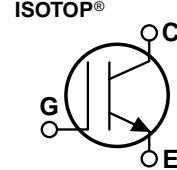
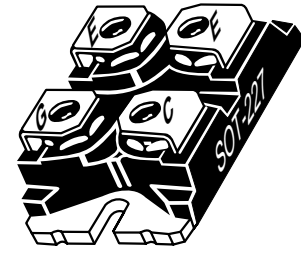


Thunderbolt IGBT™

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 ($R_{GE} = 20K\Omega$)	600	
V_{GE}	Gate Emitter Voltage	± 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 ^① @ $T_C = 25^\circ\text{C}$	360	
I_{LM}	RBSOA Clamped Inductive Load Current $R_G = 11\Omega$ $T_C = 25^\circ\text{C}$	360	
E_{AS}	Single Pule Avalanche Energy ^②	65	mJ
P_D	Total Power Dissipation	378	Watts
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°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 ($V_{CE} = V_{GE}, I_C = 500\mu A, T_j = 25^\circ\text{C}$)	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 ($V_{GE} = 15V, I_C = I_{C2}, T_j = 125^\circ\text{C}$)			2.8	
I_{CES}	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25^\circ\text{C}$)			80	μA
	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125^\circ\text{C}$)			2000	
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

APT60GT60JR

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{ MHz}$		1600		pF
C_{oes}	Output Capacitance			150		
C_{res}	Reverse Transfer Capacitance			92		
Q_g	Total Gate Charge ^③	Gate Charge $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$		257	410	nC
Q_{ge}	Gate-Emitter Charge			19	30	
Q_{gc}	Gate-Collector ("Miller") Charge			120	180	
$t_{d(on)}$	Turn-on Delay Time	Resistive Switching (25°C) $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$ $R_G = 5\Omega$		20	40	ns
t_r	Rise Time			95	190	
$t_{d(off)}$	Turn-off Delay Time			315	470	
t_f	Fall Time			245	490	
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (150°C) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 5\Omega$ $T_J = +150^\circ C$		25	50	ns
t_r	Rise Time			59	120	
$t_{d(off)}$	Turn-off Delay Time			430	650	
t_f	Fall Time			65	130	
E_{on}	Turn-on Switching Energy			1.6	3.2	
E_{off}	Turn-off Switching Energy		2.4	4.8	mJ	
E_{ts}	Total Switching Losses		4.0	8.0		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 5\Omega$ $T_J = +25^\circ C$		26	50	ns
t_r	Rise Time			63	125	
$t_{d(off)}$	Turn-off Delay Time			395	590	
t_f	Fall Time			68	140	
E_{ts}	Total Switching Losses			3.4	7.0	
gfe	Forward Transconductance	$V_{CE} = 20V, I_C = I_{C2}$	4			S

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.33	°C/W
$R_{\theta JA}$	Junction to Ambient			20	
W_T	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 $I_C = I_{C2}$, $R_{GE} = 25\Omega$, $L = 100\mu H$, $T_J = 25^\circ C$

③ See MIL-STD-750 Method 3471

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

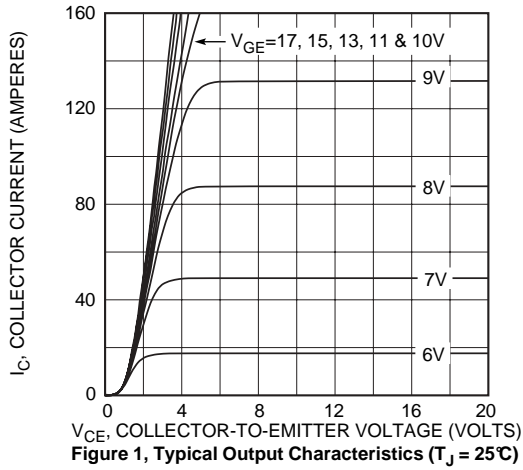


Figure 1, Typical Output Characteristics ($T_J = 25^\circ\text{C}$)

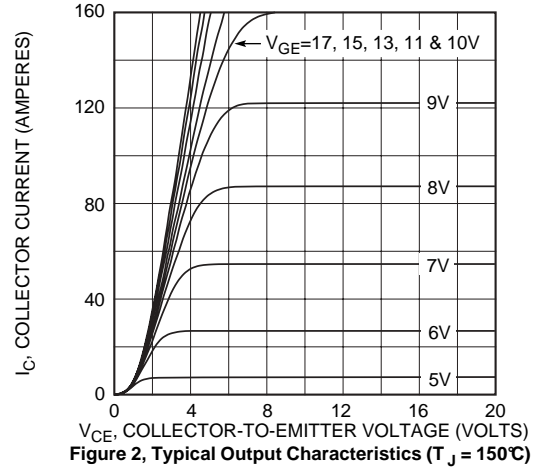


Figure 2, Typical Output Characteristics ($T_J = 150^\circ\text{C}$)

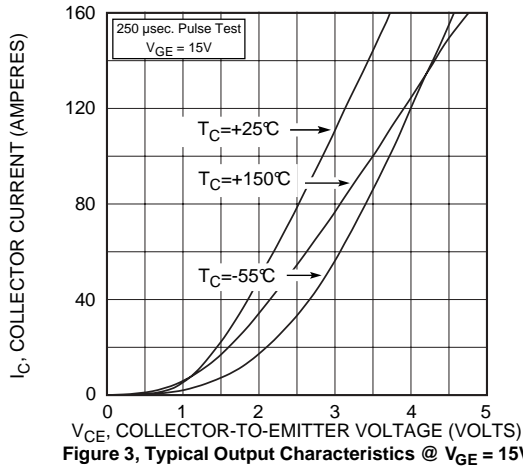


Figure 3, Typical Output Characteristics @ $V_{GE} = 15\text{V}$

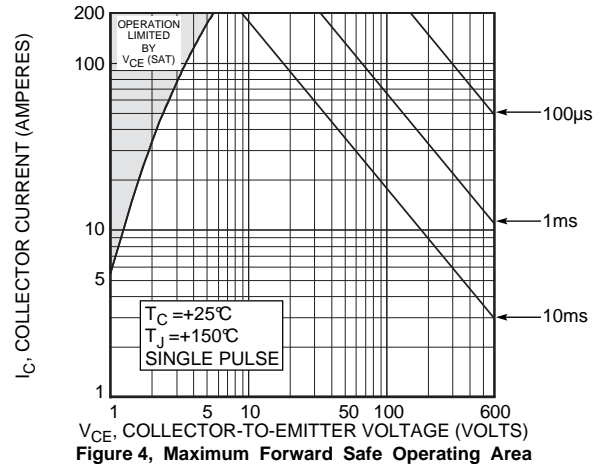


Figure 4, Maximum Forward Safe Operating Area

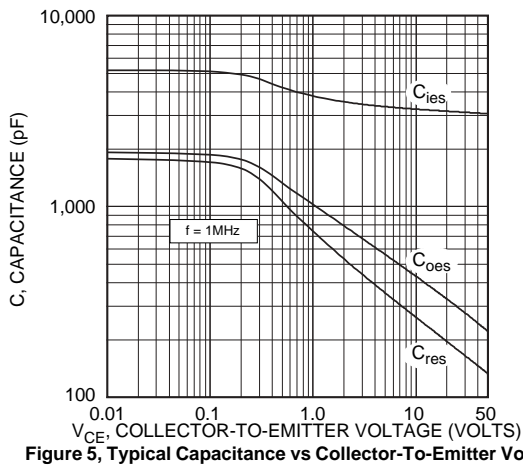


Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage

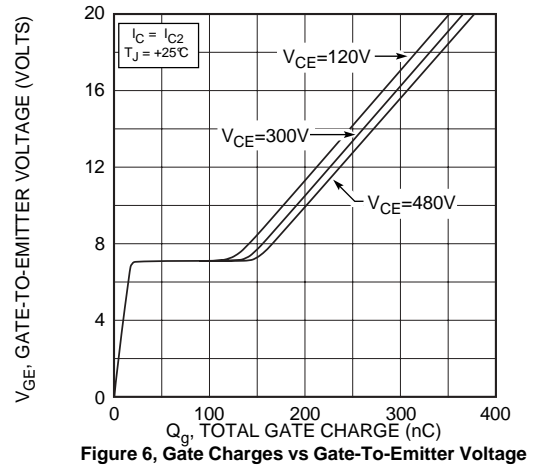


Figure 6, Gate Charges vs Gate-To-Emitter Voltage

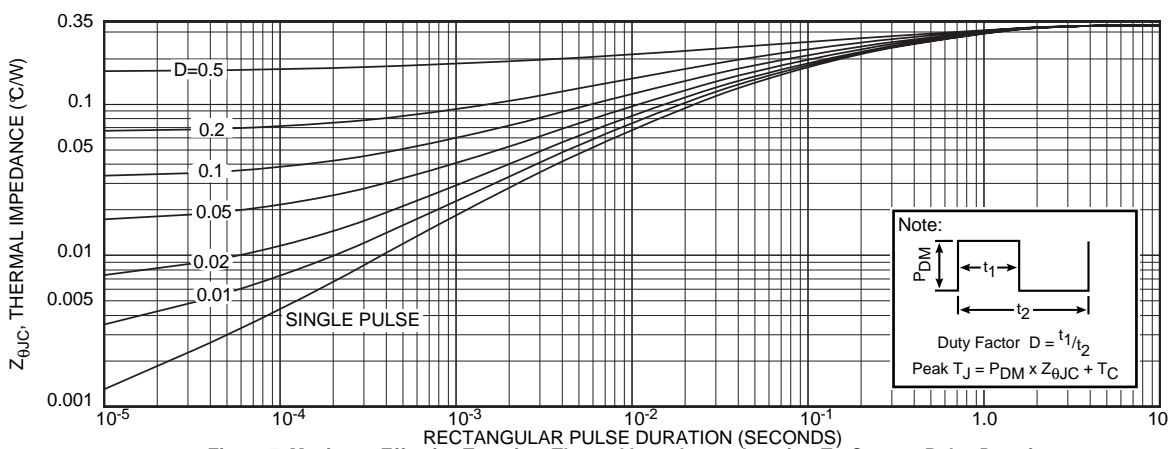


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

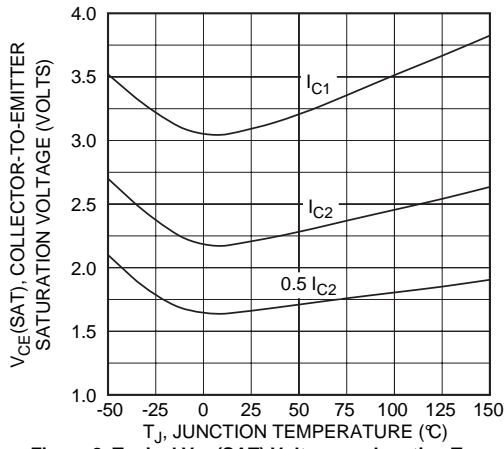


Figure 8, Typical $V_{CE(SAT)}$ Voltage vs Junction Temperature

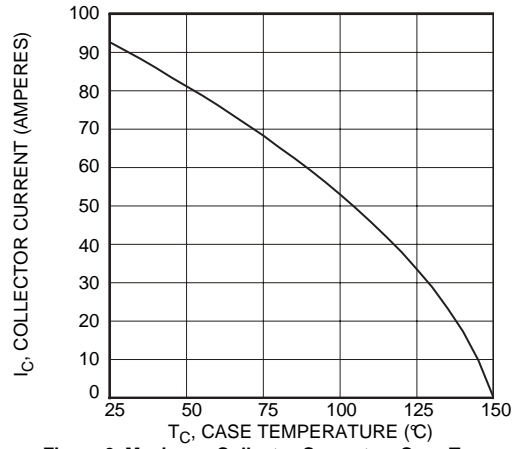


Figure 9, Maximum Collector Current vs Case Temperature

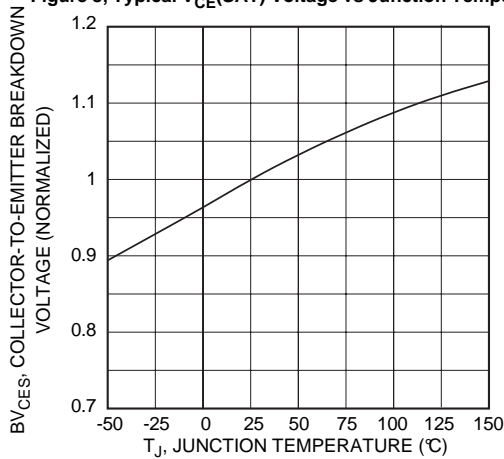


Figure 10, Breakdown Voltage vs Junction Temperature

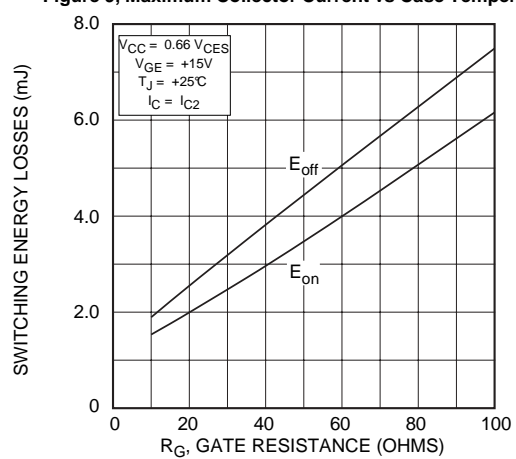


Figure 11, Typical Switching Energy Losses vs Gate Resistance

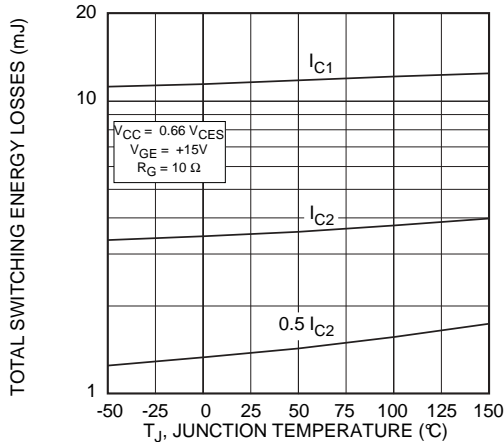


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

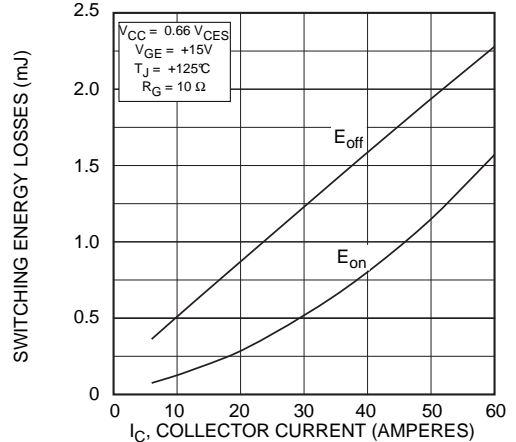


Figure 13, Typical Switching Energy Losses vs Collector Current

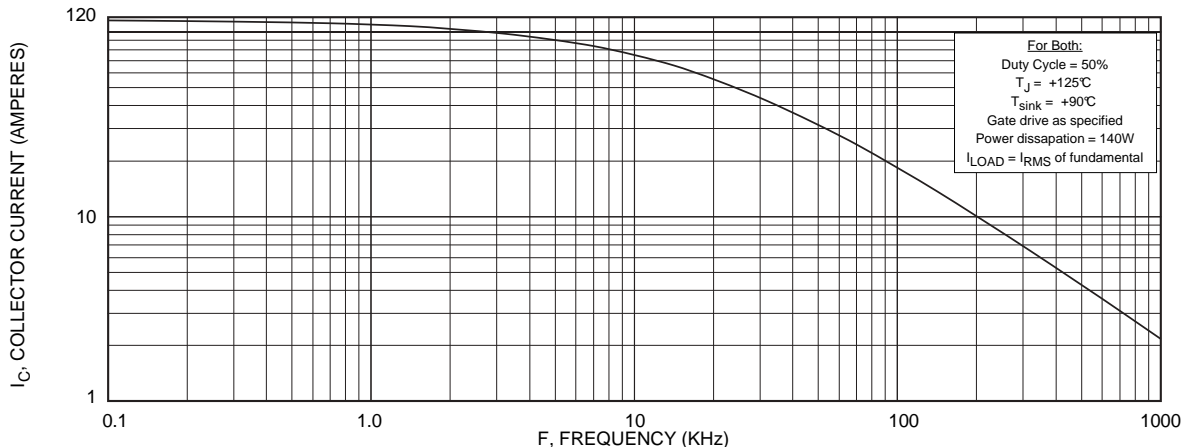


Figure 14, Typical Load Current vs Frequency

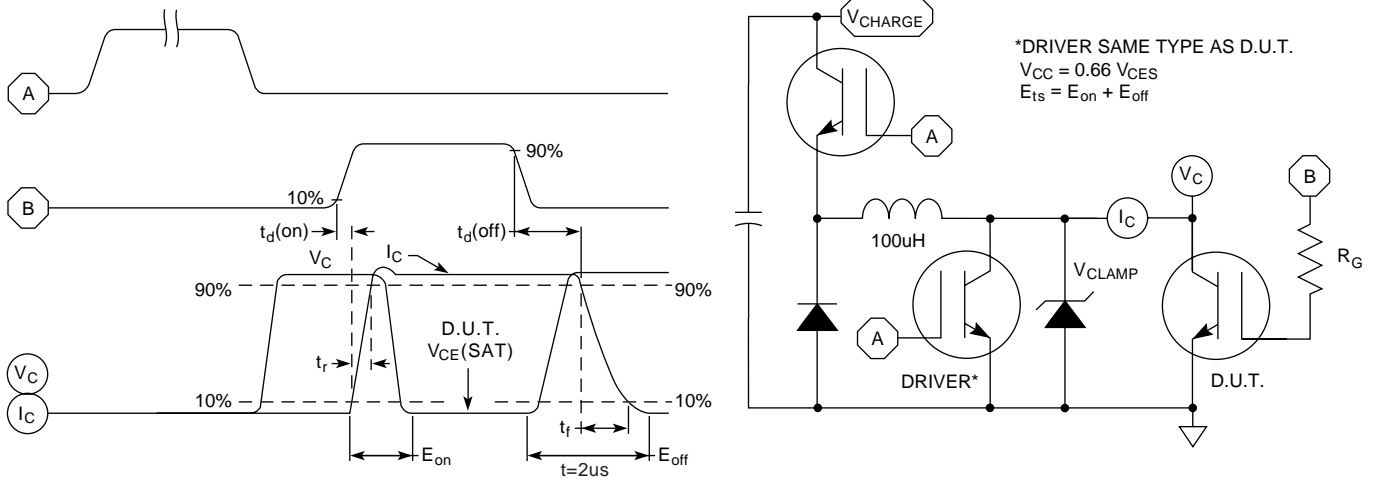


Figure 15, Switching Loss Test Circuit and Waveforms

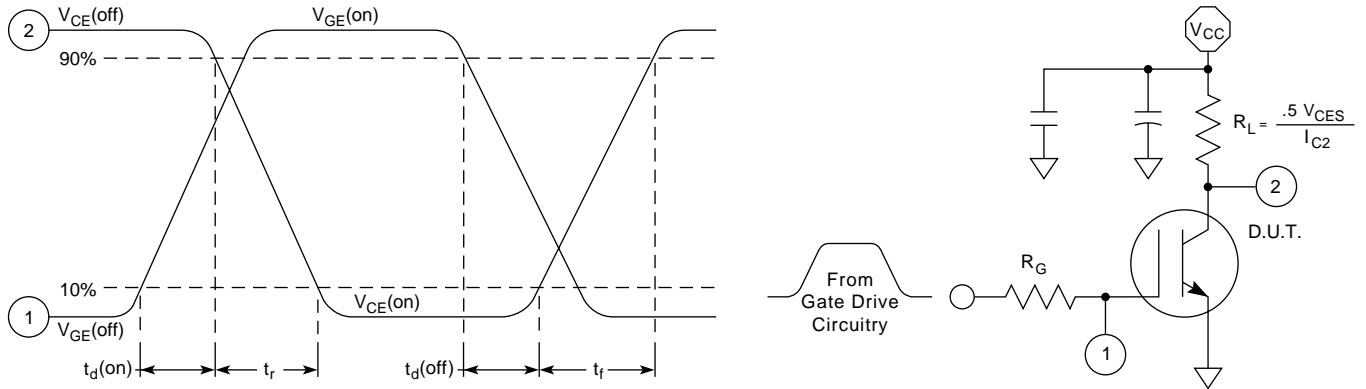
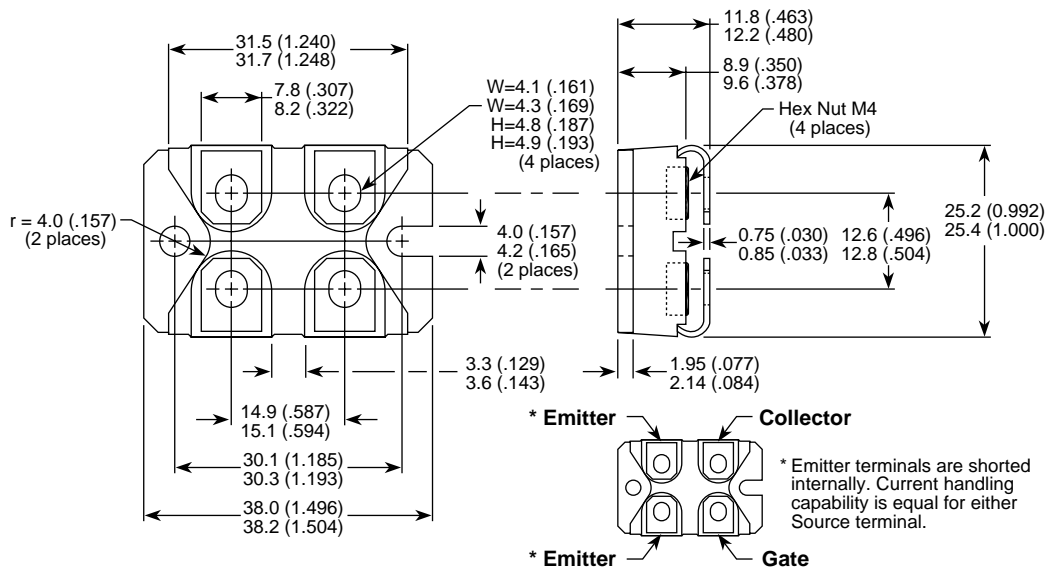


Figure 16, Resistive Switching Time Test Circuit and Waveforms

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)

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