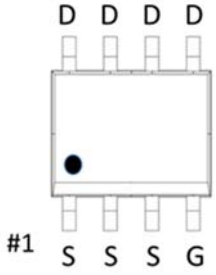
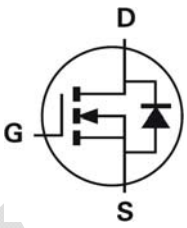
DG60N13S

DG-FET™ 60V N-Channel Power MOSFET

Key Performance Parameters		
Parameter	**Value**	**Unit**
V_{DSS}	60	V
$R_{DS(ON)\ max.}$ V_{GS}=10V	10.5	mΩ
$R_{DS(ON)\ max.}$ V_{GS}=4.5V	17.5	mΩ
I_D	24.8	A
Q_g	16.4	nC
Q_{gd}	3.5	nC
Q_{SW}	6.1	nC

SOP-8





Features	Application
• Optimized for synchronous rectification Low Input Capacitance • Low Switching Charge • Low Miller Capacitance • Fully Characterized Capacitance and Avalanche • Pb-free lead plating; RoHS compliant	• Battery powered circuits • BLDC Motor drive applications • Half-bridge and full-bridge topologies • Synchronous rectifier applications • Resonant mode power supplies

Ordering Information

Ordering Code	RoHS Status	Package	Package Code	Packing	Quantity
DG60N13S	Halogen-Free	SOP-8	S	Tape & Reel	3,000

Absolute Maximum Ratings (T_J=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	T_C=25°C	I_D	24.8	A
	T_C=100°C		15.7	A
Drain Current-Pulsed Note 1	T_C=25°C	I_{DM}	80	A
Avalanche Current Note 3		I_{AR}	15	A
Single Pulse Avalanche Energy Note 3		E_{AS}	11	mJ
Maximum Power Dissipation	T_C=25°C	P_D	10.3	W
Operating and Storage Temperature Range		T_J	150	°C

Thermal Resistance Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Thermal resistance, Junction-to-Ambient Note 2	$R_{\theta JA}$	Steady State	-	48.2	-	°C/W
Thermal resistance, Junction-to-Case Note 2	$R_{\theta JC}$	Steady State	-	12.1	-	°C/W

Notes:

1. Pulse Test: Pulse Width ≤10ms, Duty Cycle ≤ 1%.
2. For surface-mounted devices, both $R_{\theta CA}$ and $R_{\theta JC}$ are measured with the device mounted on approximately 1"×1" FR-4 PCBs. In actual applications, many factors including the PCB material and layout, may affect the thermal resistance of the device-board assembly. For best results, characterize the thermal resistance directly in the application circuit.
3. Starting T_J=25°C, VD=30V, L=0.1mH, V_{GS}=10V.

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

STATIC CHARACTERISTICS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS}=0V, I_{DS}=250uA	60	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=48V, V_{GS}=0V, T_J=25°C	-	-	10	μA
Gate-Body Leakage	I_{GSS}	V_{GS}=±20V, V_{DS}=0V	-	-	±100	nA

STATIC CHARACTERISTICS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Gate Threshold Voltage	$V_{GS(TH)}$	V_{DS}=V_{GS}, I_{DS}=250μA	1.1	1.7	2.2	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_{DS}=11A	-	-	10.5	mΩ
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{GS}=4.5V, I_{DS}=9A	-	-	17.5	mΩ
Gate Resistance	R_g	V_{GS}=0V, V_{DS}=0V, f=1MHz	-	1.74	3.9	Ω

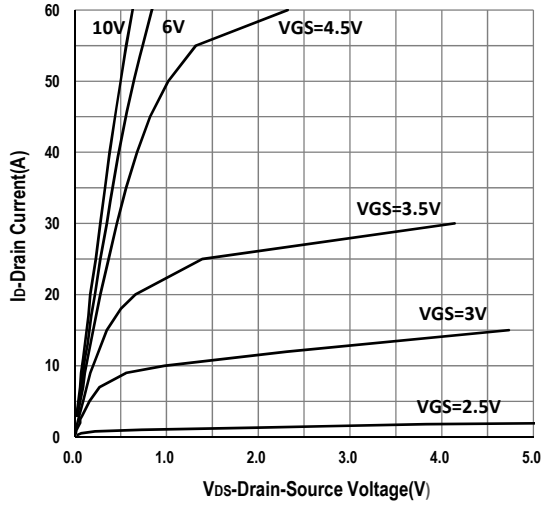
DYNAMIC CHARACTERISTICS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Input Capacitance	C_{iss}	V_{DS}=30V, V_{GS}=0V, f=1MHz	-	846	-	pF
Output Capacitance	C_{oss}	V_{DS}=30V, V_{GS}=0V, f=1MHz	-	243	-	pF
Reverse Transfer Capacitance	C_{rss}	V_{DS}=30V, V_{GS}=0V, f=1MHz	-	22	-	pF
Turn-On Delay Time	$T_{d(on)}$	V_{DS}=30V, V_{GS}=10V, I_{DS}=11A, R_{GEN}=3Ω	-	6.4	-	ns
Rise Time	t_r	V_{DS}=30V, V_{GS}=10V, I_{DS}=11A, R_{GEN}=3Ω	-	23.0	-	ns
Turn-Off Delay Time	$T_{d(off)}$	V_{DS}=30V, V_{GS}=10V, I_{DS}=11A, R_{GEN}=3Ω	-	5.6	-	ns
Fall Time	t_f	V_{DS}=30V, V_{GS}=10V, I_{DS}=11A, R_{GEN}=3Ω	-	17.3	-	ns

GATE CHARGE CHARACTERISTICS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Gate to Source Gate Charge	Q_{gs}	V_{DD}=30V, I_D=11A	-	3.8	-	nC
Gate charge at threshold	$Q_{g(th)}$	V_{DD}=30V, I_D=11A	-	1.2	-	nC
Gate to Drain Charge	Q_{gd}	V_{DD}=30V, I_D=11A	-	3.5	-	nC
Switching charge	Q_{SW}	V_{DD}=30V, I_D=11A	-	6.1	-	nC
Gate charge total	Q_g	V_{DD}=30V, I_D=11A, V_{GS}=0 to 10V	-	16.4	-	nC
Gate charge total	Q_g	V_{DD}=30V, I_D=11A, V_{GS}=0 to 4.5V	-	8.3	-	nC
Gate plateau voltage	$V_{plateau}$	V_{DD}=30V, I_D=11A	-	3.7	-	V
Gate charge total, sync. FET (Q_g- Q_{gd})	$Q_{g(sync)}$	V_{DS}=0.1V	-	12.9	-	nC

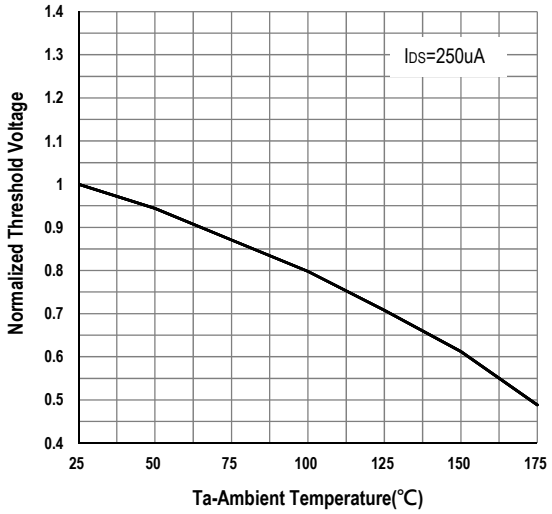
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Diode Forward Voltage	V_{SD}	V_{GS}=0V, I_F=11A	-	-	1.2	V
Body Diode Reverse Recovery Time	t_{rr}	V_{DD}=30V, I_F=11A, di/dt=100A/μs	-	30.5	-	ns
		V_{DD}=30V, I_F=11A, di/dt=200A/μs	-	24.6	-	ns
Body Diode Reverse Recovery Charge	Q_{rr}	V_{DD}=30V, I_F=11A, di/dt=100A/μs	-	19.0	-	nC
		V_{DD}=30V, I_F=11A, di/dt=200A/μs	-	27.7	-	nC
Reverse Recovery Current	I_{RRM}	V_{DD}=30V, I_F=11A, di/dt=100A/μs	-	1.14	-	A
		V_{DD}=30V, I_F=11A, di/dt=200A/μs	-	1.95	-	A

Typical Operating Characteristics

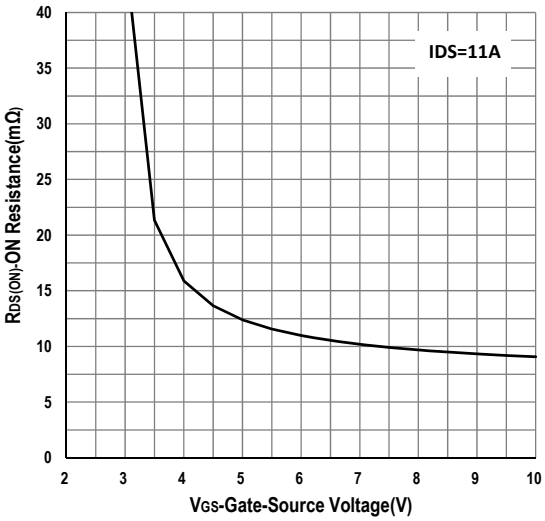
Output Characteristics



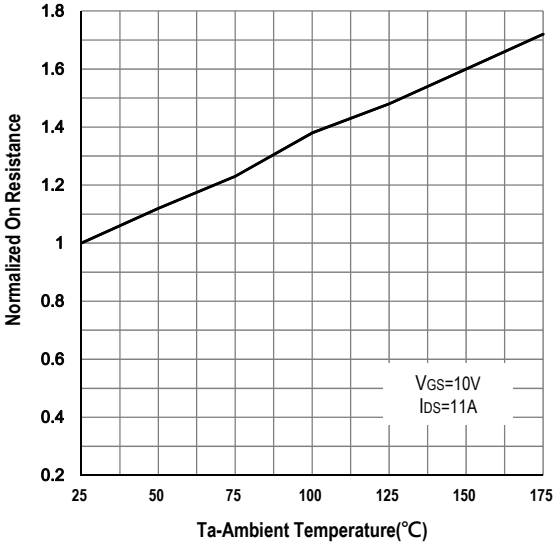
Gate Threshold Voltage



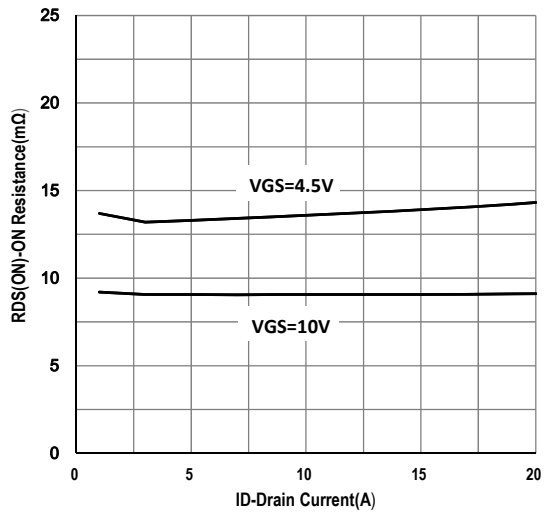
Gate-Source On Resistance



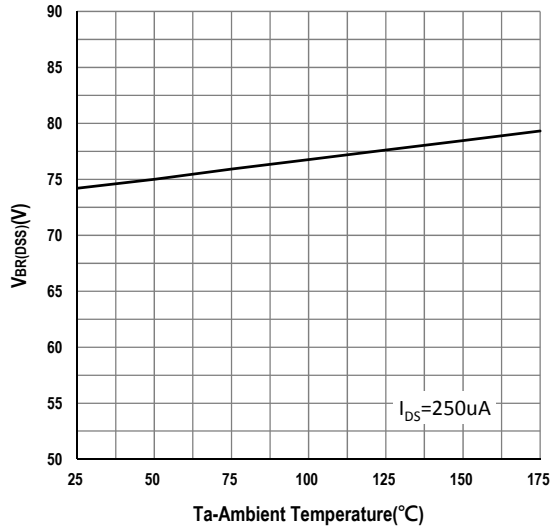
Drain-Source On Resistance



Drain-Source On Resistance

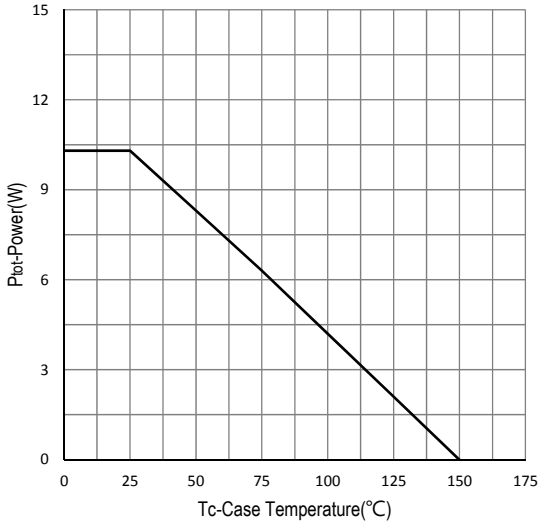


Drain-source Breakdown Voltage

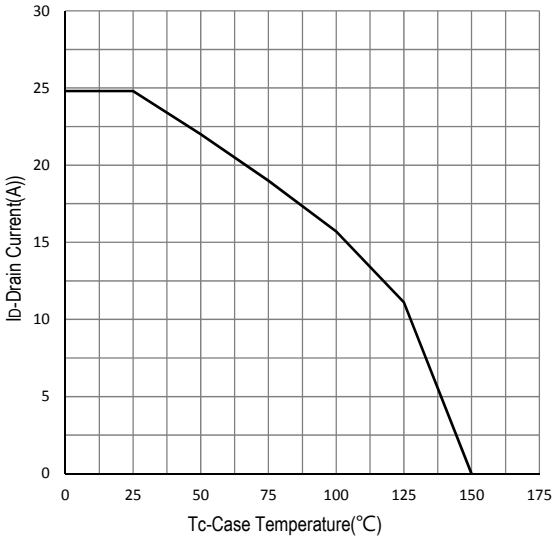


Typical Operating Characteristics (Cont.)

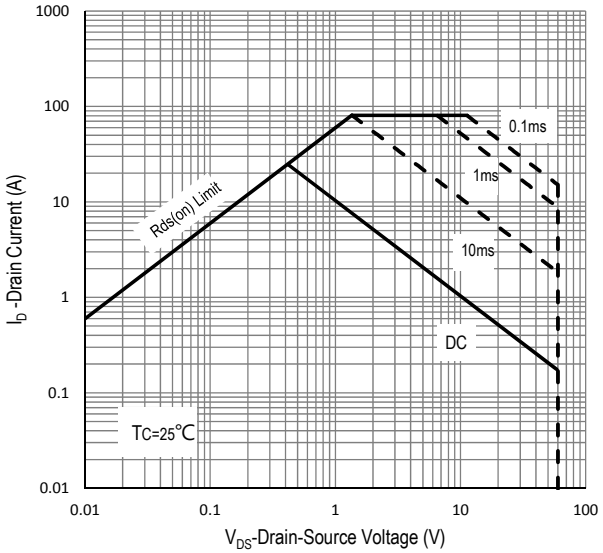
Power Dissipation



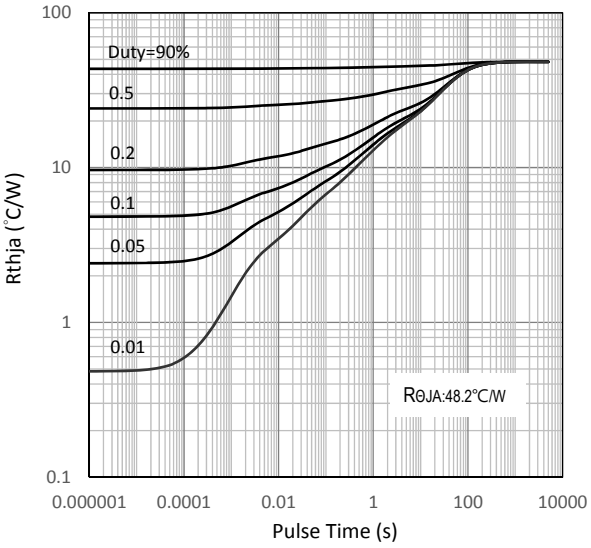
Drain Current



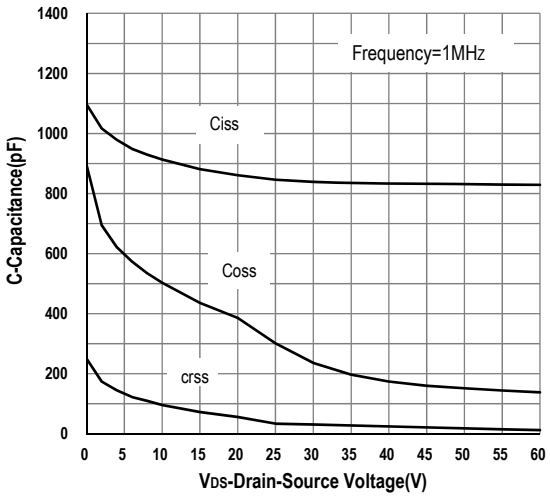
Safe Operation Area



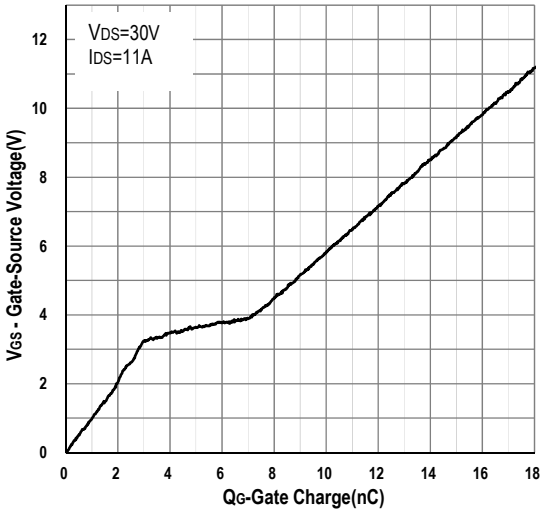
Transient Thermal Impedance



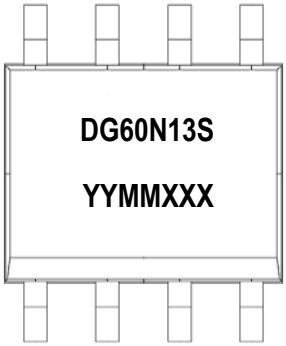
Capacitance



Gate Charge

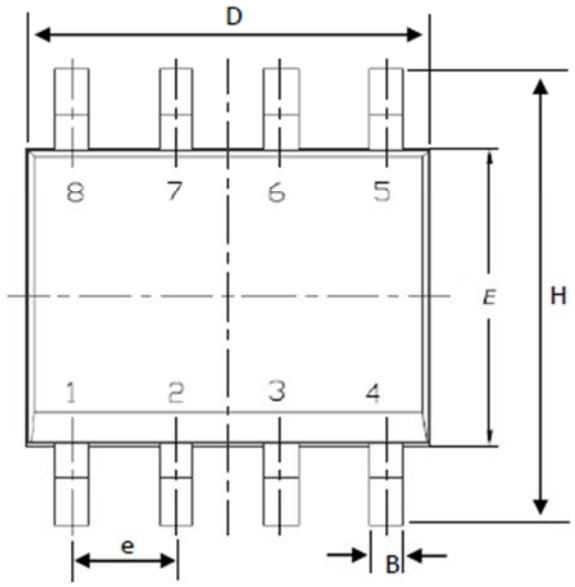


Marking Information

SOP-8 (S)	Marking Rule
Laser Marking  	Line 1：Device DG60N13S Line 2：Date Code YYMMXXX YY：Year Code MM：Month Code XXX：Serial Number

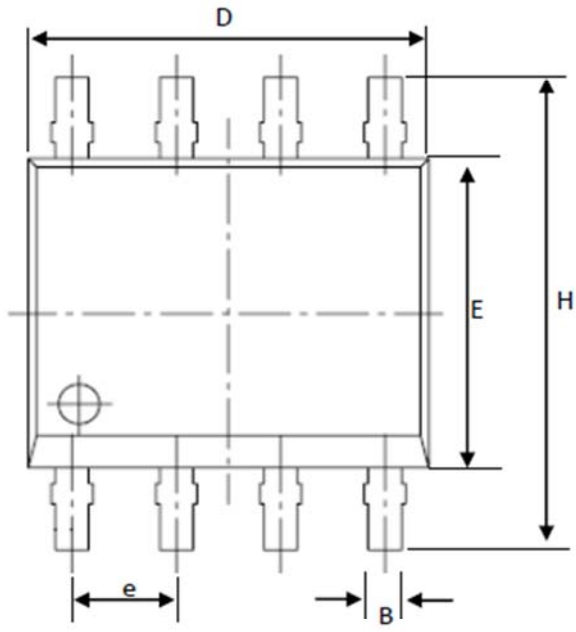
Package of Dimension

G-TYPE



Symbol	Min	Nor	Max
A	1.35	1.55	1.75
A1	0.10	0.18	0.25
B	0.31	0.41	0.51
c	0.17	0.21	0.25
D	4.80	4.90	5.00
E	3.80	3.90	4.00
e	1.27	1.27	1.27
H	5.80	6.00	6.20
L	0.40	0.84	1.27
α	0.00	4.00	8.00

B-TYPE

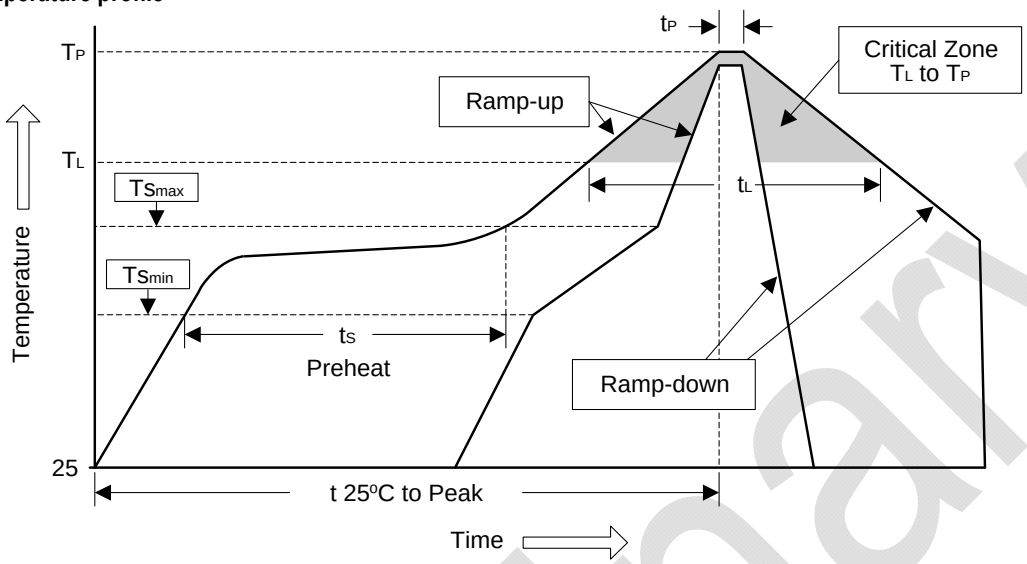


1. All dimension are in millimeters.
2. Dimension dose not include burrs and mold flash/protrusions.

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 (Ts_{min}) - Temperature Max (Ts_{max}) - Time (min to max) (ts)	 100°C 150°C 60 to 120 sec	 150°C 200°C 60 to 180 sec
Tsmax to T_L - Ramp-up Rate	 <3°C/sec	 <3°C/sec
Time maintained above: - Temperature (T_L) - Time (t_L)	 183°C 60 to 150 sec	 217°C 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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