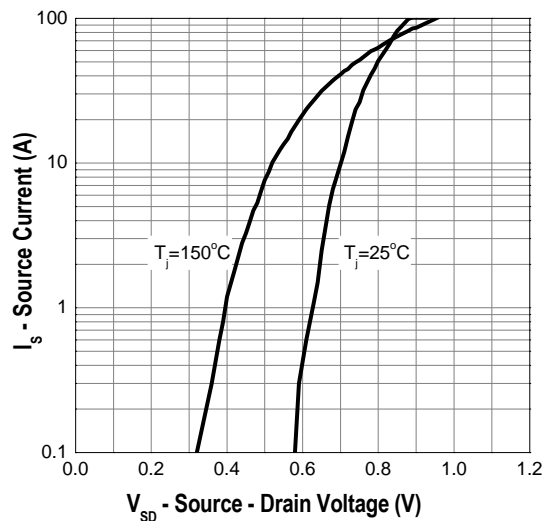
Drain-Source On Resistance



Drain-Source On Resistance

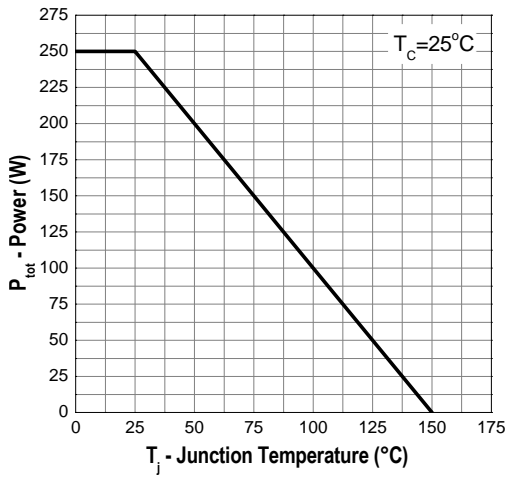


Source-Drain Diode Forward

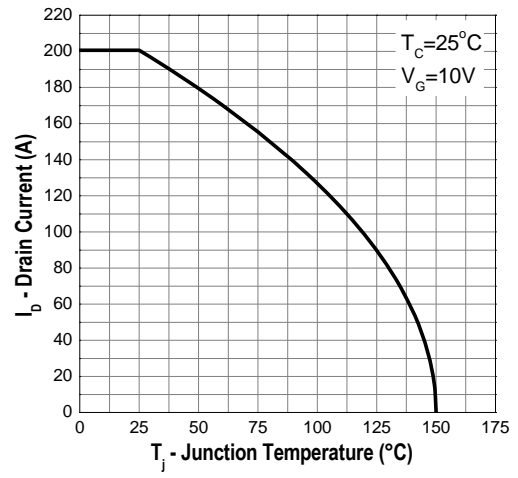


Typical Operating Characteristics (Cont.)

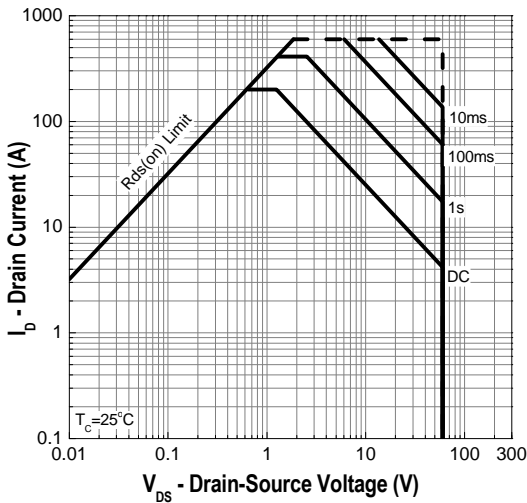
Power Dissipation



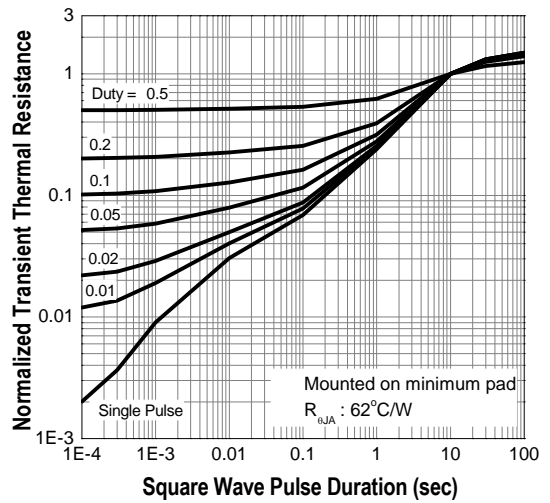
Drain Current



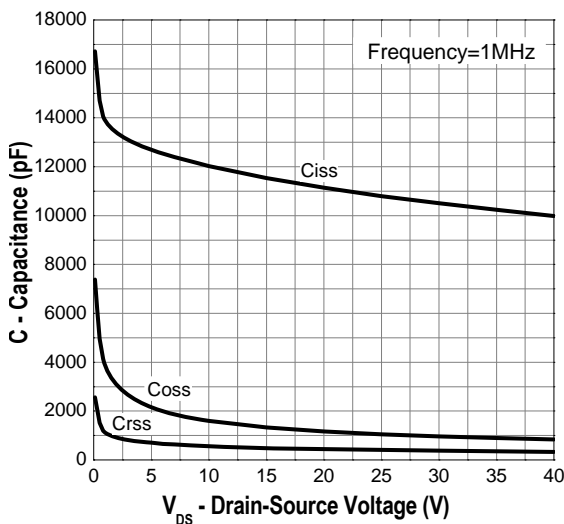
Safe Operation Area



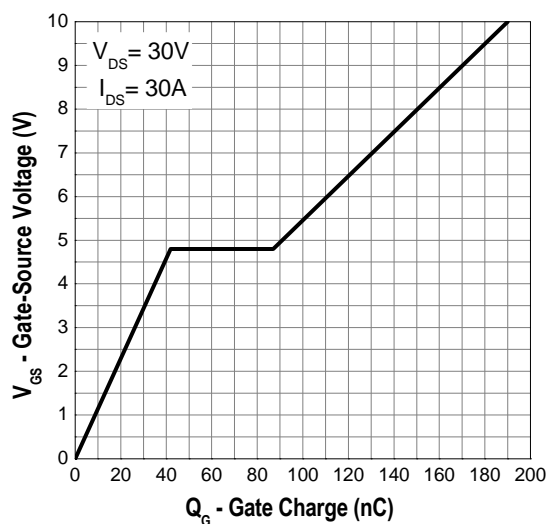
Transient Thermal Impedance



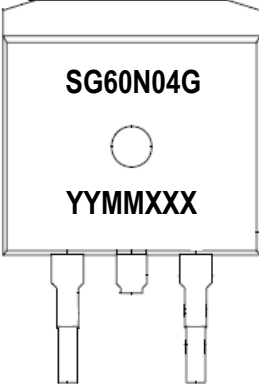
Capacitance



Gate Charge

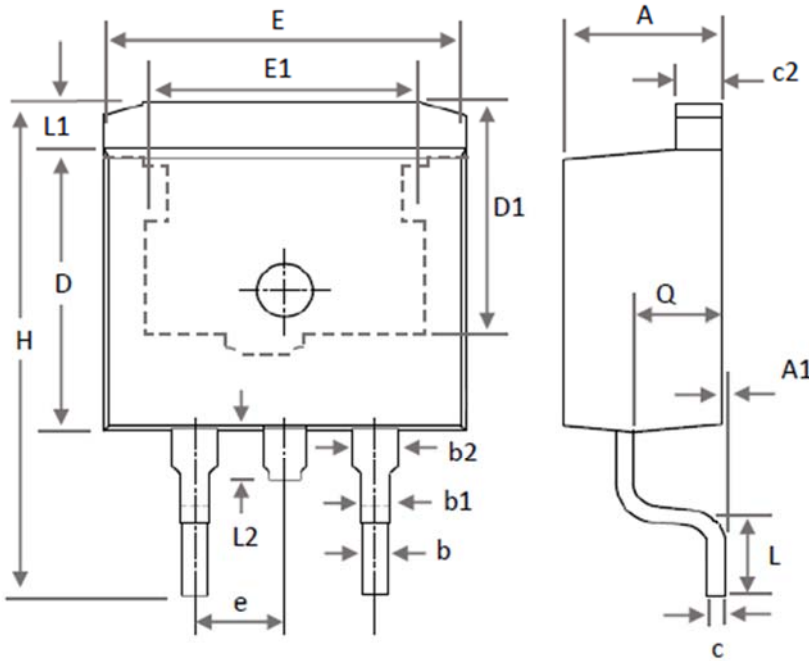


Marking Information

TO-263 (G)	Marking Rule
<p>Laser Marking</p>  <p>Diagram</p>	<p><u>Line 1</u> : Device SG60N04G</p> <p><u>Line 2</u> : Date Code YYMMXXX</p> <p>YY : Year Code MM : Month Code XXX : Serial Number</p>

Package of Dimension

TO-263S

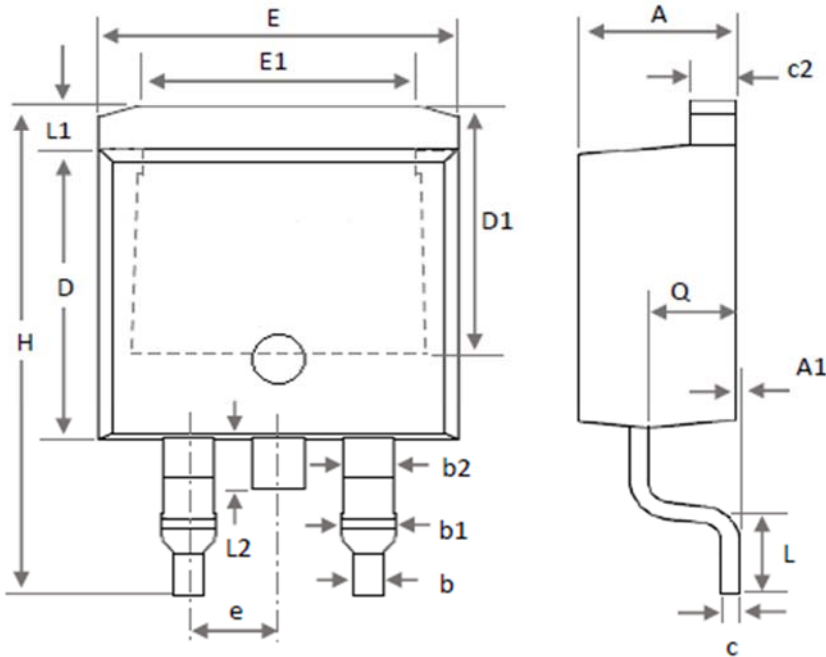


Symbol	Min	Nor	Max
A	4.24	4.44	4.64
A1	0.00	0.10	0.25
b	0.66	0.76	0.96
b1	0.76	0.86	1.06
b2	1.14	1.27	1.47
c	0.40	0.50	0.60
c2	1.15	1.30	1.45
D	8.38	8.60	8.90
D1	6.86	7.16	-
E	9.90	10.20	10.50
E1	7.80 Ref.		
e	2.54 BSC		
H	14.61	15.00	15.88
L	1.78	2.20	2.79
L1	1.40 REF.		
L2	1.50 REF.		
Q	-	2.49	2.70

Package of Dimension

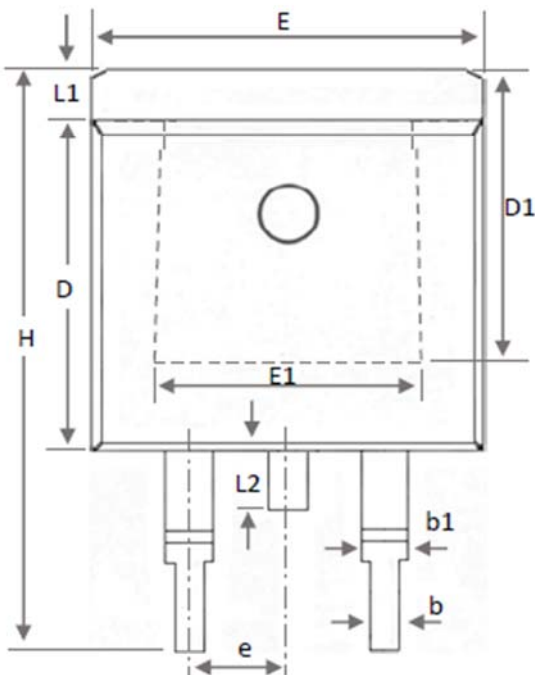
TO-263

G-TYPE



Symbol	Min	Nor	Max
A	4.24	4.51	4.77
A1	0.00	0.13	0.25
b	0.70	0.83	0.96
b1	1.17	1.46	1.75
b2	1.20	1.45	1.70
c	0.30	0.45	0.60
c2	1.15	1.29	1.42
D	8.50	8.76	9.02
D1	6.60	7.13	7.65
E	9.86	10.11	10.36
E1	6.89	7.39	7.89
e	2.54 BSC		
H	14.61	15.25	15.88
L	1.78	2.29	2.79
L1	1.07	1.27	1.47
L2	1.40	1.55	1.70
Q	2.30	2.60	2.89

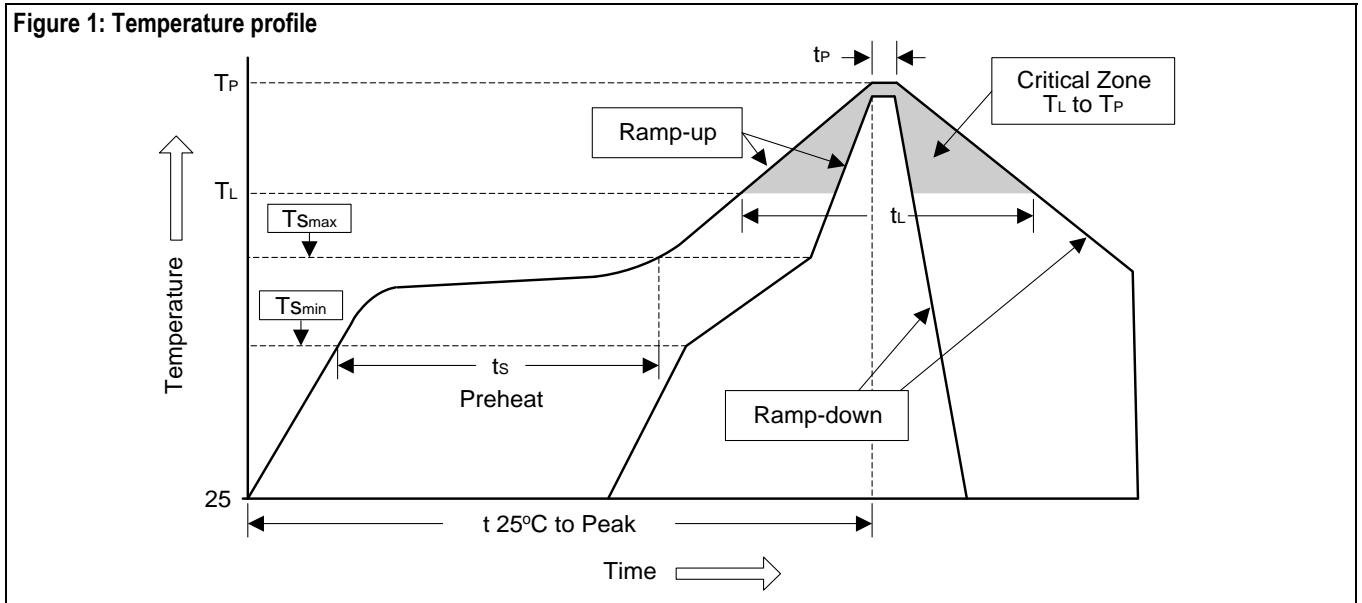
H-TYPE



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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