

## N-Channel Enhancement Mode MOSFET

### Feature Description

- 200V/90A  
 $R_{DS(ON)} = 22m\Omega (typ.) @ V_{GS} = 10V$
- 100% Avalanche Tested
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

### Pin Description



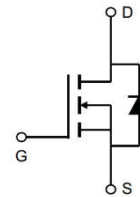
HM90N20  
TO-220-3L



HM90N20D  
TO-263-2L

### Applications

- Power Management for Inverter Systems



N-Channel MOSFET

### Ordering and Marking Information

<div> <div>HM90N20</div> <div>YYWW</div> </div> <div> <div>HM90N20D</div> <div>YYWW</div> </div>	<div>Package Code</div> <div>HM90N20: TO-220-3L      HM90N20D: TO-263-2L</div> <div>Date Code</div> <div>YYWW</div>
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Note: H&M SEMI lead-free products contain molding compounds/die attach materials and 100% matte tin plate Termination finish; which are fully compliant with RoHS. H&M SEMI lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020 for MSL classification at lead-free peak reflow temperature. H&M SEMI defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

H&M SEMI reserves the right to make changes, corrections, enhancements, modifications, and improvements to this product and/or to this document at any time without notice.

## Absolute Maximum Ratings

Symbol	Parameter		Rating	Unit
Common Ratings (Tc=25°C Unless Otherwise Noted)				
V <sub>DSS</sub>	Drain-Source Voltage		200	V
V <sub>GSS</sub>	Gate-Source Voltage		±20	V
T <sub>J</sub>	Maximum Junction Temperature		175	°C
T <sub>STG</sub>	Storage Temperature Range		-55 to 175	°C
I <sub>S</sub>	Source Current-Continuous(Body Diode)	Tc=25°C	90	A
Mounted on Large Heat Sink				
I <sub>DM</sub>	Pulsed Drain Current *	Tc=25°C	360	A
I <sub>D</sub>	Continuous Drain Current	Tc=25°C	90	A
		Tc=100°C	70	A
P <sub>D</sub>	Maximum Power Dissipation	Tc=25°C	375	W
		Tc=100°C	187.5	W
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case		0.4	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient **		62.5	°C/W
E <sub>AS</sub>	Single Pulsed-Avalanche Energy ***	L=0.5mH	784	mJ

Note: \* Repetitive rating; pulse width limited by max. junction temperature.  
 \*\* Surface mounted on FR-4 board.  
 \*\*\* Limited by T<sub>Jmax</sub>, starting T<sub>J</sub>=25°C, L = 0.5mH, R<sub>G</sub>= 25Ω, V<sub>GS</sub> =10V.

## Electrical Characteristics(Tc =25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	< A - \$B&\$			Unit
			Min	Typ.	Max	
Static Characteristics						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V,I <sub>DS</sub> =250μA	200	-		V
I <sub>DSS</sub>	Drain-to-Source Leakage Current	V <sub>DS</sub> =200V,V <sub>GS</sub> =0V	-	-	1	μA
			T <sub>J</sub> =55°C	-	-	5
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA	2.0	3.0	4.0	V
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> =± 20V,V <sub>DS</sub> =0V	-	-	±100	nA
R <sub>DS(ON)*</sub>	Drain-Source On-State Resistance	V <sub>GS</sub> =10V,I <sub>DS</sub> =45A		22.0	24.0	mΩ
Diode Characteristics						
V <sub>SD</sub> *	Diode Forward Voltage	I <sub>SD</sub> =45A,V <sub>GS</sub> =0V	-	0.82	1.1	V
t <sub>rr</sub>	Reverse Recovery Time	I <sub>SD</sub> =45A,dI <sub>SD</sub> /dt=100A/μs	-	80	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	160	-	nC

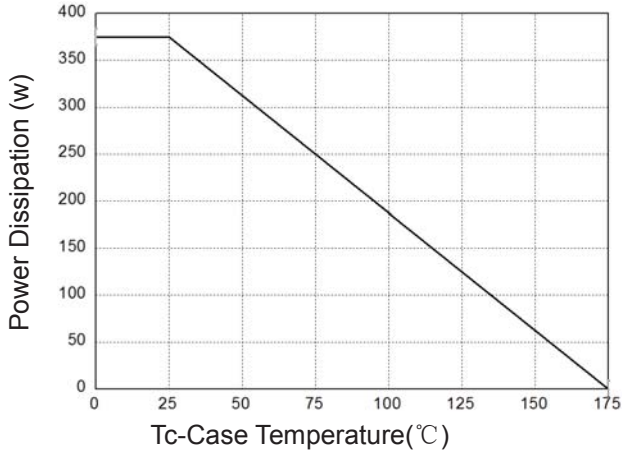
## Electrical Characteristics (Cont.) (Tc =25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	< A - \$B&\$			Unit
			Min	Typ.	Max	
Dynamic Characteristics						
R <sub>G</sub>	Gate Resistance	V <sub>GS</sub> =0V,V <sub>DS</sub> =0V, F=1MHz	-	3.4	-	Ω
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V,	-	5871	-	pF
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> =25V,	-	392	-	
C <sub>rss</sub>	Reverse Transfer Capacitance	Frequency=1.0MHz	-	165	-	
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>DD</sub> =100V,R <sub>G</sub> =4Ω, I <sub>DS</sub> =45A,V <sub>GS</sub> =10V	-	29	-	ns
T <sub>r</sub>	Turn-on Rise Time		-	45	-	
t <sub>d(OFF)</sub>	Turn-off Delay Time		-	22	-	
T <sub>f</sub>	Turn-off Fall Time		-	41	-	
Gate Charge Characteristics						
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =160V, V <sub>GS</sub> =10V, I <sub>D</sub> =45A	-	130.4	-	nC
Q <sub>gs</sub>	Gate-Source Charge		-	22.1	-	
Q <sub>gd</sub>	Gate-Drain Charge		-	38.2	-	

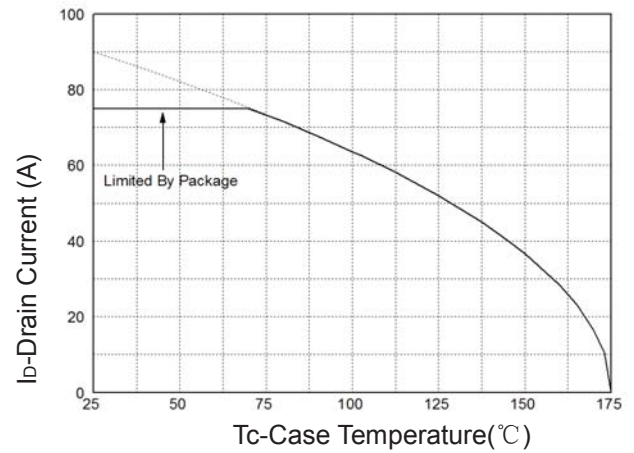
Note: \*Pulse test, pulse width ≤ 300us, duty cycle ≤ 2%

## Typical Operating Characteristics

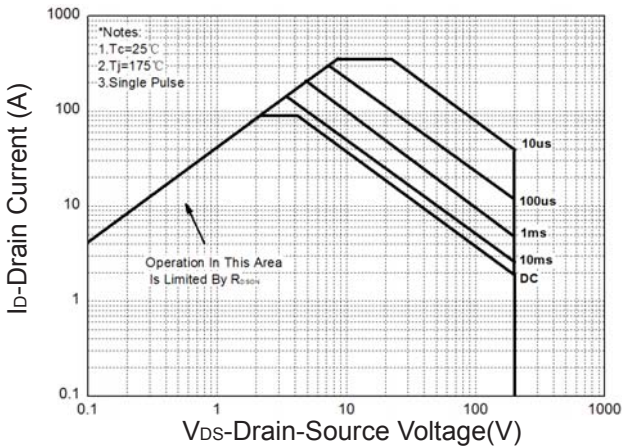
**Figure 1: Power Dissipation**



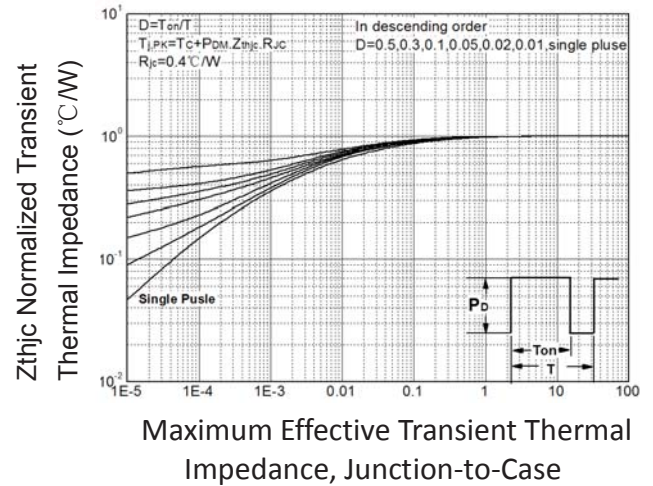
**Figure 2: Drain Current**



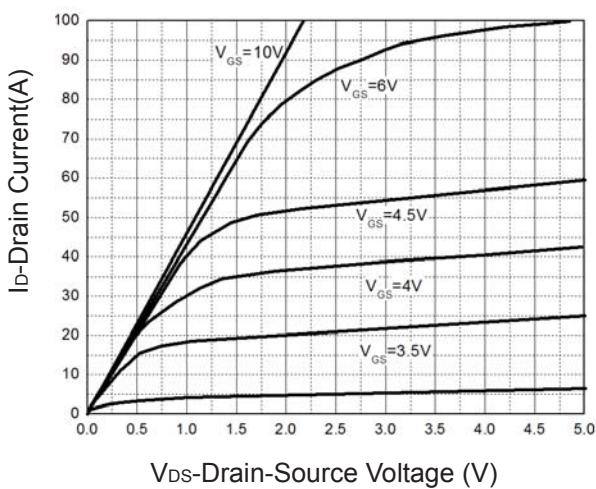
**Figure 3: Safe Operation Area**



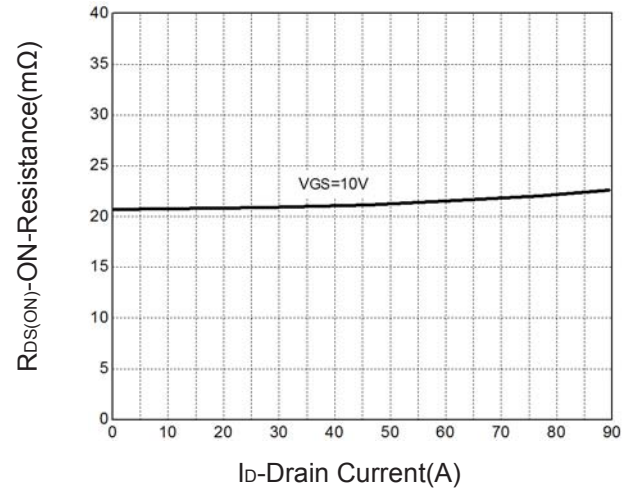
**Figure 4: Thermal Transient Impedance**



**Figure 5: Output Characteristics**

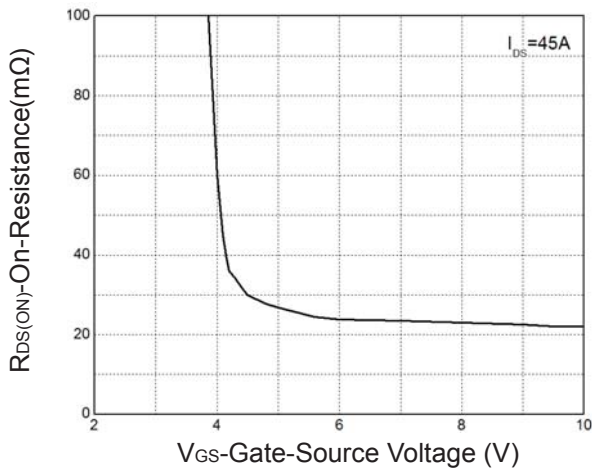


**Figure 6: Drain-Source On Resistance**

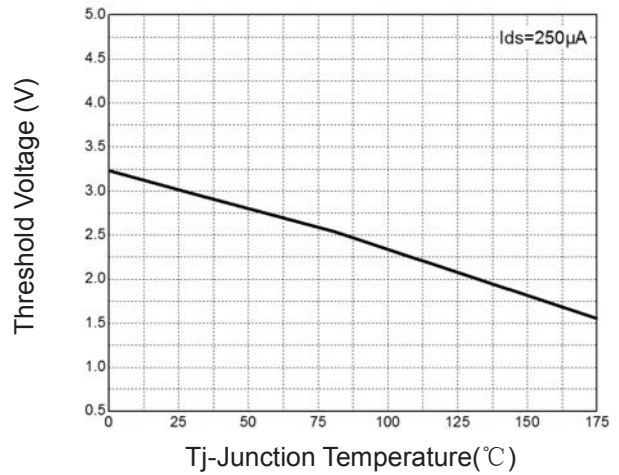


## Typical Operating Characteristics(Cont.)

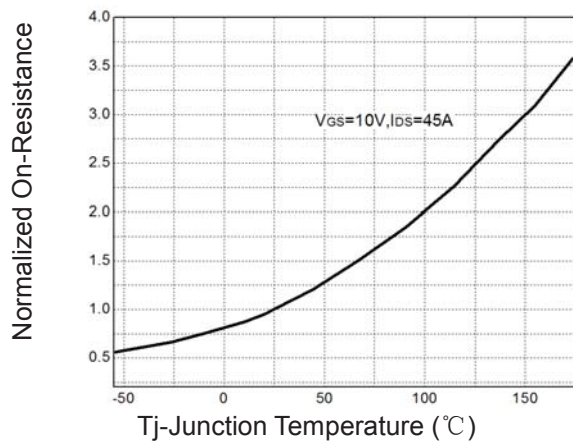
**Figure 7: Gate-Source Vs. On-Resistance**



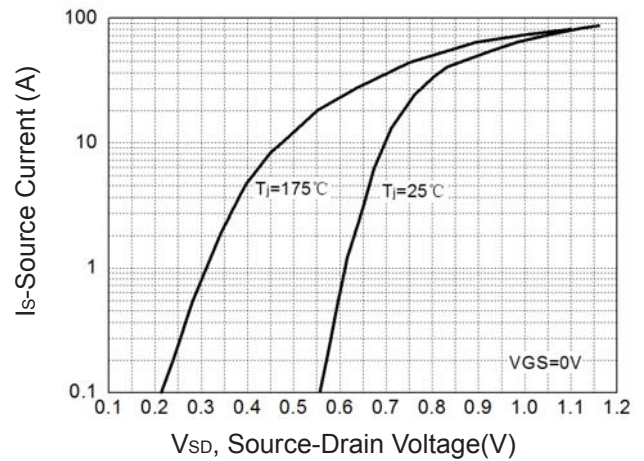
**Figure 8: Gate-Source Forward**



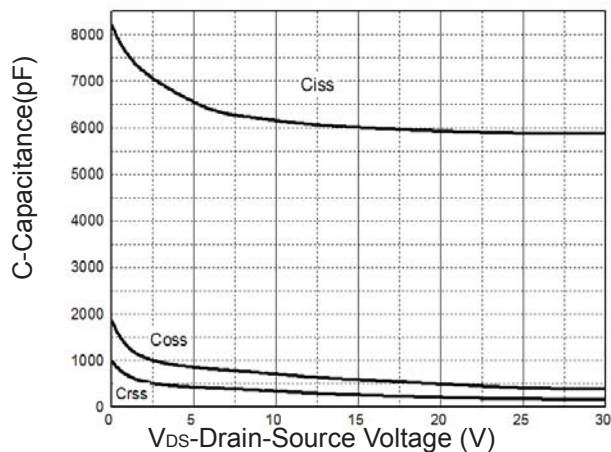
**Figure 9: On-Resistance vs. Temperature**



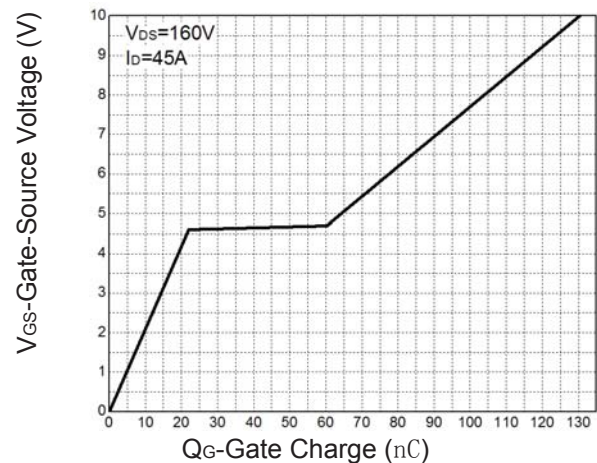
**Figure 10: Source-Drain Diode Forward**



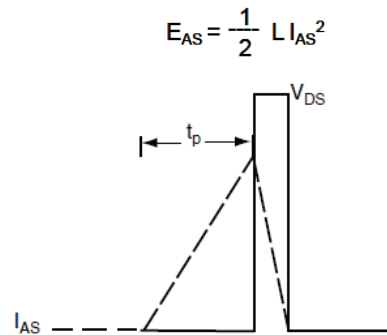
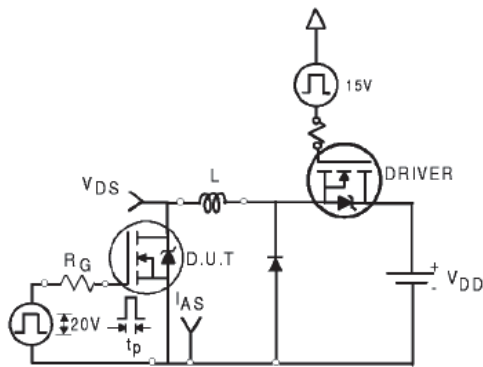
**Figure 11: Capacitance Characteristics**



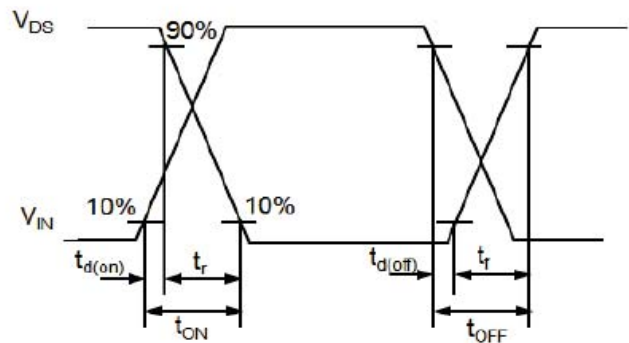
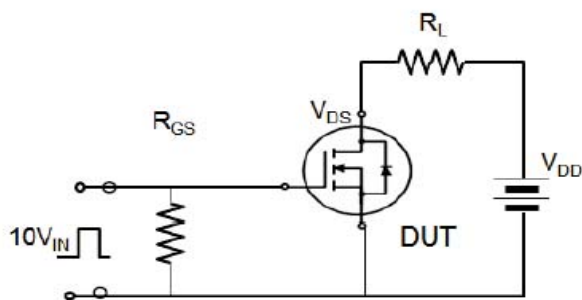
**Figure 12: Gate Charge Characteristics**



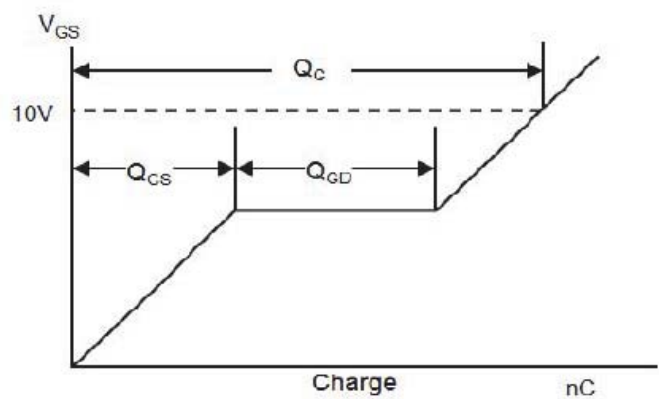
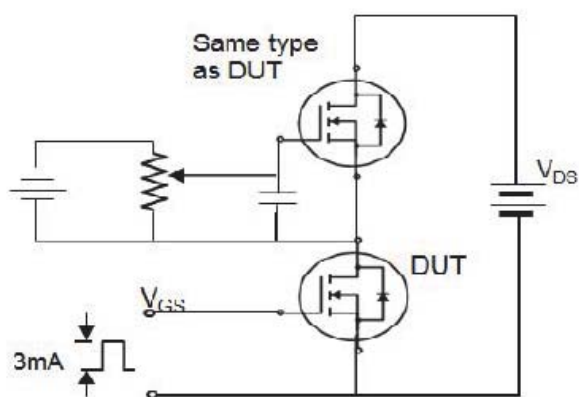
## Avalanche Test Circuit



## Switching Time Test Circuit



## Gate Charge Test Circuit

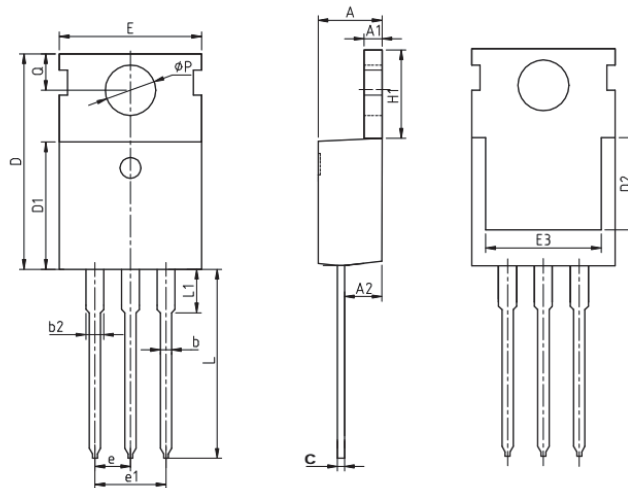


## Device Per Unit

Package Type	Unit	Quantity
TO-220-3L	Tube	50

## Package Information

### TO-220-3L



COMMON DIMENSIONS

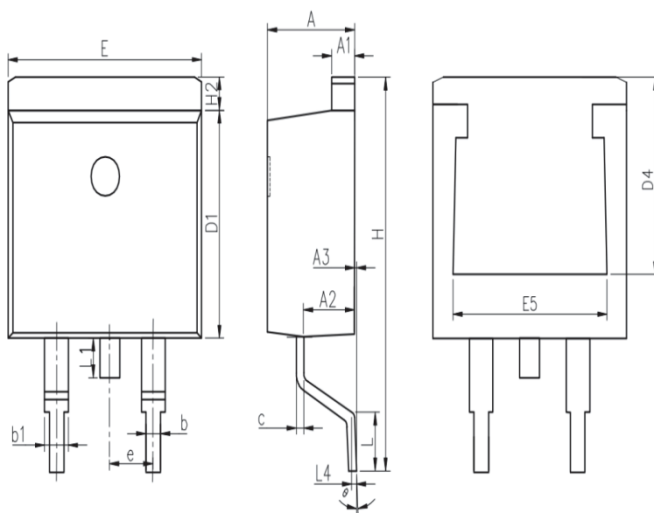
SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	1.25	1.30	1.45
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.40	0.50	0.65
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30
E3	7.00	-	-
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ΦP	3.40	3.60	3.80
Q	2.60	2.80	3.00

## Device Per Unit

Package Type	Unit	Quantity
TO-263-2L	Reel	50

## Package Information

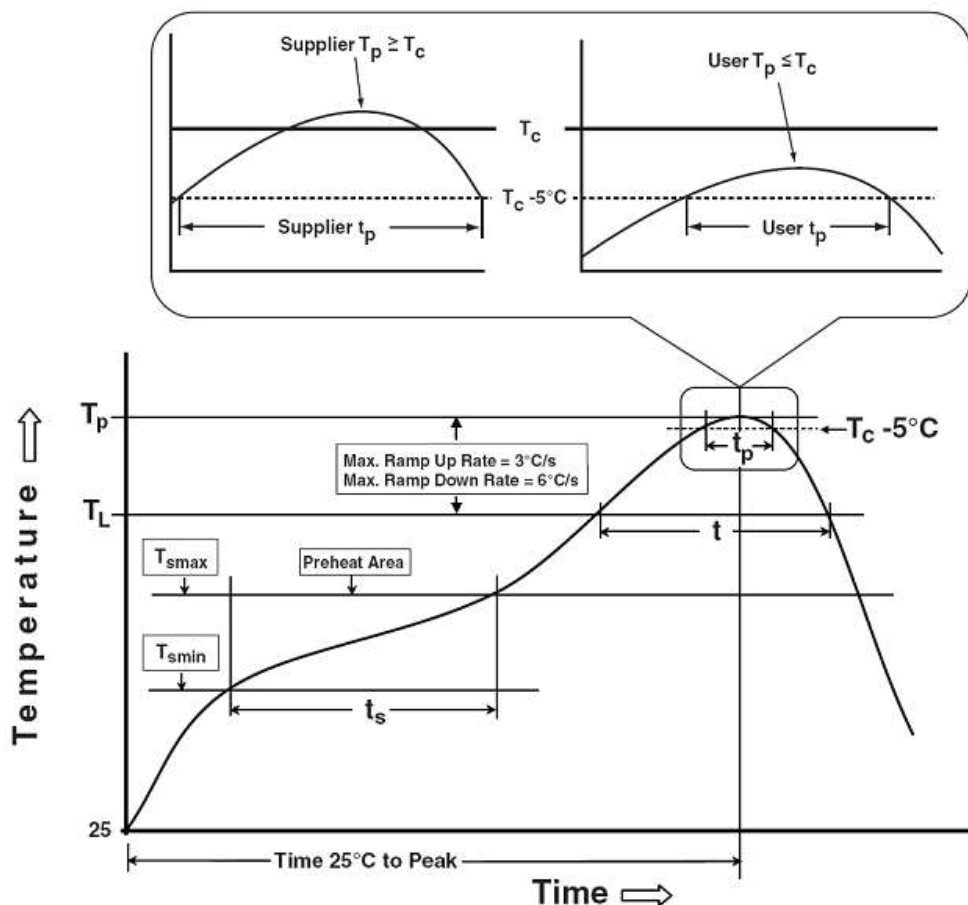
### TO-263-2L



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0	0.13	0.25
b	0.7	0.81	0.96
b1	1.17	1.27	1.47
c	0.3	0.38	0.53
D1	8.5	8.7	8.9
D4	6.6	-	-
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54 BSC		
H	14.7	15.1	15.5
H2	1.07	1.27	1.47
L	2	2.3	2.6
L1	1.4	1.55	1.7
L4	0.25 BSC		
θ	0°	5°	9°

## Classification Profile



## Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat &amp; Soak</b>		
Temperature min ( $T_{smin}$ )	100 °C	150 °C
Temperature max ( $T_{smax}$ )	150 °C	200 °C
Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )	60-120 seconds	60-120 seconds
Average ramp-up rate ( $T_{smax}$ to $T_p$ )	3 °C/second max.	3°C/second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time at liquidous ( $t_L$ )	60-150 seconds	60-150 seconds
Peak package body Temperature ( $T_p$ )*	See Classification Temp in table 1	See Classification Temp in table 2
Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_c$ )	20** seconds	30** seconds
Average ramp-down rate ( $T_p$ to $T_{smax}$ )	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
*Tolerance for peak profile Temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum.		

Table 1.SnPb Eutectic Process – Classification Temperatures (Tc)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2.Pb-free Process – Classification Temperatures (Tc)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> ≥2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

## Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HTRB	JESD-22, A108	168 Hrs/500 Hrs/1000 Hrs, Bias @ 125°C
PCT	JESD-22, A102	96 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -55°C~150°C