

## N-Channel Super Junction Power MOSFET

### General Description

The series of devices use advanced super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

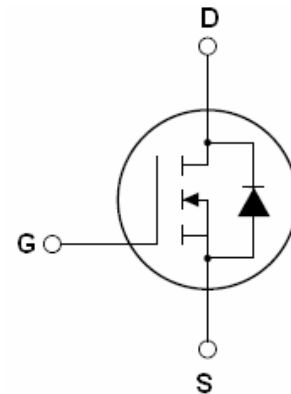
### Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

### Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)

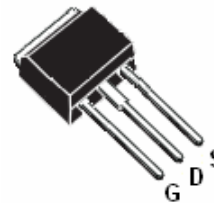
$V_{DS}$	650	V
$R_{DS(ON)}$	900	m $\Omega$
$I_D$	5	A



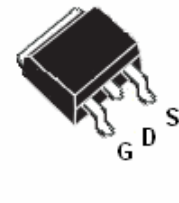
Schematic diagram

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE05N65I	TO-251	NCE05N65I
NCE05N65K	TO-252	NCE05N65K



TO-251



TO-252

Table 1. Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ )

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	650	V
Gate-Source Voltage ( $V_{DS}=0V$ )	$V_{GS}$	$\pm 30$	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	5	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	3	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	15	A
Drain Source voltage slope, $V_{DS} = 480\text{ V}$ , $I_D = 5\text{ A}$ , $T_j = 125^\circ\text{C}$	dv/dt	50	V/ns
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	50	W
Derate above $25^\circ\text{C}$		0.4	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note2)	$E_{AS}$	130	mJ
Avalanche current (Note 1)	$I_{AR}$	5	A

Parameter	Symbol	Value	Unit
Repetitive Avalanche energy , $t_{AR}$ limited by $T_{jmax}$ (Note 1)	$E_{AR}$	0.4	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+150	°C

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	2.5	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	75	°C /W

**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

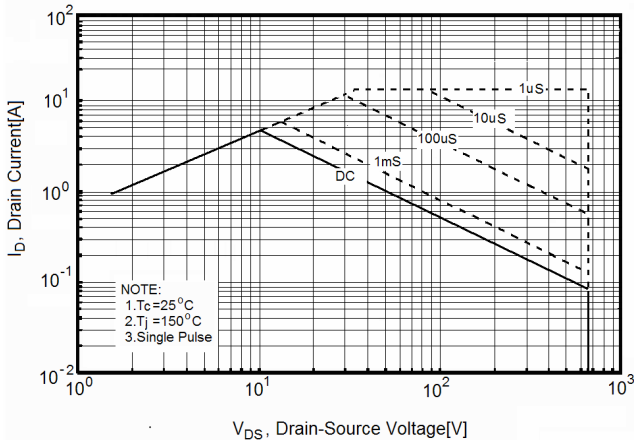
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	650			V
Zero Gate Voltage Drain Current( $T_C=25^\circ C$ )	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			1	$\mu A$
Zero Gate Voltage Drain Current( $T_C=125^\circ C$ )	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			50	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30V, V_{DS}=0V$			$\pm 100$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.5	3	3.5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=3A$		850	900	m $\Omega$
<b>Dynamic Characteristics</b>						
Forward Transconductance	$g_{FS}$	$V_{DS} = 20V, I_D = 3A$		5		S
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		520		PF
Output Capacitance	$C_{oss}$			52		PF
Reverse Transfer Capacitance	$C_{rss}$			4.5		PF
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=5A,$ $V_{GS}=10V$		12	25	nC
Gate-Source Charge	$Q_{gs}$			2.2		nC
Gate-Drain Charge	$Q_{gd}$			4.5		nC
Intrinsic gate resistance	$R_G$	$f = 1 MHz$ open drain		2.6		$\Omega$
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=5A,$ $R_G=18\Omega, V_{GS}=10V$		6		nS
Turn-on Rise Time	$t_r$			2.5		nS
Turn-Off Delay Time	$t_{d(off)}$			55	80	nS
Turn-Off Fall Time	$t_f$			9	14	nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_C=25^\circ C$			5	A
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				15	A
Forward On Voltage	$V_{SD}$	$T_j=25^\circ C, I_{SD}=5A, V_{GS}=0V$		1	1.3	V
Reverse Recovery Time	$t_{rr}$	$T_j=25^\circ C, I_F=5A, di/dt=100A/\mu s$		200		nS
Reverse Recovery Charge	$Q_{rr}$				1.6	$\mu C$
Peak reverse recovery current	$I_{rrm}$				15	A

Notes: 1.Repetitive Rating: Pulse width limited by maximum junction temperature

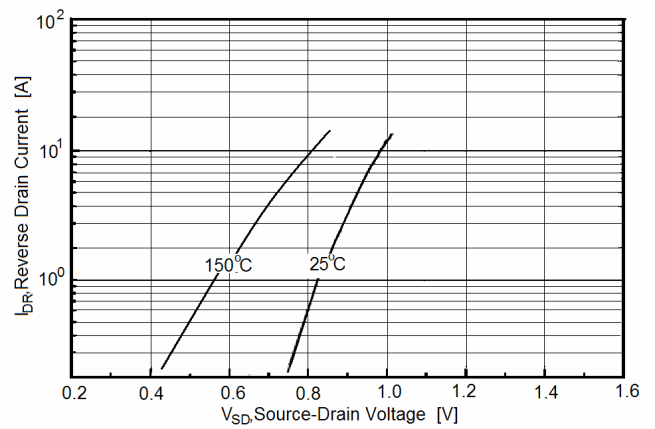
2.  $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

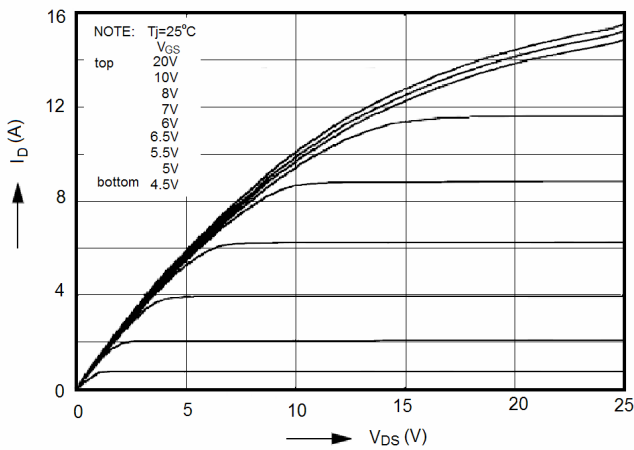
**Figure1. Safe operating area**



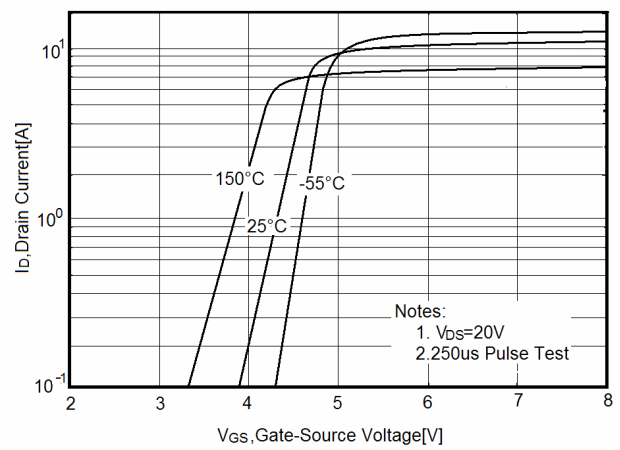
**Figure2. Source-Drain Diode Forward Voltage**



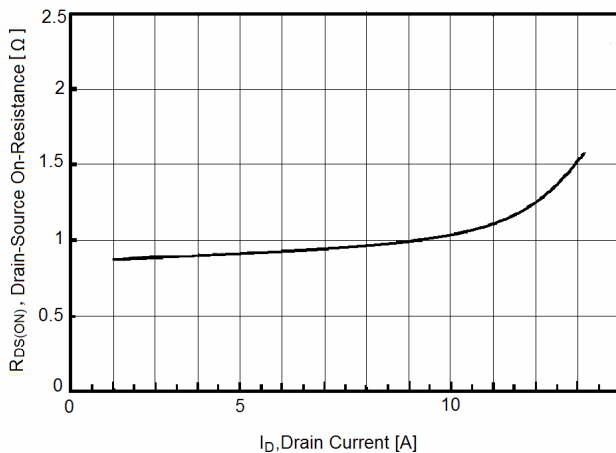
**Figure3. Output characteristics**



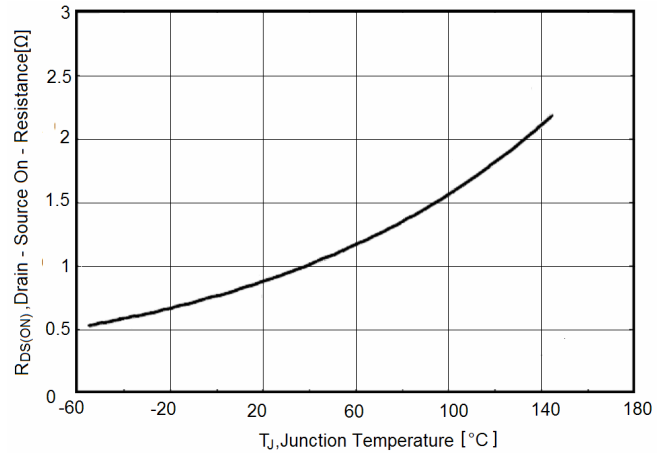
**Figure4. Transfer characteristics**



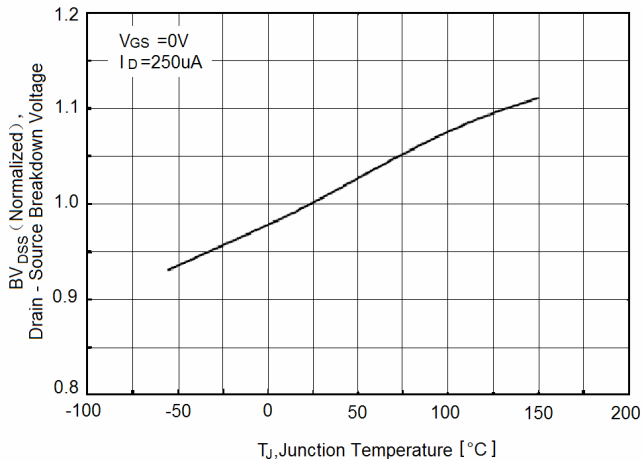
**Figure5. Static drain-source on resistance**



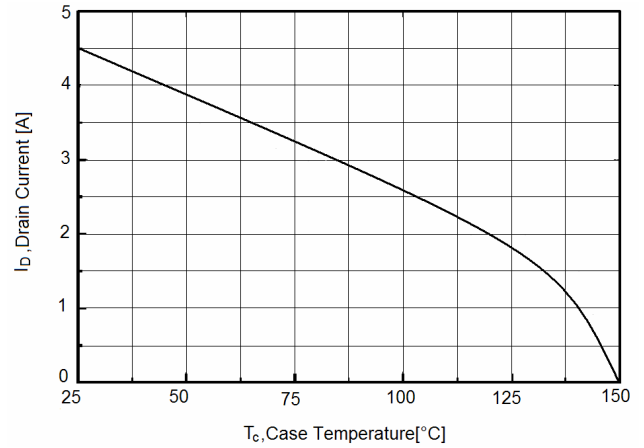
**Figure6.  $R_{DS(ON)}$  vs Junction Temperature**



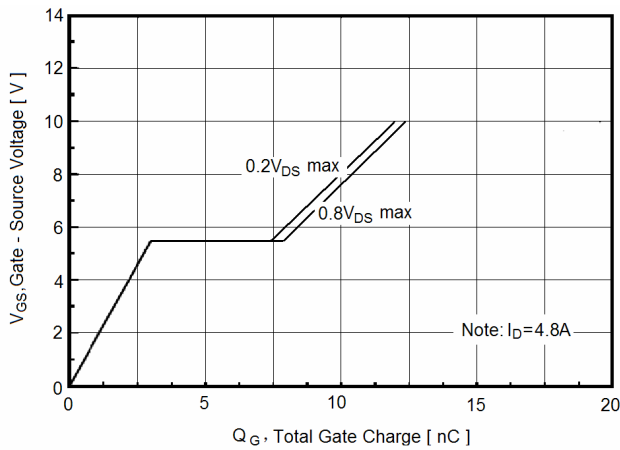
**Figure7.  $BV_{DSS}$  vs Junction Temperature**



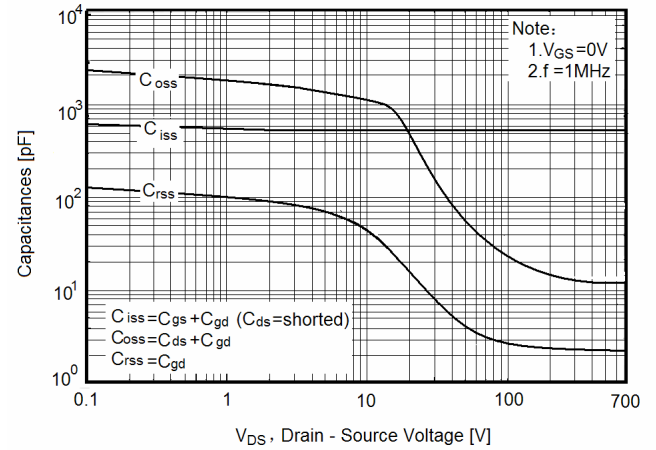
**Figure8. Maximum  $I_D$  vs Junction Temperature**



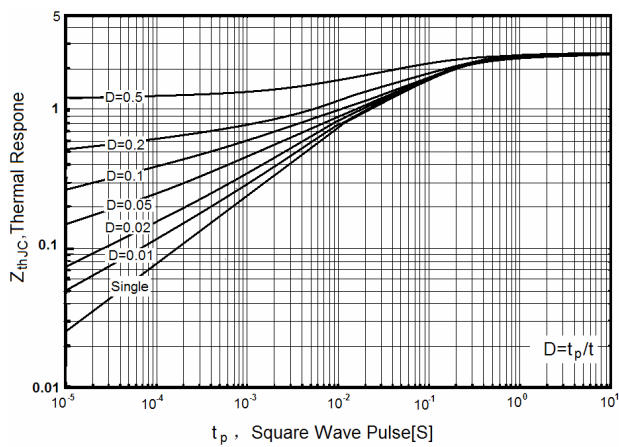
**Figure9. Gate charge waveforms**



**Figure10. Capacitance**

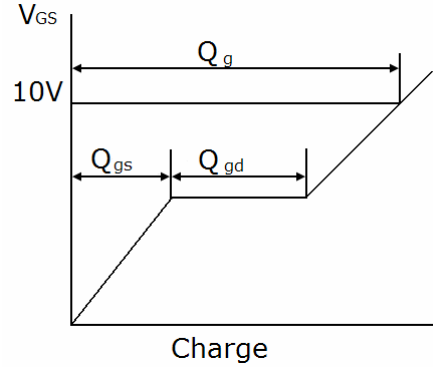
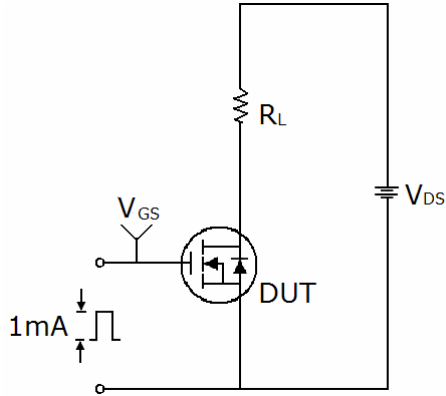


**Figure11. Transient Thermal Impedance**

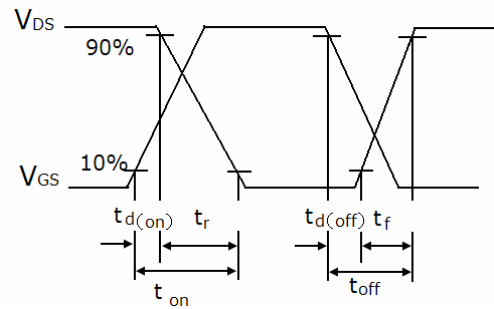
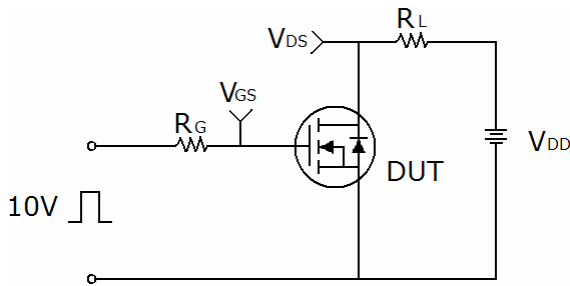


## Test circuit

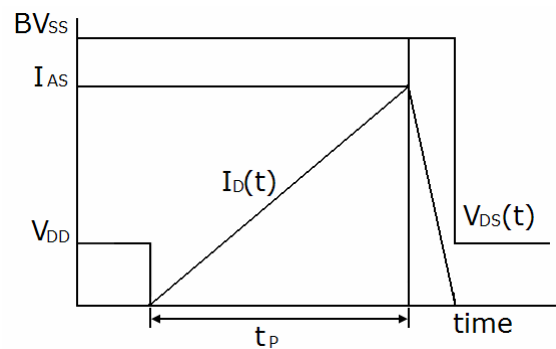
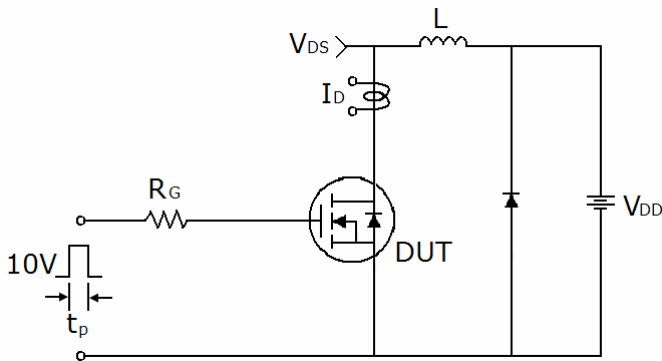
### 1) Gate charge test circuit & Waveform



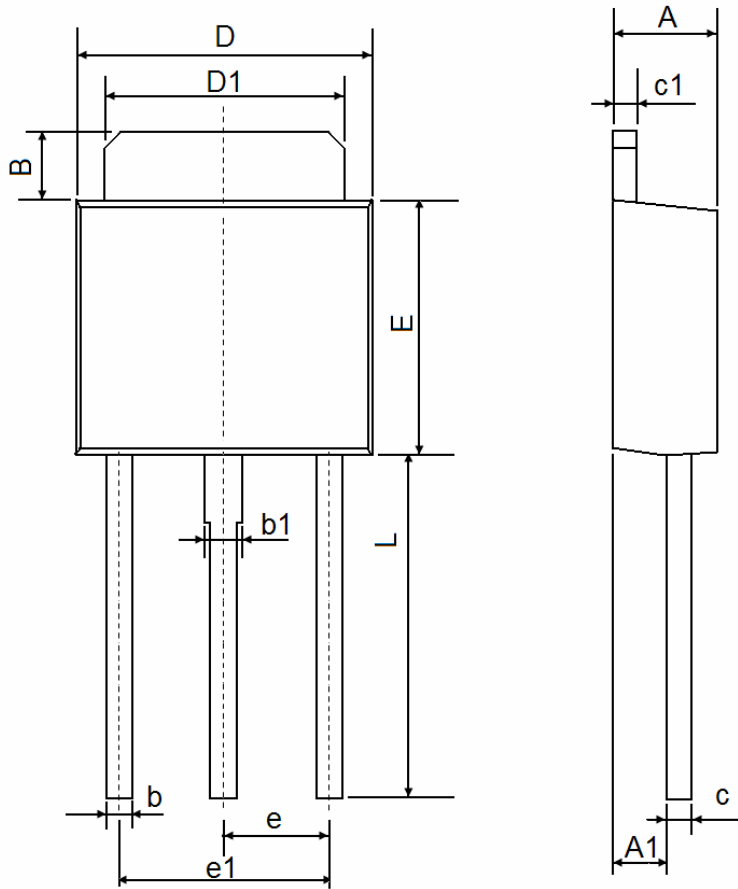
### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms

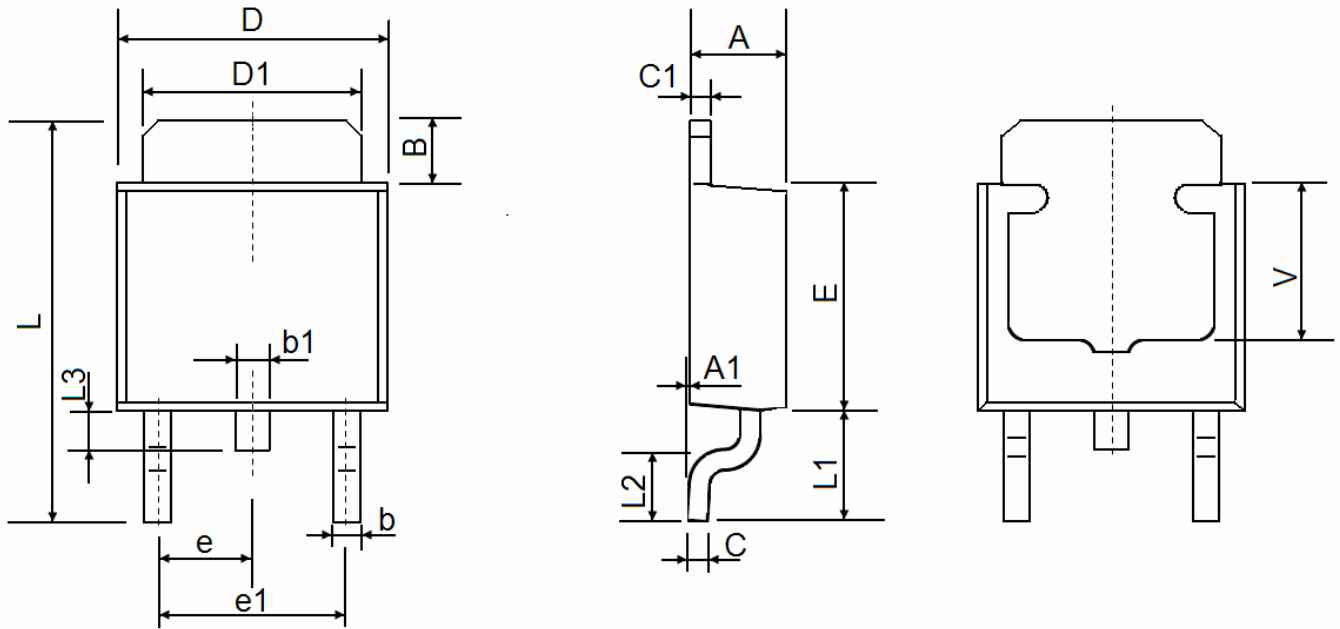


## TO-251 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	1.050	1.350	0.042	0.054
B	1.350	1.650	0.053	0.065
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
e	2.300 TYP		0.091 TYP	
e1	4.500	4.700	0.177	0.185
L	7.500	7.900	0.295	0.311

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A1	0.000	0.127	0.000	0.005
B	1.350	1.650	0.053	0.065
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
C	0.430	0.580	0.017	0.023
C1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
e	2.300 TYP		0.091 TYP	
e1	4.500	4.700	0.177	0.185
L	9.500	9.900	0.374	0.390
L1	2.550	2.900	0.100	0.114
L2	1.400	1.780	0.055	0.070
L3	0.600	0.900	0.024	0.035
V	3.800 REF		0.150 REF	

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