H04N60 Series

N-Channel Power Field Effect Transistor (600V, 4A)

H04N60 Series Pin Assignment

3-Lead Plastic **TO-263**
Package Code: U
Pin 1: Gate
Pin 2 & Tab: Drain
Pin 3: Source

3-Lead Plastic **TO-220AB**
Package Code: E
Pin 1: Gate
Pin 2 & Tab: Drain
Pin 3: Source

3-Lead Plastic **TO-220FP**
Package Code: F
Pin 1: Gate
Pin 2: Drain
Pin 3: Source

H04N60 Series Symbol:

Description

This advanced high voltage MOSFET is designed to withstand high energy in the avalanche mode and switch efficiently. This new high energy device also offers a drain-to-source diode with fast recovery time. Designed for high voltage, high speed switching applications such as power suplies, converters, power motor controls and bridge circuits.

Features

- Higher Current Rating
- Lower $R_{DS(on)}$<2.4Ω (@V_{GS}=10V, I_D=2A)
- Lower Capacitances
- Lower Total Gate Charge
- Tighter VSD Specifications
- Avalanche Energy Specified

Thermal Characteristics

Symbol	Parameter	Value		Units
$R_{\theta JC}$	Thermal Resistance Junction to Case (Maximum)	TO-263	1.7	°C/W
		TO-220AB	1.25	
		TO-220FP	3.79	
$R_{\theta JA}$	Thermal Resistance Junction to Ambient (Maximum)	TO-220AB	62.5	
		TO-220FP	120	°C/W

Absolute Maximum Ratings (T_C=25°C, unless otherwise specified)

Symbol	Parameter	Value	Units
V_{DS}	Drain to Source Voltage	600	A
V_{GS}	Gate to Source Voltage (Continue)	±30	V
I_D	Drain to Current (Continuous)	4	A
I_{DM}	Drain to Current (Pulsed)	16	A
P_D	Total Power Dissipation (T_C=25°C) H04N60U (TO-263) H04N60E (TO-220AB) H04N60F (TO-220FP)	 110 100 33	W
	Derate above 25°C H04N60U (TO-263) H04N60E (TO-220AB) H04N60F (TO-220FP)	 0.58 0.8 0.26	W/°C
T_j, T_{stg}	Operating and Storage Temperature Range	-55 to 150	°C
E_{AS}	Single Pulse Drain-to-Source Avalanche Enrgy-T_j=25°C (V_{DD}=100V, V_{GS}=10V, I_L=2A, L=10mH, R_G=25Ω)*1	276	mJ
T_L	Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	260	°C

*1: L=30mH, I_{AS}=3.81A, V_{DD}=175V, R_G=25Ω, Starting T_J=25°C

Electrical Characteristics (T_C=25°C, unless otherwise specified)

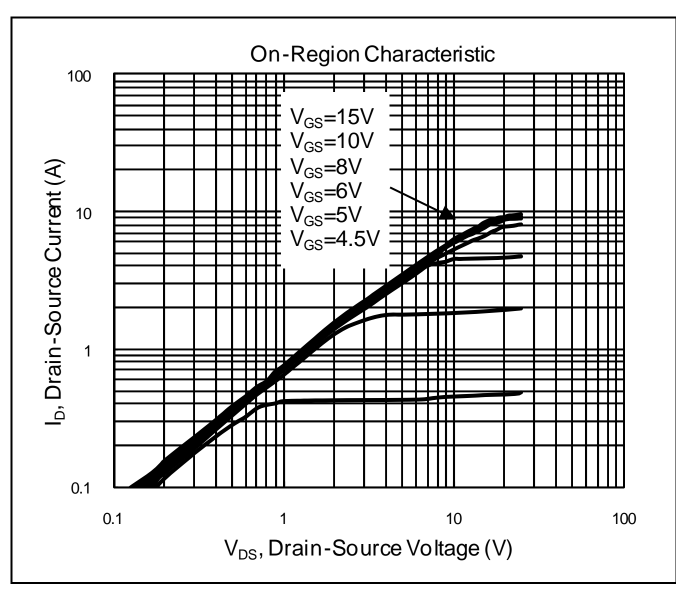
Symbol	Characteristic		Min.	Typ.	Max.	Unit
BV_{DSS}	Drain-Source Breakdown Voltage (V_{GS}=0V, I_D=250uA)		600	-	-	V
I_{DSS}	Drain-Source Leakage Current (V_{DS}=600V, V_{GS}=0V)		-	-	1	uA
I_{GSSF}	Gate-Source Leakage Current-Forward (V_{gsf}=30V, V_{DS}=0V)		-	-	100	nA
I_{GSSR}	Gate-Source Leakage Current-Reverse (V_{gsr}=-30V, V_{DS}=0V)		-	-	-100	nA
$V_{GS(th)}$	Gate Threshold Voltage (V_{DS}=V_{GS}, I_D=250uA)		2	-	4	V
$R_{DS(on)}$	Static Drain-Source On-Resistance (V_{GS}=10V, I_D=2A)		-	2	2.4	Ω
g_{FS}	Forward Transconductance (V_{DS}=15V, I_D=2A)		2	-	-	S
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	672	-	pF
C_{oss}	Output Capacitance		-	66	-	
C_{rss}	Reverse Transfer Capacitance		-	4.7	-	
$t_{d(on)}$	Turn-on Delay Time	(V_{DD}=300V, I_D=4.4A, R_G=25Ω)[*2,*3]	-	27	-	ns
t_r	Rise Time		-	19	-	
$t_{d(off)}$	Turn-off Delay Time		-	160	-	
t_f	Fall Time		-	22	-	
Q_g	Total Gate Charge	(V_{DS}=480V, I_D=4.4A, V_{GS}=10V)[*2,*3]	-	19.8	-	nC
Q_{gs}	Gate-Source Charge		-	4	-	
Q_{gd}	Gate-Drain Charge		-	7.2	-	
L_D	Internal Drain Inductance (Measured from the drain lead 0.25" from package to center of die)		-	4.5	-	nH
L_S	Internal Drain Inductance (Measured from the drain lead 0.25" from package to source bond pad)		-	7.5	-	nH

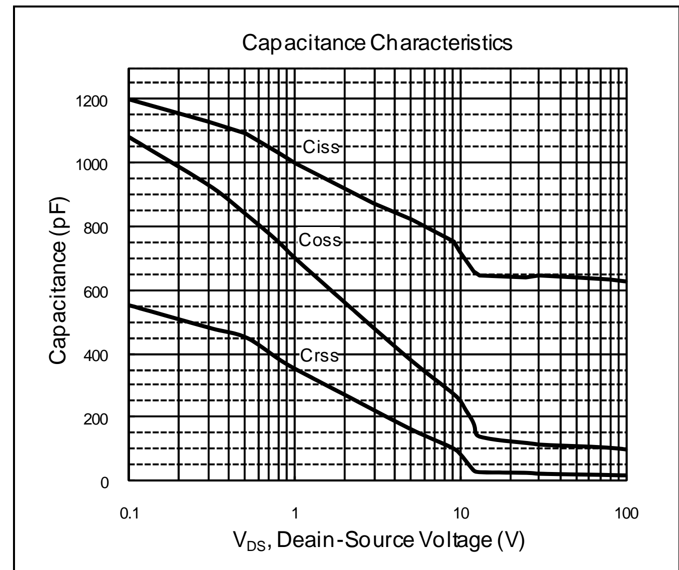
Source-Drain Diode

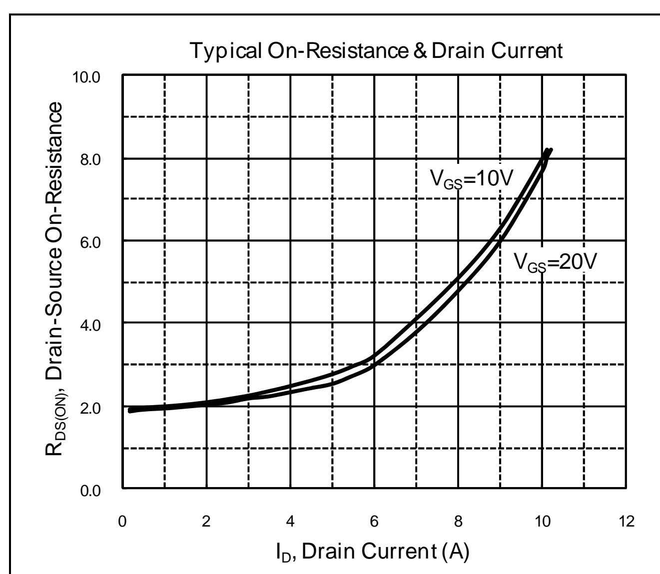
Symbol	Characteristic		Min.	Typ.	Max.	Units
I_S	Maximum Continuous Drain-Source Diode Forward Current		-	-	4	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		-	-	16	A
V_{SD}	Forward On Voltage	I_S=4A, V_{GS}=0V, T_J=25°C	-	-	1.4	V
t_{on}	Forward Turn-On Time	I_S=4A, V_{GS}=0V, d_{IF}/d_t=100A/us[*2]	-	**	-	ns
t_{rr}	Reverse Recovery Time		-	300	-	ns
Q_{rr}	Reverse Recovery Charge		-	2.2	-	uC

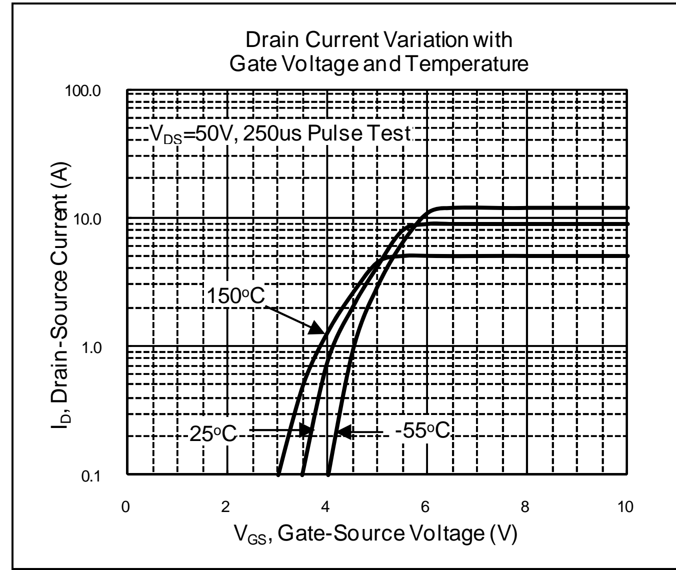
**: Negligible, Dominated by circuit inductance
*2: Pulse Test: Pulse Width ≤300us, Duty Cycle≤2%
*3: Essentially independent of operating temperature

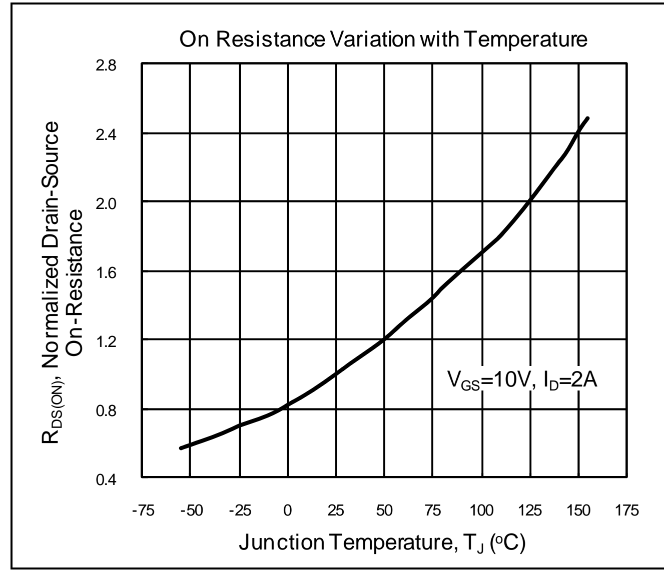
Characteristics Curve

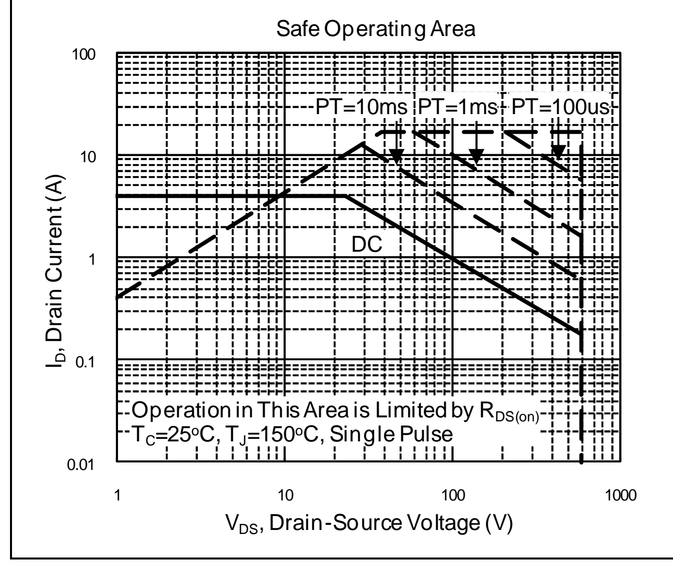




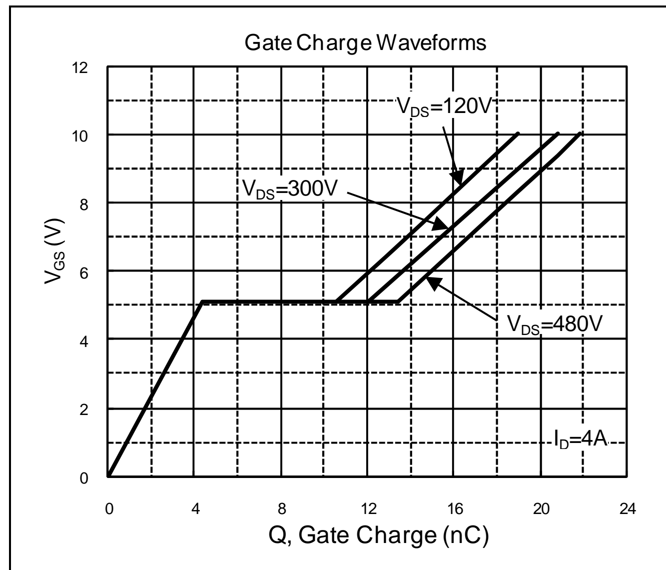


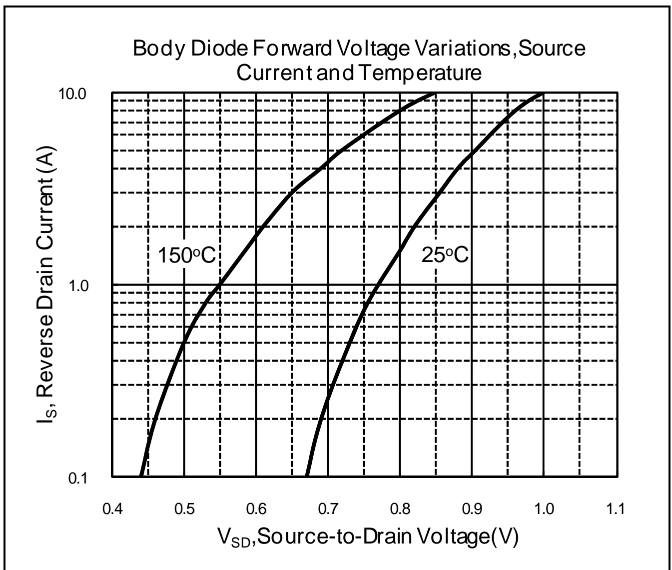


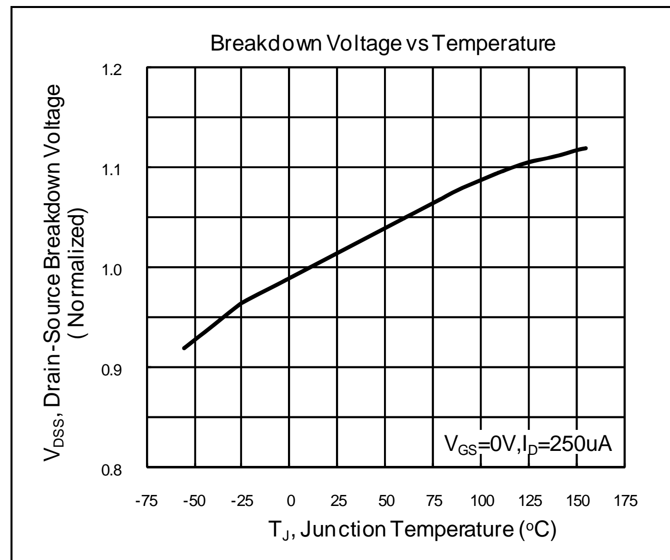




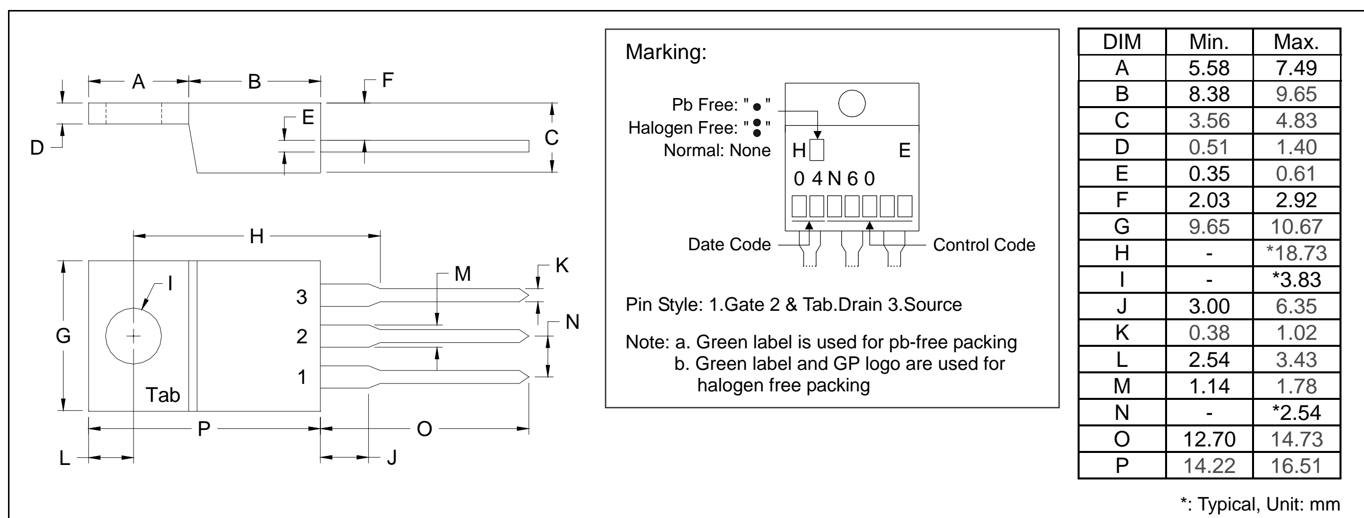
Characteristics Curve







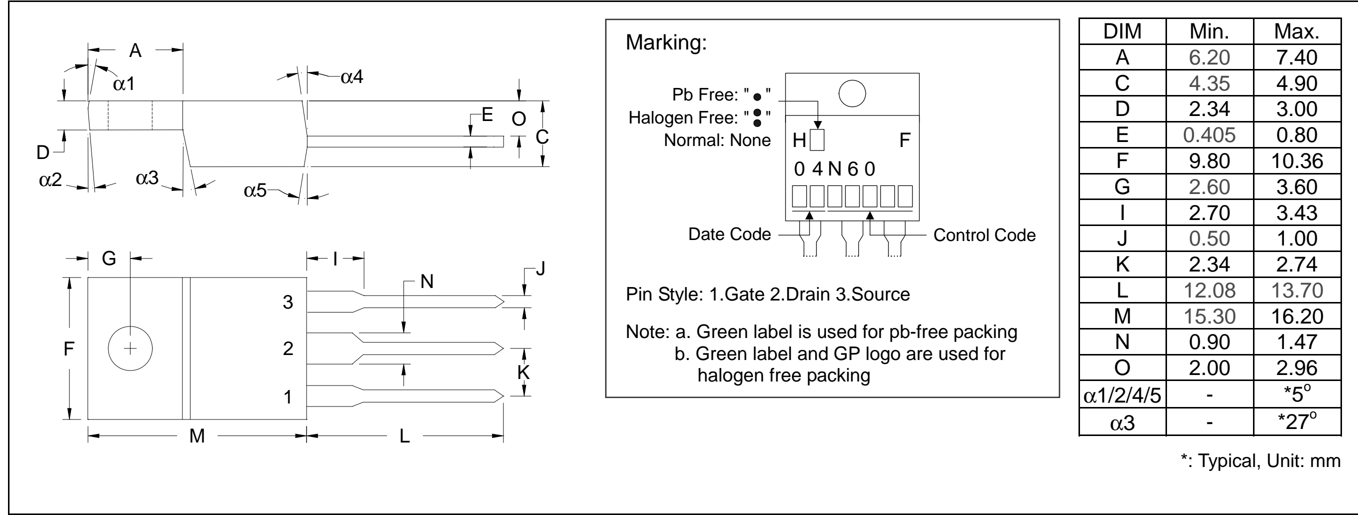
TO-220AB Dimension



DIM	Min.	Max.
A	5.58	7.49
B	8.38	9.65
C	3.56	4.83
D	0.51	1.40
E	0.35	0.61
F	2.03	2.92
G	9.65	10.67
H	-	*18.73
I	-	*3.83
J	3.00	6.35
K	0.38	1.02
L	2.54	3.43
M	1.14	1.78
N	-	*2.54
O	12.70	14.73
P	14.22	16.51

*: Typical, Unit: mm

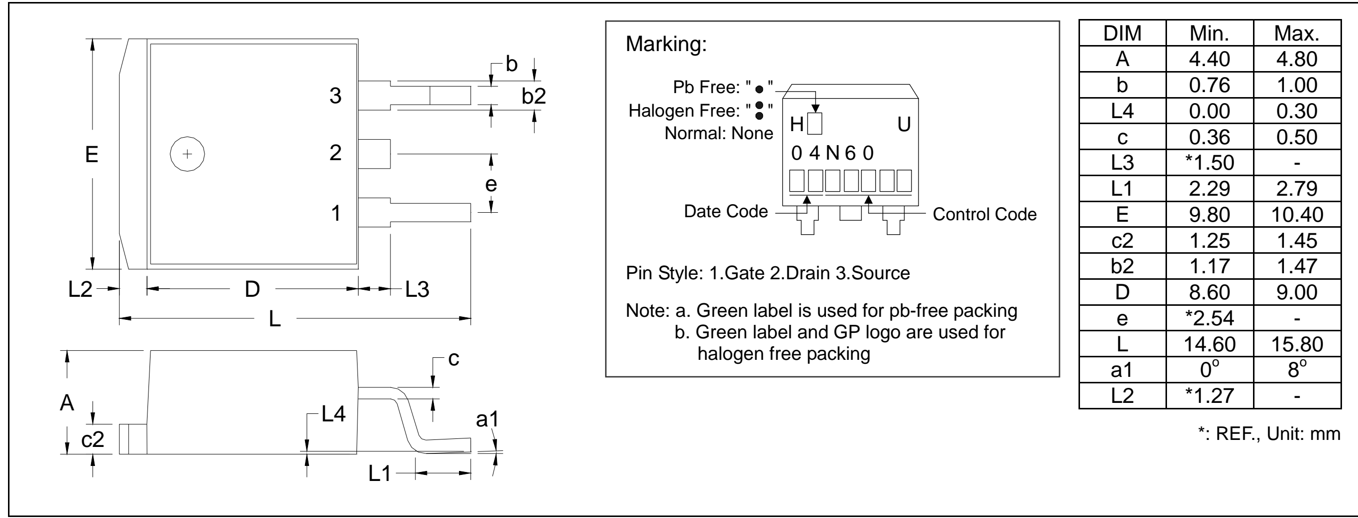
TO-220FP Dimension



DIM	Min.	Max.
A	6.20	7.40
C	4.35	4.90
D	2.34	3.00
E	0.405	0.80
F	9.80	10.36
G	2.60	3.60
I	2.70	3.43
J	0.50	1.00
K	2.34	2.74
L	12.08	13.70
M	15.30	16.20
N	0.90	1.47
O	2.00	2.96
α1/2/4/5	-	*5°
α3	-	*27°

*: Typical, Unit: mm

TO-263 Dimension



DIM	Min.	Max.
A	4.40	4.80
b	0.76	1.00
L4	0.00	0.30
c	0.36	0.50
L3	*1.50	-
L1	2.29	2.79
E	9.80	10.40
c2	1.25	1.45
b2	1.17	1.47
D	8.60	9.00
e	*2.54	-
L	14.60	15.80
a1	0°	8°
L2	*1.27	-

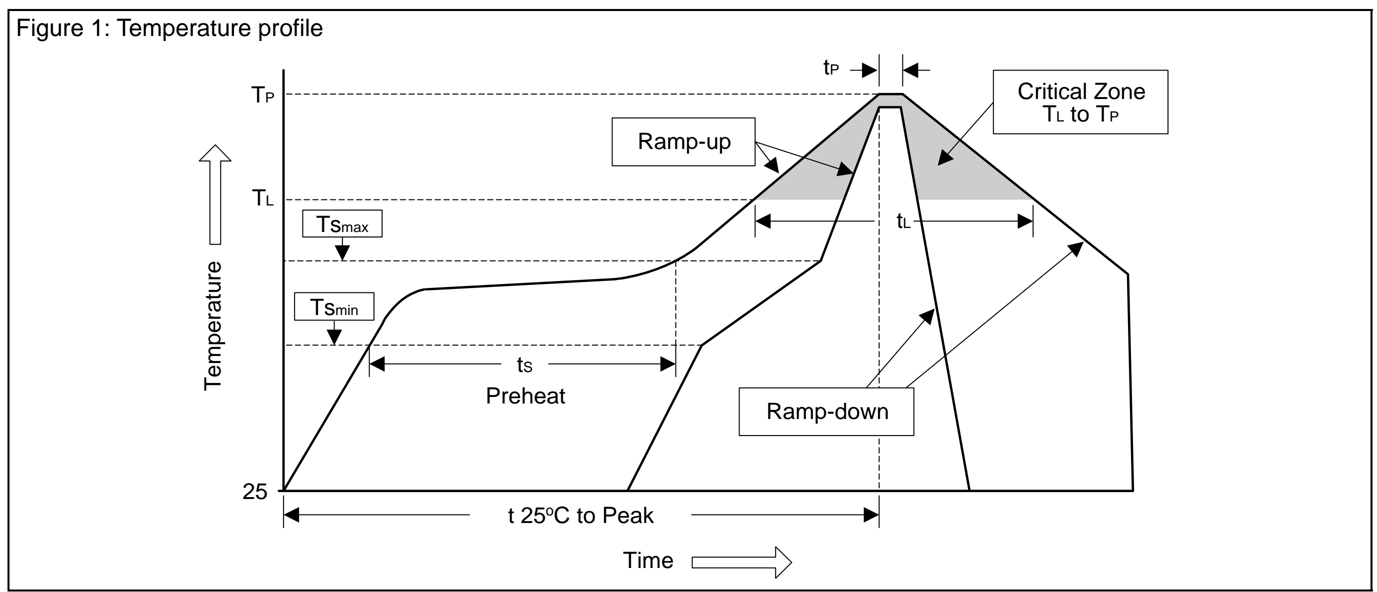
*: REF., Unit: mm

Soldering Methods for HSMC's Products

1. Storage environment: Temperature=10°C~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 60~120 sec	 150°C 200°C 60~180 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 60~150 sec	 217°C 60~150 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)	10~30 sec	20~40 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	10sec ±1sec
Pb-Free devices.	260°C ±5°C	10sec ±1sec

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