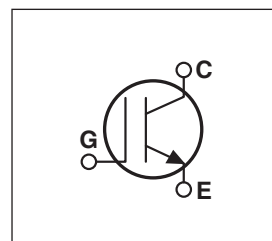
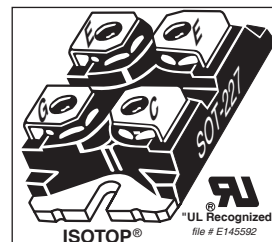


Utilizing the latest Field Stop and Trench Gate technologies, these IGBT's have ultra low  $V_{CE(ON)}$  and are ideal for low frequency applications that require absolute minimum conduction loss. Easy paralleling is a result of very tight parameter distribution and a slightly positive  $V_{CE(ON)}$  temperature coefficient. A built-in gate resistor ensures extremely reliable operation, even in the event of a short circuit fault. Low gate charge simplifies gate drive design and minimizes losses.

- 1200V Field Stop
- Trench Gate: Low  $V_{CE(on)}$
- Easy Paralleling
- Intergrated Gate Resistor: Low EMI, High Reliability



**Applications:** Welding, Inductive Heating, Solar Inverters, SMPS, Motor drives, UPS

## MAXIMUM RATINGS

All Ratings:  $T_C = 25^\circ\text{C}$  unless otherwise specified.

| Symbol         | Parameter                                                   | APT150GN120J | UNIT             |
|----------------|-------------------------------------------------------------|--------------|------------------|
| $V_{CES}$      | Collector-Emitter Voltage                                   | 1200         | Volts            |
| $V_{GE}$       | Gate-Emitter Voltage                                        | $\pm 30$     |                  |
| $I_{C1}$       | Continuous Collector Current @ $T_C = 25^\circ\text{C}$     | 215          | Amps             |
| $I_{C2}$       | Continuous Collector Current @ $T_C = 110^\circ\text{C}$    | 99           |                  |
| $I_{CM}$       | Pulsed Collector Current <sup>①</sup>                       | 450          |                  |
| SSOA           | Switching Safe Operating Area @ $T_J = 150^\circ\text{C}$   | 450A @ 1200V |                  |
| $P_D$          | Total Power Dissipation                                     | 625          | Watts            |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range            | -55 to 150   | $^\circ\text{C}$ |
| $T_L$          | Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec. | 300          |                  |

## STATIC ELECTRICAL CHARACTERISTICS

| Symbol        | Characteristic / Test Conditions                                                                  | MIN  | TYP  | MAX | Units         |
|---------------|---------------------------------------------------------------------------------------------------|------|------|-----|---------------|
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V, I_C = 6mA$ )                                  | 1200 |      |     | Volts         |
| $V_{GE(TH)}$  | Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 6mA, T_J = 25^\circ\text{C}$ )                   | 5.0  | 5.8  | 6.5 |               |
| $V_{CE(ON)}$  | Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 150A, T_J = 25^\circ\text{C}$ )               | 1.4  | 1.7  | 2.1 |               |
|               | Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 150A, T_J = 125^\circ\text{C}$ )              |      | 2.08 |     |               |
| $I_{CES}$     | Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 25^\circ\text{C}$ ) <sup>②</sup>  |      |      | 100 | $\mu\text{A}$ |
|               | Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 125^\circ\text{C}$ ) <sup>②</sup> |      |      | TBD |               |
| $I_{GES}$     | Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )                                               |      |      | 600 | nA            |
| $R_{G(int)}$  | Integrated Gate Resistor                                                                          |      | 5    |     | $\Omega$      |



**CAUTION:** These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

# DYNAMIC CHARACTERISTICS

APT150GN120J

| Symbol       | Characteristic                                | Test Conditions                                                                                                                                        | MIN | TYP  | MAX | UNIT |
|--------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| $C_{ies}$    | Input Capacitance                             | <b>Capacitance</b><br>$V_{GE} = 0V, V_{CE} = 25V$<br>$f = 1 \text{ MHz}$                                                                               |     | 9500 |     | pF   |
| $C_{oes}$    | Output Capacitance                            |                                                                                                                                                        |     | 500  |     |      |
| $C_{res}$    | Reverse Transfer Capacitance                  |                                                                                                                                                        |     | 400  |     |      |
| $V_{GEP}$    | Gate-to-Emitter Plateau Voltage               | <b>Gate Charge</b><br>$V_{GE} = 15V$<br>$V_{CE} = 600V$<br>$I_C = 150A$                                                                                |     | 9.5  |     | V    |
| $Q_g$        | Total Gate Charge <sup>③</sup>                |                                                                                                                                                        |     | 800  |     | nC   |
| $Q_{ge}$     | Gate-Emitter Charge                           |                                                                                                                                                        |     | 70   |     |      |
| $Q_{gc}$     | Gate-Collector ("Miller") Charge              |                                                                                                                                                        |     | 430  |     |      |
| SSOA         | Switching Safe Operating Area                 | $T_J = 150^\circ C, R_G = 4.3\Omega^{\textcircled{7}}, V_{GE} = 15V, L = 100\mu H, V_{CE} = 1200V$                                                     | 450 |      |     | A    |
| $t_{d(on)}$  | Turn-on Delay Time                            | <b>Inductive Switching (25°C)</b><br>$V_{CC} = 800V$<br>$V_{GE} = 15V$<br>$I_C = 150A$<br>$R_G = 1.0\Omega^{\textcircled{7}}$<br>$T_J = +25^\circ C$   |     | 55   |     | ns   |
| $t_r$        | Current Rise Time                             |                                                                                                                                                        |     | 65   |     |      |
| $t_{d(off)}$ | Turn-off Delay Time                           |                                                                                                                                                        |     | 675  |     |      |
| $t_f$        | Current Fall Time                             |                                                                                                                                                        |     | 85   |     |      |
| $E_{on1}$    | Turn-on Switching Energy <sup>④</sup>         |                                                                                                                                                        |     | 22   |     | mJ   |
| $E_{on2}$    | Turn-on Switching Energy (Diode) <sup>⑤</sup> |                                                                                                                                                        |     | 27   |     |      |
| $E_{off}$    | Turn-off Switching Energy <sup>⑥</sup>        |                                                                                                                                                        |     | 15   |     |      |
| $t_{d(on)}$  | Turn-on Delay Time                            | <b>Inductive Switching (125°C)</b><br>$V_{CC} = 800V$<br>$V_{GE} = 15V$<br>$I_C = 150A$<br>$R_G = 1.0\Omega^{\textcircled{7}}$<br>$T_J = +125^\circ C$ |     | 55   |     | ns   |
| $t_r$        | Current Rise Time                             |                                                                                                                                                        |     | 65   |     |      |
| $t_{d(off)}$ | Turn-off Delay Time                           |                                                                                                                                                        |     | 780  |     |      |
| $t_f$        | Current Fall Time                             |                                                                                                                                                        |     | 175  |     |      |
| $E_{on1}$    | Turn-on Switching Energy <sup>④</sup>         |                                                                                                                                                        |     | 23   |     | mJ   |
| $E_{on2}$    | Turn-on Switching Energy (Diode) <sup>⑤</sup> |                                                                                                                                                        |     | 35   |     |      |
| $E_{off}$    | Turn-off Switching Energy <sup>⑥</sup>        |                                                                                                                                                        |     | 22   |     |      |

# THERMAL AND MECHANICAL CHARACTERISTICS

| Symbol          | Characteristic                                                                       | MIN  | TYP  | MAX  | UNIT  |
|-----------------|--------------------------------------------------------------------------------------|------|------|------|-------|
| $R_{\theta JC}$ | Junction to Case ( <b>IGBT</b> )                                                     |      |      | 0.20 | °C/W  |
| $R_{\theta JC}$ | Junction to Case ( <b>DIODE</b> )                                                    |      |      | N/A  |       |
| $V_{Isolation}$ | RMS Voltage (50-60Hz Sinusoidal Waveform from Terminals to Mounting Base for 1 Min.) | 2500 |      |      | Volts |
| $W_T$           | Package Weight                                                                       |      | 1.03 |      | oz    |
|                 |                                                                                      |      | 29.2 |      | gm    |
| Torque          | Maximum Terminal & Mounting Torque                                                   |      |      | 10   | lb•in |
|                 |                                                                                      |      |      | 1.1  | N•m   |

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

② For Combi devices,  $I_{ces}$  includes both IGBT and FRED leakages

③ See MIL-STD-750 Method 3471.

④  $E_{on1}$  is the clamped inductive turn-on energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to the IGBT turn-on loss. Tested in inductive switching test circuit shown in figure 21, but with a Silicon Carbide diode.

⑤  $E_{on2}$  is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22.)

⑥  $E_{off}$  is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See Figures 21, 23.)

⑦  $R_G$  is external gate resistance, not including  $R_{G(int)}$  nor gate driver impedance. (MIC4452)

APT Reserves the right to change, without notice, the specifications and information contained herein.

# TYPICAL PERFORMANCE CURVES

APT150GN120J

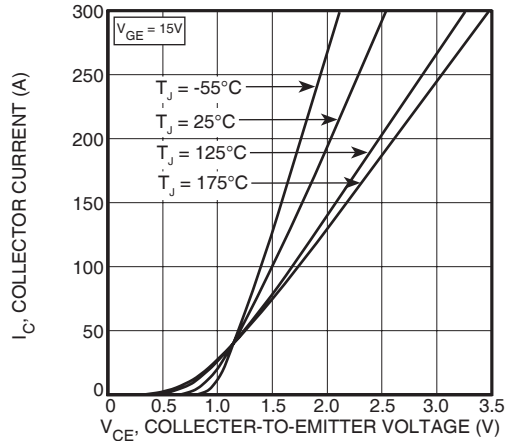


FIGURE 1, Output Characteristics( $T_J = 25^\circ\text{C}$ )

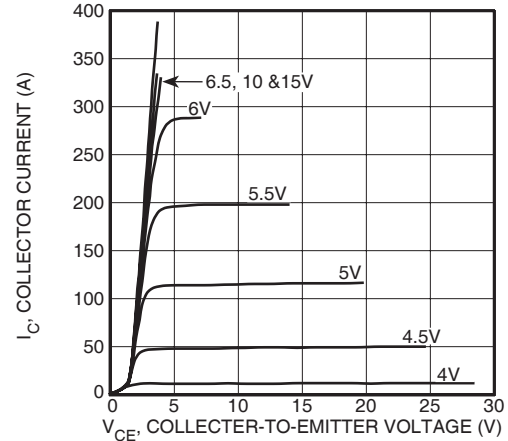


FIGURE 2, Output Characteristics ( $T_J = 125^\circ\text{C}$ )

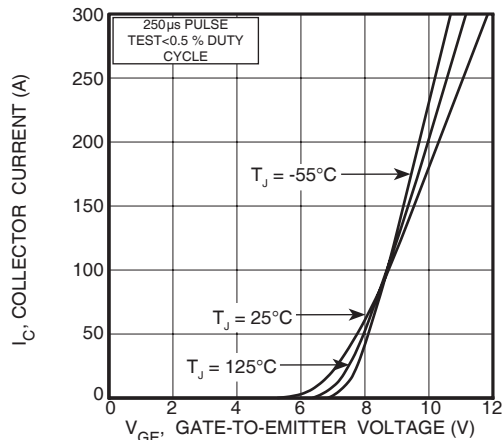


FIGURE 3, Transfer Characteristics

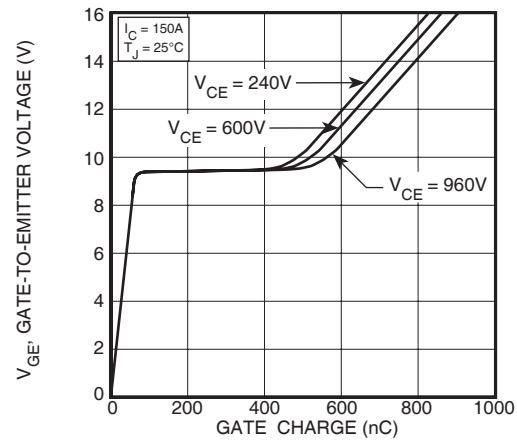


FIGURE 4, Gate Charge

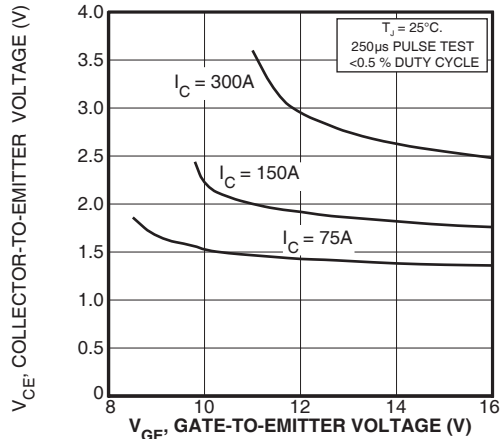


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

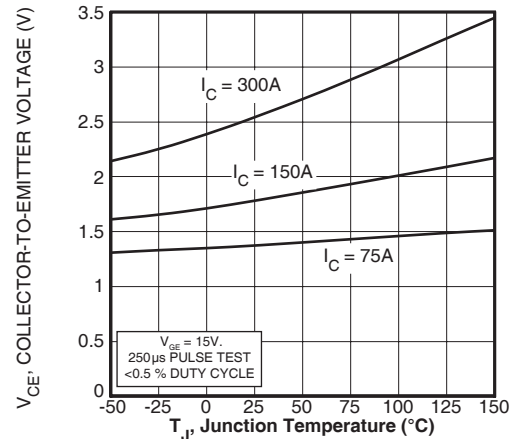


FIGURE 6, On State Voltage vs Junction Temperature

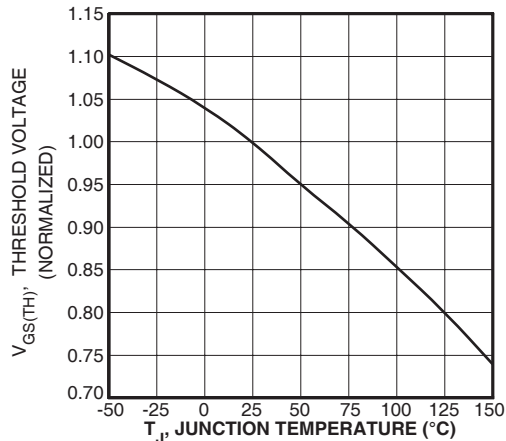


FIGURE 7, Threshold Voltage vs. Junction Temperature

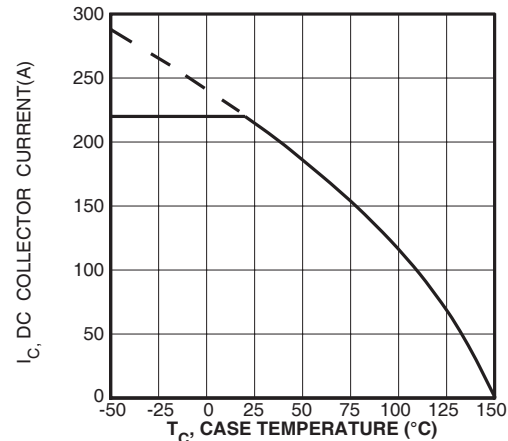


FIGURE 8, DC Collector Current vs Case Temperature

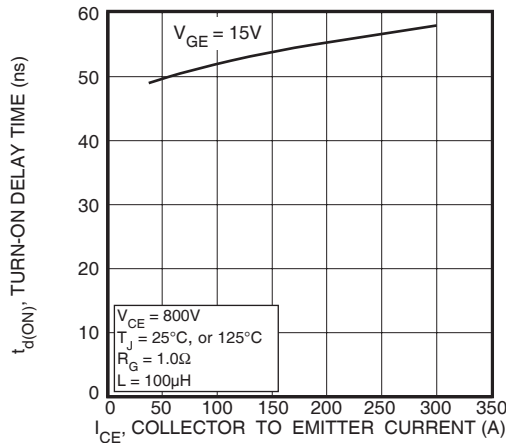


FIGURE 9, Turn-On Delay Time vs Collector Current

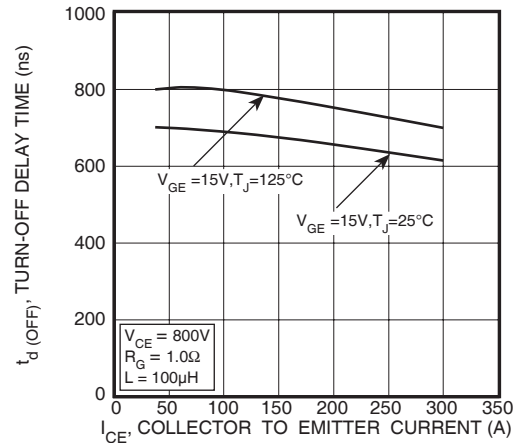


FIGURE 10, Turn-Off Delay Time vs Collector Current

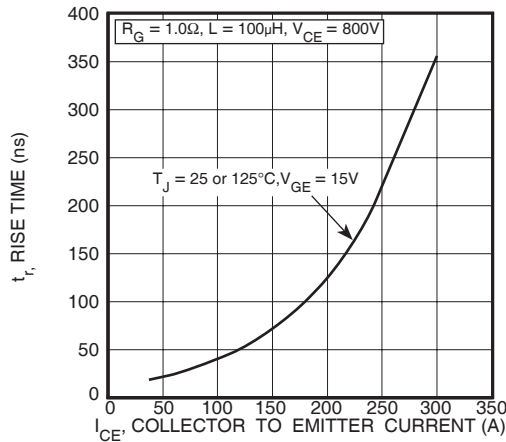


FIGURE 11, Current Rise Time vs Collector Current

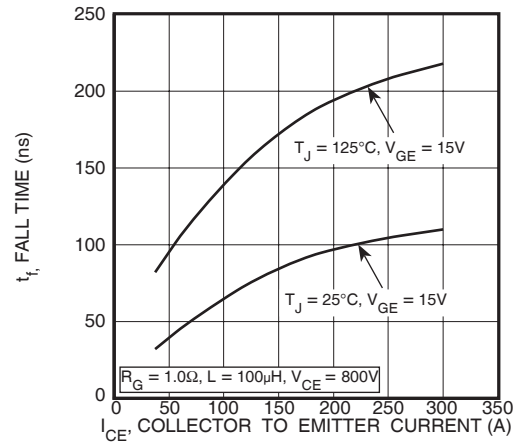


FIGURE 12, Current Fall Time vs Collector Current

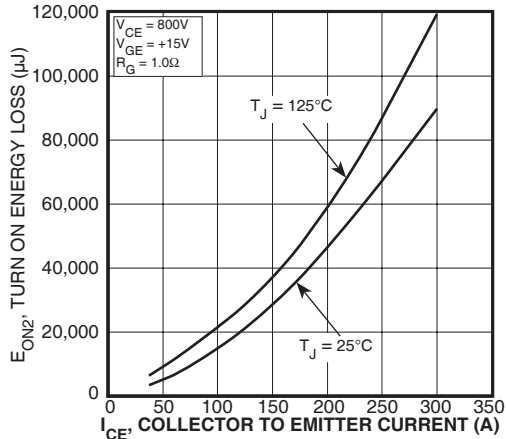


FIGURE 13, Turn-On Energy Loss vs Collector Current

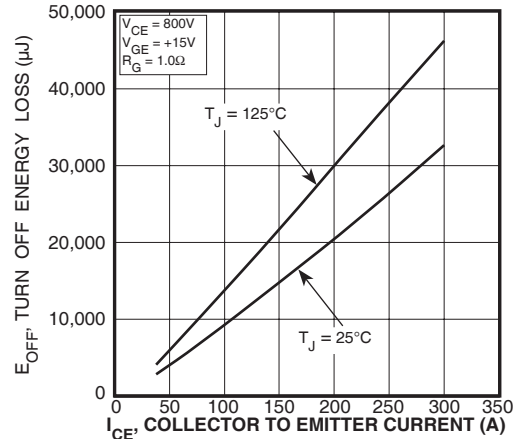


FIGURE 14, Turn Off Energy Loss vs Collector Current

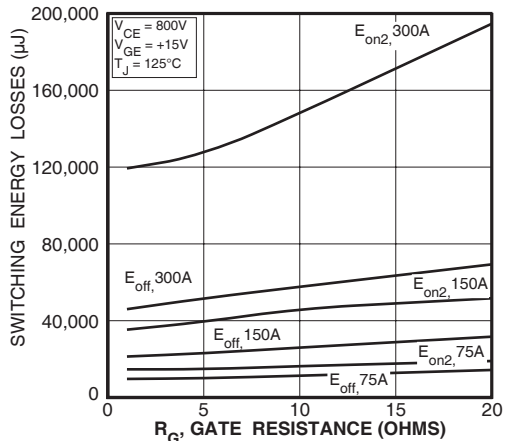


FIGURE 15, Switching Energy Losses vs. Gate Resistance

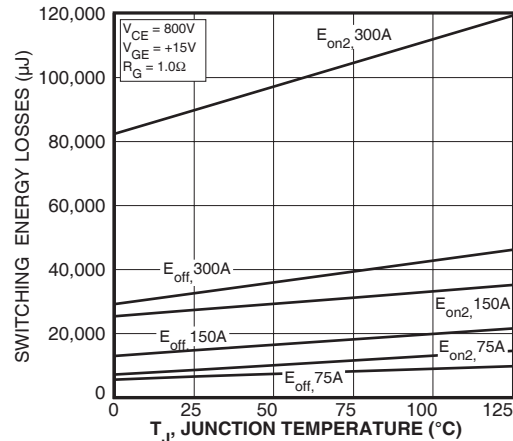


FIGURE 16, Switching Energy Losses vs Junction Temperature

## TYPICAL PERFORMANCE CURVES

APT150GN120J

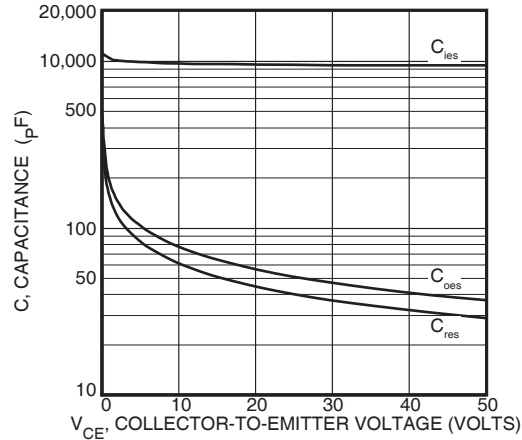


Figure 17, Capacitance vs Collector-To-Emitter Voltage

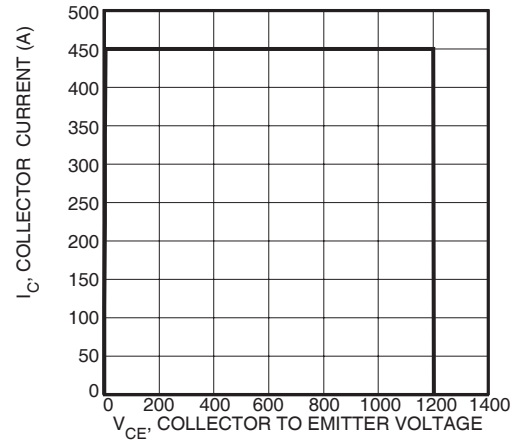


Figure 18, Minimum Switching Safe Operating Area

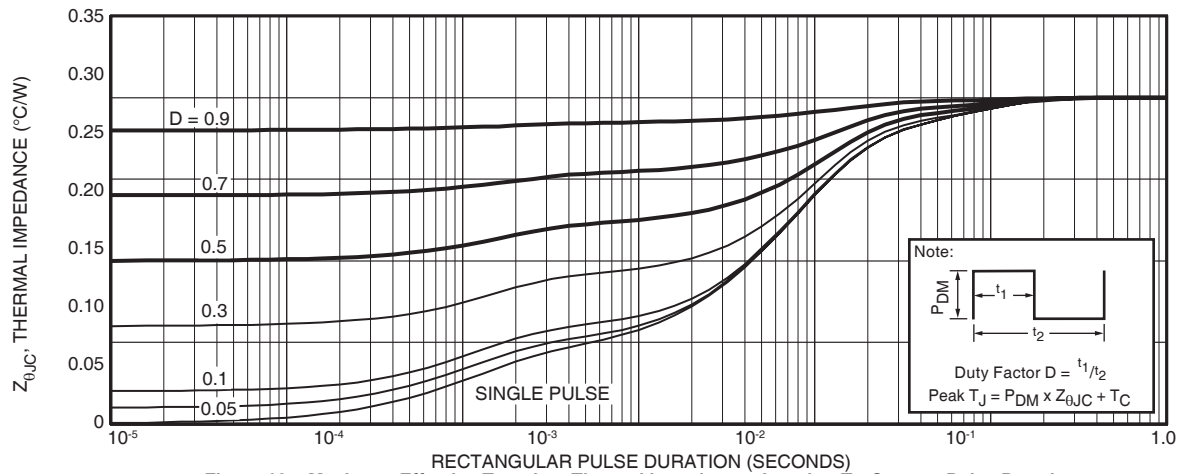


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

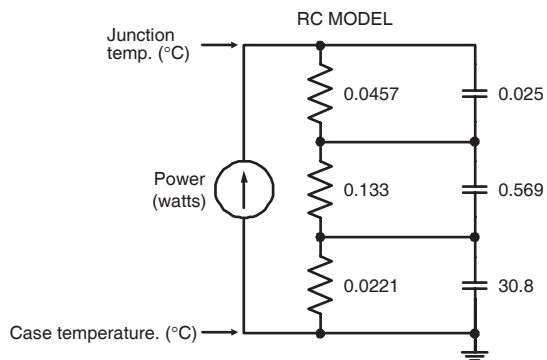


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

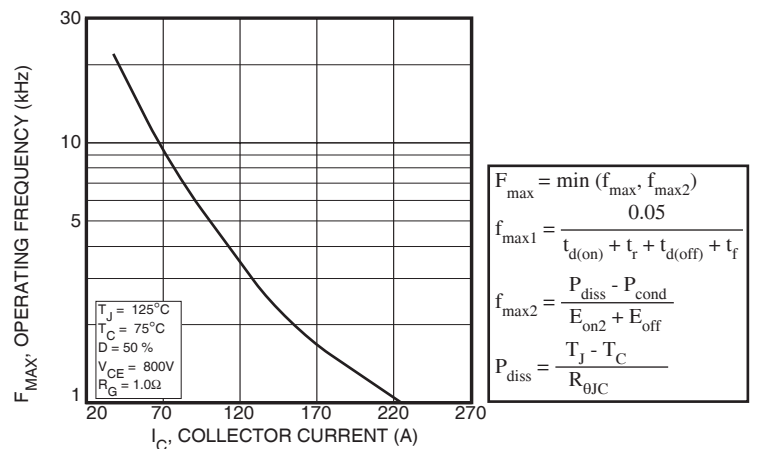


Figure 20, Operating Frequency vs Collector Current

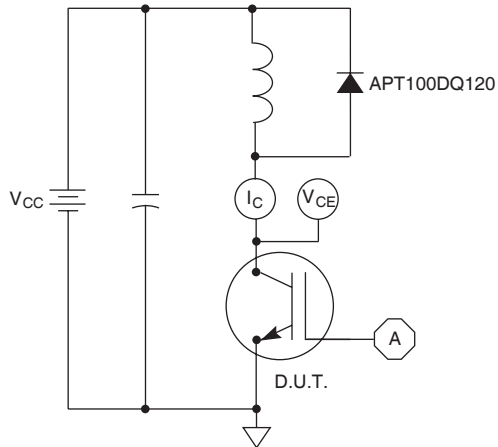


Figure 21, Inductive Switching Test Circuit

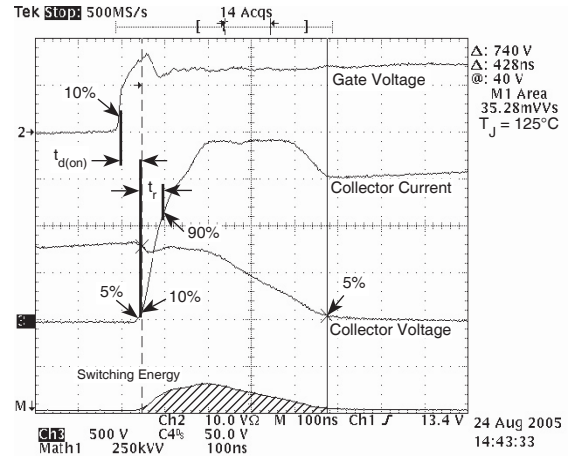


Figure 22, Turn-on Switching Waveforms and Definitions

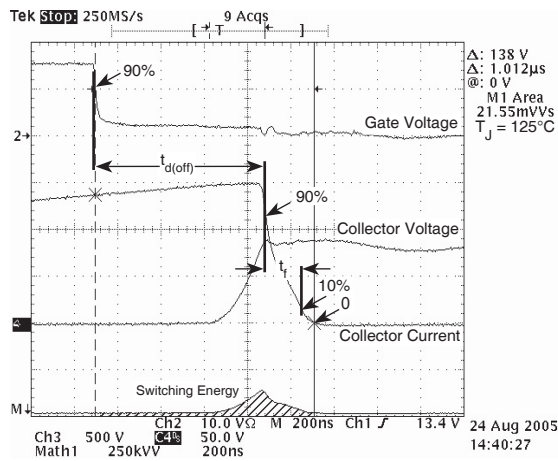
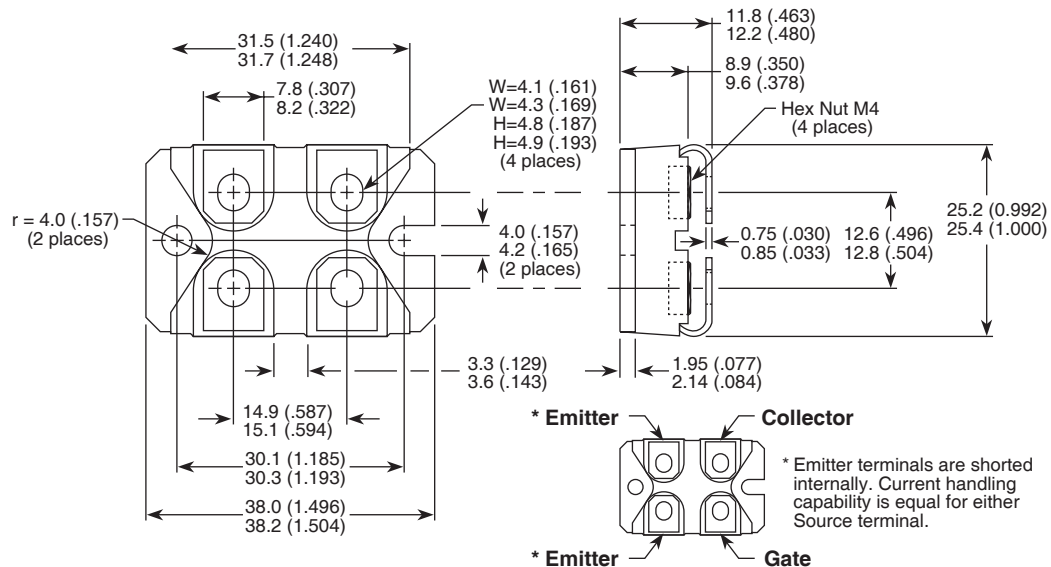


Figure 23, Turn-off Switching Waveforms and Definitions

### SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)

ISOTOP® is a Registered Trademark of SGS Thomson.