

## N-Channel Super Trench II Power MOSFET

### Description

The series of devices uses **Super Trench II** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of  $R_{DS(on)}$  and  $Q_g$ . This device is ideal for high-frequency switching and synchronous rectification.

### Application

- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

### General Features

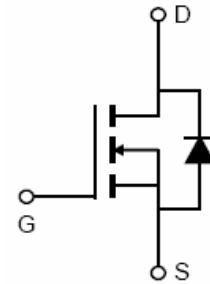
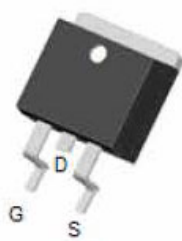
- $V_{DS} = 250V, I_D = 80A$   
 $R_{DS(on)} = 34m\Omega$ , typical (TO-220) @  $V_{GS} = 10V$   
 $R_{DS(on)} = 34m\Omega$ , typical (TO-263) @  $V_{GS} = 10V$
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating

**100% UIS TESTED!**  
**100%  $\Delta V_{ds}$  TESTED!**

TO-220



TO-263



Schematic Diagram

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
HMS40N25	HMS40N25	TO-220	-	-	-
HMS40N25D	HMS40N25D	TO-263	-	-	-

### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	250	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	40	A
Drain Current-Continuous( $T_C = 100^\circ C$ )	$I_D(100^\circ C)$	28	A
Pulsed Drain Current	$I_{DM}$	120	A
Maximum Power Dissipation	$P_D$	200	W
Derating factor		1.33	W/ $^\circ C$
Single pulse avalanche energy <sup>(Note 5)</sup>	$E_{AS}$	1050	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 175	$^\circ C$

## Thermal Characteristic

Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup>	$R_{\theta JC}$	0.75	$^{\circ}\text{C/W}$
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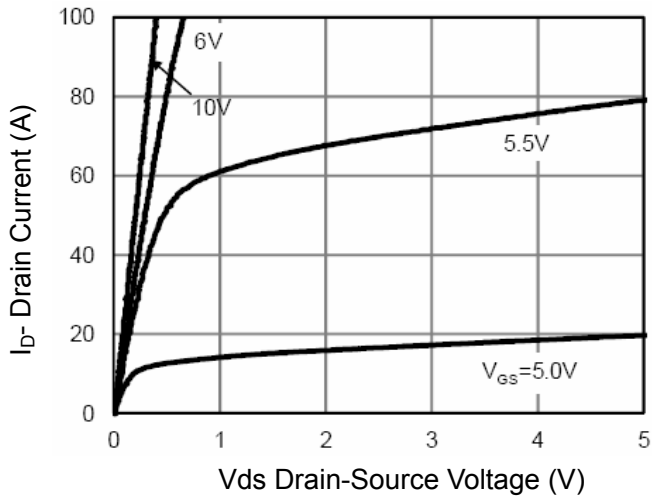
## Electrical Characteristics ( $T_C=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit	
Off Characteristics							
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	250		-	V	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =250V, V <sub>GS</sub> =0V	-	-	1	μA	
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA	
On Characteristics <sup>(Note 3)</sup>							
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	2.5	3.5	4.5	V	
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =70A	TO-220	-	34	40	mΩ
			TO-263		34	40	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =70A		90	-	S	
Dynamic Characteristics <sup>(Note4)</sup>							
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =40V, V <sub>GS</sub> =0V, F=1.0MHz	-	4950	-	PF	
Output Capacitance	C <sub>OSS</sub>		-	850	-	PF	
Reverse Transfer Capacitance	C <sub>rss</sub>		-	40	-	PF	
Switching Characteristics <sup>(Note 4)</sup>							
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =40V, I <sub>D</sub> =70A V <sub>GS</sub> =10V, R <sub>G</sub> =1.6Ω	-	18	-	nS	
Turn-on Rise Time	t <sub>r</sub>		-	11	-	nS	
Turn-Off Delay Time	t <sub>d(off)</sub>		-	38	-	nS	
Turn-Off Fall Time	t <sub>f</sub>		-	9	-	nS	
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =40V, I <sub>D</sub> =70A, V <sub>GS</sub> =10V	-	88	-	nC	
Gate-Source Charge	Q <sub>gs</sub>		-	22		nC	
Gate-Drain Charge	Q <sub>gd</sub>		-	25		nC	
Drain-Source Diode Characteristics							
Diode Forward Voltage <sup>(Note 3)</sup>	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =70A	-		1.2	V	
Diode Forward Current <sup>(Note 2)</sup>	I <sub>S</sub>		-	-	80	A	
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25°C, I <sub>F</sub> = 70A di/dt = 100A/μs <sup>(Note3)</sup>	-	72	-	nS	
Reverse Recovery Charge	Q <sub>rr</sub>		-	102	-	nC	

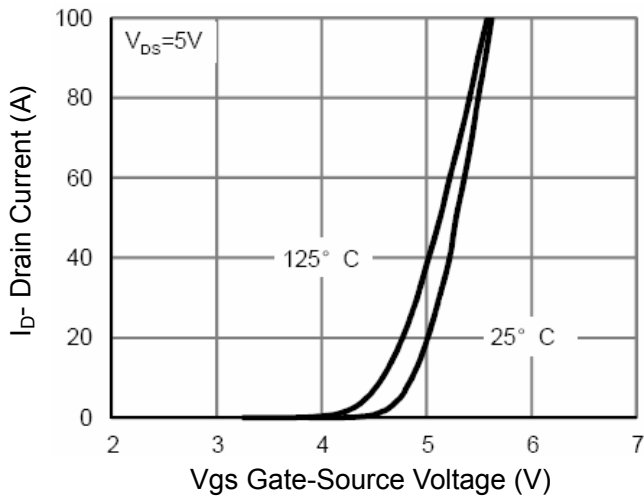
## Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=40V, V_G=10V, L=0.5\text{mH}, R_g=25\Omega$

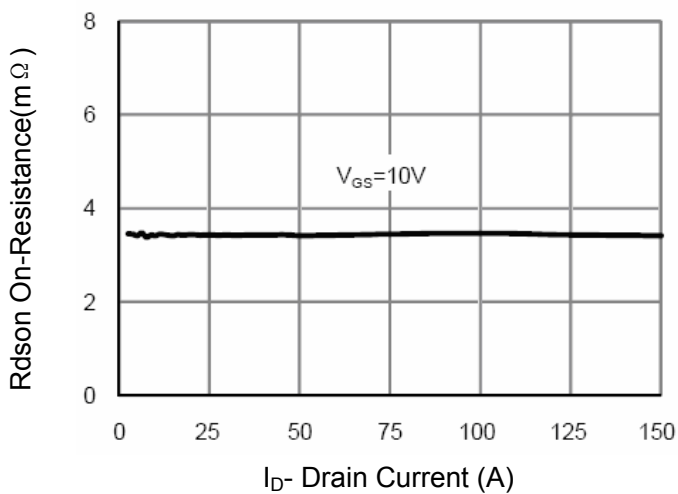
## Typical Electrical and Thermal Characteristics



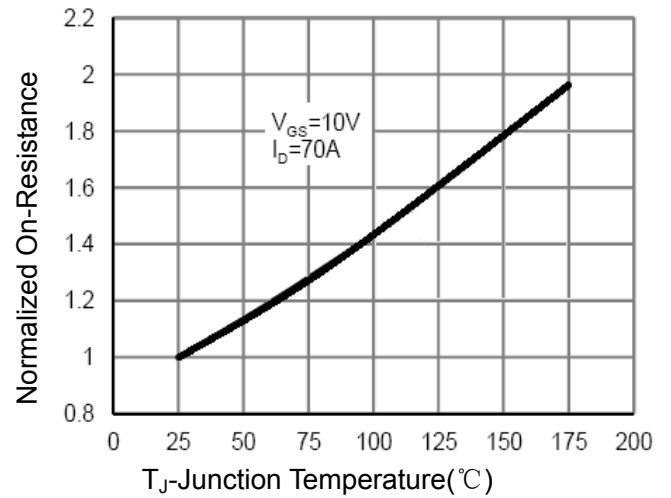
**Figure 1 Output Characteristics**



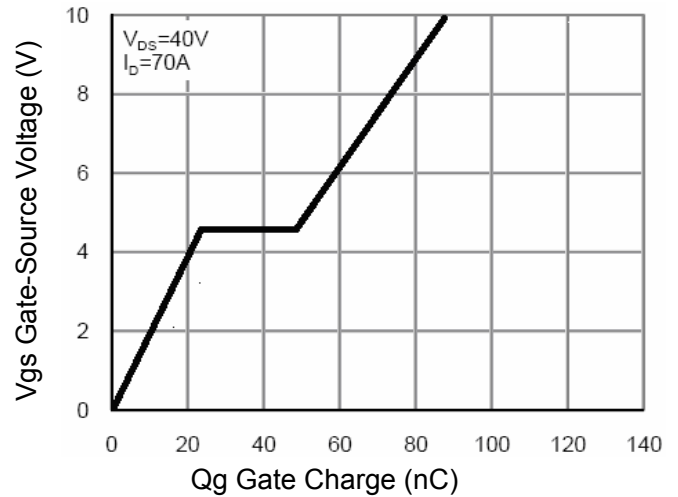
**Figure 2 Transfer Characteristics**



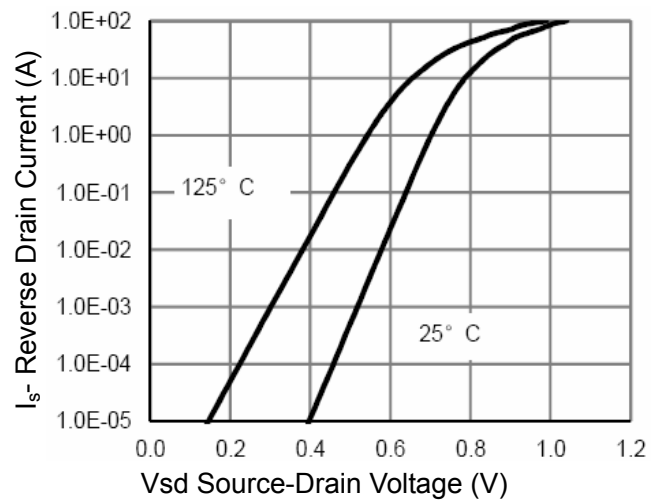
**Figure 3 Rdson- Drain Current**



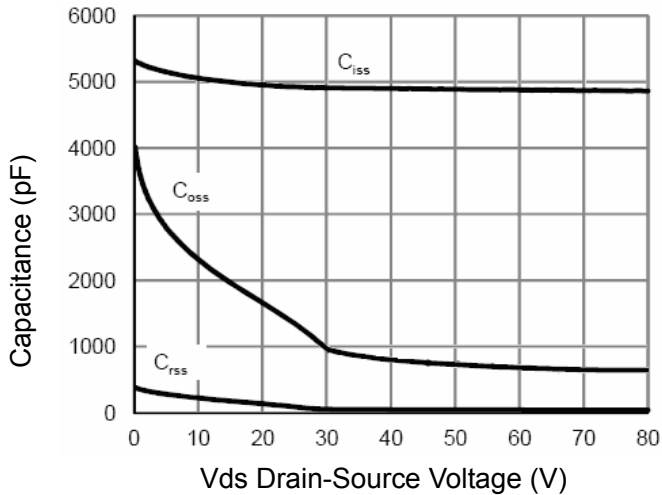
**Figure 4 Rdson-Junction Temperature**



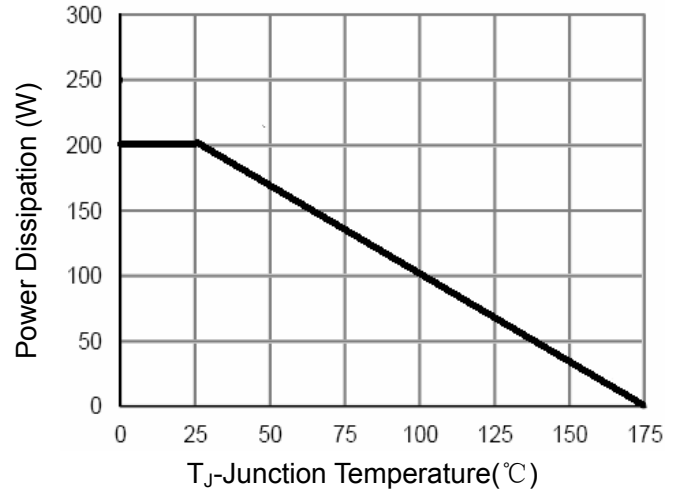
**Figure 5 Gate Charge**



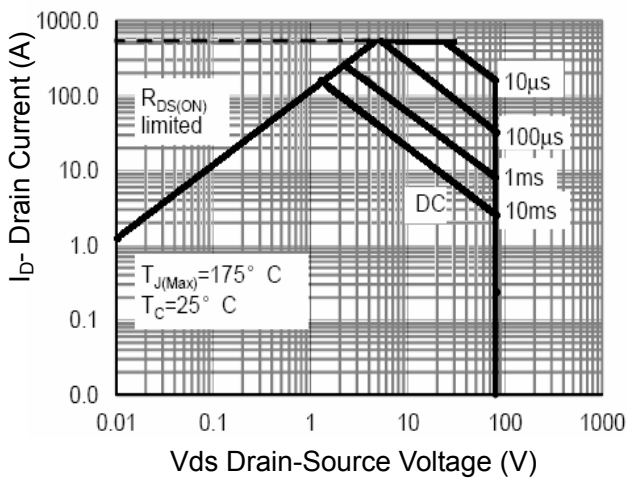
**Figure 6 Source- Drain Diode Forward**



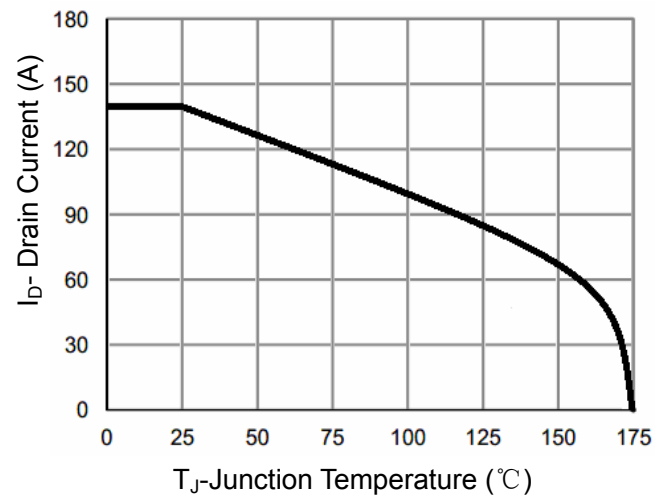
**Figure 7 Capacitance vs Vds**



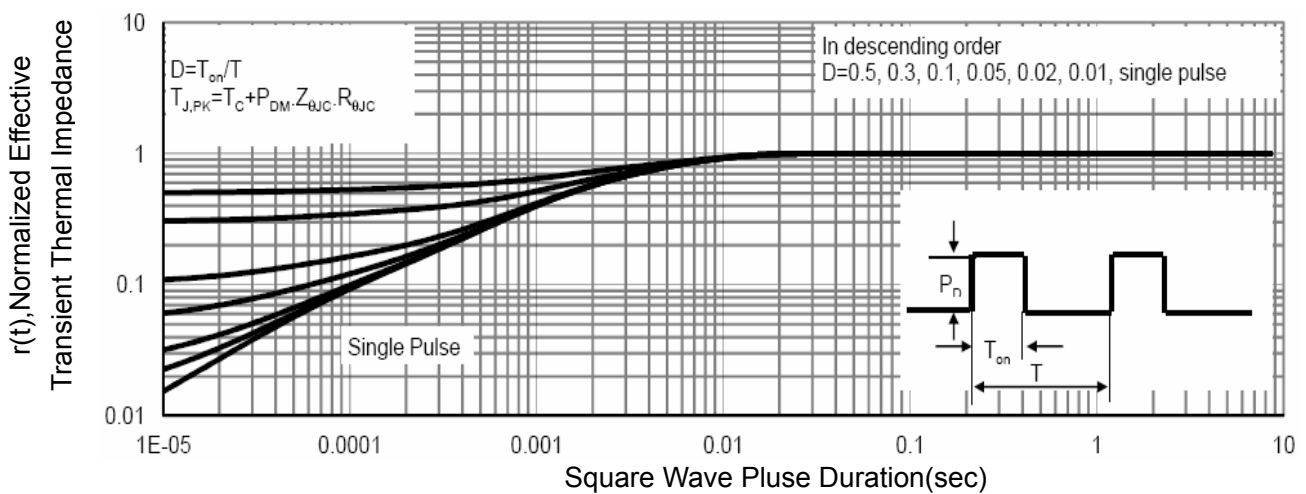
**Figure 9 Power De-rating**



**Figure 8 Safe Operation Area**

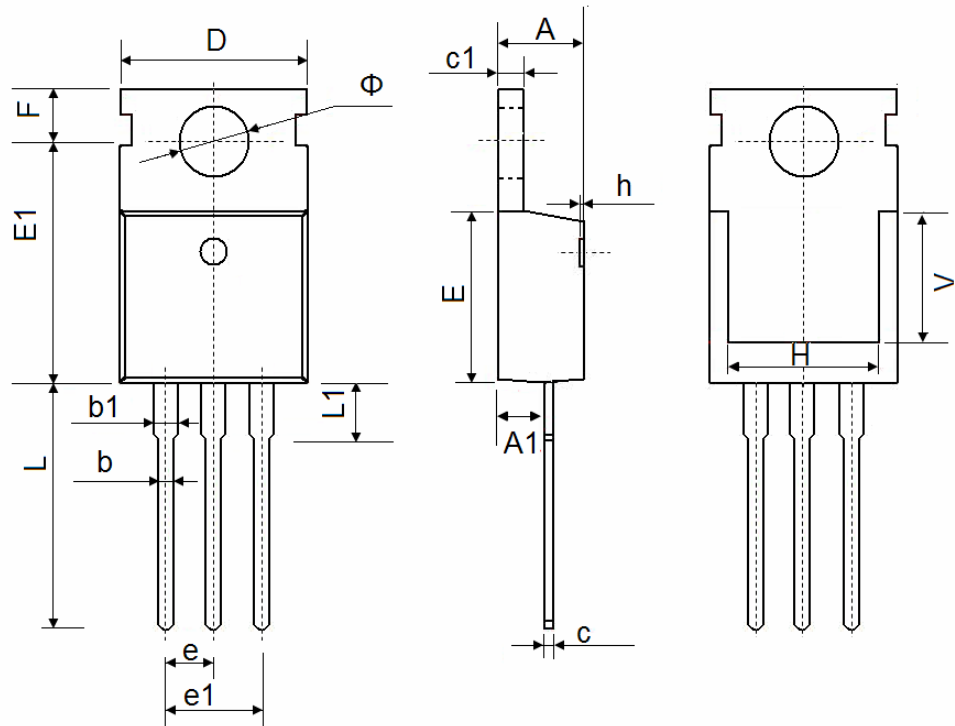


**Figure 10 Current De-rating**



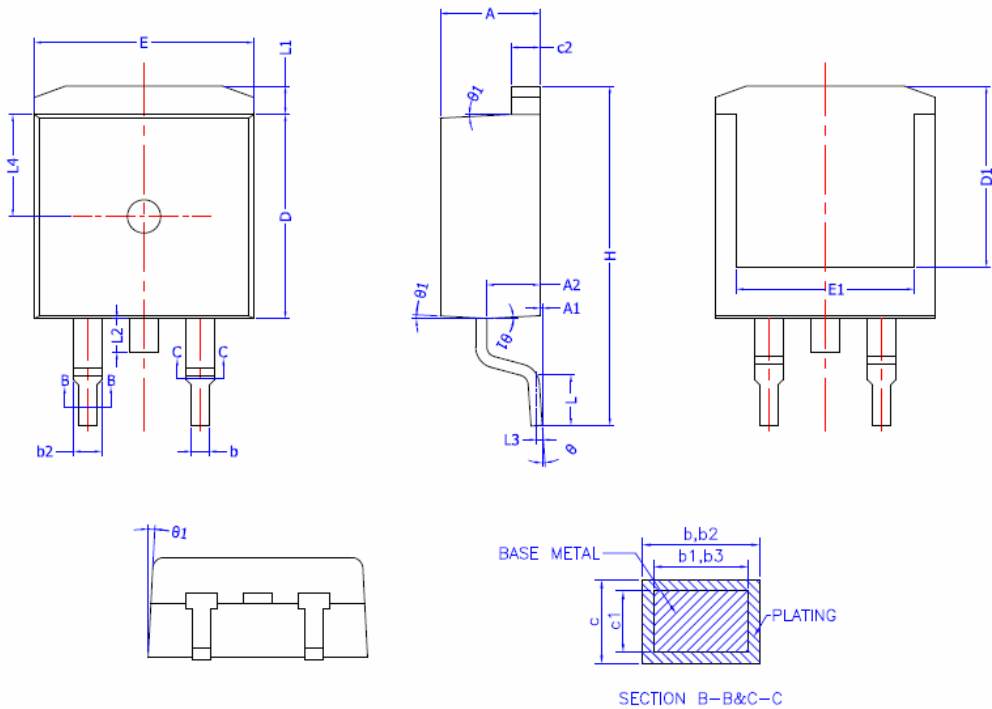
**Figure 11 Normalized Maximum Transient Thermal Impedance**

TO-220-3L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	6.900 REF.		0.276 REF.	
Φ	3.400	3.800	0.134	0.150

TO-263-2L Package Information



COMMON DIMENSIONS  
 (UNITS OF MEASURE =MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	0	0.10	0.25
A2	2.20	2.40	2.60
b	0.76	—	0.89
b1	0.75	0.80	0.85
b2	1.23	—	1.37
b3	1.22	1.27	1.32
c	0.47	—	0.60
c1	0.46	0.51	0.56
c2	1.25	1.30	1.35
D	9.10	9.20	9.30
D1	8.00	—	—
E	9.80	9.90	10.00
E1	7.80	—	—
e	2.54 BSC		
H	14.90	15.30	15.70
L	2.00	2.30	2.60
L1	1.17	1.27	1.40
L2	—	—	1.75
L3	0.25BSC		
L4	4.60 REF		
$\theta$	0°	—	8°
$\theta_1$	1°	3°	5°