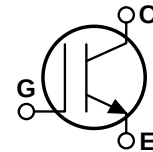
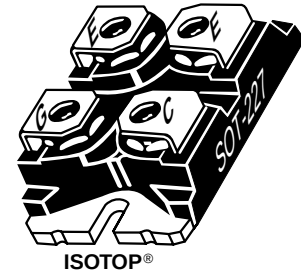


## Thunderbolt IGBT™

The Thunderbolt IGBT™ is a new generation of high voltage power IGBTs. Using Non-Punch Through Technology the Thunderbolt IGBT™ offers superior ruggedness and ultrafast switching speed.

- Low Forward Voltage Drop
- Low Tail Current
- Avalanche Rated
- High Freq. Switching to 150KHz
- Ultra Low Leakage Current
- RBSOA and SCSOA Rated



### MAXIMUM RATINGS

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

| Symbol         | Parameter                                                                      | APT60GT60JR | UNIT             |
|----------------|--------------------------------------------------------------------------------|-------------|------------------|
| $V_{CES}$      | Collector-Emitter Voltage                                                      | 600         | Volts            |
| $V_{CGR}$      | Collector-Gate Voltage ( $R_{GE} = 20\text{K}\Omega$ )                         | 600         |                  |
| $V_{GE}$       | Gate Emitter Voltage                                                           | $\pm 20$    |                  |
| $I_{C1}$       | Continuous Collector Current @ $T_C = 25^\circ\text{C}$                        | 93          | Amps             |
| $I_{C2}$       | Continuous Collector Current @ $T_C = 95^\circ\text{C}$                        | 60          |                  |
| $I_{CM}$       | Pulsed Collector Current <sup>①</sup> @ $T_C = 25^\circ\text{C}$               | 360         |                  |
| $I_{LM}$       | RBSOA Clamped Inductive Load Current $R_G = 11\Omega$ $T_C = 25^\circ\text{C}$ | 360         |                  |
| $E_{AS}$       | Single Pulse Avalanche Energy <sup>②</sup>                                     | 65          | mJ               |
| $P_D$          | Total Power Dissipation                                                        | 378         | 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       | UNIT          |
|--------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----------|---------------|
| $BV_{CES}$   | Collector-Emitter Breakdown Voltage ( $V_{GE} = 0\text{V}$ , $I_C = 0.5\text{mA}$ )                 | 600 |     |           | Volts         |
| $V_{GE(TH)}$ | Gate Threshold Voltage ( $V_{CE} = V_{GE}$ , $I_C = 500\mu\text{A}$ , $T_J = 25^\circ\text{C}$ )    | 3   | 4   | 5         |               |
| $V_{CE(ON)}$ | Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}$ , $I_C = I_{C2}$ , $T_J = 25^\circ\text{C}$ )  |     | 2.0 | 2.5       |               |
|              | Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}$ , $I_C = I_{C2}$ , $T_J = 125^\circ\text{C}$ ) |     |     | 2.8       |               |
| $I_{CES}$    | Collector Cut-off Current ( $V_{CE} = V_{CES}$ , $V_{GE} = 0\text{V}$ , $T_J = 25^\circ\text{C}$ )  |     |     | 80        | $\mu\text{A}$ |
|              | Collector Cut-off Current ( $V_{CE} = V_{CES}$ , $V_{GE} = 0\text{V}$ , $T_J = 125^\circ\text{C}$ ) |     |     | 2000      |               |
| $I_{GES}$    | Gate-Emitter Leakage Current ( $V_{GE} = \pm 20\text{V}$ , $V_{CE} = 0\text{V}$ )                   |     |     | $\pm 100$ | nA            |



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

APT Website - <http://www.advancedpower.com>

**USA** 405 S.W. Columbia Street  
**EUROPE** Chemin de Magret

Bend, Oregon 97702-1035  
F-33700 Merignac - France

Phone: (541) 382-8028  
Phone: (33) 5 57 92 15 15

FAX: (541) 388-0364  
FAX: (33) 5 56 47 97 61

# DYNAMIC CHARACTERISTICS

APT60GT60JR

| Symbol              | Characteristic                   | Test Conditions                                                                                                                                                                                      | MIN | TYP  | MAX | UNIT |
|---------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| C <sub>ies</sub>    | Input Capacitance                | <b>Capacitance</b><br>V <sub>GE</sub> = 0V<br>V <sub>CE</sub> = 25V<br>f = 1 MHz                                                                                                                     |     | 1600 |     | pF   |
| C <sub>oes</sub>    | Output Capacitance               |                                                                                                                                                                                                      |     | 150  |     |      |
| C <sub>res</sub>    | Reverse Transfer Capacitance     |                                                                                                                                                                                                      |     | 92   |     |      |
| Q <sub>g</sub>      | Total Gate Charge ③              | <b>Gate Charge</b><br>V <sub>GE</sub> = 15V<br>V <sub>CC</sub> = 0.5V <sub>CES</sub><br>I <sub>C</sub> = I <sub>C2</sub>                                                                             |     | 257  | 410 | nC   |
| Q <sub>ge</sub>     | Gate-Emitter Charge              |                                                                                                                                                                                                      |     | 19   | 30  |      |
| Q <sub>gc</sub>     | Gate-Collector ("Miller") Charge |                                                                                                                                                                                                      |     | 120  | 180 |      |
| t <sub>d(on)</sub>  | Turn-on Delay Time               | <b>Resistive Switching (25°C)</b><br>V <sub>GE</sub> = 15V<br>V <sub>CC</sub> = 0.5V <sub>CES</sub><br>I <sub>C</sub> = I <sub>C2</sub><br>R <sub>G</sub> = 5Ω                                       |     | 20   | 40  | ns   |
| t <sub>r</sub>      | Rise Time                        |                                                                                                                                                                                                      |     | 95   | 190 |      |
| t <sub>d(off)</sub> | Turn-off Delay Time              |                                                                                                                                                                                                      |     | 315  | 470 |      |
| t <sub>f</sub>      | Fall Time                        |                                                                                                                                                                                                      |     | 245  | 490 |      |
| t <sub>d(on)</sub>  | Turn-on Delay Time               | <b>Inductive Switching (150°C)</b><br>V <sub>CLAMP(Peak)</sub> = 0.66V <sub>CES</sub><br>V <sub>GE</sub> = 15V<br>I <sub>C</sub> = I <sub>C2</sub><br>R <sub>G</sub> = 5Ω<br>T <sub>J</sub> = +150°C |     | 25   | 50  | ns   |
| t <sub>r</sub>      | Rise Time                        |                                                                                                                                                                                                      |     | 59   | 120 |      |
| t <sub>d(off)</sub> | Turn-off Delay Time              |                                                                                                                                                                                                      |     | 430  | 650 |      |
| t <sub>f</sub>      | Fall Time                        |                                                                                                                                                                                                      |     | 65   | 130 |      |
| E <sub>on</sub>     | Turn-on Switching Energy         |                                                                                                                                                                                                      |     | 1.6  | 3.2 | mJ   |
| E <sub>off</sub>    | Turn-off Switching Energy        |                                                                                                                                                                                                      |     | 2.4  | 4.8 |      |
| E <sub>ts</sub>     | Total Switching Losses           |                                                                                                                                                                                                      |     | 4.0  | 8.0 |      |
| t <sub>d(on)</sub>  | Turn-on Delay Time               | <b>Inductive Switching (25°C)</b><br>V <sub>CLAMP(Peak)</sub> = 0.66V <sub>CES</sub><br>V <sub>GE</sub> = 15V<br>I <sub>C</sub> = I <sub>C2</sub><br>R <sub>G</sub> = 5Ω<br>T <sub>J</sub> = +25°C   |     | 26   | 50  | ns   |
| t <sub>r</sub>      | Rise Time                        |                                                                                                                                                                                                      |     | 63   | 125 |      |
| t <sub>d(off)</sub> | Turn-off Delay Time              |                                                                                                                                                                                                      |     | 395  | 590 |      |
| t <sub>f</sub>      | Fall Time                        |                                                                                                                                                                                                      |     | 68   | 140 |      |
| E <sub>ts</sub>     | Total Switching Losses           |                                                                                                                                                                                                      |     | 3.4  | 7.0 | mJ   |
| g <sub>fe</sub>     | Forward Transconductance         | V <sub>CE</sub> = 20V, I <sub>C</sub> = I <sub>C2</sub>                                                                                                                                              | 4   |      |     | S    |

# THERMAL AND MECHANICAL CHARACTERISTICS

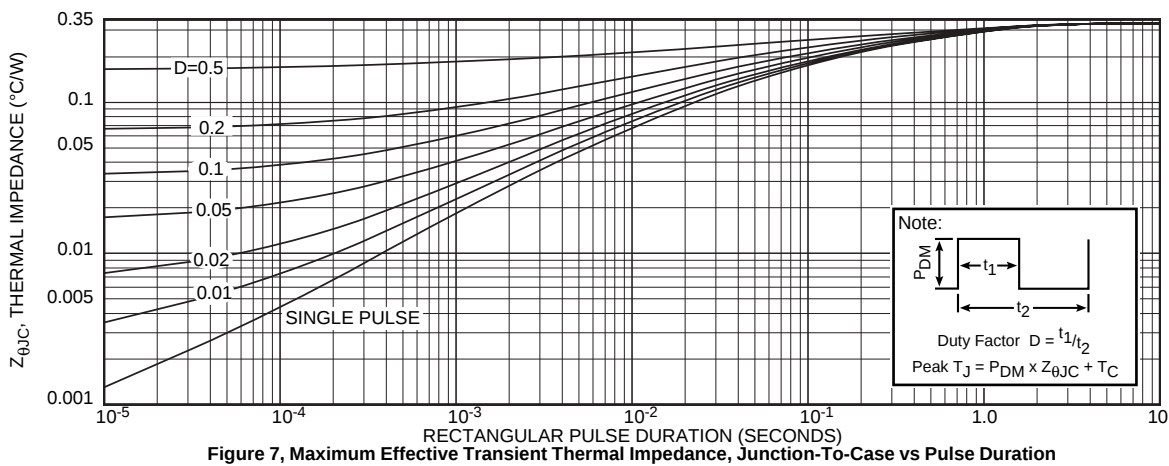
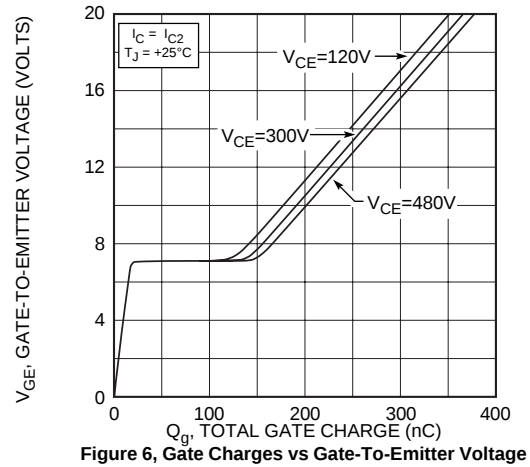
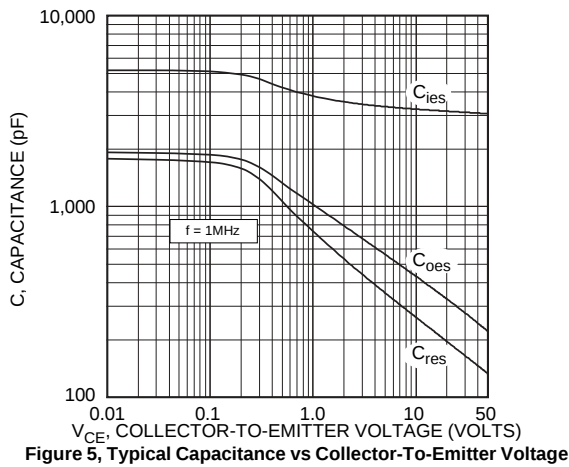
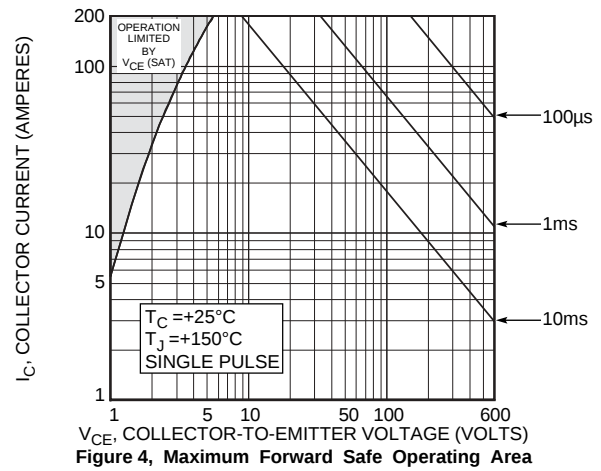
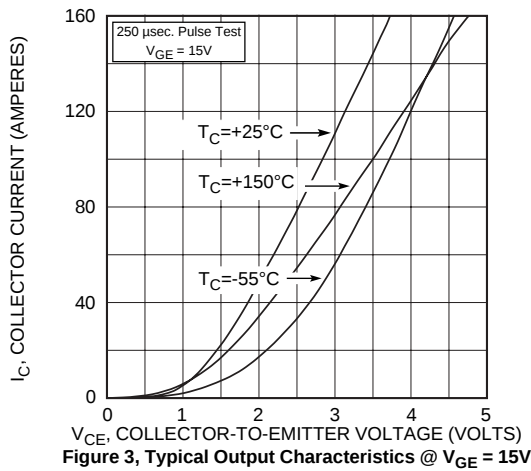
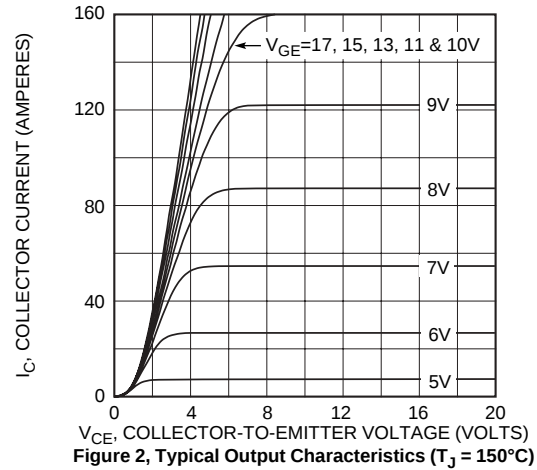
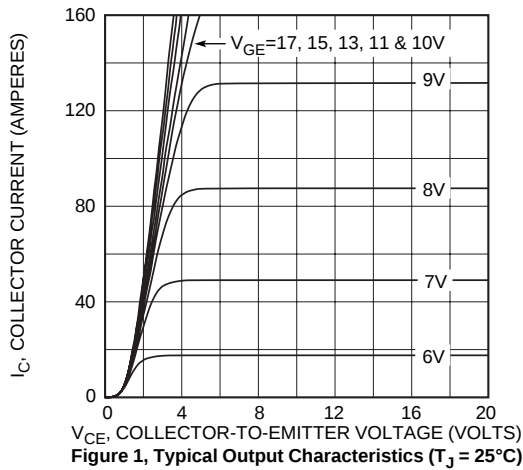
| Symbol           | Characteristic                                                               | MIN | TYP  | MAX  | UNIT  |
|------------------|------------------------------------------------------------------------------|-----|------|------|-------|
| R <sub>θJC</sub> | Junction to Case                                                             |     |      | 0.33 | °C/W  |
| R <sub>θJA</sub> | Junction to Ambient                                                          |     |      | 20   |       |
| W <sub>T</sub>   | Package Weight                                                               |     | 1.03 |      | oz    |
|                  |                                                                              |     | 29.2 |      | gm    |
| Torque           | Mounting Torque (Mounting = 8-32 or 4mm Machine and Terminals = 4mm Machine) |     |      | 10   | lb•in |
|                  |                                                                              |     |      | 1.5  | N•m   |

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

② I<sub>C</sub> = I<sub>C2</sub>, R<sub>GE</sub> = 25Ω, L = 100μH, T<sub>J</sub> = 25°C

③ See MIL-STD-750 Method 3471

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



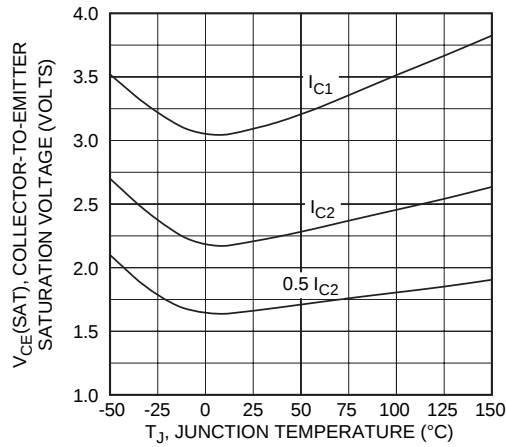


Figure 8, Typical  $V_{CE(SAT)}$  Voltage vs Junction Temperature

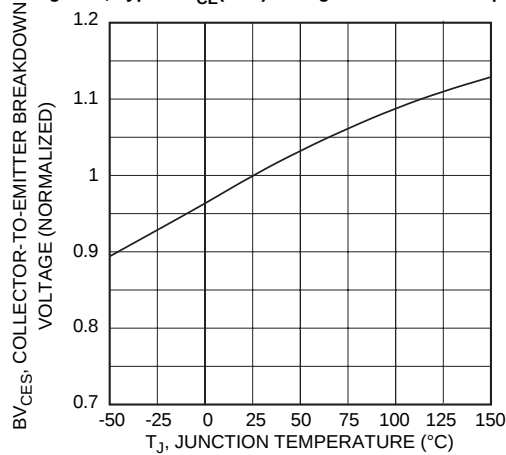


Figure 10, Breakdown Voltage vs Junction Temperature

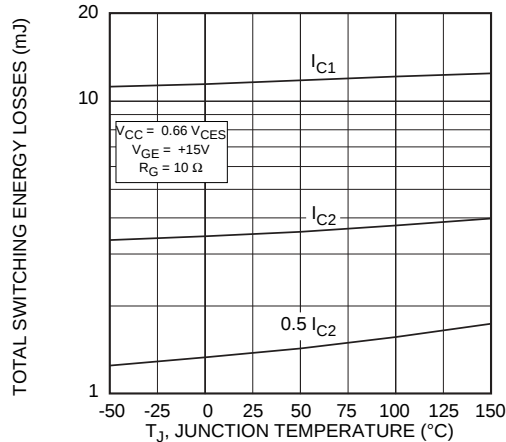


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

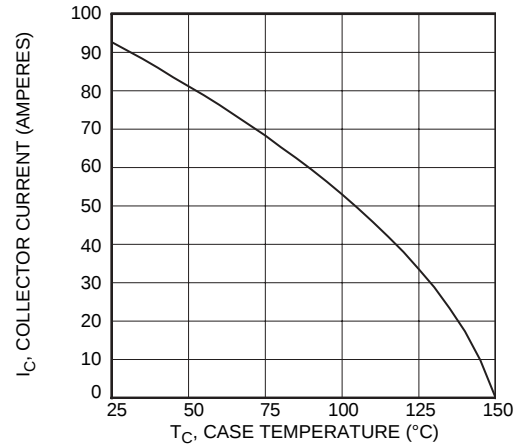


Figure 9, Maximum Collector Current vs Case Temperature

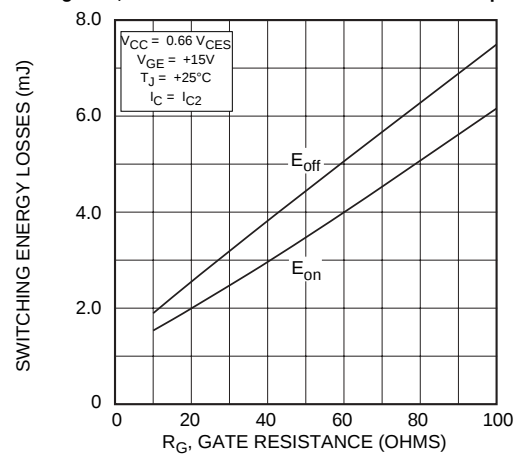


Figure 11, Typical Switching Energy Losses vs Gate Resistance

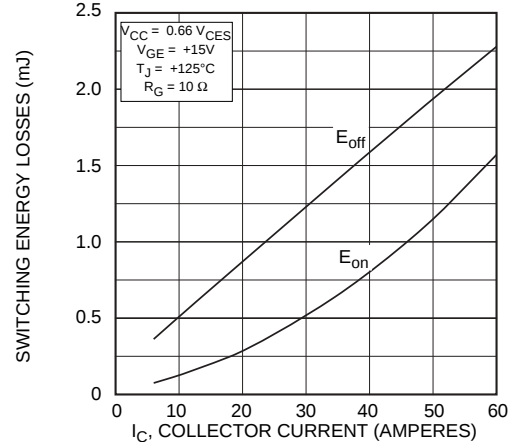


Figure 13, Typical Switching Energy Losses vs Collector Current

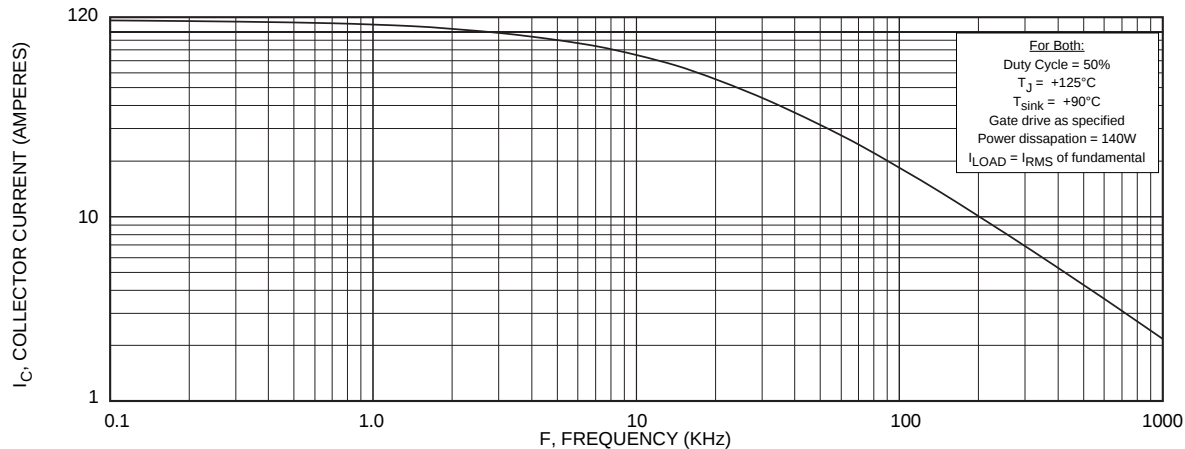


Figure 14, Typical Load Current vs Frequency

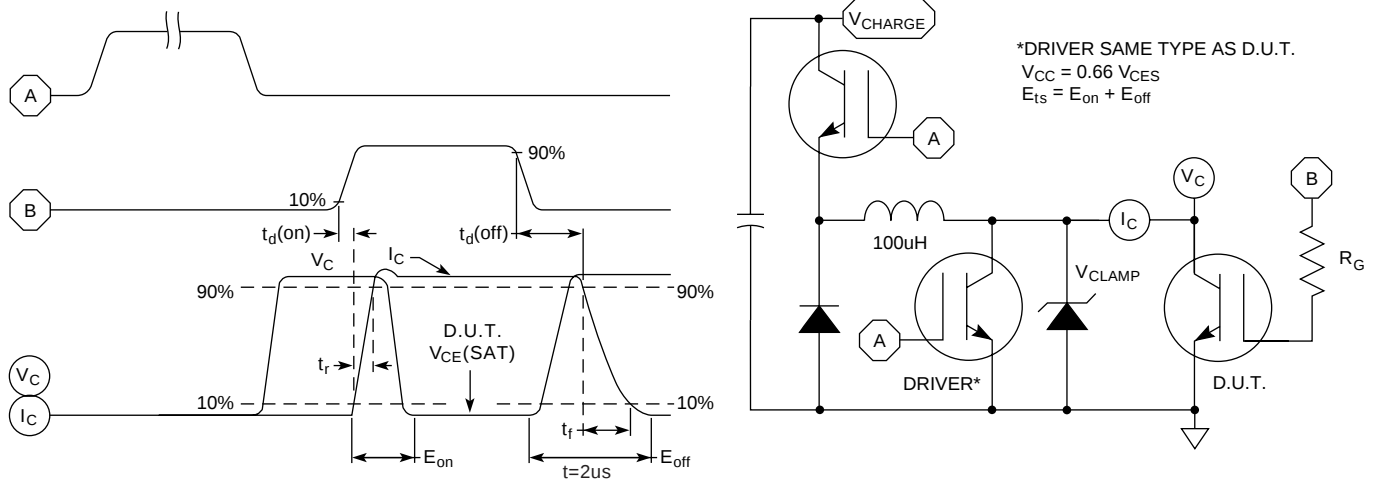


Figure 15, Switching Loss Test Circuit and Waveforms

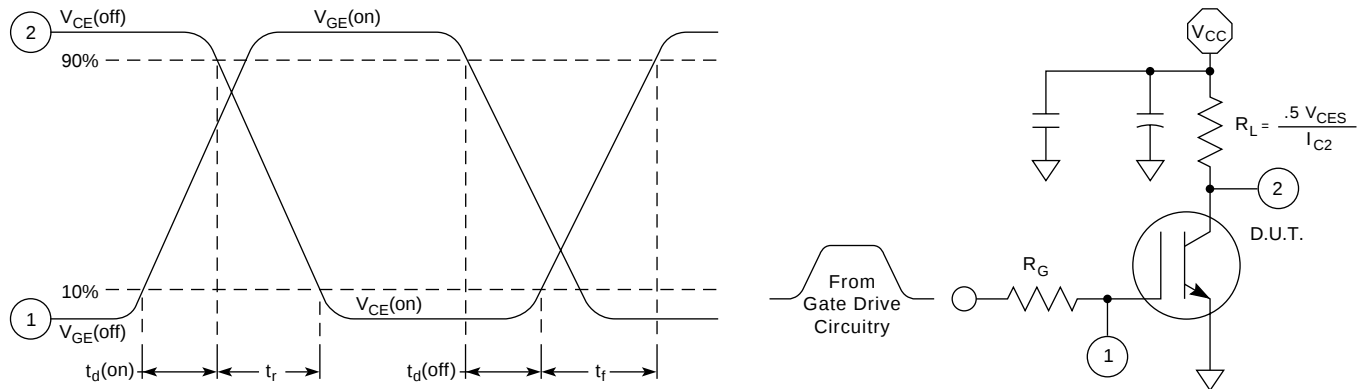
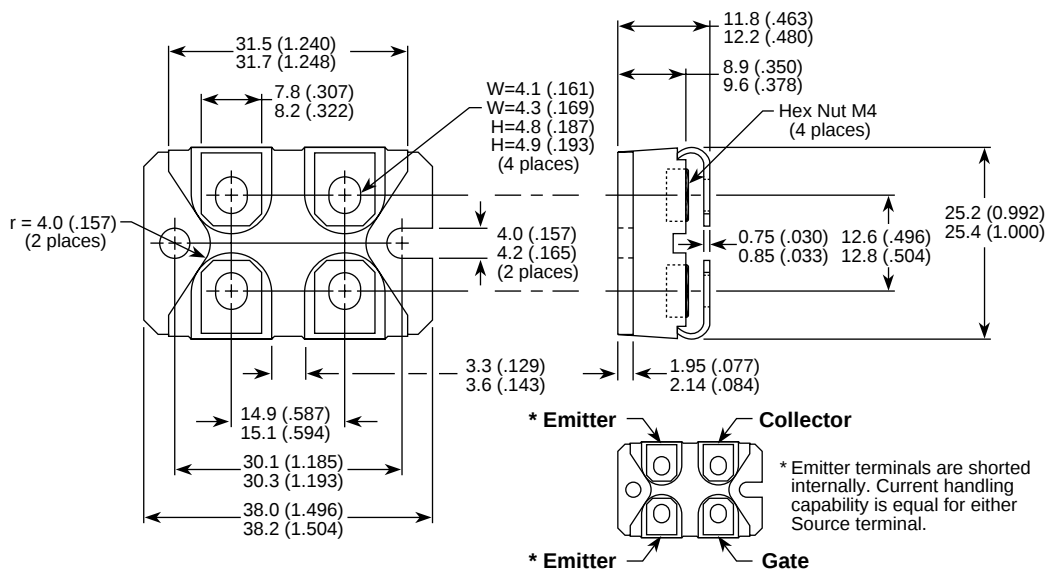


Figure 16, Resistive Switching Time Test Circuit and Waveforms

### SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)