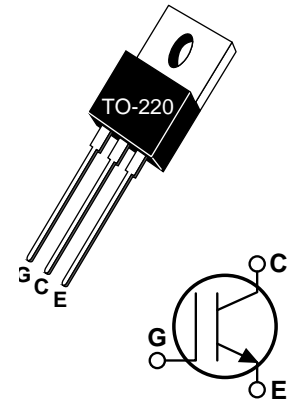


### Fast IGBT

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> $V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{ MHz}$		1050	1210	pF
$C_{oes}$	Output Capacitance			100	150	
$C_{res}$	Reverse Transfer Capacitance			63	110	
$Q_g$	Total Gate Charge <sup>③</sup>	<b>Gate Charge</b> $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$		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> $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$ $R_G = 10\Omega$		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> $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +150^\circ C$		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	$R_G = 10\Omega$ $T_J = +150^\circ C$		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> $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +25^\circ C$		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	
$g_{fe}$	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

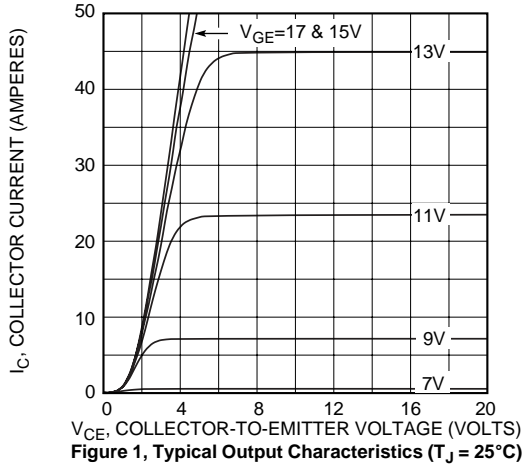
① Repetitive Rating: Pulse width limited by maximum junction temperature.

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

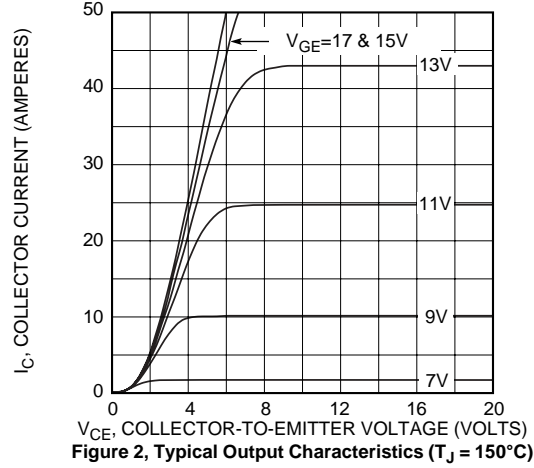
③ See MIL-STD-750 Method 3471

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

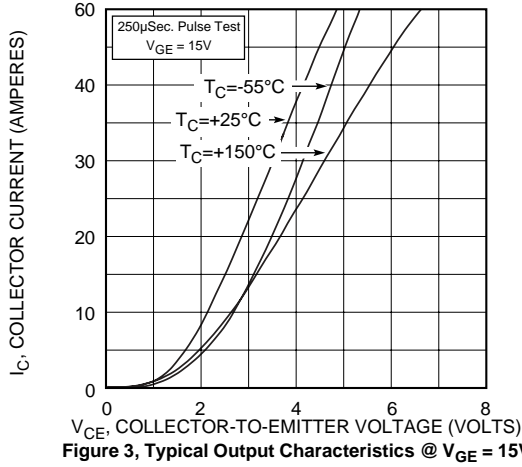
**APT20GF120KR**



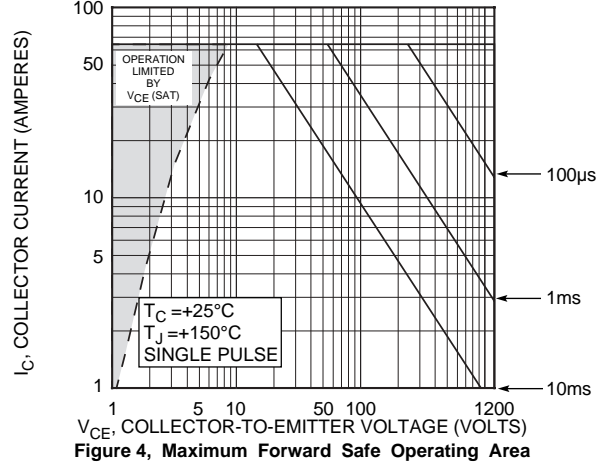
**Figure 1, Typical Output Characteristics ( $T_J = 25^\circ\text{C}$ )**



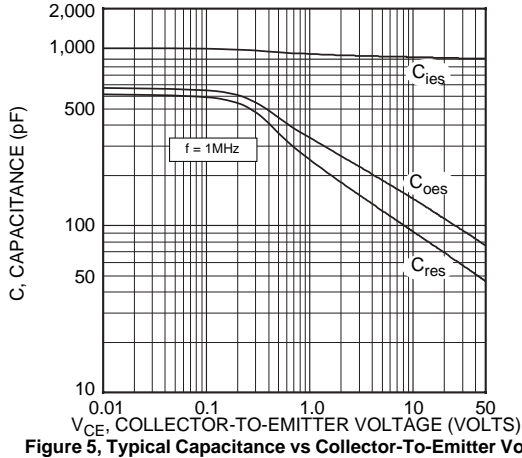
**Figure 2, Typical Output Characteristics ( $T_J = 150^\circ\text{C}$ )**



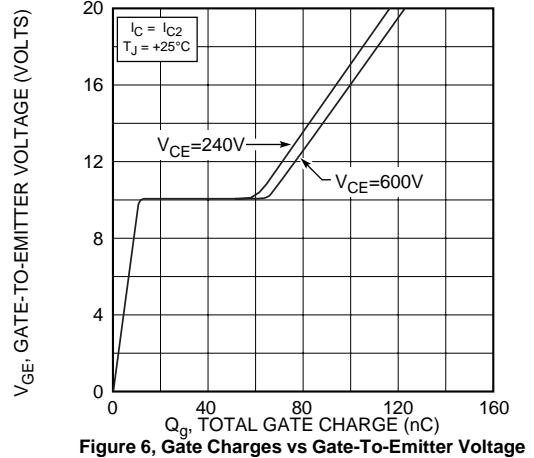
**Figure 3, Typical Output Characteristics @  $V_{GE} = 15\text{V}$**



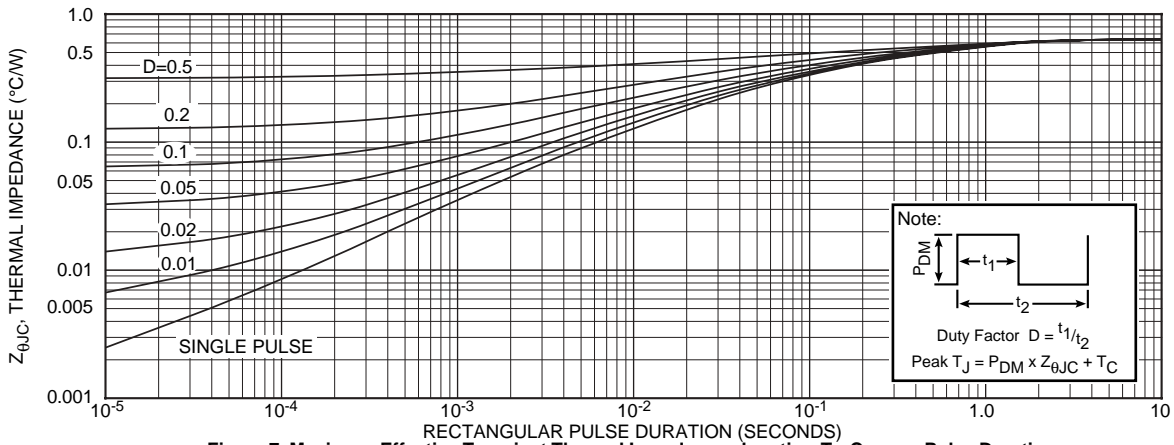
**Figure 4, Maximum Forward Safe Operating Area**



**Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage**



**Figure 6, Gate Charges vs Gate-To-Emitter Voltage**



**Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration**

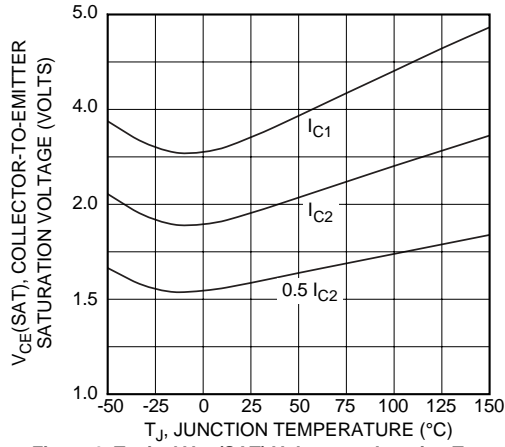


Figure 8, Typical  $V_{CE(SAT)}$  Voltage vs Junction Temperature

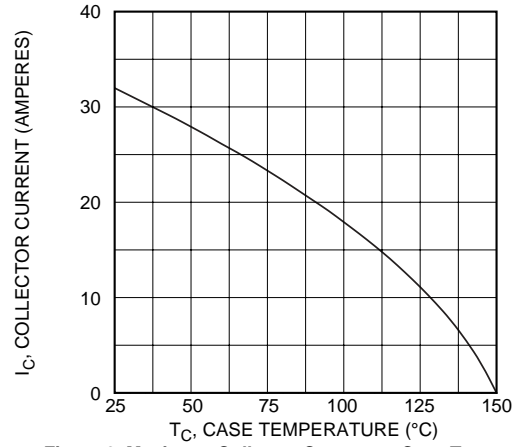


Figure 9, Maximum Collector Current vs Case Temperature

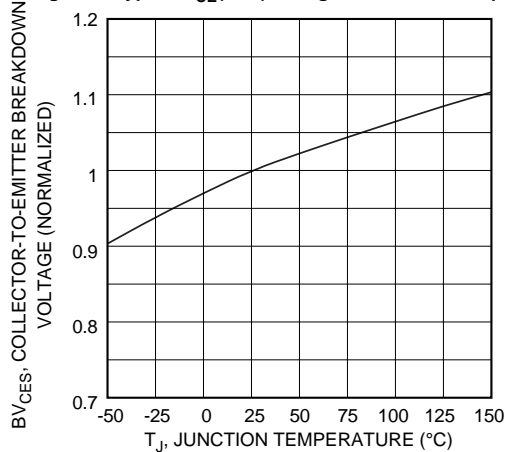


Figure 10, Breakdown Voltage vs Junction Temperature

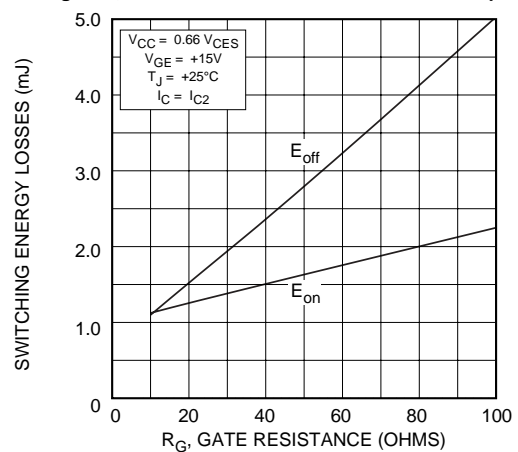


Figure 11, Typical Switching Energy Losses vs Gate Resistance

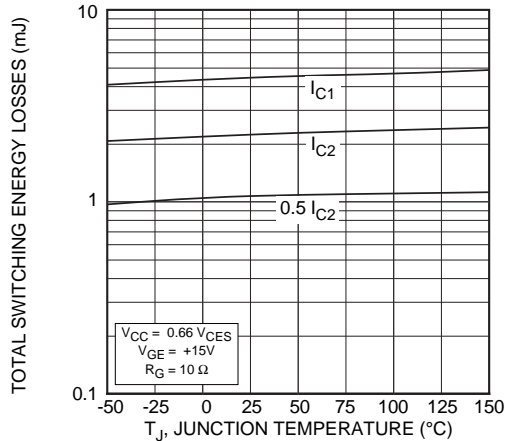


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

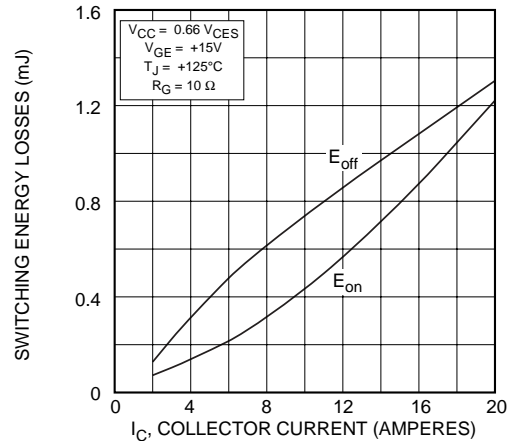


Figure 13, Typical Switching Energy Losses vs Collector Current

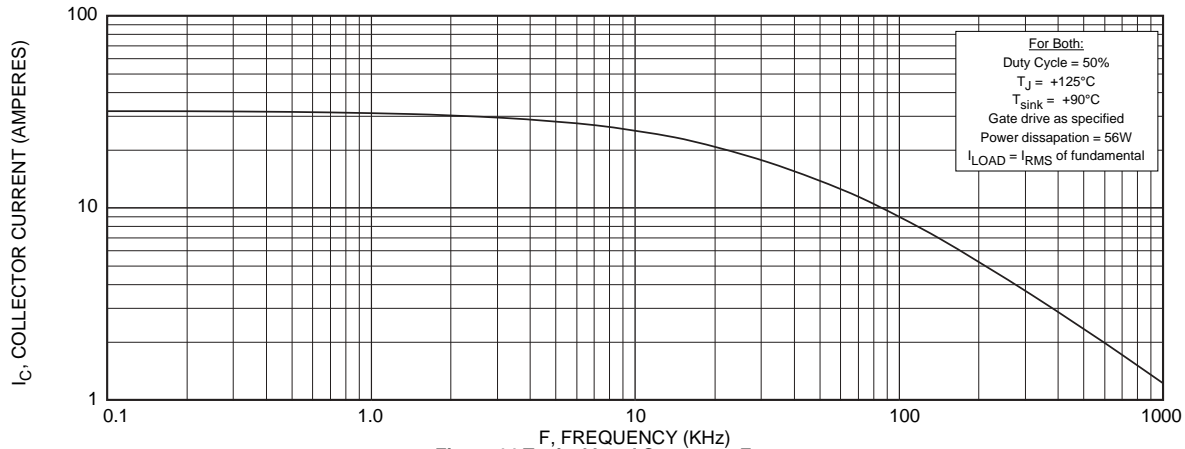


Figure 14, Typical Load Current vs Frequency

# APT20GF120KR

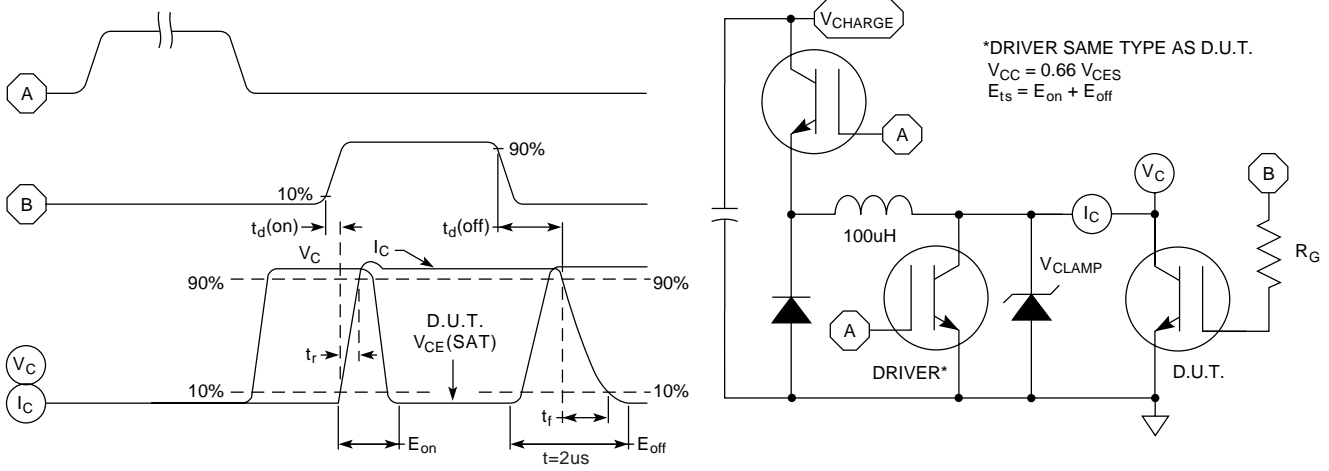


Figure 15, Switching Loss Test Circuit and Waveforms

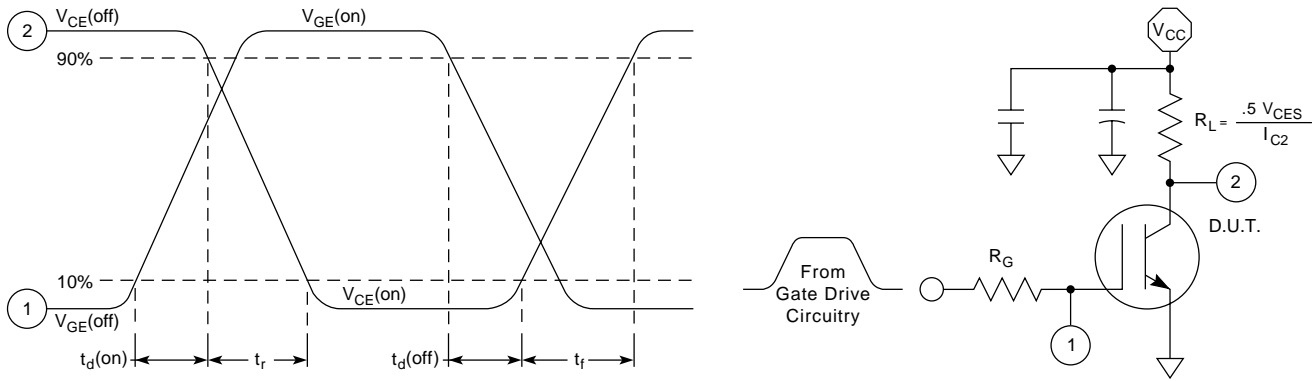
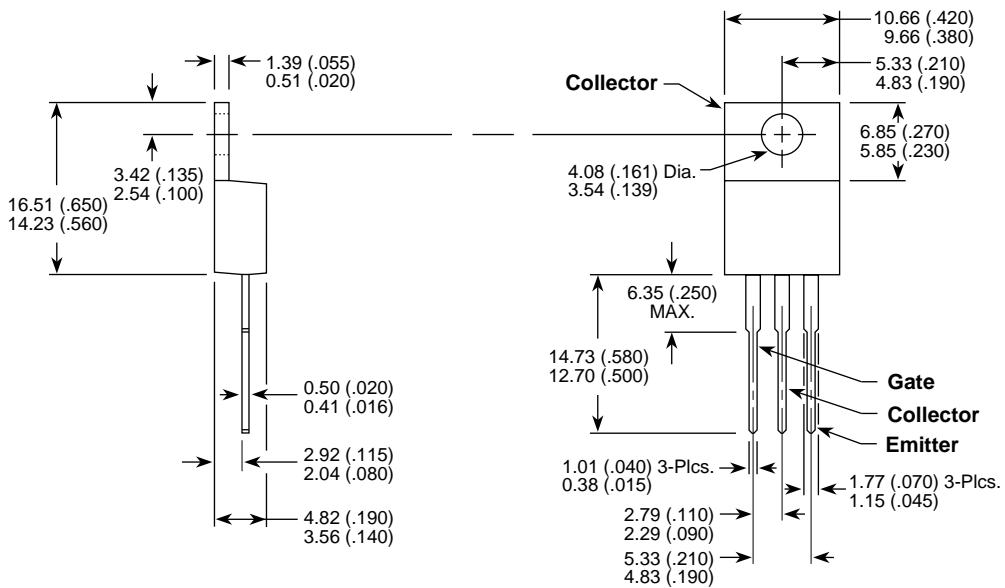


Figure 16, Resistive Switching Time Test Circuit and Waveforms

## 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