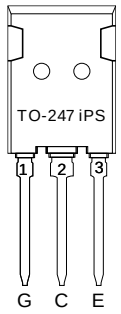
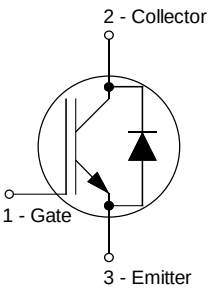
# KJG40N120PS

## 1200V 40A Trench and Field Stop IGBT

### Product Information

| Features | Package Marking and Ordering Information | |
|---|---|---|
| ◆ Advanced Field Stop technology | ◆ Product Name: | KJG40N120PS |
| ◆ Low switching power loss | ◆ Marking: | KJG40N120PS |
| ◆ Low switching surge and noise | ◆ Package: | TO-247 iPS-3L |
| ◆ Low EMI | ◆ Quantity: | 300 pcs |
| ◆ $T_{VJ}$ 175℃ |   |   |
| **Applications** | | |
| ◆ Industrial UPS | | |
| ◆ Welding machine | | |
| ◆ Solar converters | | |
| ◆ Energy storage | | |
| ◆ EV Charger | | |

### Maximum Rated Values ($T_{vj}$=25℃, unless otherwise specified)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CES}$ | 1200 | V |
| Gate-Emitter Voltage | $V_{GE}$ | ±20 | V |
| Transient Gate-Emitter Voltage ($t_p$≤10 μs, D<0.010) | | ±30 | |
| DC Collector Current, $T_C$=25℃ (Limited by $T_{VJ}$ max) | $I_C$ | 65 | A |
| DC Collector Current, $T_C$=100℃ (Limited by $T_{VJ}$ max) | | 40 | |
| Pulsed collector current ($T_p$ limited by $T_{VJ}$ max) [1] | $I_{Cpuls}$ | 160 | |
| Diode Forward Current, $T_C$=25℃ ($T_p$ limited by $T_{VJ}$ max) | $I_F$ | 65 | |
| Diode Forward Current, $T_C$=100℃ ($T_p$ limited by $T_{VJ}$ max) | | 40 | |
| Turn-Off Safe Operating Area<br>$V_{CE}$≤1200 V, $T_{vj}$≤175℃, $t_p$=1 μs | - | 160 | |
| IGBT Max. Power Dissipation | $P_{D\_IGBT}$ | 420 | W |
| FWD Max. Power Dissipation | $P_{D\_FRD}$ | 300 | |
| Operating Junction Temperature | $T_{VJ}$ | -40 to 175 | ℃ |
| Storage Temperature | $T_{stg}$ | -55 to 150 | |

### Thermal Characteristics

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Thermal Resistance, Junction-Ambient | $R_{\theta JA}$ | - | 50 | - | ℃/W |
| IGBT Thermal Resistance, Junction-Case | $R_{\theta JC}$ | - | 0.35 | - | |
| Diode Thermal Resistance, Junction-Case | $R_{\theta JCD}$ | - | 0.6 | - | |

## Electrical Characteristics ($T_{VJ}$=25℃, unless otherwise specified)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CES}$ | $V_{GE}$=0 V, $I_C$=0.25 mA | 1200 | - | - | V |
| C-E Leakage Current | $I_{CES}$ | $V_{CE}$=1200 V, $V_{GE}$=0 V | - | - | 200 | μA |
| G-E Leakage Current | $I_{GES}$ | $V_{CE}$=0 V, $V_{GE}$=±20 V | - | - | ±200 | nA |
| G-E Threshold Voltage | $V_{GE(th)}$ | $V_{CE}$=$V_{GE}$, $I_C$=250 μA | 5.1 | 5.9 | 6.7 | V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_{GE}$=15V, $I_C$=40 A<br>$T_{VJ}$=25℃<br>$T_{VJ}$=175℃ | <br>-<br>- | <br>1.75<br>2.40 | <br>2.20<br>- | V |
| Diode Forward Voltage | $V_F$ | $V_{GE}$=0 V, $I_F$=40 A<br>$T_{VJ}$=25℃<br>$T_{VJ}$=175℃ | <br>-<br>- | <br>1.7<br>1.5 | <br>3.0<br>- | |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{ies}$ | $V_{CE}$=25 V, $V_{GE}$=0 V, f=1 MHz | - | 9500 | - | pF |
| Output Capacitance | $C_{oes}$ | | - | 150 | - | |
| Reverse Transfer Capacitance | $C_{res}$ | | - | 86 | - | |
| Gate Charge | $Q_G$ | $V_{CC}$=600 V, $I_C$=40 A, $V_{GE}$=15 V | - | 320 | - | nC |
| **IGBT Switching Characteristics** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $T_{VJ}$=25℃, $V_{CC}$=600 V, $I_C$=40 A, $V_{GE}$=15 V, $R_G$=10 Ω, Inductive load | - | 65 | - | ns |
| Rise Time | $t_r$ | | - | 110 | - | |
| Turn-off Delay Time | $t_{d(off)}$ | | - | 250 | - | |
| Fall Time | $t_f$ | | - | 75 | - | |
| Turn-on Energy | $E_{on}$ | | - | 2.1 | - | mJ |
| Turn-off Energy | $E_{off}$ | | - | 1.2 | - | |
| Total Switching Energy | $E_{ts}$ | | - | 3.3 | - | |
| Turn-on Delay Time | $t_{d(on)}$ | $T_{VJ}$=175℃, $V_{CC}$=600 V, $I_C$=40 A, $V_{GE}$=15 V, $R_G$=10 Ω, Inductive load | - | 60 | - | ns |
| Rise Time | $t_r$ | | - | 100 | - | |
| Turn-off Delay Time | $t_{d(off)}$ | | - | 360 | - | |
| Fall Time | $t_f$ | | - | 150 | - | |
| Turn-on Energy | $E_{on}$ | | - | 3.3 | - | mJ |
| Turn-off Energy | $E_{off}$ | | - | 2.3 | - | |
| Total Switching Energy | $E_{ts}$ | | - | 5.6 | - | |
| **Diode Characteristics** | | | | | | |
| Diode Reverse Recovery Time | $t_{rr}$ | $T_j$=25℃, $V_{CC}$=600 V, $I_F$=40 A, $di_F/dt$=300 A/μs | - | 270 | - | ns |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 2.8 | - | μC |
| Diode Peak Reverse Recovery Current | $I_{rrm}$ | | - | 19 | - | A |
| Diode Reverse Recovery Time | $t_{rr}$ | $T_j$=175℃,$V_{CC}$=600 V, $I_F$=40 A, $di_F/dt$=300 A/μs | - | 440 | - | ns |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 8.5 | - | μC |
| Diode Peak Reverse Recovery Current | $I_{rrm}$ | | - | 89 | - | A |

## Typical Electrical and Thermal Characteristics

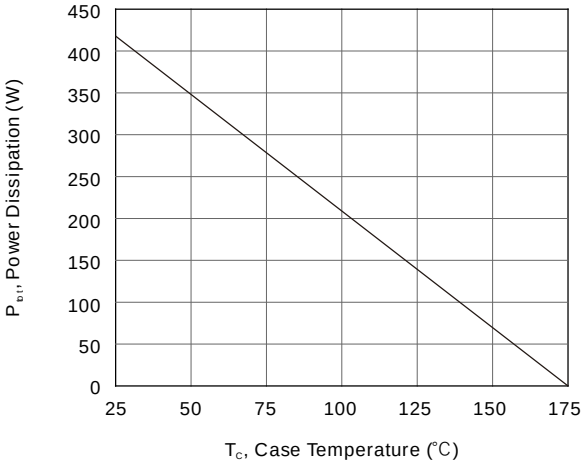



**Figure 1. Power dissipation vs. case temperature**
($T_{VJ}$≤175℃)

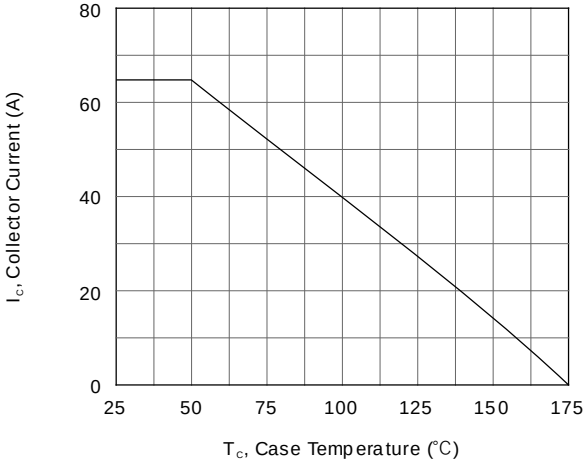



**Figure 2. Collector current vs. case temperature**
($V_{GE}$≤15V, $T_{VJ}$≤175℃)

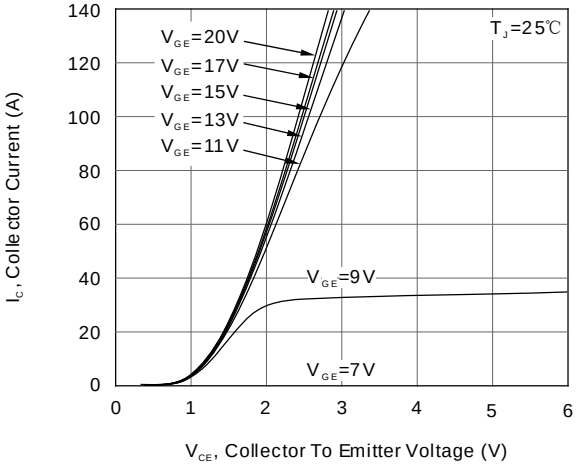



**Figure 3. Typical output characteristic**
($T_{VJ}$=25℃)

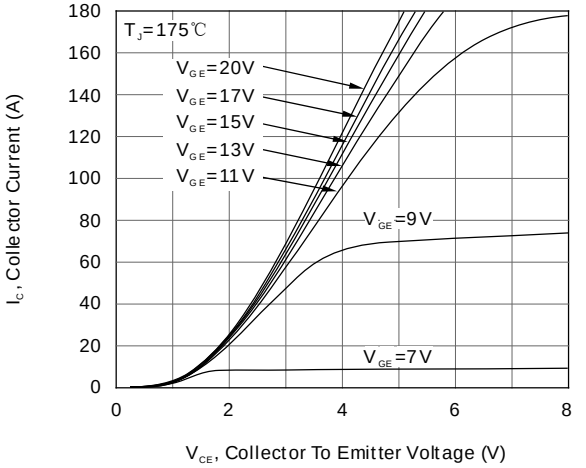



**Figure 4. Typical output characteristic**
($T_{VJ}$=175 )

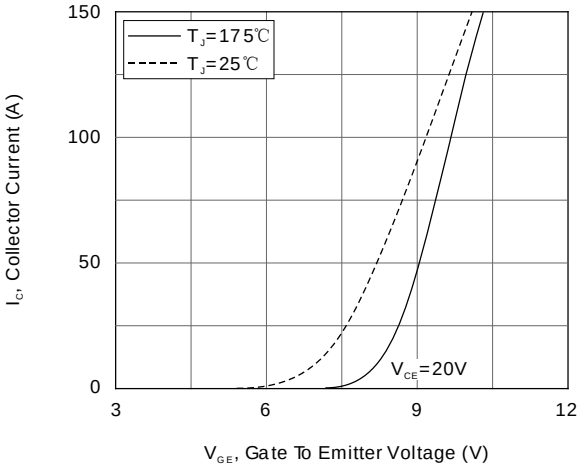



**Figure 5. Typical transfer characteristic**
($V_{CE}$=20V)

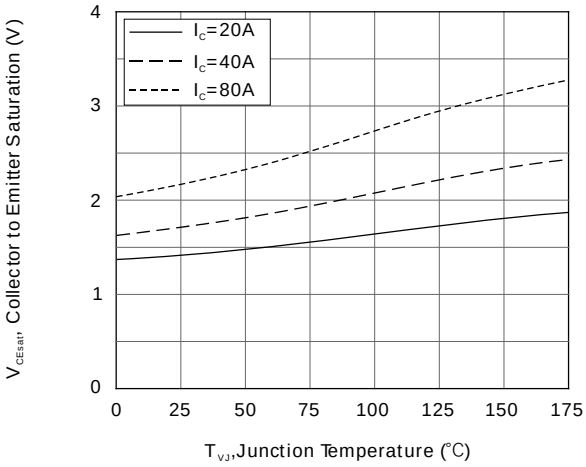



**Figure 6. Typical collector-emitter saturation voltage vs. $T_{VJ}$**
($V_{GE}$=20V)

## Typical Electrical and Thermal Characteristics (cont.)

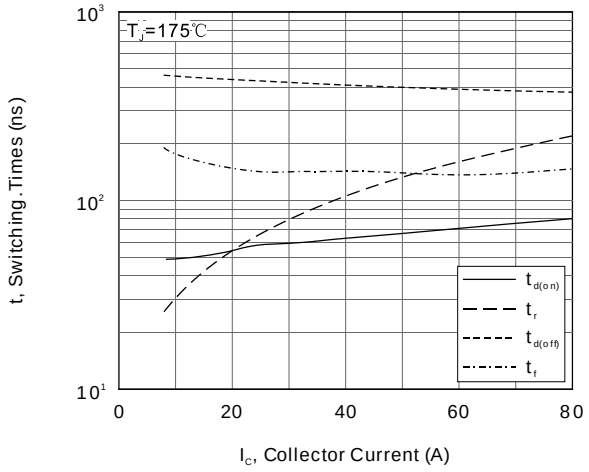



**Figure 7. Typical switching times vs. collector current**
(Ind. load, $T_{VJ}$=175℃, $V_{CE}$=600V, $V_{GE}$=15/0V, $R_g$=12Ω)

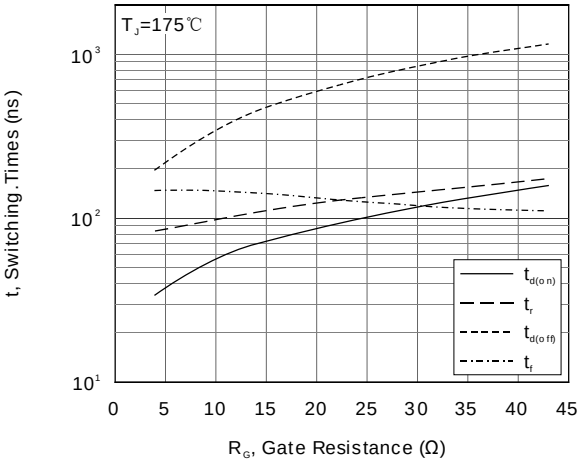



**Figure 8. Typical switching times vs. gate resistor**
(Ind. Load, $T_{VJ}$=175℃, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=40A)

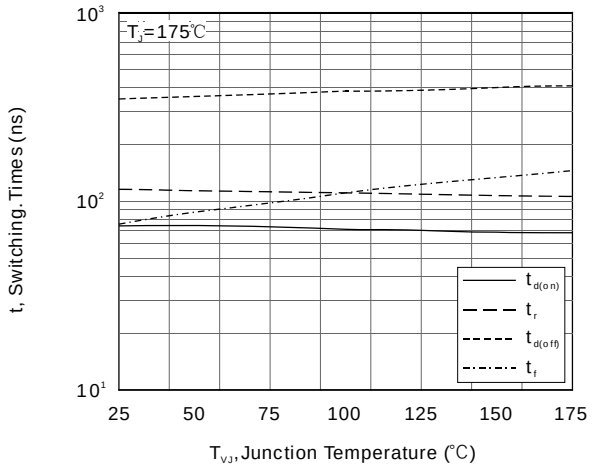



**Figure 9. Typical switching times vs. $T_{VJ}$**
(Ind. Load, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=40A, $R_g$=12Ω)

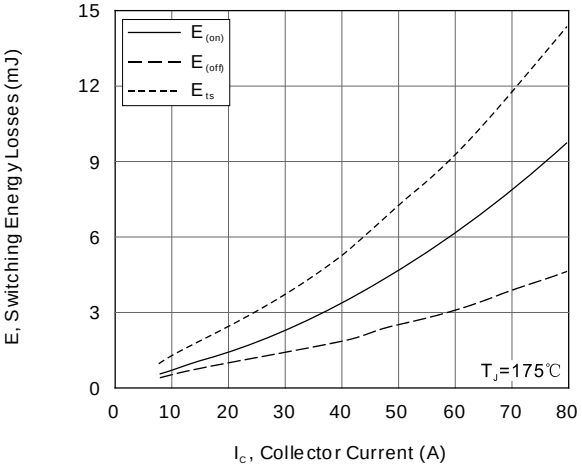



**Figure 10. Typical switching energy losses vs. collector current** (Ind. load, $T_{VJ}$=175℃, $V_{CE}$=600V, $V_{GE}$=15/0V, $R_g$=12Ω)

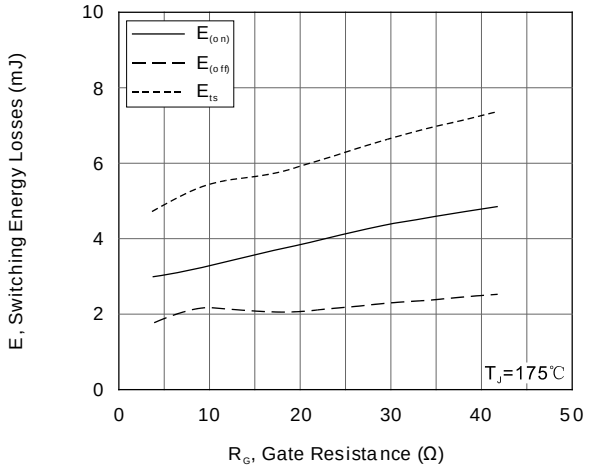



**Figure 11. Typical switching energy losses vs. gate resistor**
(Ind. load, $T_{VJ}$=175℃, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=40A)

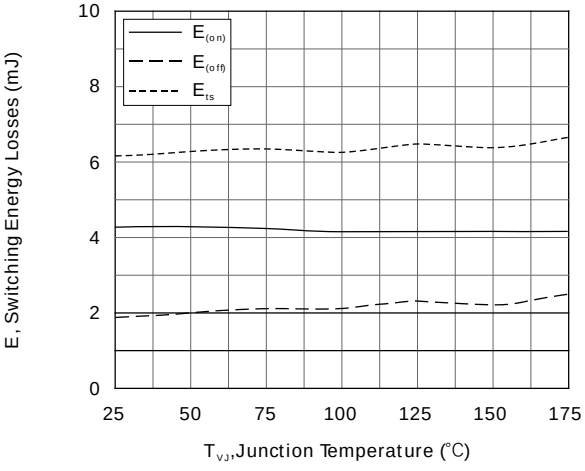



**Figure 12. Typical switching energy losses vs. $T_{VJ}$**
(Ind load, $V_{CE}$=600V, $V_{GE}$=15/0V, $I_C$=40A, $R_g$=12Ω)

## Typical Electrical and Thermal Characteristics (cont.)

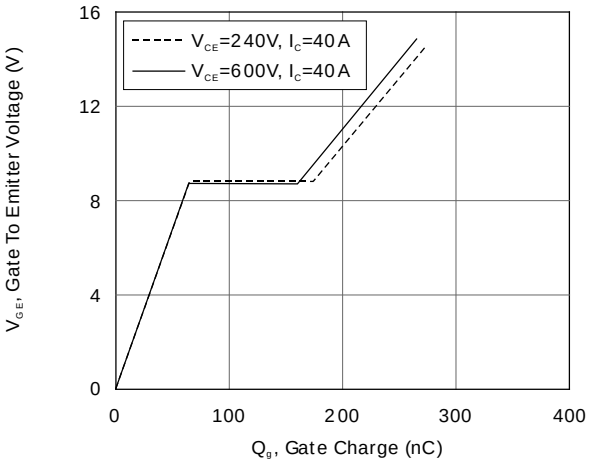



**Figure 13. Typical gate charge**
($I_C$=40A)

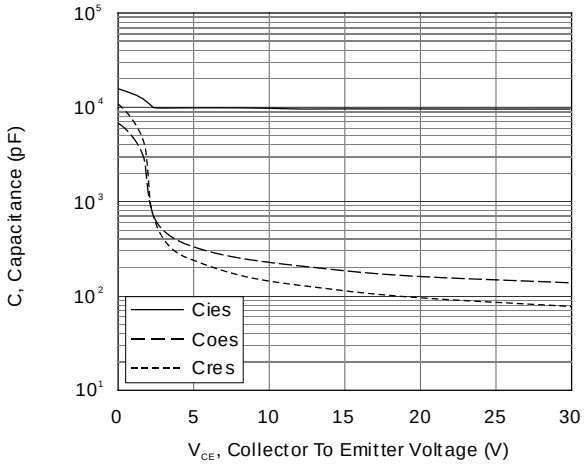



**Figure 14. Typical capacitance vs. collector-emitter voltage**
($V_{GE}$=0V, f=1MHz)

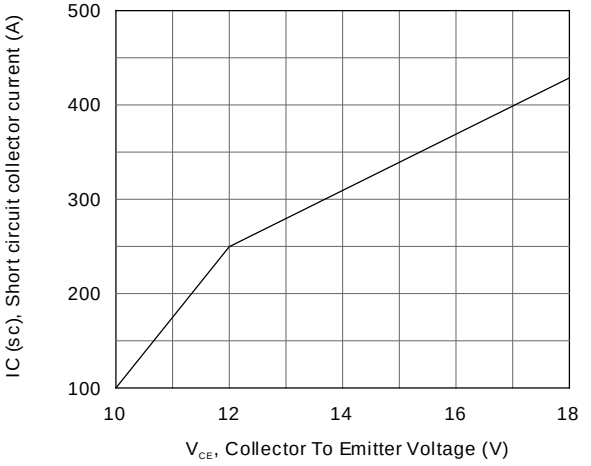



**Figure 15. Typical short circuit collector current vs. gate-emitter voltage** ($V_{CE}$≤600V start at $T_J$=25℃)

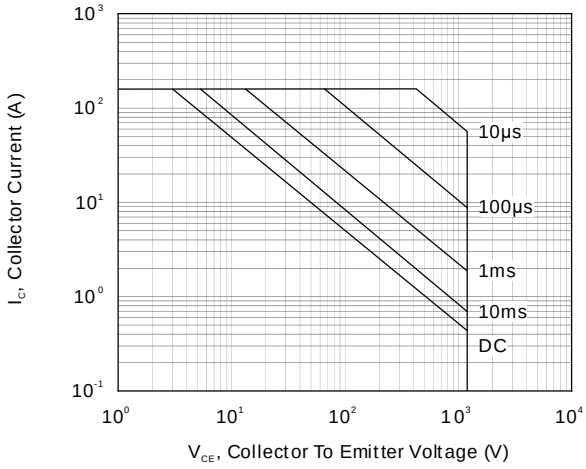



**Figure 16. Forward bias safe operating area**
(D=0, $T_C$=25℃, $T_{VJ}$≤175℃; $V_{GE}$=15V)

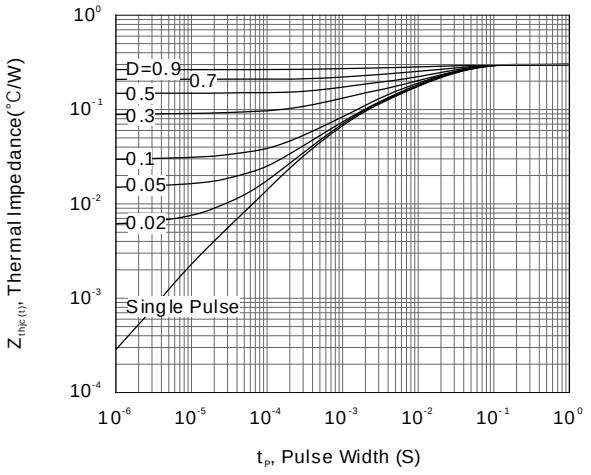



**Figure 17. IGBT transient thermal impedance**
(D=tp/T)

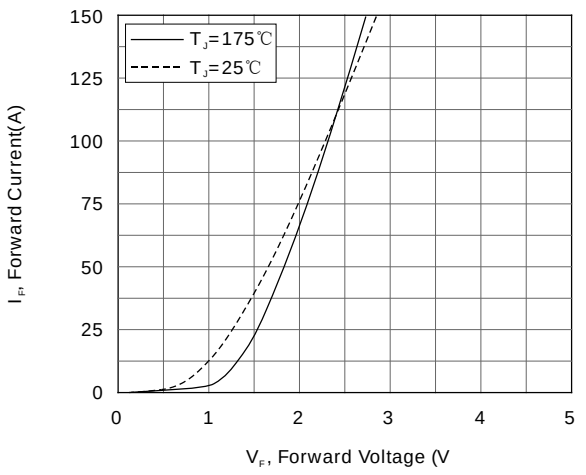



**Figure 18. Typical diode forward current vs. forward voltage**

## Typical Electrical and Thermal Characteristics (cont.)

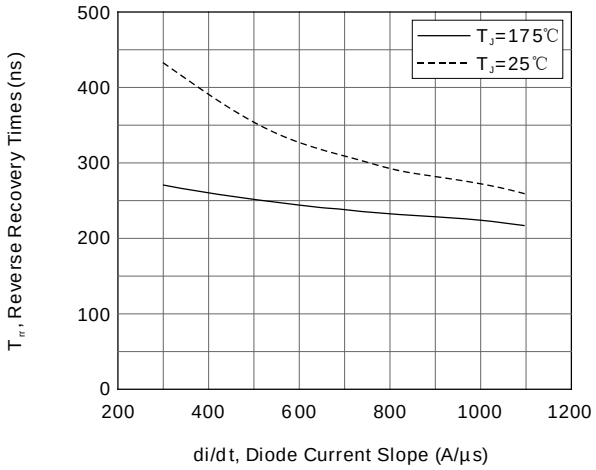



**Figure 19. Typical reverse recovery time vs. diode current slope** ($V_R$=600V)

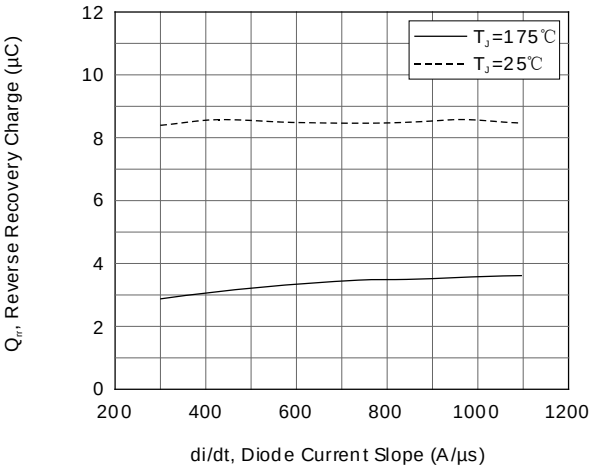



**Figure 20. Typical reverse recovery charge vs. diode current slope** ($V_R$=600V)

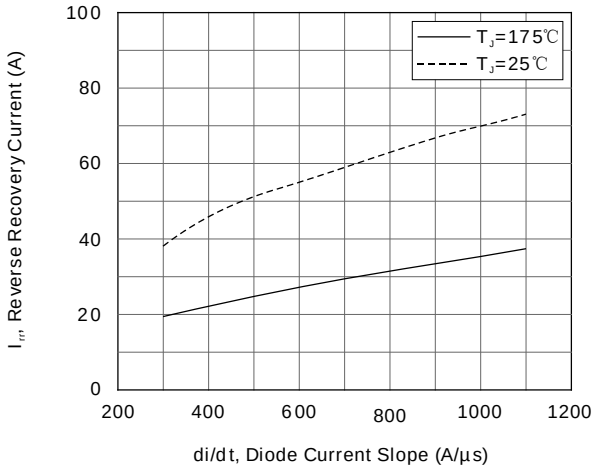
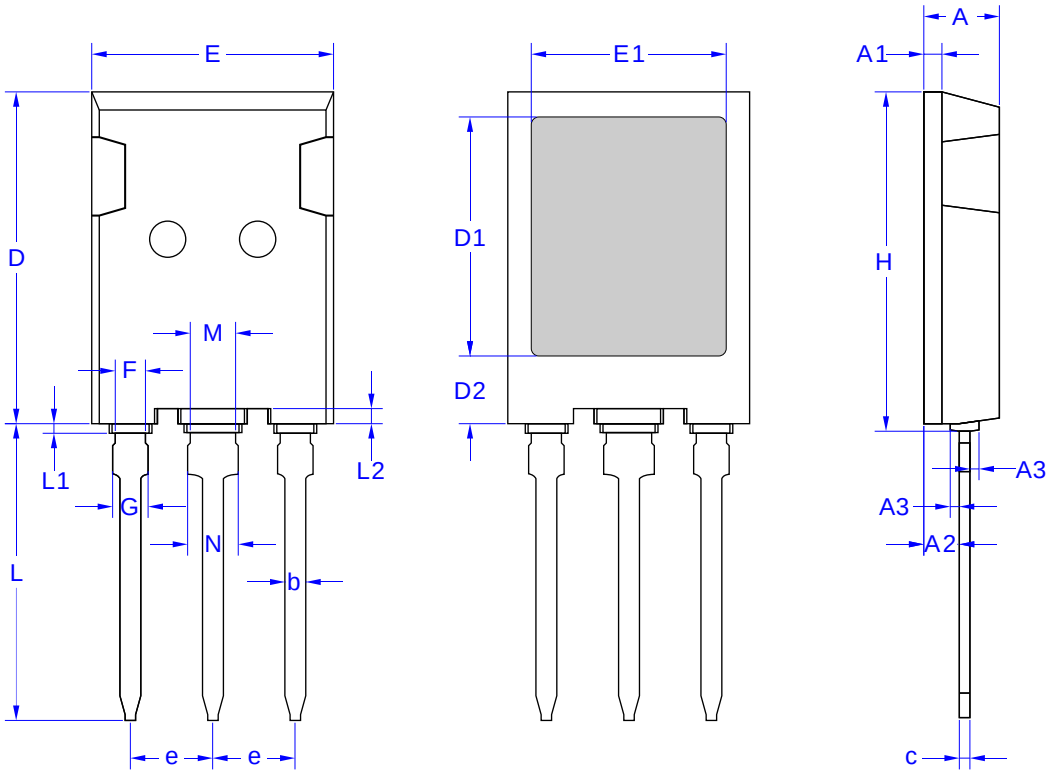



**Figure 21. Typical reverse recovery current vs. diode current slope** ($V_R$=600V)

## Package Mechanical Data

### TO-247 iPS-3L Package




| Symbol | Dimensions in Millimeters | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.80 | 5.00 | 5.20 |
| A1 | 1.10 | 1.20 | 1.30 |
| A2 | 2.20 | 2.35 | 2.50 |
| A3 | 0.45 | 0.60 | 0.75 |
| b | 1.16 | 1.36 | 1.56 |
| c | 0.51 | 0.70 | 0.89 |
| D | 21.80 | 22.00 | 22.20 |
| D1 | 12.60 | 12.90 | 13.20 |
| D2 | 3.55 | 3.75 | 3.95 |
| E | 15.70 | 16.00 | 16.30 |

| Symbol | Dimensions in Millimeters | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| E1 | 15.55 | 15.85 | 16.15 |
| e | 5.25 | 5.45 | 5.65 |
| F | 1.80 | 2.00 | 2.20 |
| G | 2.15 | 2.35 | 2.55 |
| H | 4.80 | 5.00 | 5.20 |
| L | 19.40 | 19.70 | 20.00 |
| L1 | 0.44 | 0.64 | 0.84 |
| L2 | 0.80 | 1.00 | 1.20 |
| M | 2.80 | 3.00 | 3.20 |
| N | 3.15 | 3.35 | 3.55 |