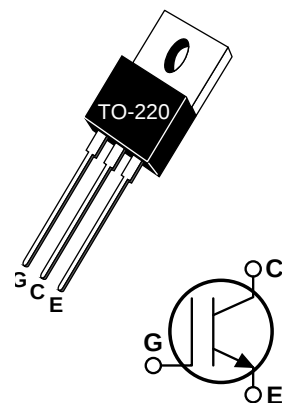


### Fast IGBT

The Fast IGBT is a new generation of high voltage power IGBTs. Using Non-Punch Through Technology the Fast IGBT offers superior ruggedness, fast switching speed and low Collector-Emitter On voltage.

- Low Forward Voltage Drop
- Low Tail Current
- Avalanche Rated
- High Freq. Switching to 20KHz
- Ultra Low Leakage Current
- RBSOA and SCSOA Rated



#### MAXIMUM RATINGS

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

| Symbol         | Parameter                                                                         | APT20GF120KR | UNIT             |
|----------------|-----------------------------------------------------------------------------------|--------------|------------------|
| $V_{CES}$      | Collector-Emitter Voltage                                                         | 1200         | Volts            |
| $V_{CGR}$      | Collector-Gate Voltage ( $R_{GE} = 20K\Omega$ )                                   | 1200         |                  |
| $V_{GE}$       | Gate-Emitter Voltage                                                              | $\pm 20$     |                  |
| $I_{C1}$       | Continuous Collector Current @ $T_C = 25^\circ\text{C}$                           | 32           | Amps             |
| $I_{C2}$       | Continuous Collector Current @ $T_C = 90^\circ\text{C}$                           | 20           |                  |
| $I_{CM}$       | Pulsed Collector Current <sup>①</sup> @ $T_C = 25^\circ\text{C}$                  | 64           |                  |
| $I_{LM}$       | RBSOA Clamped Inductive Load Current @ $R_g = 11\Omega$ $T_C = 125^\circ\text{C}$ | 40           |                  |
| $E_{AS}$       | Single Pulse Avalanche Energy <sup>②</sup>                                        | 22           | mJ               |
| $P_D$          | Total Power Dissipation                                                           | 200          | 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 ( $V_{GE} = 0V$ , $I_C = 0.8mA$ )                        | 1200 |     |           | Volts |
| $V_{GE(TH)}$ | Gate Threshold Voltage ( $V_{CE} = V_{GE}$ , $I_C = 350\mu A$ , $T_J = 25^\circ\text{C}$ )   | 4.5  | 5.5 | 6.5       |       |
| $V_{CE(ON)}$ | Collector-Emitter On Voltage ( $V_{GE} = 15V$ , $I_C = 15A$ , $T_J = 25^\circ\text{C}$ )     |      | 2.7 | 3.2       |       |
|              | Collector-Emitter On Voltage ( $V_{GE} = 15V$ , $I_C = 15A$ , $T_J = 125^\circ\text{C}$ )    |      | 3.3 | 3.9       |       |
| $I_{CES}$    | Collector Cut-off Current ( $V_{CE} = V_{CES}$ , $V_{GE} = 0V$ , $T_J = 25^\circ\text{C}$ )  |      |     | 0.8       | mA    |
|              | Collector Cut-off Current ( $V_{CE} = V_{CES}$ , $V_{GE} = 0V$ , $T_J = 125^\circ\text{C}$ ) |      |     | 5.0       |       |
| $I_{GES}$    | Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ , $V_{CE} = 0V$ )                          |      |     | $\pm 100$ | nA    |

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

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

# DYNAMIC CHARACTERISTICS

APT20GF120KR

| Symbol     | Characteristic                   | Test Conditions                                                                                                                                       | MIN | TYP  | MAX  | UNIT |
|------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| $C_{ies}$  | Input Capacitance                | <b>Capacitance</b><br>$V_{GE} = 0V$<br>$V_{CE} = 25V$<br>$f = 1\text{ MHz}$                                                                           |     | 1050 | 1210 | pF   |
| $C_{oes}$  | Output Capacitance               |                                                                                                                                                       |     | 100  | 150  |      |
| $C_{res}$  | Reverse Transfer Capacitance     |                                                                                                                                                       |     | 63   | 110  |      |
| $Q_g$      | Total Gate Charge ③              | <b>Gate Charge</b><br>$V_{GE} = 15V$<br>$V_{CC} = 0.5V_{CES}$<br>$I_C = I_{C2}$                                                                       |     | 95   | 140  | nC   |
| $Q_{ge}$   | Gate-Emitter Charge              |                                                                                                                                                       |     | 13   | 20   |      |
| $Q_{gc}$   | Gate-Collector ("Miller") Charge |                                                                                                                                                       |     | 62   | 90   |      |
| $t_d(on)$  | Turn-on Delay Time               | <b>Resistive Switching (25°C)</b><br>$V_{GE} = 15V$<br>$V_{CC} = 0.5V_{CES}$<br>$I_C = I_{C2}$<br>$R_G = 10\Omega$                                    |     | 15   | 30   | ns   |
| $t_r$      | Rise Time                        |                                                                                                                                                       |     | 67   | 130  |      |
| $t_d(off)$ | Turn-off Delay Time              |                                                                                                                                                       |     | 92   | 140  |      |
| $t_f$      | Fall Time                        |                                                                                                                                                       |     | 93   | 190  |      |
| $t_d(on)$  | Turn-on Delay Time               | <b>Inductive Switching (150°C)</b><br>$V_{CLAMP(Peak)} = 0.66V_{CES}$<br>$V_{GE} = 15V$<br>$I_C = I_{C2}$<br>$R_G = 10\Omega$<br>$T_J = +150^\circ C$ |     | 17   | 34   | ns   |
| $t_r$      | Rise Time                        |                                                                                                                                                       |     | 30   | 60   |      |
| $t_d(off)$ | Turn-off Delay Time              |                                                                                                                                                       |     | 105  | 160  |      |
| $t_f$      | Fall Time                        |                                                                                                                                                       |     | 71   | 140  |      |
| $E_{on}$   | Turn-on Switching Energy         | $R_G = 10\Omega$<br>$T_J = +150^\circ C$                                                                                                              |     | 1.3  | 3.0  | mJ   |
| $E_{off}$  | Turn-off Switching Energy        |                                                                                                                                                       |     | 1.5  | 3.0  |      |
| $E_{ts}$   | Total Switching Losses           |                                                                                                                                                       |     | 2.7  | 5.0  |      |
| $t_d(on)$  | Turn-on Delay Time               | <b>Inductive Switching (25°C)</b><br>$V_{CLAMP(Peak)} = 0.66V_{CES}$<br>$V_{GE} = 15V$<br>$I_C = I_{C2}$<br>$R_G = 10\Omega$<br>$T_J = +25^\circ C$   |     | 17   | 30   | ns   |
| $t_r$      | Rise Time                        |                                                                                                                                                       |     | 35   | 70   |      |
| $t_d(off)$ | Turn-off Delay Time              |                                                                                                                                                       |     | 93   | 140  |      |
| $t_f$      | Fall Time                        |                                                                                                                                                       |     | 70   | 140  |      |
| $E_{ts}$   | Total Switching Losses           |                                                                                                                                                       |     | 2.4  | 5.0  | mJ   |
| $g_{fe}$   | Forward Transconductance         | $V_{CE} = 20V, I_C = I_{C2}$                                                                                                                          |     | 12   |      | S    |

# THERMAL AND MECHANICAL CHARACTERISTICS

| Symbol          | Characteristic                                                   | MIN | TYP  | MAX  | UNIT  |
|-----------------|------------------------------------------------------------------|-----|------|------|-------|
| $R_{\theta JC}$ | Junction to Case                                                 |     |      | 0.63 | °C/W  |
| $R_{\theta JA}$ | Junction to Ambient                                              |     |      | 80   |       |
| $W_T$           | Package Weight                                                   |     | 0.07 |      | oz    |
|                 |                                                                  |     | 1.9  |      | gm    |
| Torque          | Mounting Torque (using a 6-32 or 3mm Binding Head Machine Screw) |     |      | 10   | lb•in |
|                 |                                                                  |     |      | 1.1  | N•m   |

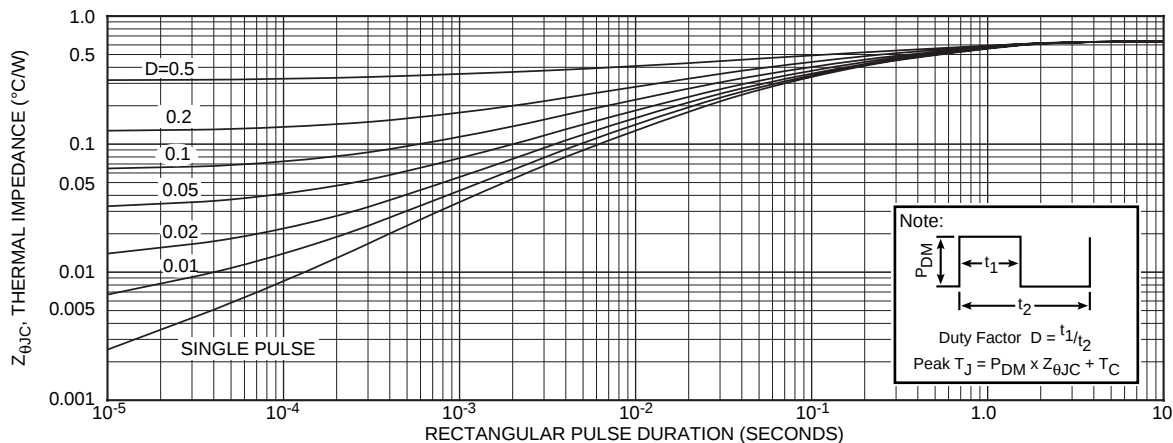
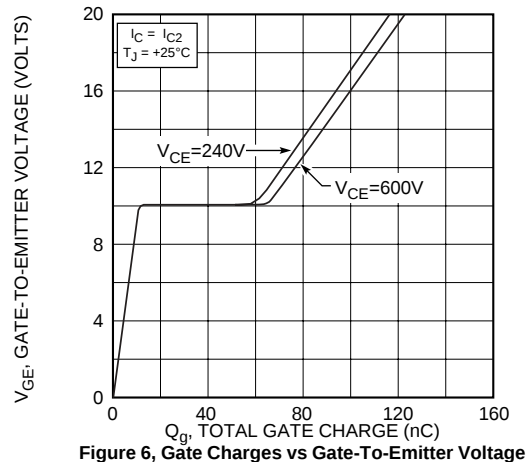
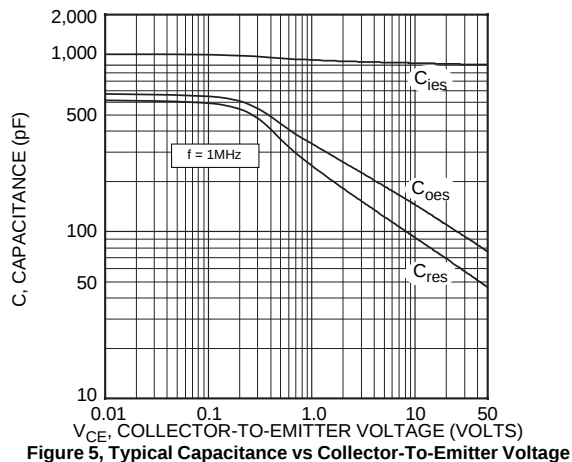
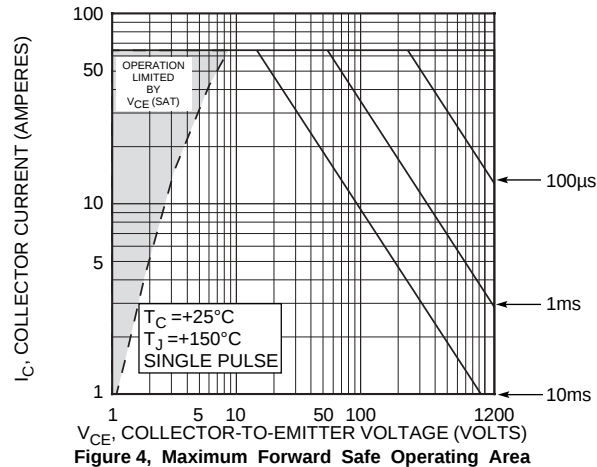
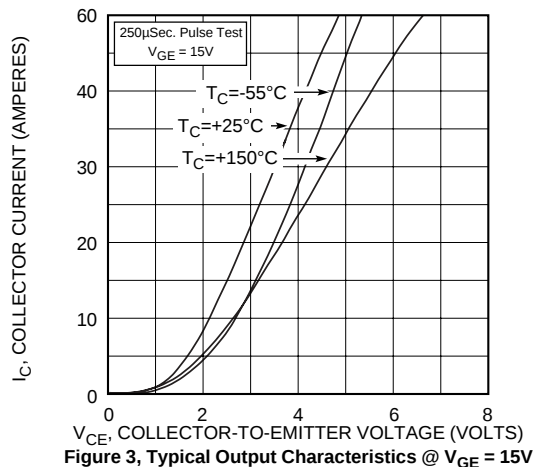
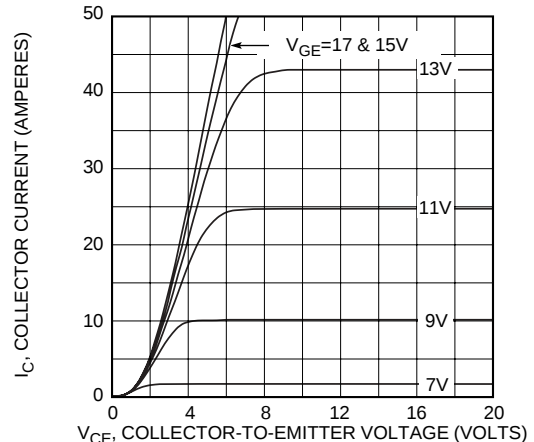
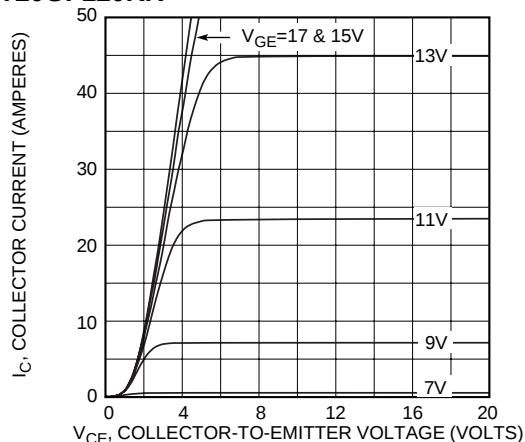
① Repetitive Rating: Pulse width limited by maximum junction temperature.

②  $I_C = I_{C2}$ ,  $R_{GE} = 25\Omega$ ,  $L = 110\mu H$ ,  $T_J = 25^\circ C$

③ See MIL-STD-750 Method 3471

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

# APT20GF120KR



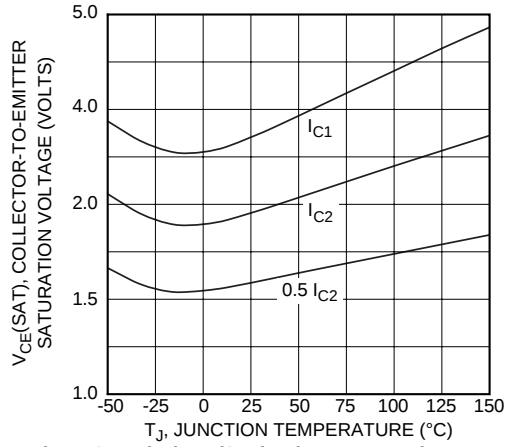


Figure 8, Typical  $V_{CE(SAT)}$  Voltage vs Junction Temperature

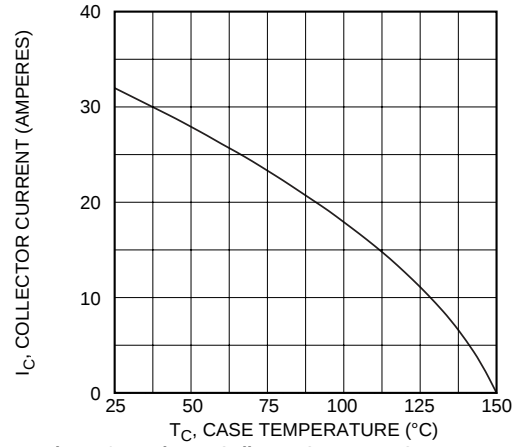


Figure 9, Maximum Collector Current vs Case Temperature

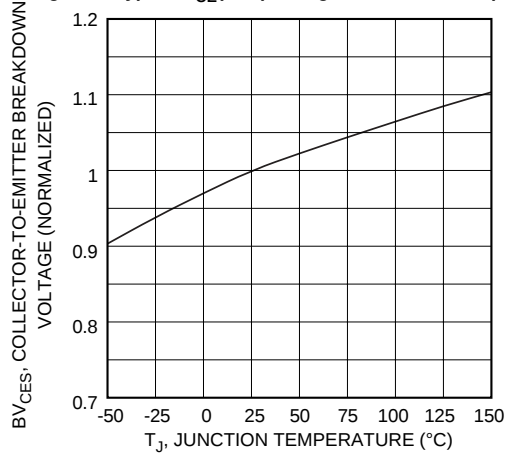


Figure 10, Breakdown Voltage vs Junction Temperature

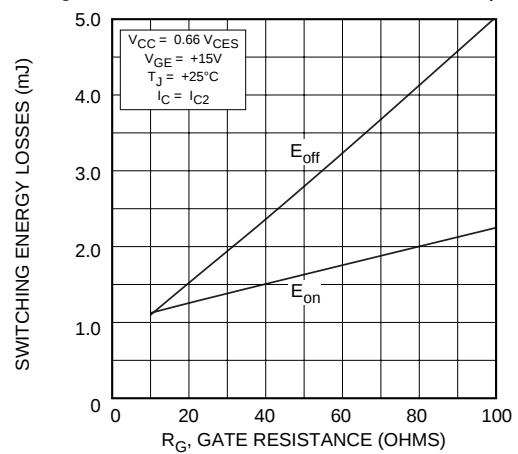


Figure 11, Typical Switching Energy Losses vs Gate Resistance

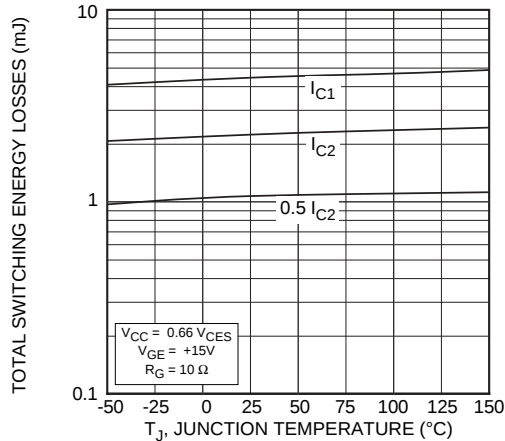


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

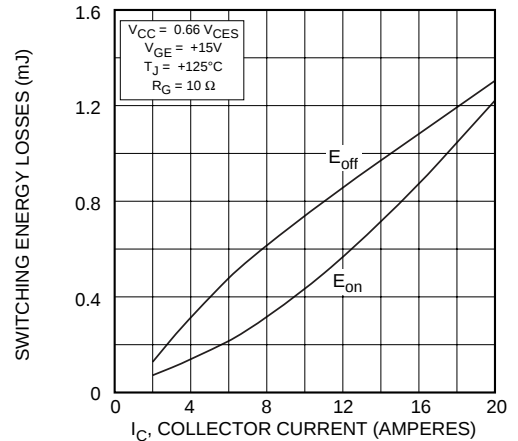


Figure 13, Typical Switching Energy Losses vs Collector Current

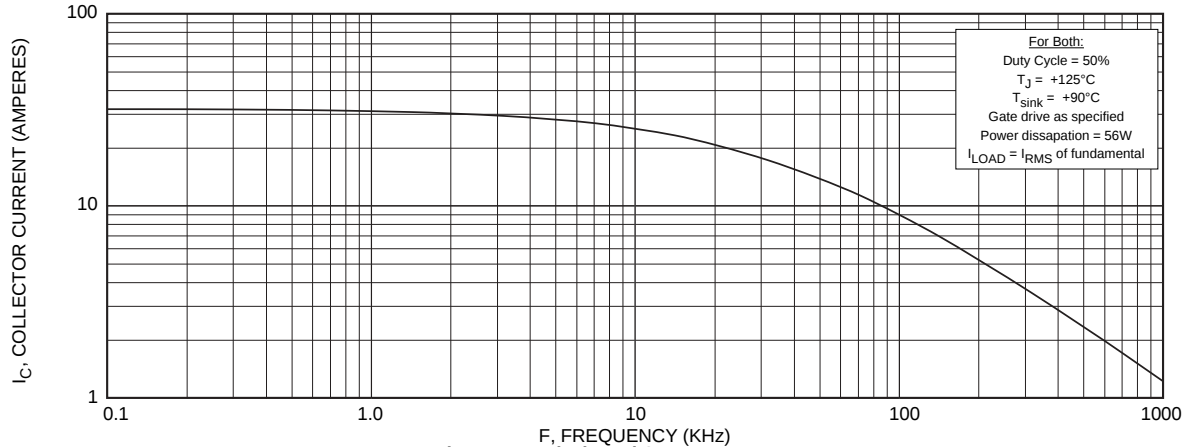


Figure 14, Typical Load Current vs Frequency

## APT20GF120KR

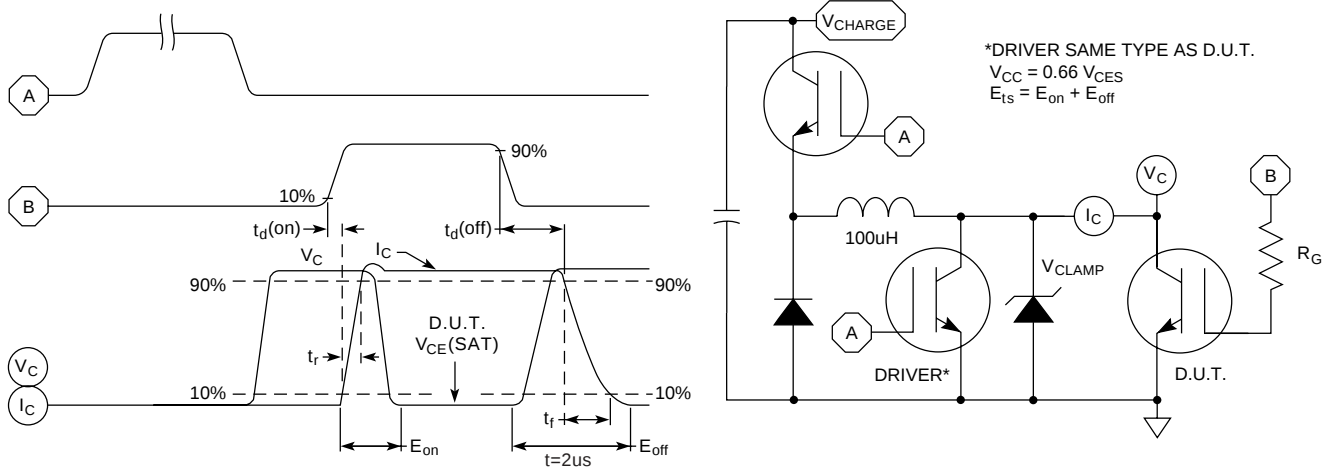


Figure 15, Switching Loss Test Circuit and Waveforms

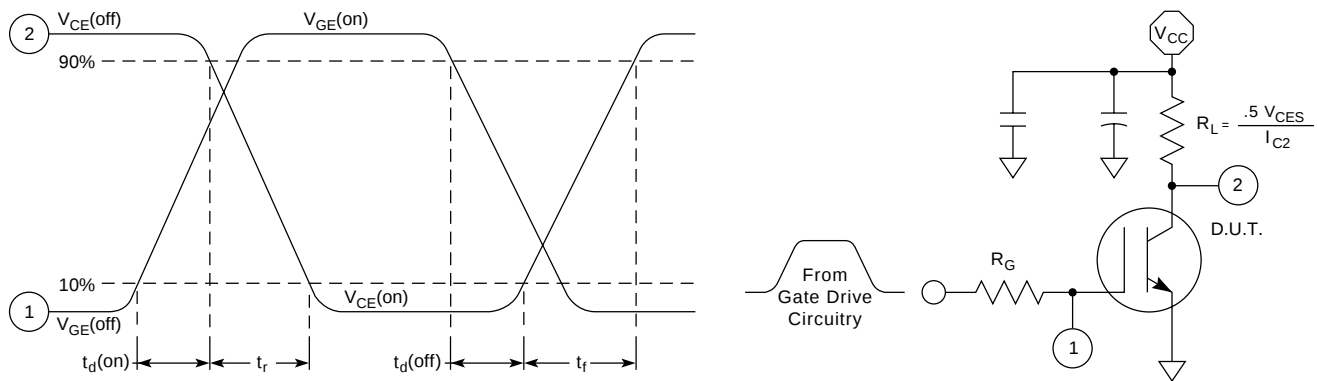
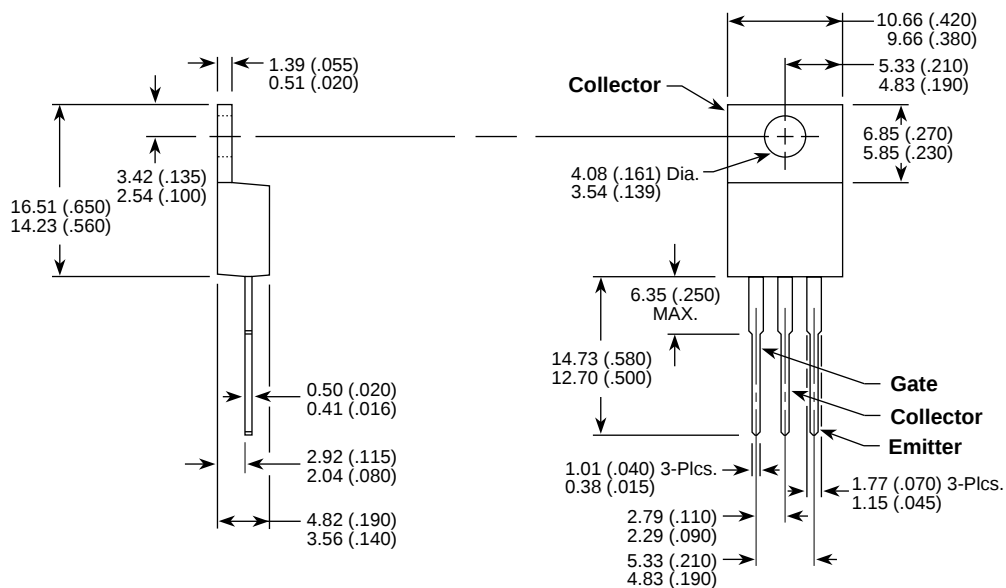


Figure 16, Resistive Switching Time Test Circuit and Waveforms

## TO-220AC Package Outline



Dimensions in Millimeters and (Inches)

APT's devices are covered by one or more of the following U.S. patents:

|           |           |           |           |           |           |
|-----------|-----------|-----------|-----------|-----------|-----------|
| 4,895,810 | 5,045,903 | 5,089,434 | 5,182,234 | 5,019,522 | 5,262,336 |
| 5,256,583 | 4,748,103 | 5,283,202 | 5,231,474 | 5,434,095 | 5,528,058 |