

## NCE P-Channel Enhancement Mode Power MOSFET

### Description

The NCE60P82A uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This device is well suited for high current load applications.

### General Features

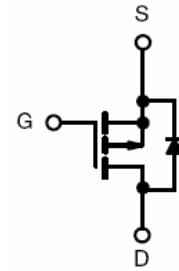
- $V_{DS} = -60V, I_D = -82A$   
 $R_{DS(ON)} < 13m\Omega @ V_{GS} = -10V$   
 $R_{DS(ON)} < 16m\Omega @ V_{GS} = -4.5V$
- High density cell design for ultra low  $R_{DS(ON)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation

### Application

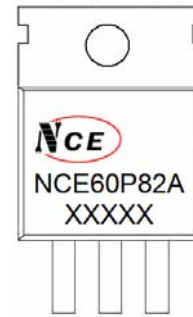
- Load switch

**100% UIS TESTED!**

**100%  $\Delta V_{DS}$  TESTED!**



Schematic diagram



Marking and pin assignment



TO-220-3L top view

### Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| NCE60P82A      | NCE60P82A | TO-220-3L      | -         | -          | -        |

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

| Parameter  | Symbol              | Limit      | Unit          |
|--|---------------------|------------|---------------|
| Drain-Source Voltage                             | $V_{DS}$            | -60        | V             |
| Gate-Source Voltage                              | $V_{GS}$            | $\pm 20$   | V             |
| Drain Current-Continuous                         | $I_D$               | -82        | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )  | $I_D (100^\circ C)$ | -58        | A             |
| Pulsed Drain Current                             | $I_{DM}$            | -328       | A             |
| Maximum Power Dissipation                        | $P_D$               | 150        | W             |
| Derating factor                                  |                     | 1.0        | W/ $^\circ C$ |
| Single pulse avalanche energy (Note 5)           | $E_{AS}$            | 722        | 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> | $R_{\theta JC}$ | 1.0 | $^{\circ}\text{C/W}$ |
|--|-----------------|-----|----------------------|

## Electrical Characteristics ( $T_C=25^{\circ}\text{C}$ unless otherwise noted)

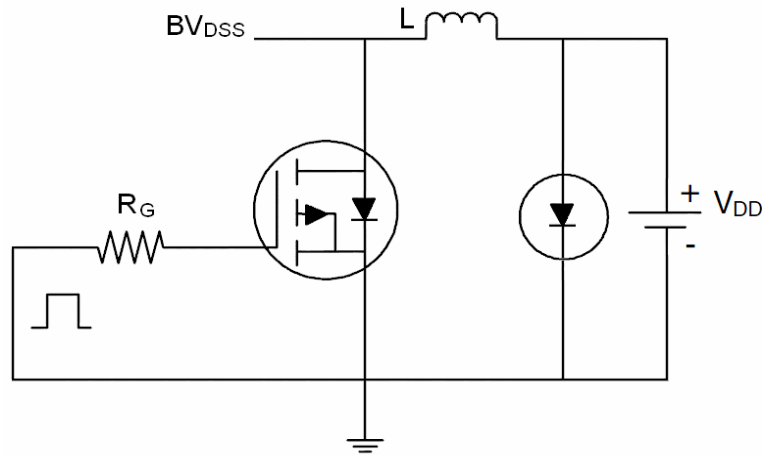
| Parameter                                     | Symbol              | Condition   | Min  | Typ  | Max  | Unit |
|---|---------------------|---|------|------|------|------|
| Off Characteristics                           |                     |   |      |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =-250μA  | -60  | -    | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =-60V, 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                                 | -1.2 | -1.8 | -2.4 | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-20A   | -    | 11   | 13   | mΩ   |
|   |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-20A  | -    | 13   | 16   | mΩ   |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =-5V, I <sub>D</sub> =-20A  | -    | 25   | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |   |      |      |      |      |
| Input Capacitance                             | C <sub>iss</sub>    | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -    | 5604 | -    | PF   |
| Output Capacitance                            | C <sub>oss</sub>    |   | -    | 356  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |   | -    | 265  | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |   |      |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =-30V, R <sub>L</sub> =1.5Ω,<br>V <sub>GS</sub> =-10V, R <sub>G</sub> =3Ω | -    | 18   | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |   | -    | 20   | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |   | -    | 55   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |   | -    | 35   | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =-30, I <sub>D</sub> =-20A,<br>V <sub>GS</sub> =-10V                      | -    | 62.1 |      | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |   | -    | 9.3  |      | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |   | -    | 16.8 |      | 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> =-20A   | -    |      | -1.2 | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |   | -    | -    | -82  | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> =-20A<br>di/dt = -100A/μs <sup>(Note3)</sup>        | -    | 49   |      | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     |   | -    | 71   |      | nC   |
| Forward Turn-On Time                          | t <sub>on</sub>     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)                      |      |      |      |      |

## Notes:

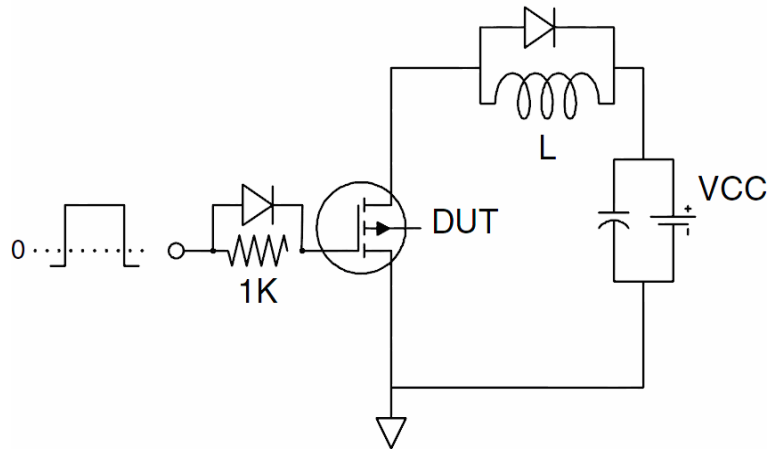
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5.  $E_{AS}$  condition:  $T_J=25^{\circ}\text{C}, V_{DD}=-30V, V_G=-10V, L=0.5\text{mH}, R_G=25\Omega$

## Test Circuit

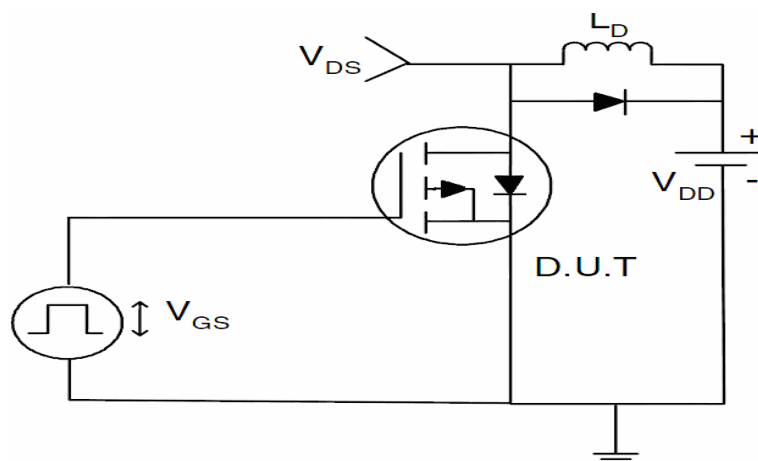
### 1) $E_{AS}$ Test Circuit



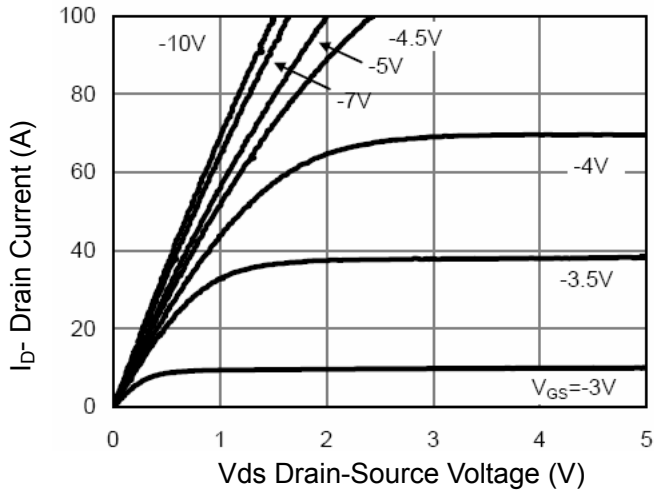
### 2) Gate Charge Test Circuit



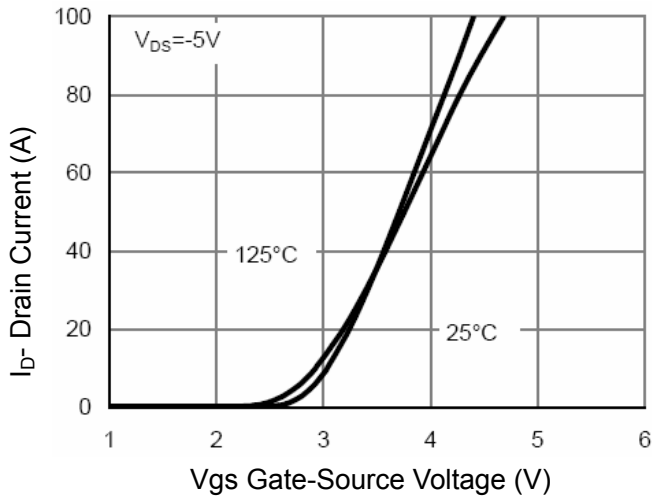
### 3) Switch Time Test Circuit



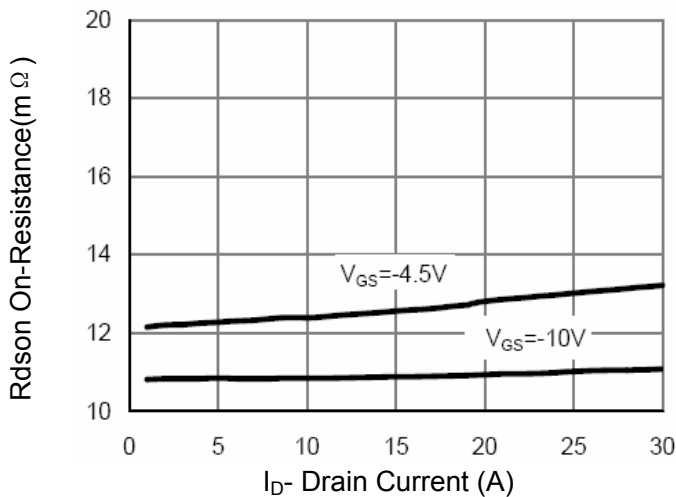
## Typical Electrical and Thermal Characteristics (Curves)



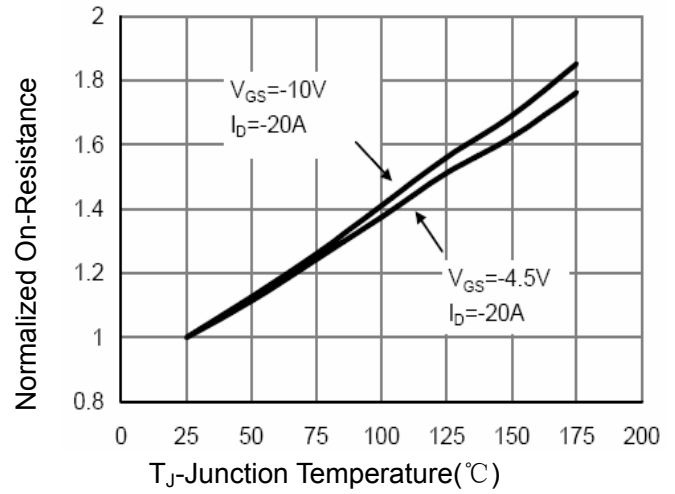
**Figure 1 Output Characteristics**



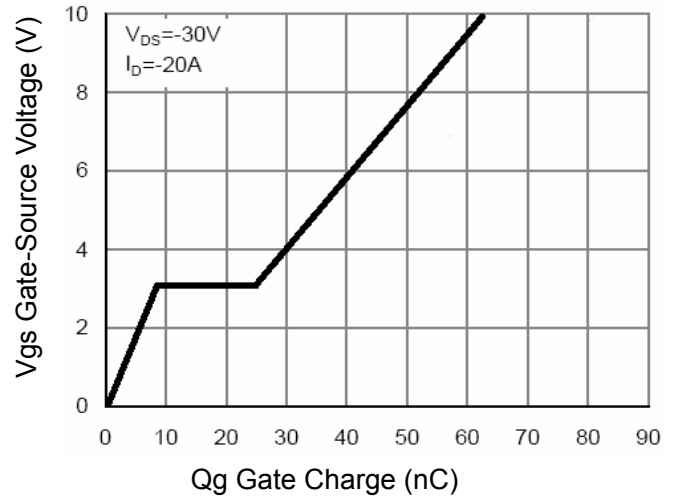
**Figure 2 Transfer Characteristics**



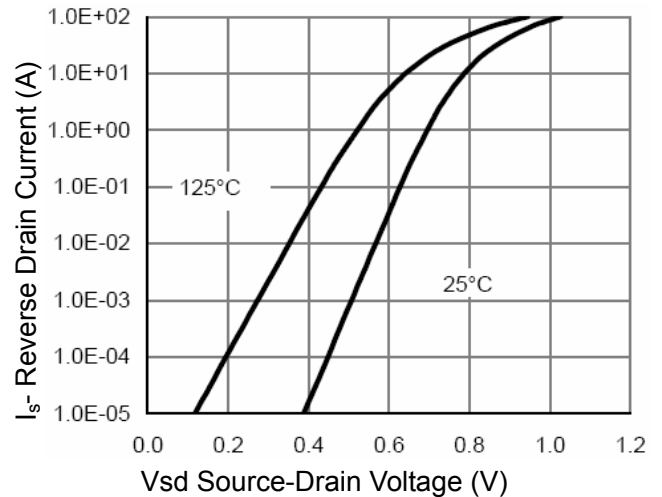
**Figure 3 Rdson- Drain Current**



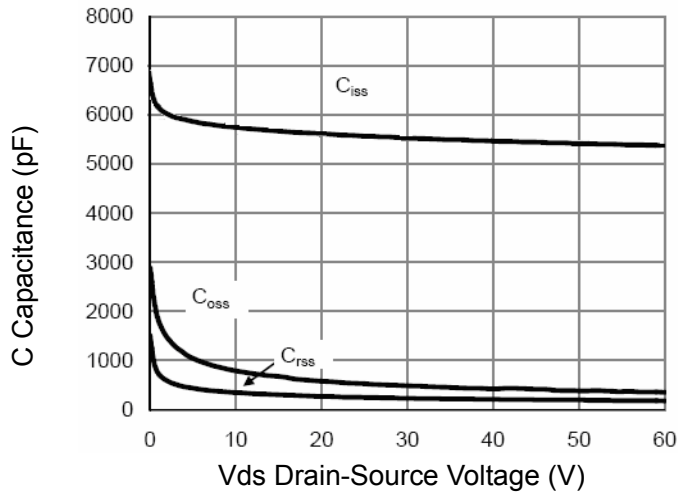
**Figure 4 Rdson-Junction Temperature**



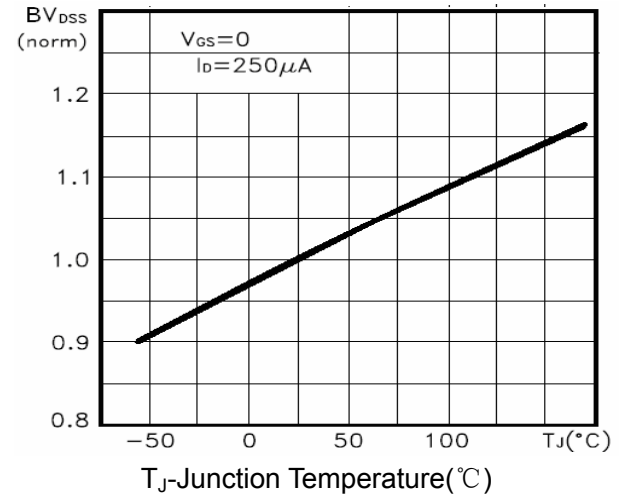
**Figure 5 Gate Charge**



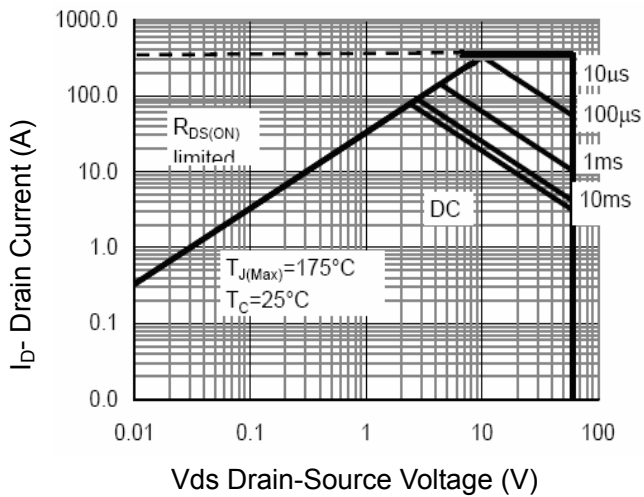
**Figure 6 Source- Drain Diode Forward**



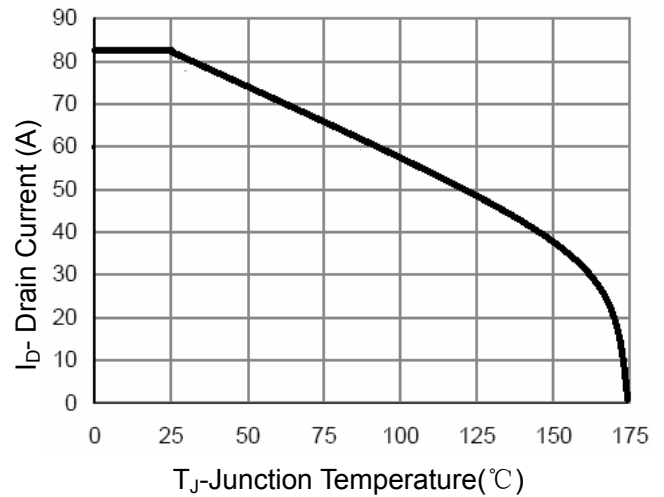
**Figure 7 Capacitance vs Vds**



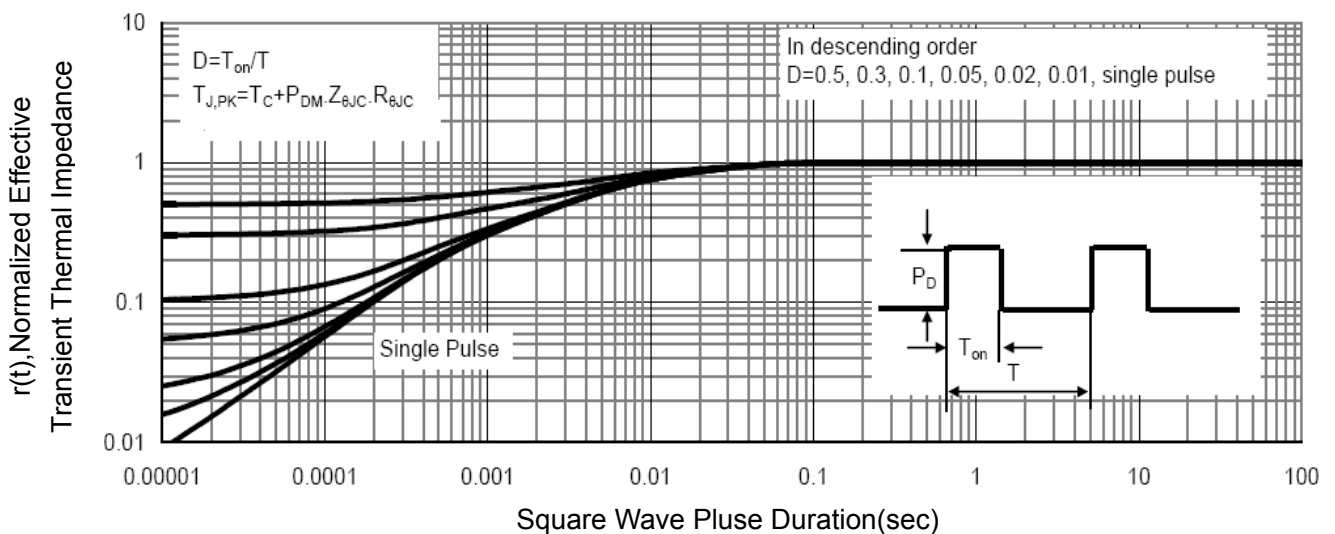
**Figure 9  $BV_{DSS}$  vs Junction Temperature**



**Figure 8 Safe Operation Area**

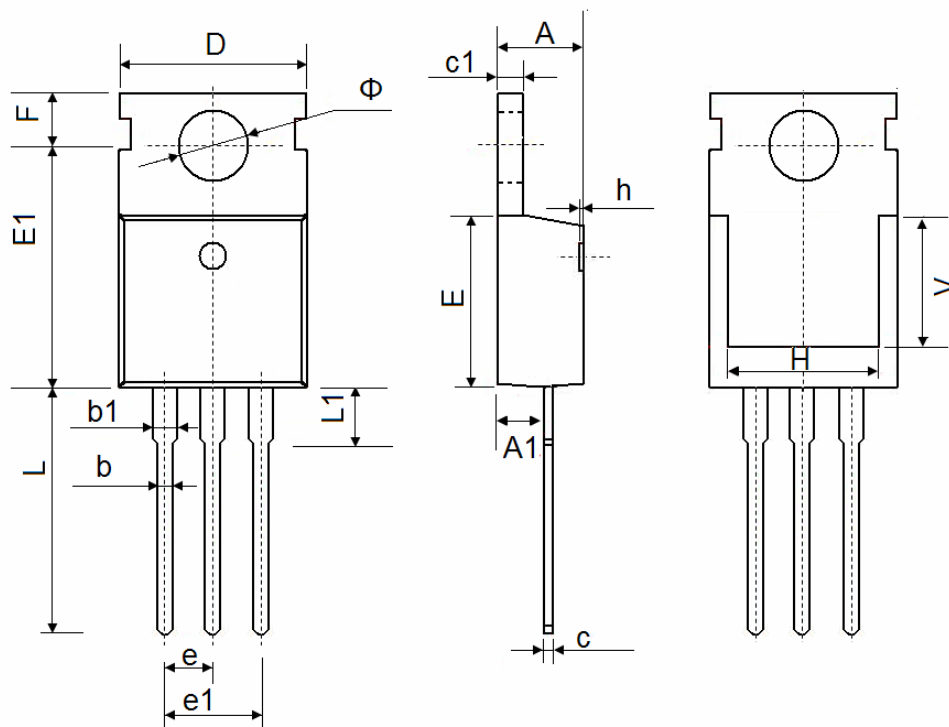


**Figure 10  $I_D$  Current Derating vs Junction Temperature**



**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      | 7.500 REF.                |        | 0.295 REF.           |       |
| Φ      | 3.400                     | 3.800  | 0.134                | 0.150 |

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