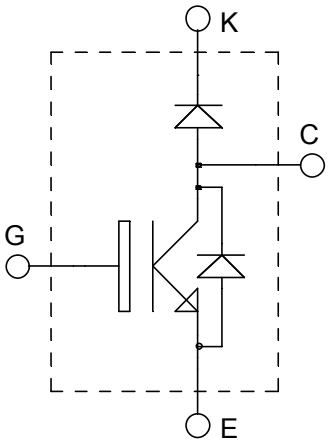
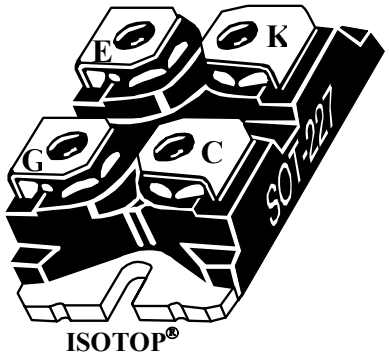
# APT30GU60JU2



## *ISOTOP® Boost chopper PT IGBT*

**$V_{CES}$ = 600V**
**$I_C$ = 30A @ Tc = 110°C**




ISOTOP®

**Application**

- AC and DC motor control
- Switched Mode Power Supplies
- Power Factor Correction
- Brake switch

**Features**

- Power MOS 7® Punch Through (PT) IGBT
  - Low conduction loss
  - Ultra fast tail current shutoff
  - Low gate charge
  - Switching frequency capability in the 200kHz range
  - Soft recovery parallel diodes
  - Low diode VF
- ISOTOP® Package (SOT-227)
- Very low stray inductance
- High level of integration

**Benefits**

- Outstanding performance at high frequency operation
- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance

## Absolute maximum ratings

| *Symbol* | *Parameter* | | | *Max ratings* | *Unit* |
|---|---|---|---|---|---|
| $V_{CES}$ | Collector - Emitter Breakdown Voltage | | | 600 | V |
| $I_{C1}$ | Continuous Collector Current | | $T_C$ = 25°C | 67 | A |
| $I_{C2}$ | | | $T_C$ = 110°C | 30 | |
| $I_{CM}$ | Pulsed Collector Current | | $T_C$ = 25°C | 120 | |
| $V_{GE}$ | Gate – Emitter Voltage | | | ±20 | V |
| $P_D$ | Maximum Power Dissipation | | $T_C$ = 25°C | 245 | W |
| SSOA | Switching Safe Operating Area | | $T_J$=150°C | 120A @ 600V | |
| $IF_{AV}$ | Maximum Average Forward Current | Duty cycle=0.5 | $T_C$ = 80°C | 30 | A |
| $IF_{RMS}$ | RMS Forward Current (Square wave, 50% duty) | | | 39 | |

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handing Procedures Should Be Followed.

**All ratings @ $T_j$ = 25°C unless otherwise specified**

## Electrical Characteristics

| *Symbol* | *Characteristic* | *Test Conditions* | | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|---|
| $BV_{CES}$ | Collector - Emitter Breakdown Voltage | $V_{GE}$ = 0V, $I_C$ = 0.5mA | | 600 | | | V |
| $I_{CES}$ | Zero Gate Voltage Collector Current | $V_{GE}$ = 0V, $V_{CE}$ = 600V | $T_j$ = 25°C | | | 500 | µA |
| | | | $T_j$ = 125°C | | | 3000 | |
| $V_{CE(on)}$ | Collector Emitter on Voltage | $V_{GE}$ =15V, $I_C$ = 30A | $T_j$ = 25°C | | 2.2 | 2.7 | V |
| | | | $T_j$ = 125°C | | 2.1 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 1mA | | 3 | 4.5 | 6 | V |
| $I_{GES}$ | Gate – Emitter Leakage Current | $V_{GE}$ = ±20V, $V_{CE}$ = 0V | | | | ±100 | nA |

## Dynamic Characteristics

| *Symbol* | *Characteristic* | *Test Conditions* | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | $V_{GE}$ = 0V<br>$V_{CE}$ = 25V<br>f = 1MHz | | 3200 | | pF |
| $C_{oes}$ | Output Capacitance | | | 295 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | 20 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 15V<br>$V_{Bus}$ = 300V<br>$I_C$ = 30A | | 90 | | nC |
| $Q_{ge}$ | Gate – Emitter Charge | | | 20 | | |
| $Q_{gc}$ | Gate – Collector Charge | | | 30 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C)<br>$V_{GE}$ = 15V<br>$V_{Bus}$ = 400V<br>$I_C$ = 30A<br>$R_G$ = 5Ω | | 15 | | ns |
| $T_r$ | Rise Time | | | 20 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 55 | | |
| $T_f$ | Fall Time | | | 46 | | |
| $E_{on1}$ | Turn-on Switching Energy | | | 260 | | µJ |
| $E_{on2}$ | Turn-on Switching Energy ❶ | | | 335 | | |
| $E_{off}$ | Turn-off Switching Energy ❷ | | | 250 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (125°C)<br>$V_{GE}$ = 15V<br>$V_{Bus}$ = 400V<br>$I_C$ = 30A<br>$R_G$ = 5Ω | | 15 | | ns |
| $T_r$ | Rise Time | | | 18 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 84 | | |
| $T_f$ | Fall Time | | | 80 | | |
| $E_{on1}$ | Turn-on Switching Energy | | | 260 | | µJ |
| $E_{on2}$ | Turn-on Switching Energy ❶ | | | 508 | | |
| $E_{off}$ | Turn-off Switching Energy ❷ | | | 518 | | |

❶ $E_{on2}$ includes diode reverse recovery
❷ In accordance with JEDEC standard JESD24-1

## Diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_F$ | Diode Forward Voltage | $I_F$ = 30A | | | 1.6 | 1.8 | V |
| | | $I_F$ = 60A | | | 1.9 | | |
| | | $I_F$ = 30A | $T_j$ = 125°C | | 1.4 | | |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$ = 600V | $T_j$ = 25°C | | | 250 | µA |
| | | $V_R$ = 600V | $T_j$ = 125°C | | | 500 | |
| $C_T$ | Junction Capacitance | $V_R$ = 200V | | | 44 | | pF |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=1A,$V_R$=30V di/dt =100A/µs | $T_j$ = 25°C | | 23 | | ns |
| | Reverse Recovery Time | $I_F$ = 30A $V_R$ = 400V di/dt =200A/µs | $T_j$ = 25°C | | 85 | | |
| | | | $T_j$ = 125°C | | 160 | | |
| $I_{RRM}$ | Maximum Reverse Recovery Current | | $T_j$ = 25°C | | 4 | | A |
| | | | $T_j$ = 125°C | | 8 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 130 | | nC |
| | | | $T_j$ = 125°C | | 700 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 30A $V_R$ = 400V di/dt =1000A/µs | $T_j$ = 125°C | | 70 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | | 1300 | | nC |
| $I_{RRM}$ | Maximum Reverse Recovery Current | | | | 30 | | A |

## Thermal and package characteristics

| Symbol | Characteristic | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction to Case | IGBT | | | 0.51 | °C/W |
| | | Diode | | | 1.21 | |
| $R_{thJA}$ | Junction to Ambient (IGBT & Diode) | | | | 20 | |
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz | | 2500 | | | V |
| $T_J$,$T_{STG}$ | Storage Temperature Range | | -55 | | 150 | °C |
| $T_L$ | Max Lead Temp for Soldering:0.063" from case for 10 sec | | | | 300 | |
| Torque | Mounting torque (Mounting = 8-32 or 4mm Machine and terminals = 4mm Machine) | | | | 1.5 | N.m |
| Wt | Package Weight | | | 29.2 | | g |

## Typical IGBT Performance Curve

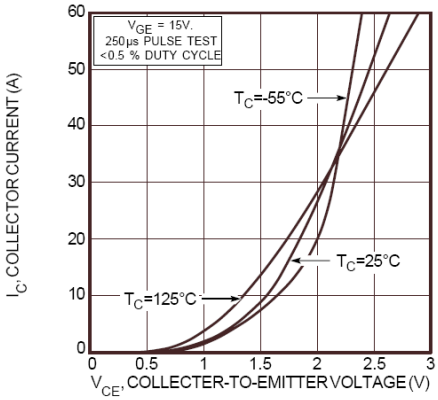



FIGURE 1, Output Characteristics($V_{GE}$ = 15V)

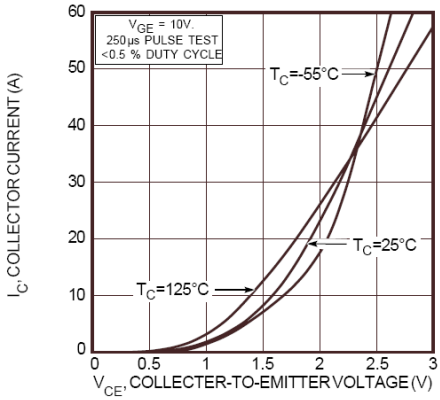



FIGURE 2, Output Characteristics ($V_{GE}$ = 10V)

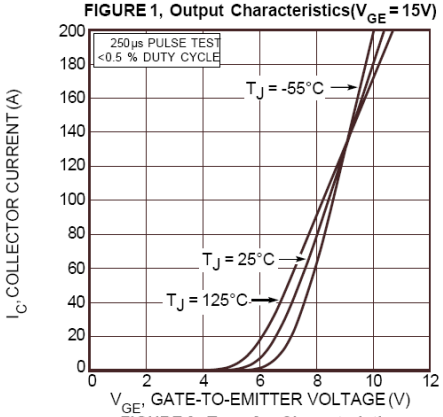



FIGURE 3, Transfer Characteristics

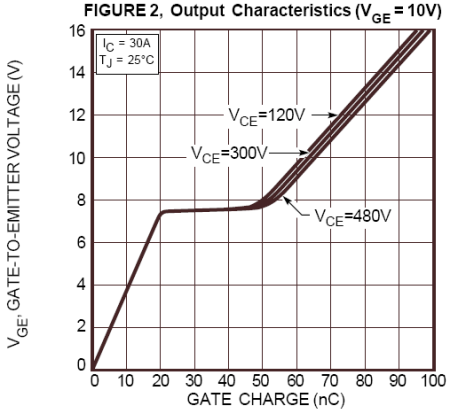



FIGURE 4, Gate Charge

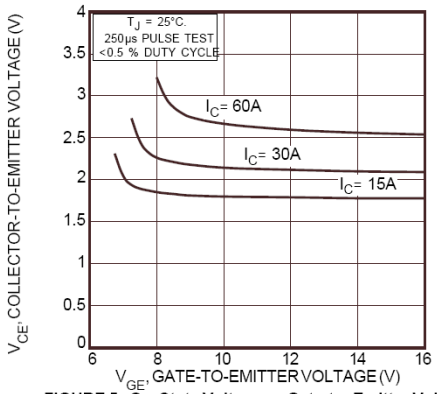



FIGURE 5, On State Voltage vs Gate-to- Emitter Voltage

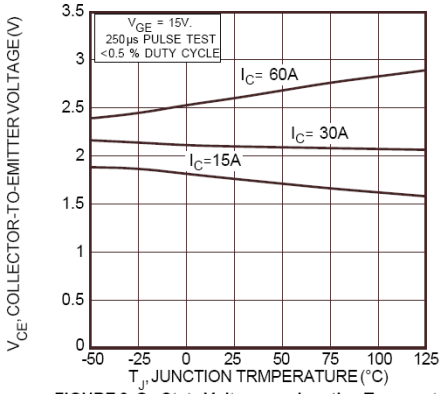



FIGURE 6, On State Voltage vs Junction Temperature

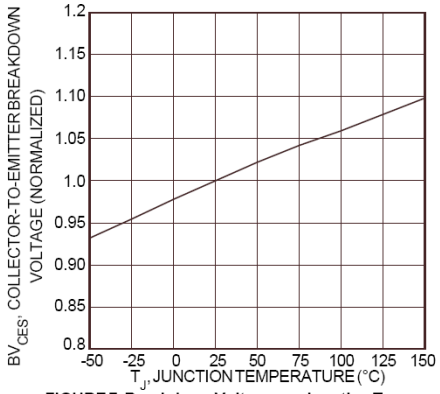



FIGURE 7, Breakdown Voltage vs. Junction Temperature

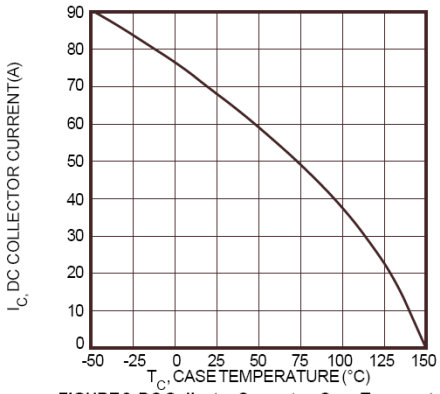



FIGURE 8, DC Collector Current vs Case Temperature

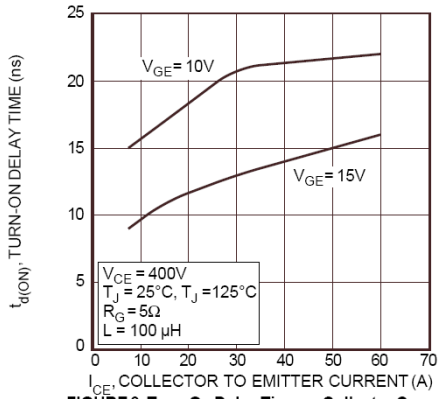



**FIGURE 9, Turn-On Delay Time vs Collector Current**

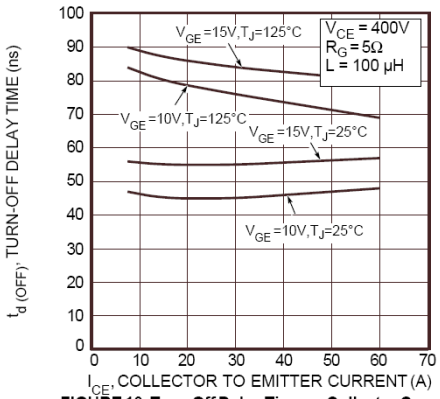



**FIGURE 10, Turn-Off Delay Time vs Collector Current**

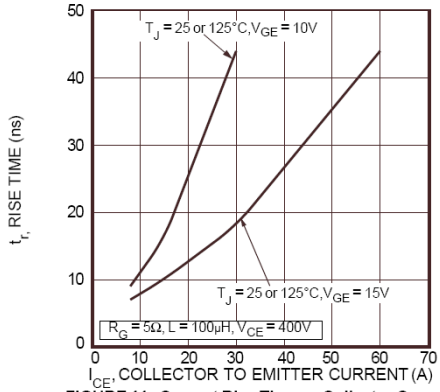



**FIGURE 11, Current Rise Time vs Collector Current**

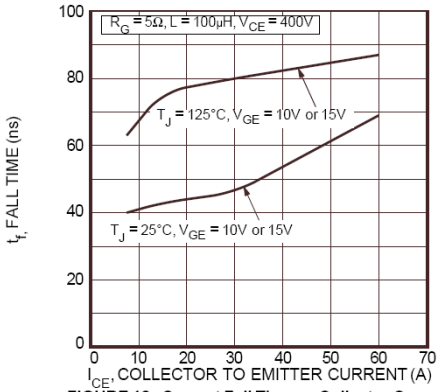



**FIGURE 12, Current Fall Time vs Collector Current**

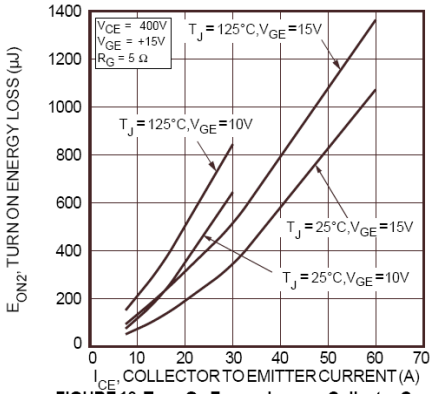



**FIGURE 13, Turn-On Energy Loss vs Collector Current**

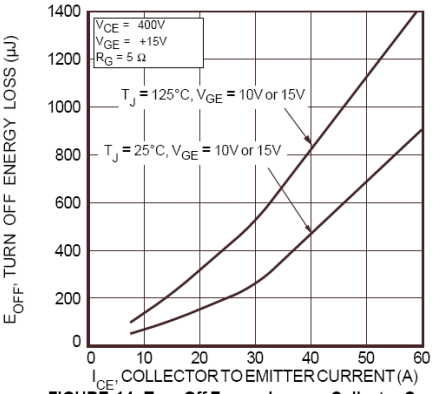



**FIGURE 14, Turn Off Energy Loss vs Collector Current**

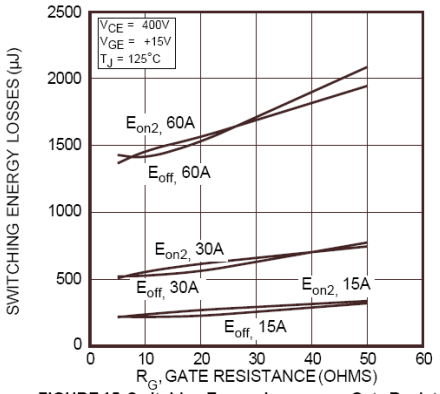



**FIGURE 15, Switching Energy Losses vs. Gate Resistance**

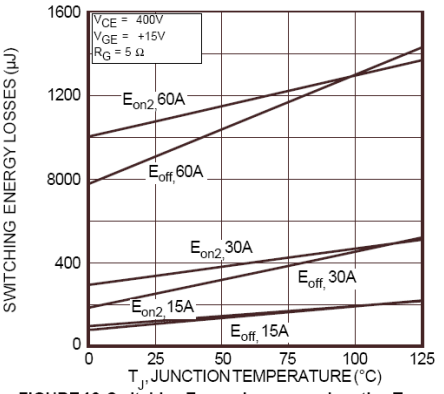



**FIGURE 16, Switching Energy Losses vs Junction Temperature**

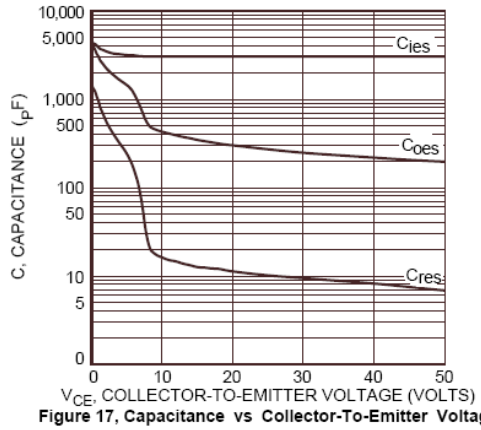



**Figure 17, Capacitance vs Collector-To-Emitter Voltage**

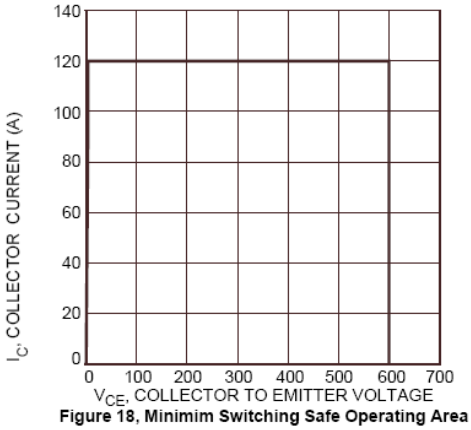



**Figure 18, Minimim Switching Safe Operating Area**

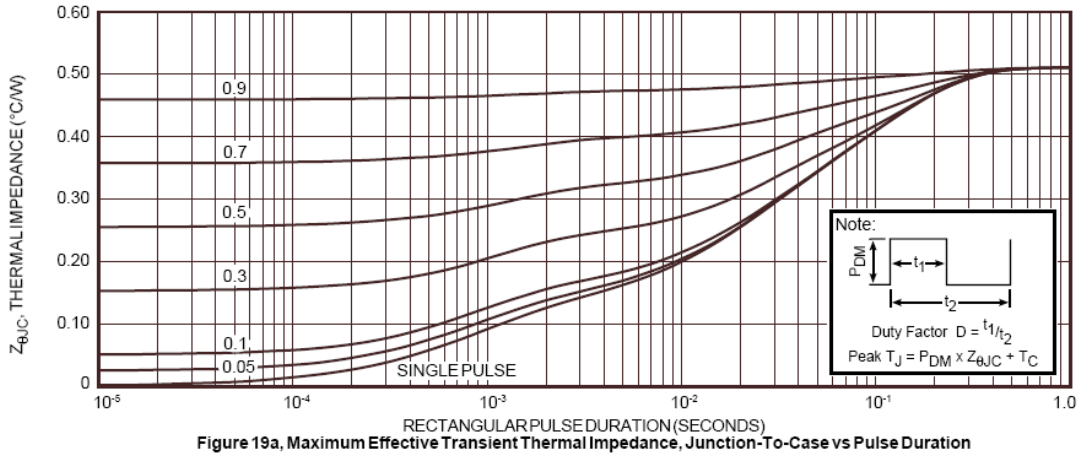



**Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration**

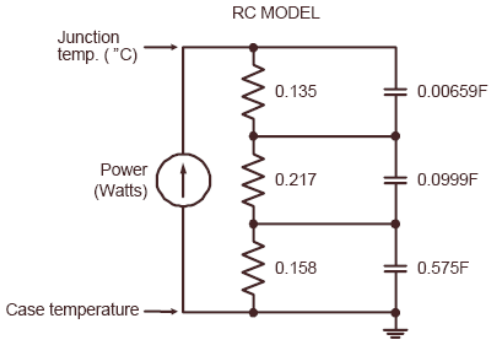



**FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL**

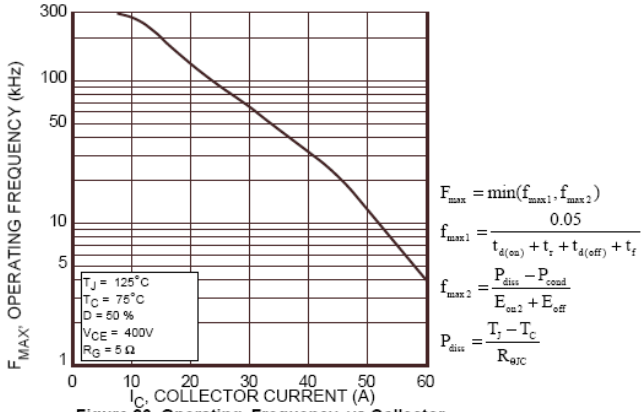



**Figure 20, Operating Frequency vs Collector Current**

## Typical Diode Performance Curve

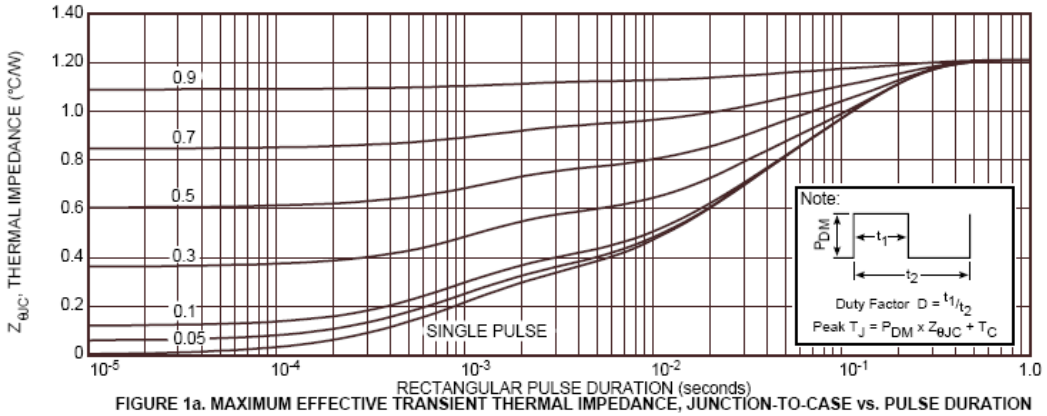



FIGURE 1a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

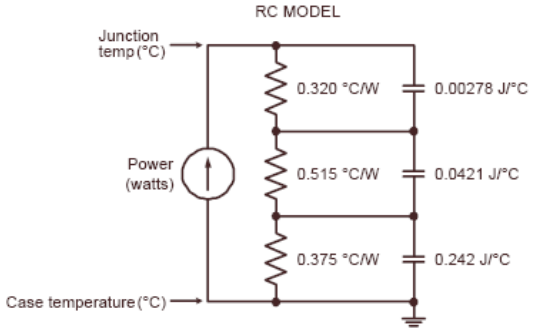



FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

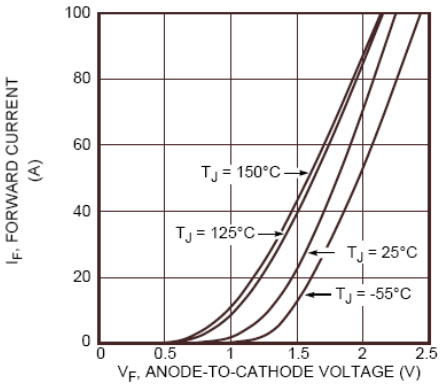



**Figure 2. Forward Current *vs.* Forward Voltage**

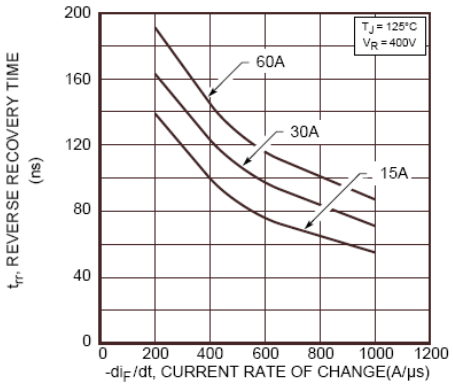



**Figure 3. Reverse Recovery Time *vs.* Current Rate of Change**

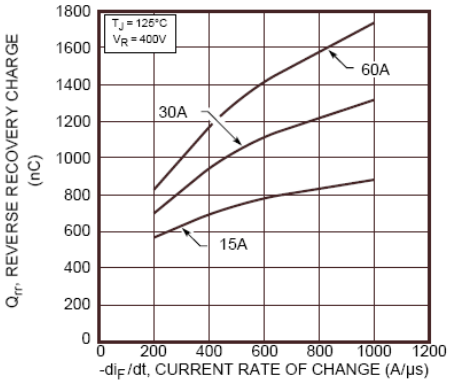



**Figure 4. Reverse Recovery Charge *vs.* Current Rate of Change**

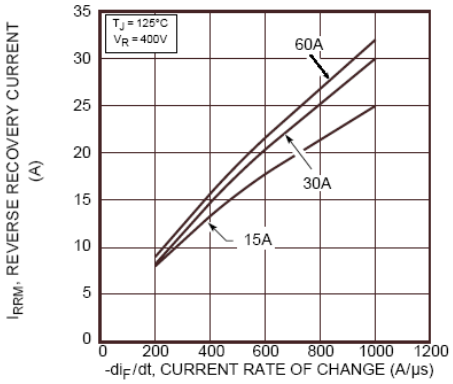



**Figure 5. Reverse Recovery Current *vs.* Current Rate of Change**

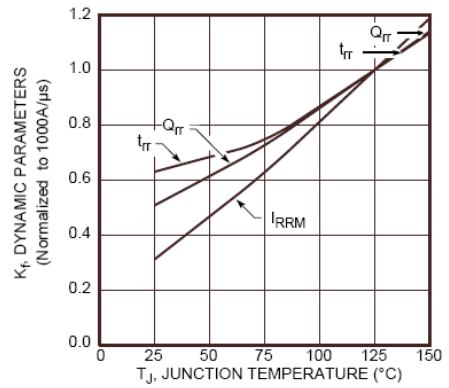



**Figure 6. Dynamic Parameters *vs.* Junction Temperature**

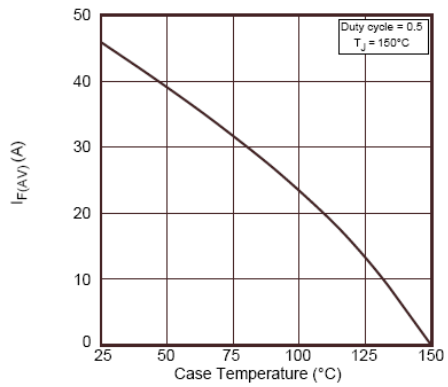



**Figure 7. Maximum Average Forward Current *vs.* CaseTemperature**

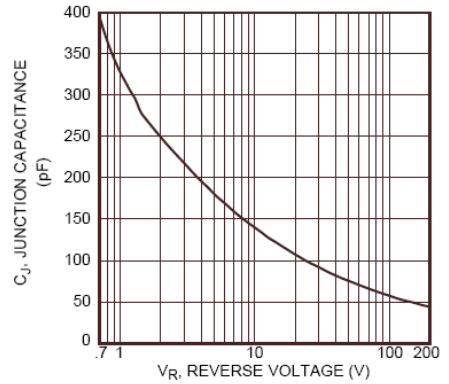



**Figure 8. Junction Capacitance *vs.* Reverse Voltage**

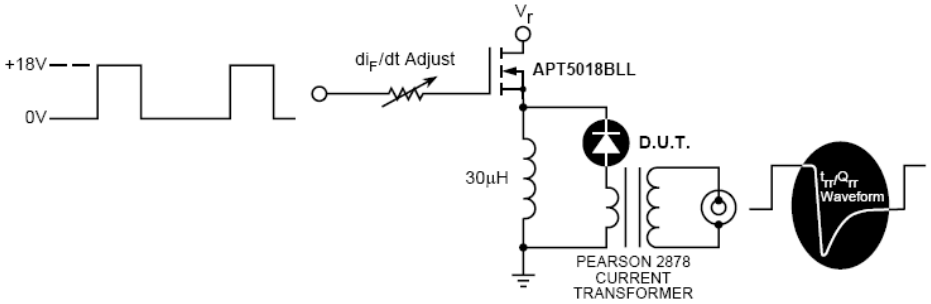
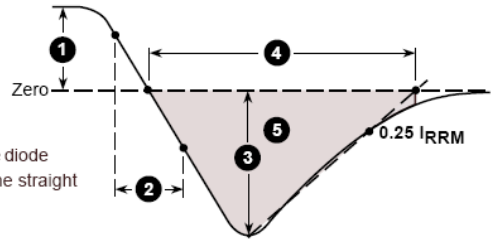


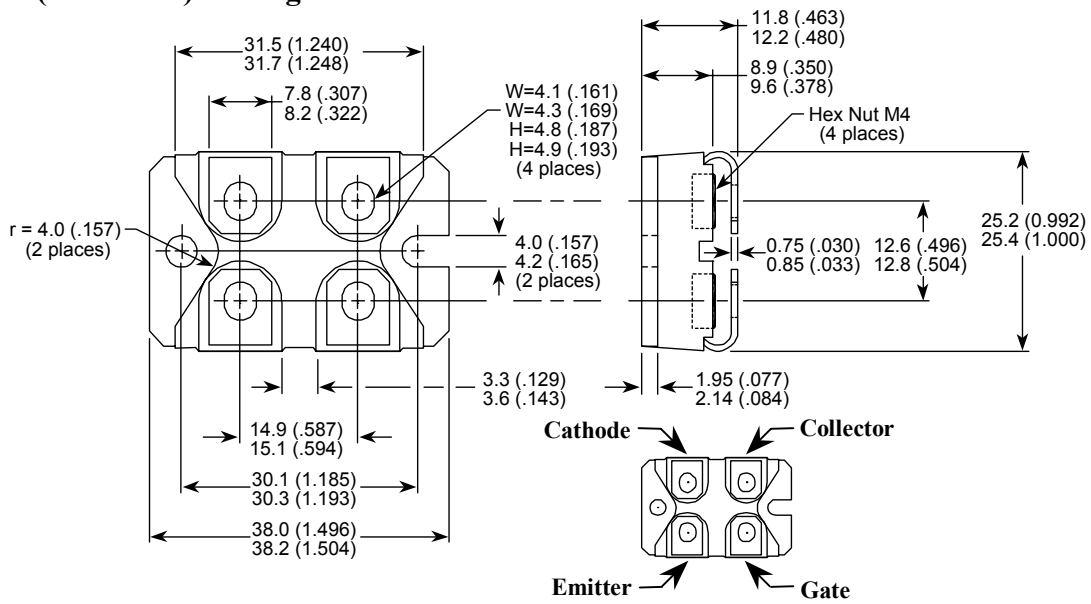

Figure 9. Diode Test Circuit




1. $I_F$ - Forward Conduction Current
2. $di_F/dt$ - Rate of Diode Current Change Through Zero Crossing.
3. $I_{RRM}$ - Maximum Reverse Recovery Current.
4. $t_{rr}$ - Reverse Recovery Time, measured from zero crossing where diode current goes from positive to negative, to the point at which the straight line through $I_{RRM}$ and $0.25 \bullet I_{RRM}$ passes through zero.
5. $Q_{rr}$ - Area Under the Curve Defined by $I_{RRM}$ and $t_{rr}$.

Figure 10, Diode Reverse Recovery Waveform and Definitions

## SOT-227 (ISOTOP®) Package Outline




Dimensions in Millimeters and (Inches)

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