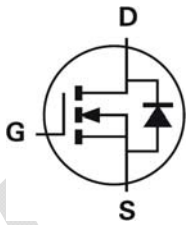
DG60N12I

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	18	mΩ
I_D	58	A
Q_g	15.7	nC
Q_{gd}	3.7	nC
Q_{SW}	5.2	nC

TO-251AA



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
DG60N12I	Halogen-Free	TO-251AA-3L	I	Tube	75

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	58	A
	T_C=100°C		36	A
Drain Current-Pulsed Note 1	T_C=25°C	I_{DM}	82	A
Avalanche Current Note 3		I_{AR}	17	A
Single Pulse Avalanche Energy Note 3		E_{AS}	15	mJ
Maximum Power Dissipation	T_C=25°C	P_D	63	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	-	53.9	-	°C/W
Thermal resistance, Junction-to-Case Note 2	$R_{\theta JC}$	Steady State	-	1.97	-	°C/W

Notes:

1. Pulse Test: Pulse Width ≤10ms, Duty Cycle ≤ 1%.
2. $R_{\theta JA}$ 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. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design. $R_{\theta JA}$ shown below for single device operation on FR-4 in still air.
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
		V_{DS}=48V, V_{GS}=0V, T_J=125°C	-	-	100	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	-	-	18	mΩ
Gate Resistance	R_g	V_{GS}=0V, V_{DS}=0V, f=1MHz	-	1.38	4.4	Ω
Forward Transconductance	g_{fs}	V_{DS}=5V, I_{DS}=11A	-	16	-	S

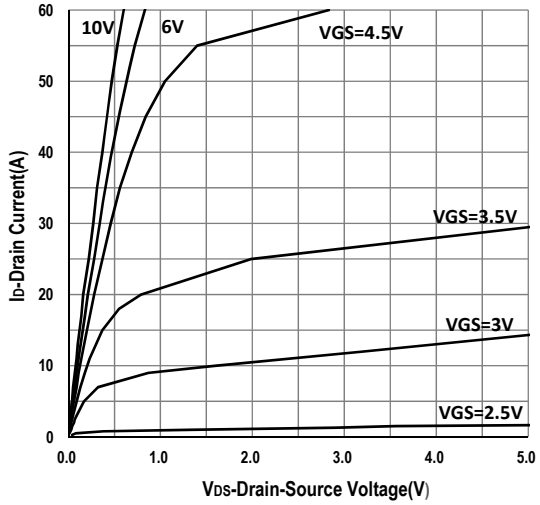
DYNAMIC CHARACTERISTICS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Input Capacitance	C_{iss}	V_{DS}=30V, V_{GS}=0V, f=1MHz	-	811	-	pF
Output Capacitance	C_{oss}	V_{DS}=30V, V_{GS}=0V, f=1MHz	-	302	-	pF
Reverse Transfer Capacitance	C_{rss}	V_{DS}=30V, V_{GS}=0V, f=1MHz	-	36	-	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	-	25.6	-	ns
Turn-Off Delay Time	$T_{d(off)}$	V_{DS}=30V, V_{GS}=10V, I_{DS}=11A, R_{GEN}=3Ω	-	15.5	-	ns
Fall Time	t_f	V_{DS}=30V, V_{GS}=10V, I_{DS}=11A, R_{GEN}=3Ω	-	38.2	-	ns

GATE CHARGE CHARACTERISTICS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Gate to Source Gate Charge	Q_{gs}	V_{DD}=30V, I_D=11A	-	3.1	-	nC
Gate charge at threshold	$Q_{g(th)}$	V_{DD}=30V, I_D=11A	-	1.6	-	nC
Gate to Drain Charge	Q_{gd}	V_{DD}=30V, I_D=11A	-	3.7	-	nC
Switching charge	Q_{SW}	V_{DD}=30V, I_D=11A	-	5.2	-	nC
Gate charge total	Q_g	V_{DD}=30V, I_D=11A, V_{GS}=0 to 10V	-	15.7	-	nC
Gate plateau voltage	$V_{plateau}$	V_{DD}=30V, I_D=11A	-	3.5	-	V
Gate charge total, sync. FET (Q_g- Q_{gd})	$Q_{g(sync)}$	V_{DS}=0.1V	-	12.0	-	nC

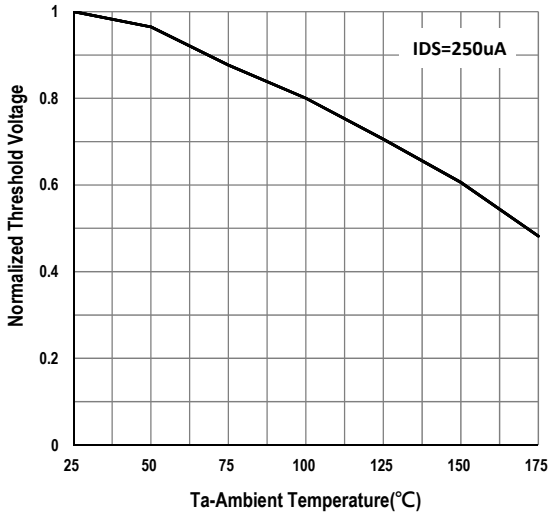
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Unit**
Diode Forward Voltage	V_{SD}	V_{GS}=0V, I_F=11A	-	-	1.2	V
Body Diode Reverse Recovery Time	t_{rr}	V_{DD}=30V, I_F=11A, di/dt=100A/μs	-	27.1	-	ns
		V_{DD}=30V, I_F=11A, di/dt=200A/μs	-	23.9	-	ns
Body Diode Reverse Recovery Charge	Q_{rr}	V_{DD}=30V, I_F=11A, di/dt=100A/μs	-	15.2	-	nC
		V_{DD}=30V, I_F=11A, di/dt=200A/μs	-	24.2	-	nC
Reverse Recovery Current	I_{RRM}	V_{DD}=30V, I_F=11A, di/dt=100A/μs	-	1.0	-	A
		V_{DD}=30V, I_F=11A, di/dt=200A/μs	-	1.8	-	A

Typical Operating Characteristics

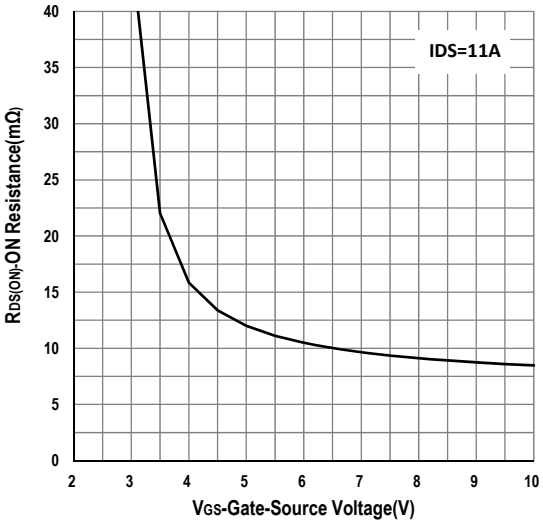
Output Characteristics



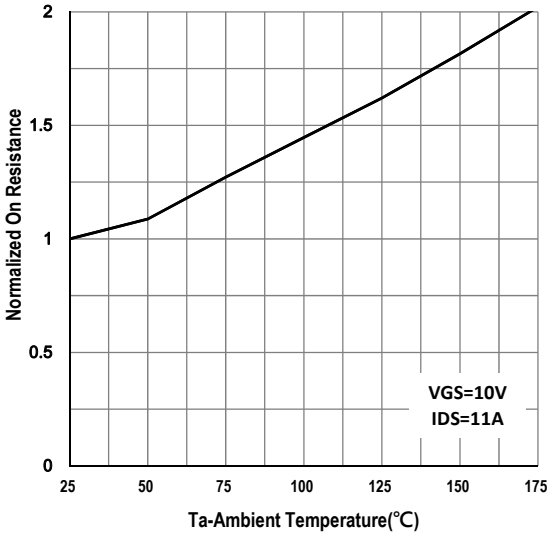
Gate Threshold Voltage



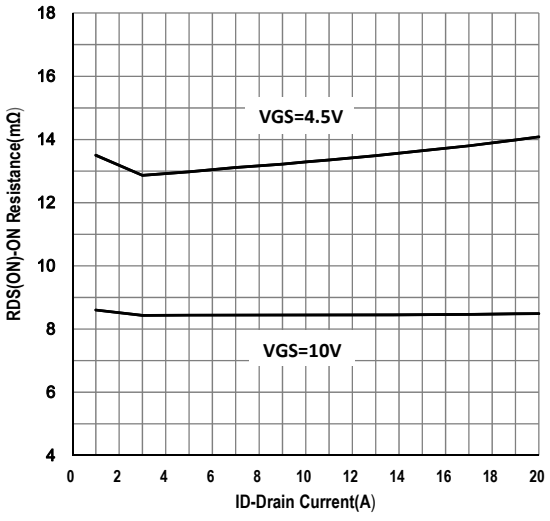
Gate-Source On Resistance



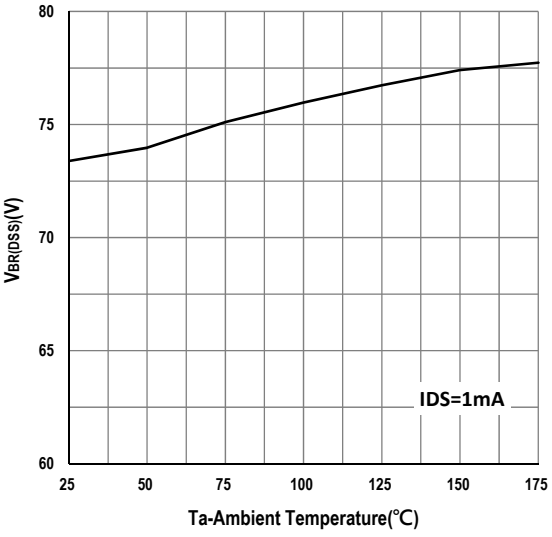
Drain-Source On Resistance



Drain-Source On Resistance

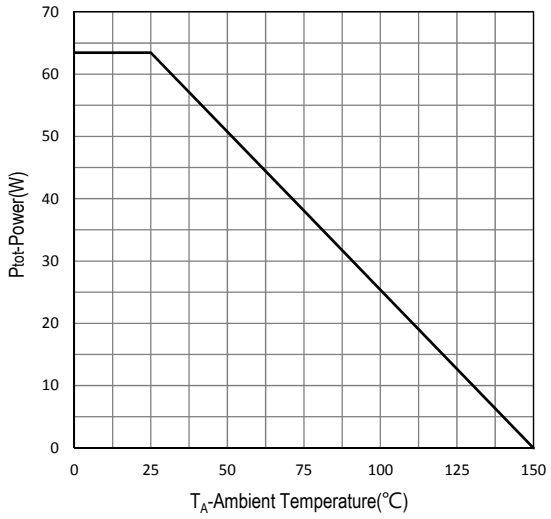


Drain-source Breakdown Voltage

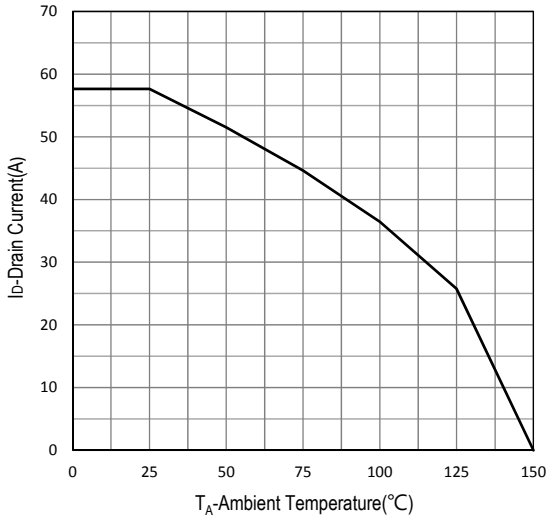


Typical Operating Characteristics (Cont.)

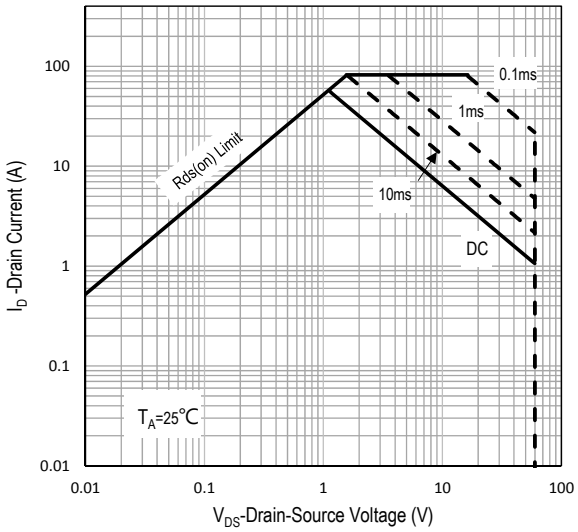
Power Dissipation



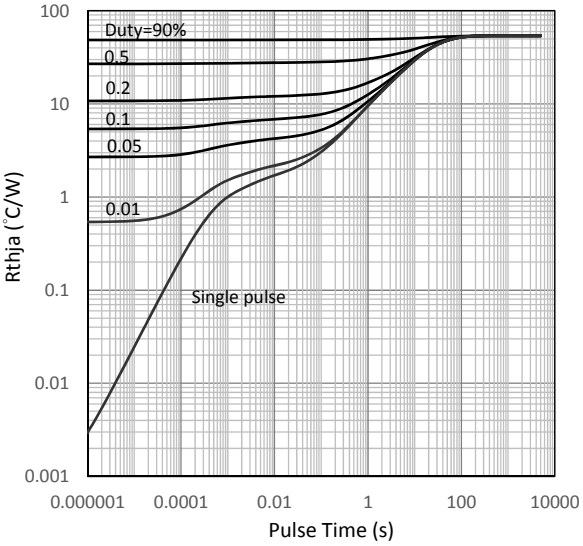
Drain Current



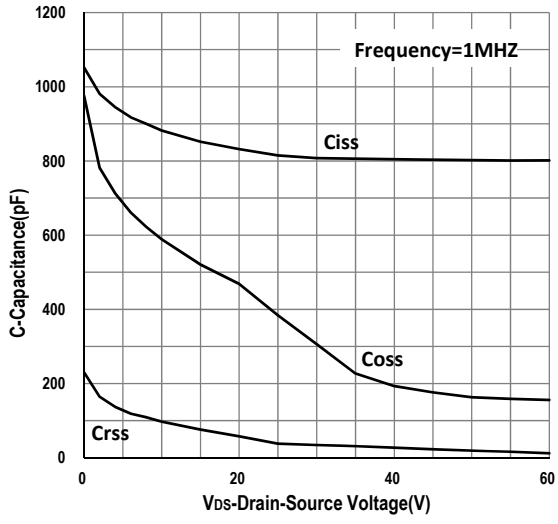
Safe Operation Area



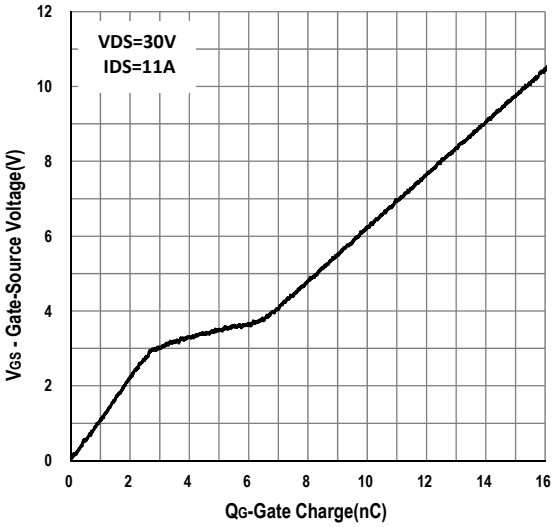
Transient Thermal Impedance



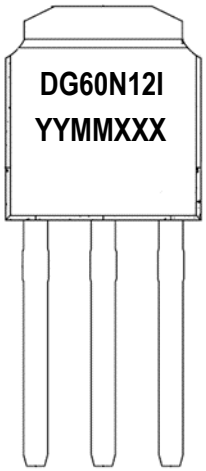
Capacitance



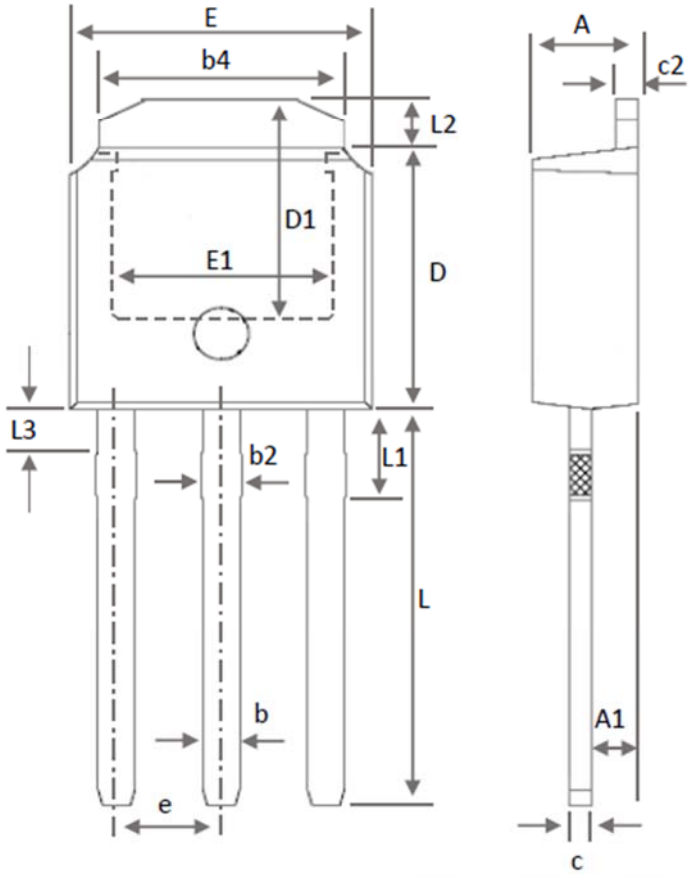
Gate Charge



Marking Information

TO-251AA	Marking Rule
Laser Marking  	Line 1：Device DG60N12I Line 2：Date Code YYMMXXX YY：Year Code MM：Month Code XXX：Serial Number

Package of Dimension



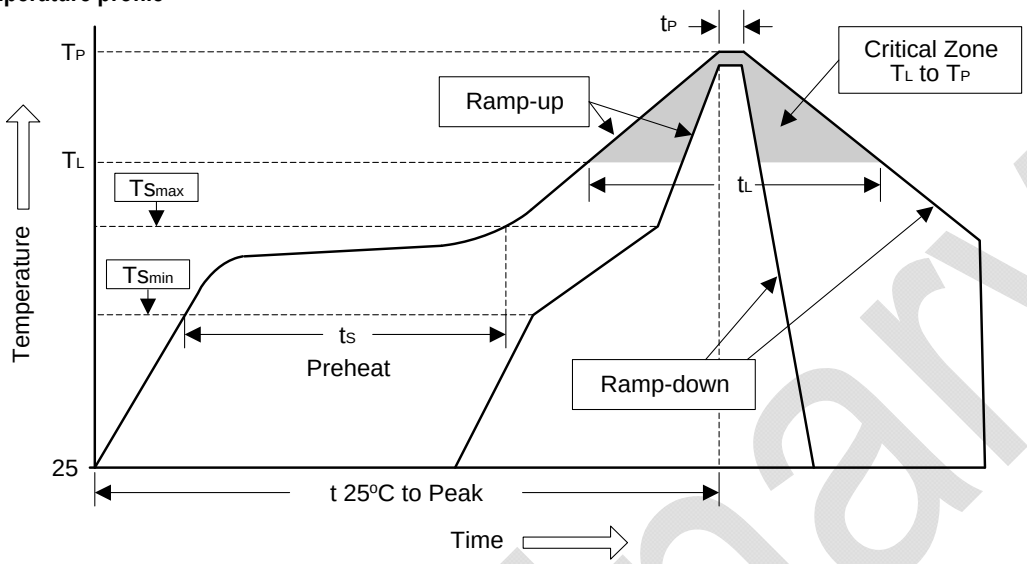
Symbol	Min	Nor	Max
A	2.20	2.30	2.38
A1	0.89	1.02	1.14
b	0.65	0.81	0.88
b2	0.95	1.05	1.14
b4	5.00	5.33	5.46
c	0.46	0.50	0.60
c2	0.46	-	0.70
D	6.00	6.10	6.20
D1	5.21	-	-
E	6.40	6.60	6.73
E1	4.32	-	-
e	2.29	2.29	2.29
L	9.00	9.20	9.40
L1	1.91	2.11	2.28
L2	1.00	1.15	1.27
L3	0.94	-	1.19

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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