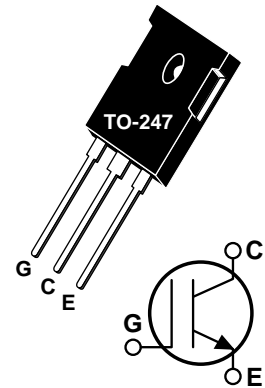


Thunderbolt IGBT™

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	APT15GT60BR	UNIT
V_{CES}	Collector-Emitter Voltage	600	Volts
V_{CGR}	Collector-Gate Voltage ($R_{GE} = 20K\Omega$)	600	
V_{GE}	Gate Emitter Voltage	± 20	
I_{C1}	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	30	Amps
I_{C2}	Continuous Collector Current @ $T_C = 105^\circ\text{C}$	15	
I_{CM}	Pulsed Collector Current ^① @ $T_C = 25^\circ\text{C}$	60	
I_{LM}	RBSOA Clamped Inductive Load Current $R_G = 11\Omega$ $T_C = 110^\circ\text{C}$	30	
E_{AS}	Single Pule Avalanche Energy ^②	24	mJ
P_D	Total Power Dissipation	125	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 ($V_{GE} = 0V, I_C = 0.5mA$)	600			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 700\mu A, T_J = 25^\circ\text{C}$)	3	4	5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = I_{C2}, T_J = 25^\circ\text{C}$)		2.0	2.5	
	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = I_{C2}, T_J = 150^\circ\text{C}$)			2.8	
I_{CES}	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_J = 25^\circ\text{C}$)			200	μA
	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_J = 150^\circ\text{C}$)			1500	
I_{GES}	Gate-Emitter Leakage Current ($V_{GE} = \pm 20V, V_{CE} = 0V$)			± 100	nA

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

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

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{ MHz}$		810	930	pF
C_{oes}	Output Capacitance			130	190	
C_{res}	Reverse Transfer Capacitance			52	90	
Q_g	Total Gate Charge ^③	Gate Charge $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$		74	110	nC
Q_{ge}	Gate-Emitter Charge			5	8	
Q_{gc}	Gate-Collector ("Miller") Charge			34	50	
$t_d(\text{on})$	Turn-on Delay Time	Resistive Switching (25°C) $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$ $R_G = 10\Omega$		9	20	ns
t_r	Rise Time			27	50	
$t_d(\text{off})$	Turn-off Delay Time			92	140	
t_f	Fall Time			123	250	
$t_d(\text{on})$	Turn-on Delay Time	Inductive Switching (150°C) $V_{CLAMP}(\text{Peak}) = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +150^\circ\text{C}$		11	21	ns
t_r	Rise Time			13	30	
$t_d(\text{off})$	Turn-off Delay Time			110	170	
t_f	Fall Time			148	300	
E_{on}	Turn-on Switching Energy			160	320	
E_{off}	Turn-off Switching Energy		465	930	μJ	
E_{ts}	Total Switching Losses		625	1250		
$t_d(\text{on})$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CLAMP}(\text{Peak}) = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +25^\circ\text{C}$		11	20	ns
t_r	Rise Time			13	30	
$t_d(\text{off})$	Turn-off Delay Time			91	140	
t_f	Fall Time			67	130	
E_{ts}	Total Switching Losses			395	790	
g_{fe}	Forward Transconductance	$V_{CE} = 20V, I_C = I_{C2}$	3			S

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			1.0	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction to Ambient			40	
W_T	Package Weight		0.22		oz
			5.90		gm

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

② $I_C = I_{C2}, V_{CC} = 50V, R_{GE} = 25\Omega, L = 200\mu\text{H}, T_J = 25^\circ\text{C}$

③ See MIL-STD-750 Method 3471

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

APT15GT60BR

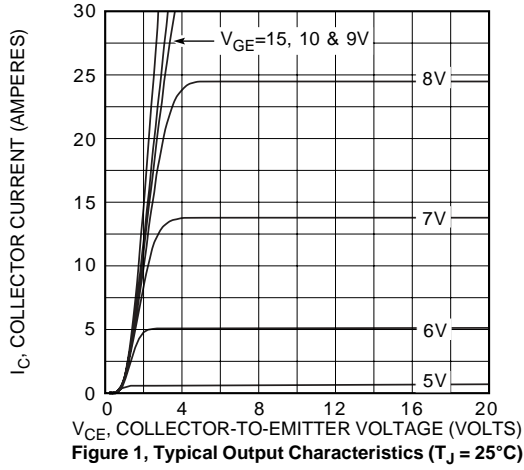


Figure 1, Typical Output Characteristics ($T_J = 25^\circ\text{C}$)

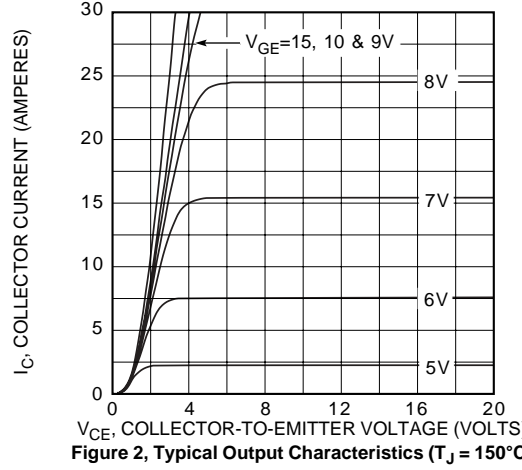


Figure 2, Typical Output Characteristics ($T_J = 150^\circ\text{C}$)

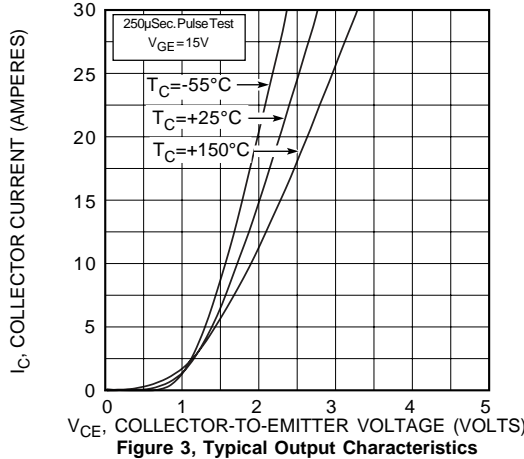


Figure 3, Typical Output Characteristics

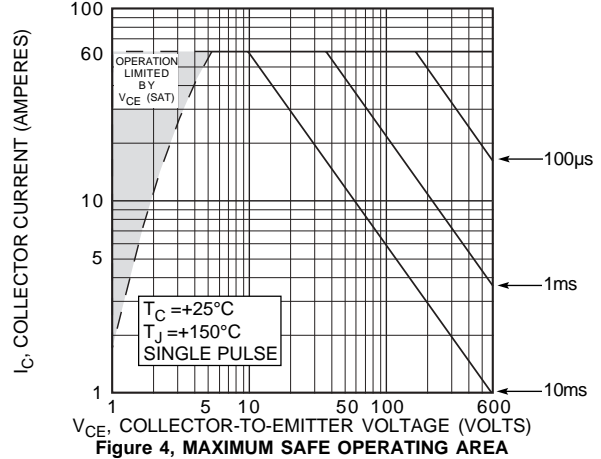


Figure 4, MAXIMUM SAFE OPERATING AREA

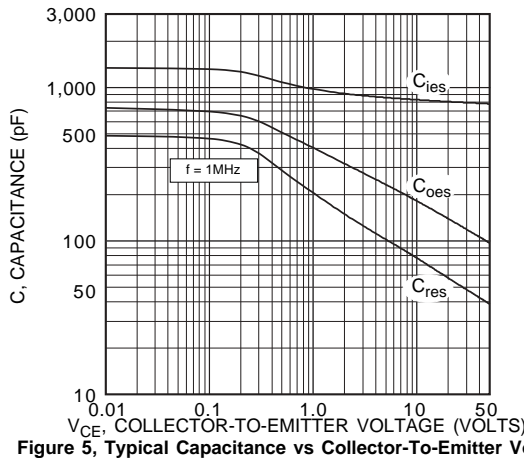


Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage

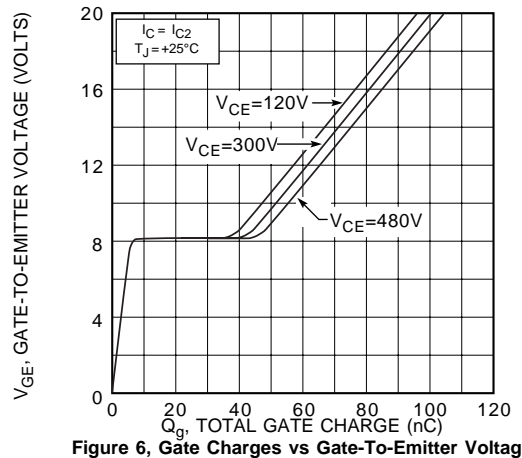


Figure 6, Gate Charges vs Gate-To-Emitter Voltage

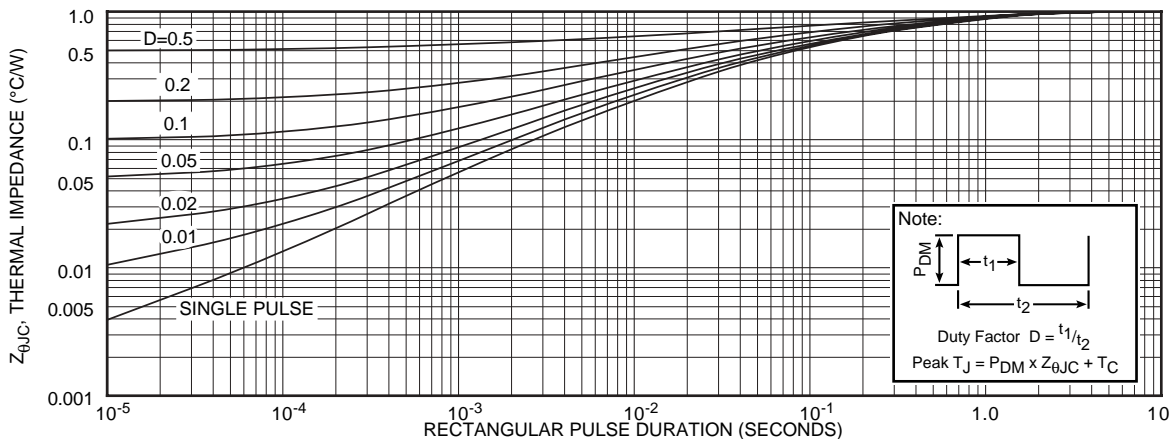


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

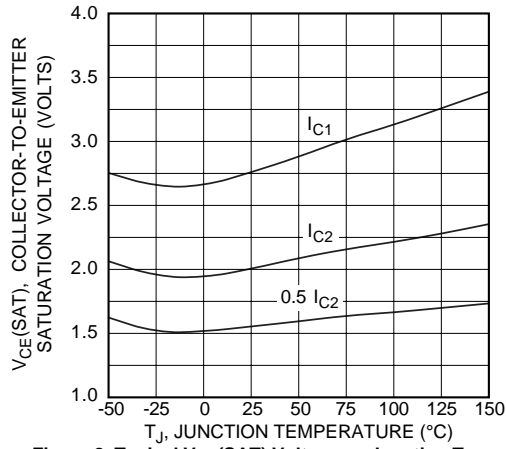


Figure 8, Typical $V_{CE(SAT)}$ Voltage vs Junction Temperature

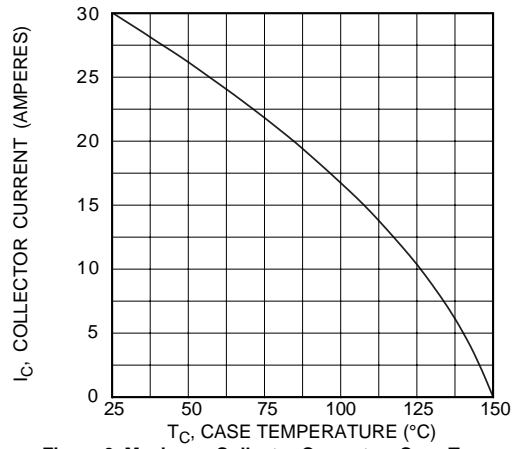


Figure 9, Maximum Collector Current vs Case Temperature

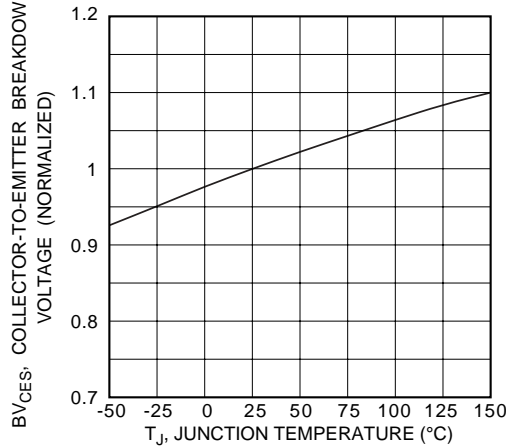


Figure 10, Breakdown Voltage vs Junction Temperature

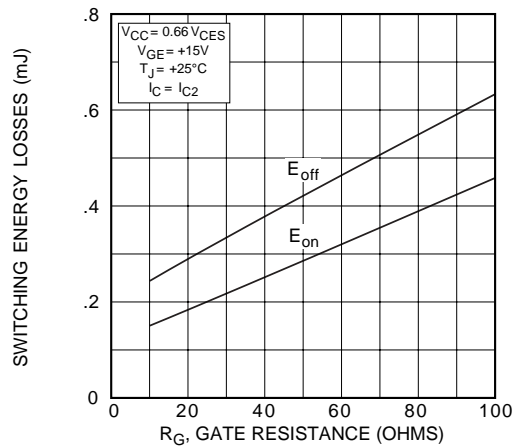


Figure 11, Typical Switching Energy Losses vs Gate Resistance

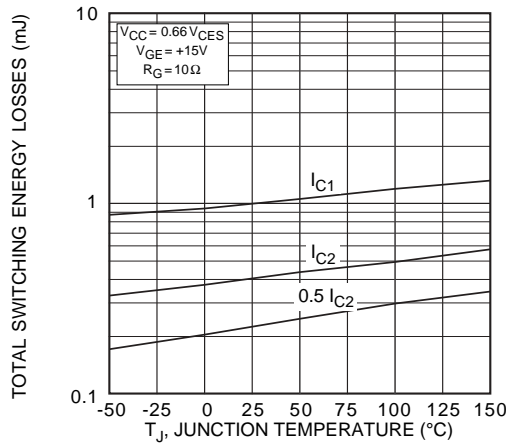


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

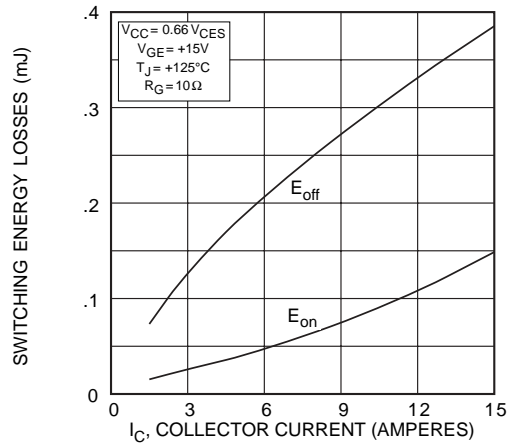


Figure 13, Typical Switching Energy Losses vs Collector Current

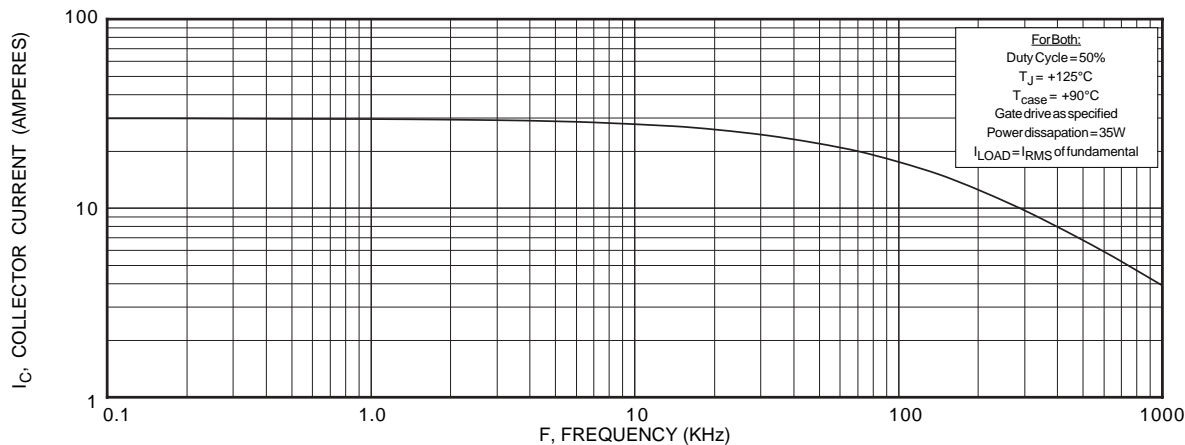


Figure 14, Typical Load Current vs Frequency

APT15GT60BR

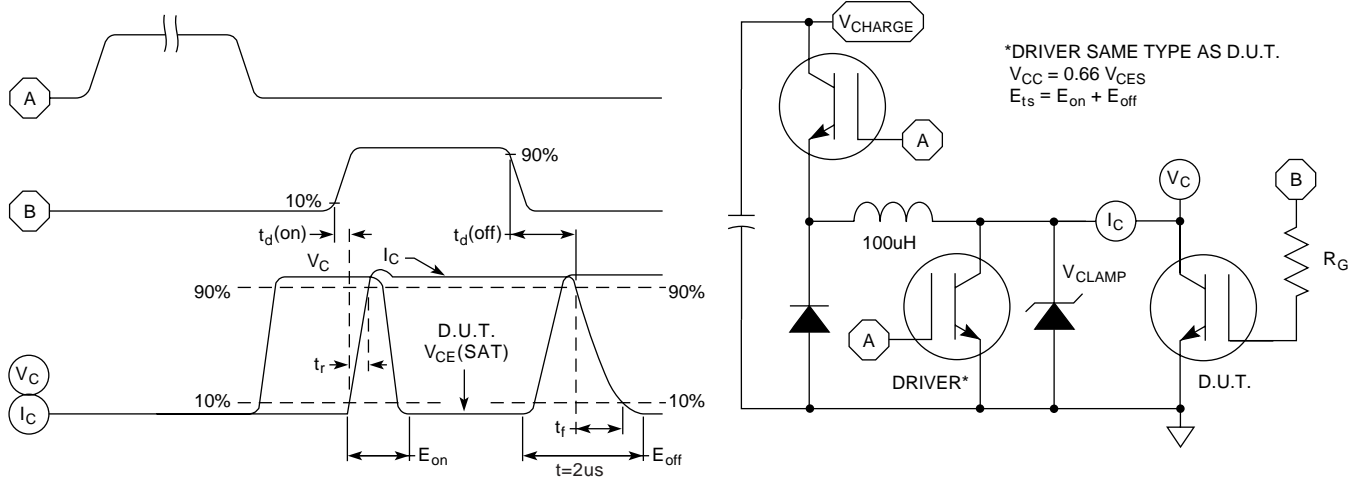


Figure 15, Switching Loss Test Circuit and Waveforms

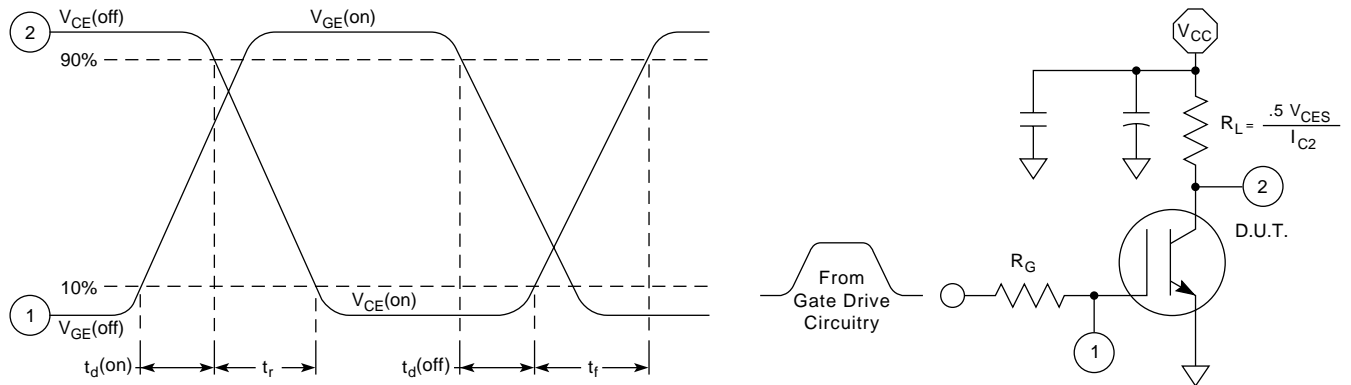
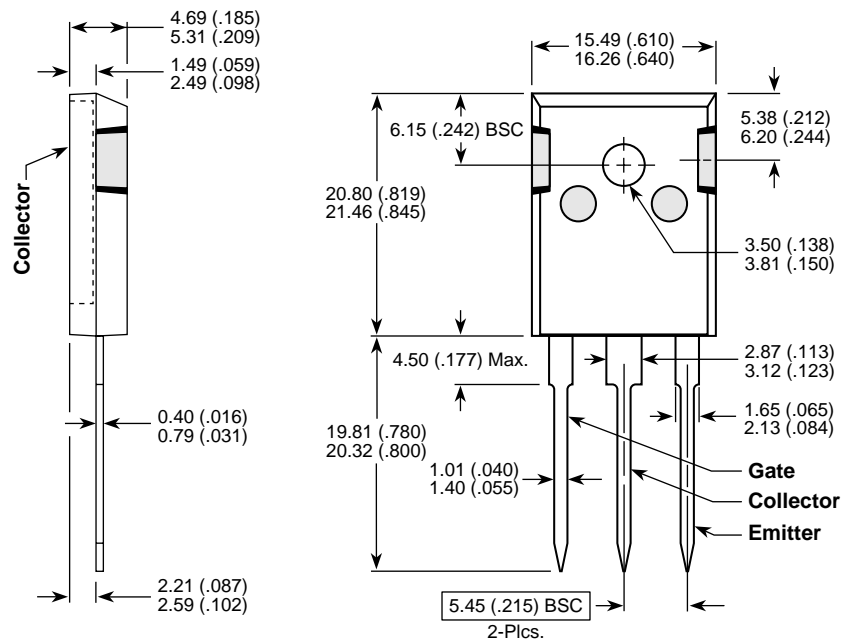


Figure 16, Resistive Switching Time Test Circuit and Waveforms

T0-247 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