


## 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.

### Features

- Low Forward Voltage Drop
- Low Tail Current
- Integrated Gate Resistor
- Low EMI, High Reliability
- RoHS Compliant 
- RBSOA and SCSOA Rated
- High Frequency Switching to 50KHz
- Ultra Low Leakage Current



Unless stated otherwise, Microsemi discrete IGBTs contain a single IGBT die. This device is made with two parallel IGBT die. It is intended for switch-mode operation. It is not suitable for linear mode operation.

### Maximum Ratings

All Ratings:  $T_c = 25^\circ C$  unless otherwise specified.

Symbol	Parameter	Ratings	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	Volts
$V_{GE}$	Gate-Emitter Voltage	$\pm 20$	
$I_{C1}$	Continuous Collector Current @ $T_c = 25^\circ C$	123	Amps
$I_{C2}$	Continuous Collector Current @ $T_c = 100^\circ C$	67	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	200	
SSOA	Switching Safe Operating Area @ $T_j = 150^\circ C$	200A @ 1200V	
$P_D$	Total Power Dissipation	570	Watts
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ C$
$T_L$	Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec.	300	

### Static Electrical Characteristics

Symbol	Characteristic / Test Conditions	Min	Typ	Max	Unit
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V, I_C = 5mA$ )	1200	-	-	Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 4mA, T_j = 25^\circ C$ )	4.5	5.5	6.5	
$V_{CE(ON)}$	Collector Emitter On Voltage ( $V_{GE} = 15V, I_C = 100A, T_j = 25^\circ C$ )	2.7	3.2	3.7	
	Collector Emitter On Voltage ( $V_{GE} = 15V, I_C = 100A, T_j = 125^\circ C$ )	-	4.0	-	
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_j = 25^\circ C$ ) <sup>②</sup>	-	-	100	$\mu A$
	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_j = 125^\circ C$ ) <sup>②</sup>	-	-	TBD	
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )	-	-	600	nA
$R_{G(int)}$	Integrated Gate Resistor	-	5	-	$\Omega$



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

## Dynamic Characteristics

APT100GT120JR

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	$V_{GE} = 0V, V_{CE} = 25V$ $f = 1MHz$	-	6700	-	pF
$C_{oes}$	Output Capacitance		-	653	-	
$C_{res}$	Reverse Transfer Capacitance		-	440	-	
$V_{GEP}$	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 100A$	-	10	-	V
$Q_g$	Total Gate Charge		-	685	-	nC
$Q_{ge}$	Gate-Emitter Charge		-	75	-	
$Q_{gc}$	Gate-Collector Charge		-	400	-	
SSOA	Switching Safe Operating Area	$T_J = 150^\circ C, R_G = 1.0\Omega^{(2)}, V_{GE} = 15V,$ $L = 100\mu H, V_{CE} = 1200V$	150			A
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching ( $25^\circ C$ ) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 100A$ $R_G = 4.7\Omega$ $T_J = +25^\circ C$	-	50	-	ns
$t_r$	Current Rise Time		-	100	-	
$t_{d(off)}$	Turn-Off Delay Time		-	630	-	
$t_f$	Current Fall Time		-	36	-	$\mu J$
$E_{on1}$	Turn-On Switching Energy <sup>(4)</sup>		-	TBD	-	
$E_{on2}$	Turn-On Switching Energy <sup>(5)</sup>		-	17600	-	
$E_{off}$	Turn-Off Switching Energy <sup>(6)</sup>	-	7240	-		
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching ( $125^\circ C$ ) $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 100A$ $R_G = 4.7\Omega$ $T_J = 125^\circ C$	-	50	-	ns
$t_r$	Current Rise Time		-	100	-	
$t_{d(off)}$	Turn-Off Delay Time		-	710	-	
$t_f$	Current Fall Time		-	37	-	$\mu J$
$E_{on1}$	Turn-On Switching Energy <sup>(4)</sup>		-	TBD	-	
$E_{on2}$	Turn-On Switching Energy <sup>(5)</sup>		-	22380	-	
$E_{off}$	Turn-Off Switching Energy <sup>(6)</sup>	-	10950	-		

## Thermal and Mechanical Characteristics

Symbol	Characteristic / Test Conditions	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case	-	-	0.22	$^\circ C/W$
$W_T$	Package Weight	-	29.2	-	gm
$V_{isolation}$	RMS Voltage (50-60Hz Sinusoidal Waveform from Terminals to Mounting Base for 1 Min.)	2500	-	-	Volts

- ① Repetitive Rating: Pulse width limited by maximum junction temperature.
- ② For Combi devices,  $I_{ces}$  includes both IGBT and FRED leakages
- ③ See MIL-STD-750 Method 3471.
- ④  $E_{on1}$  is the clamped inductive turn-on energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to the IGBT turn-on loss. Tested in inductive switching test circuit shown in figure 21, but with a Silicon Carbide diode.
- ⑤  $E_{on2}$  is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22.)
- ⑥  $E_{off}$  is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See Figures 21, 23.)
- ⑦  $R_G$  is external gate resistance not including gate driver impedance.

Microsemi reserves the right to change, without notice, the specifications and information contained herein.

Typical Performance Curves

APT100GT120JR

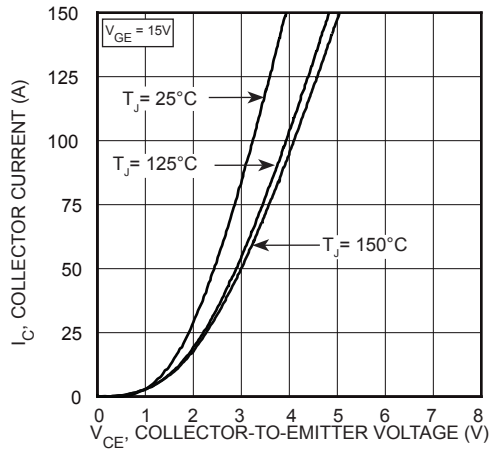


FIGURE 1, Output Characteristics ( $T_j = 25^\circ\text{C}$ )

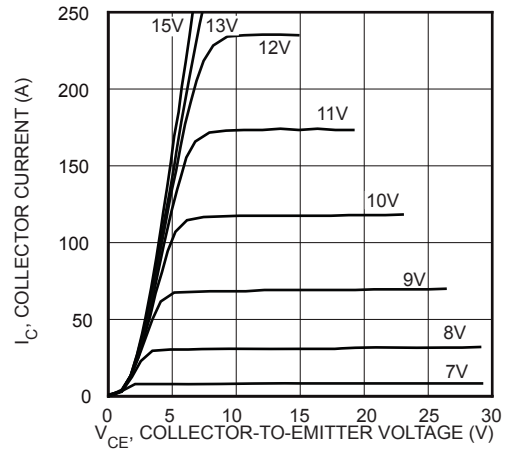


FIGURE 2, Output Characteristics ( $T_j = 25^\circ\text{C}$ )

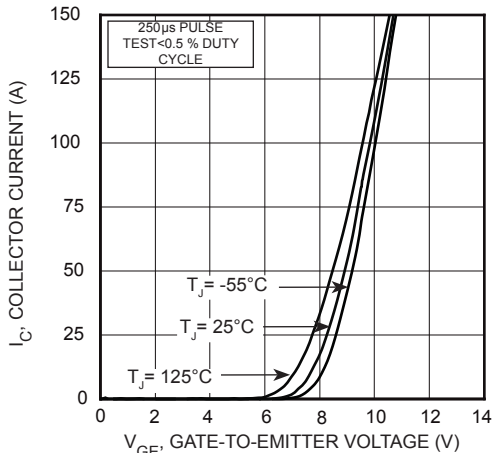


FIGURE 3, Transfer Characteristics

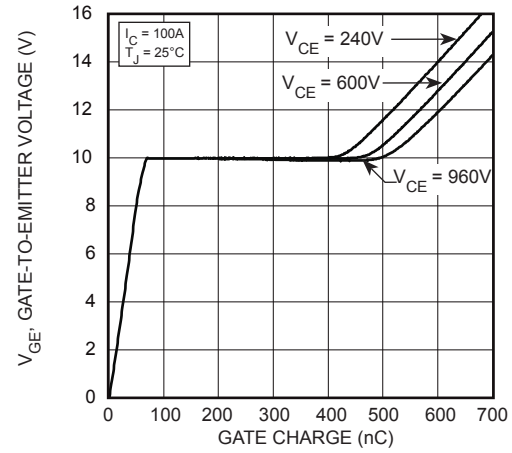


FIGURE 4, Gate charge

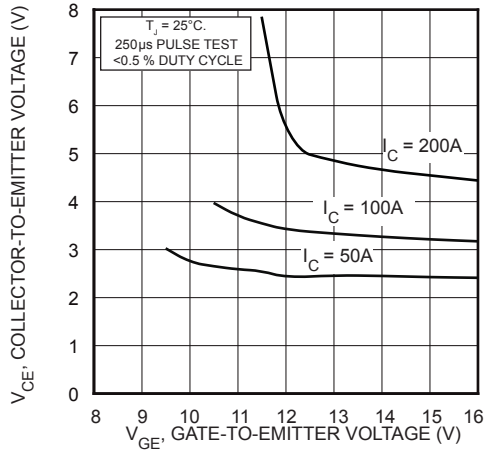


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

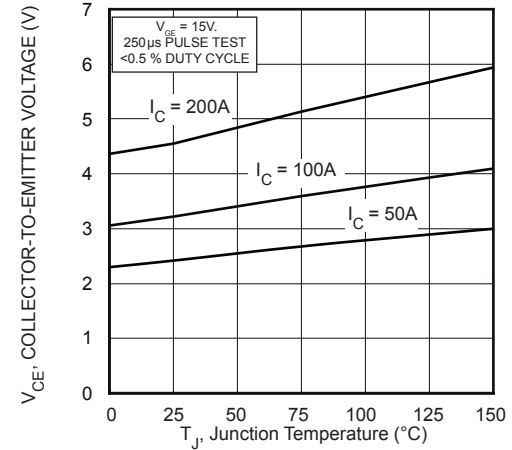


FIGURE 6, On State Voltage vs Junction Temperature

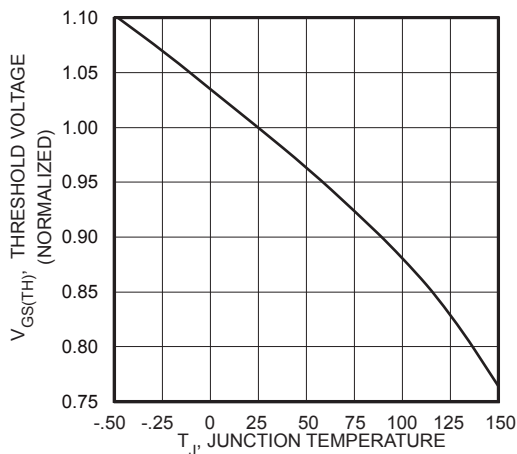


FIGURE 7, Threshold Voltage vs Junction Temperature

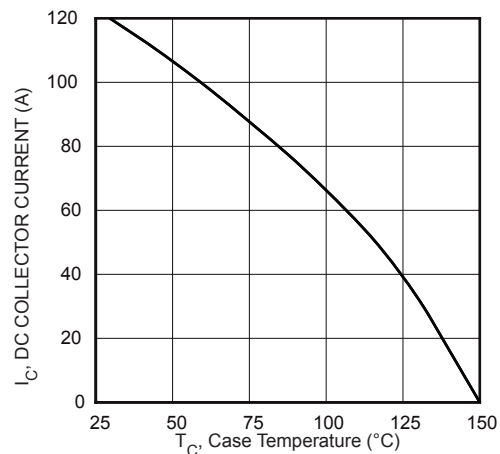


FIGURE 8, DC Collector Current vs Case Temperature

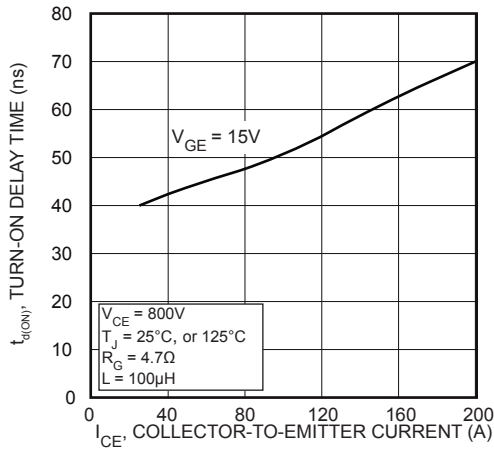


FIGURE 9, Turn-On Delay Time vs Collector Current

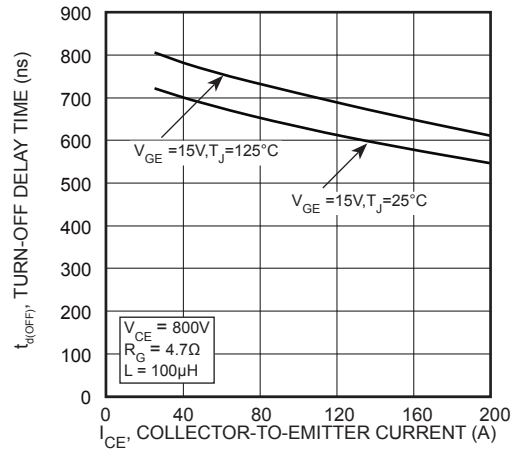


FIGURE 10, Turn-Off Delay Time vs Collector Current

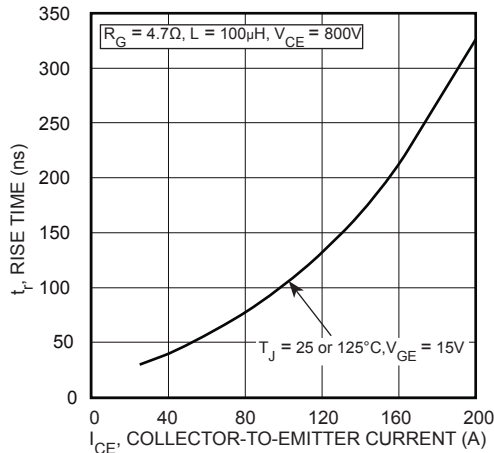


FIGURE 11, Current Rise Time vs Collector Current

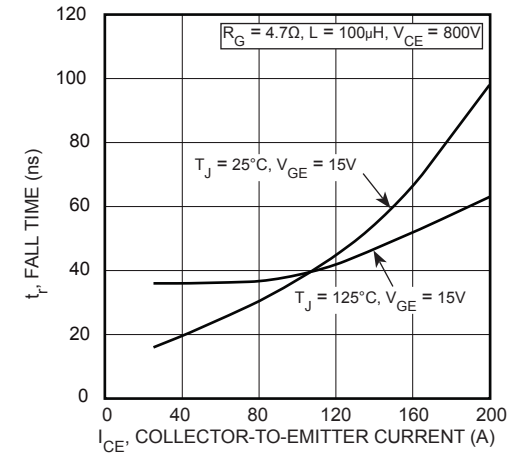


FIGURE 12, Current Fall Time vs Collector Current

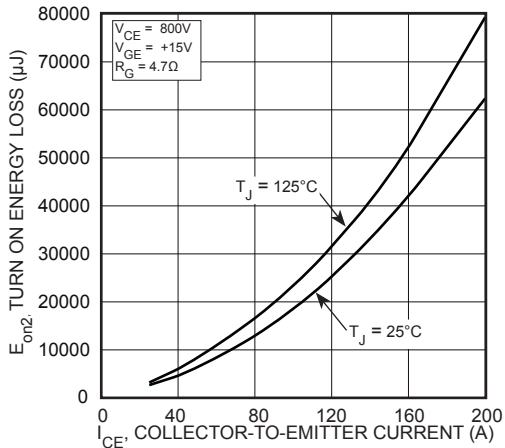


FIGURE 13, Turn-On Energy Loss vs Collector Current

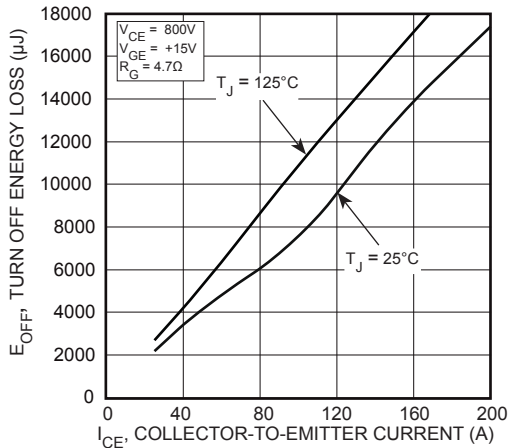


FIGURE 14, Turn-Off Energy Loss vs Collector Current

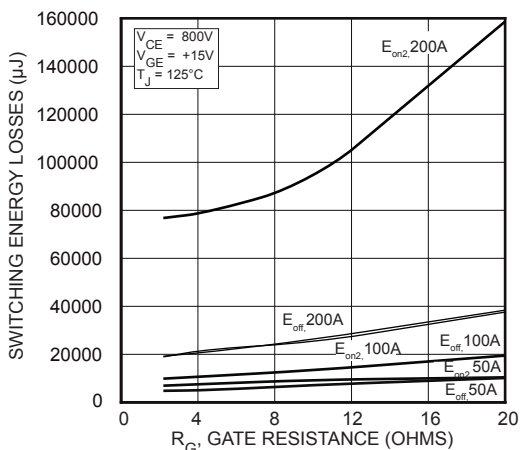


FIGURE 15, Switching Energy Losses vs Gate Resistance

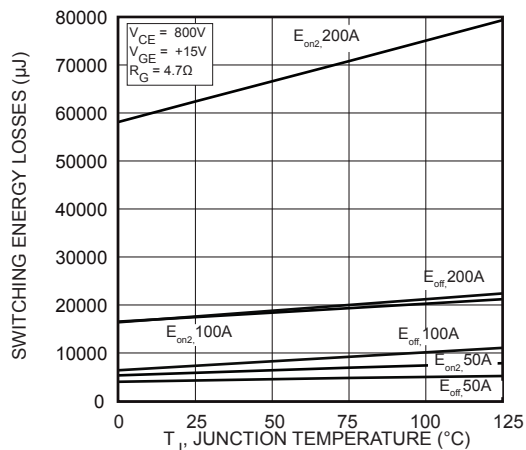


FIGURE 16, Switching Energy Losses vs Junction Temperature

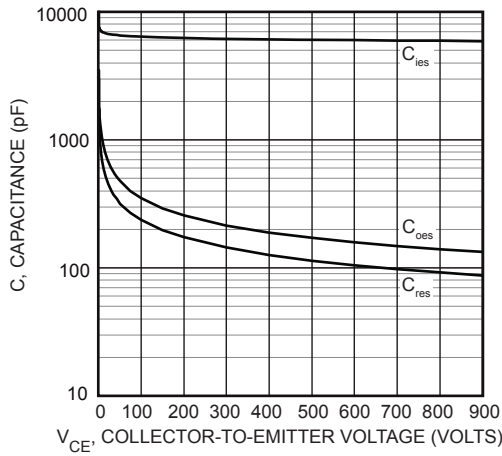


FIGURE 17, Capacitance vs Collector-To-Emitter Voltage

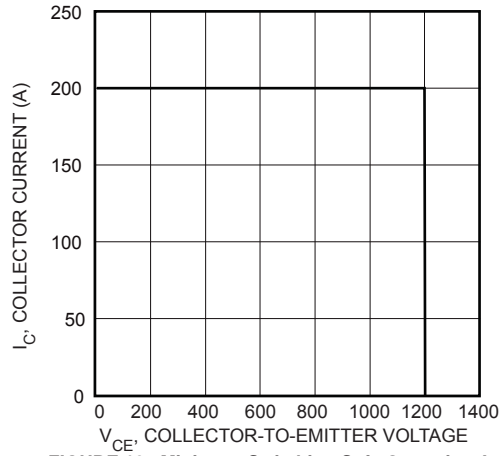


FIGURE 18, Minimum Switching Safe Operating Area

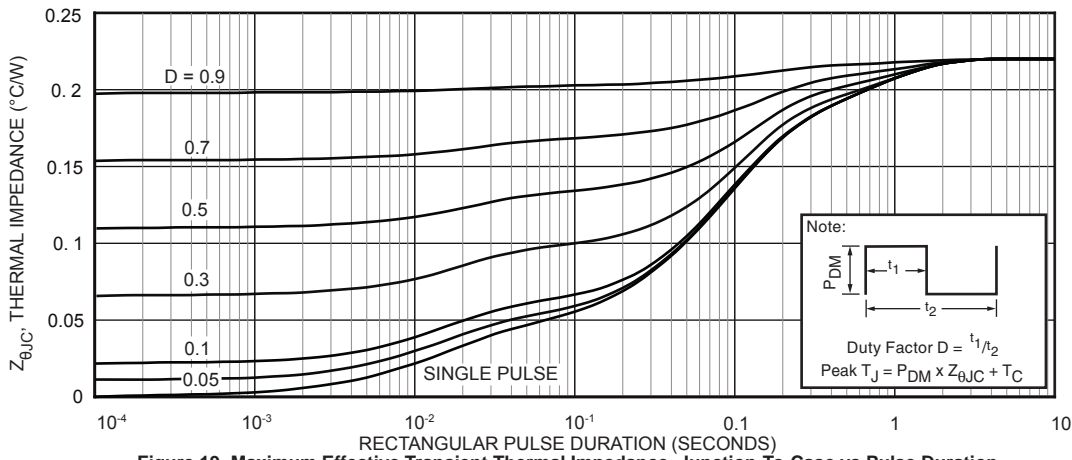


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

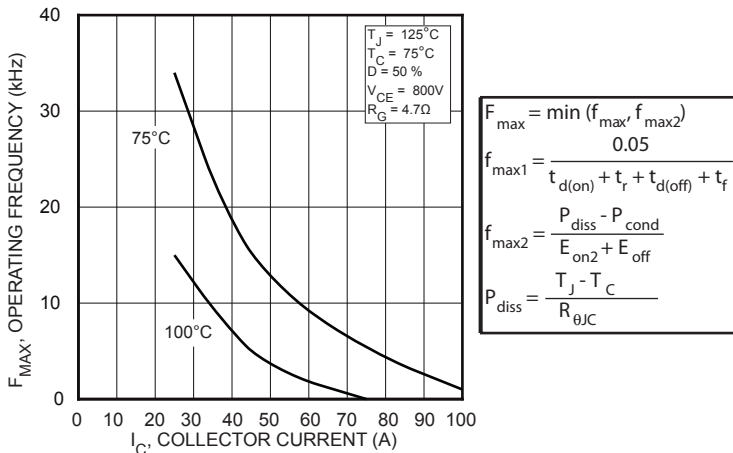


Figure 20, Operating Frequency vs Collector Current

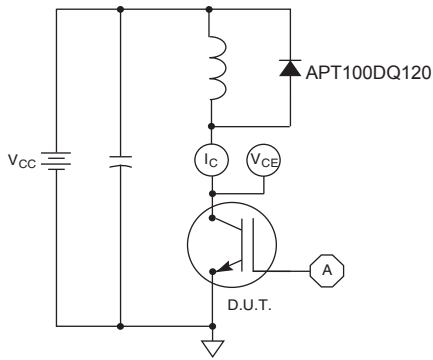


Figure 21, Inductive Switching Test Circuit

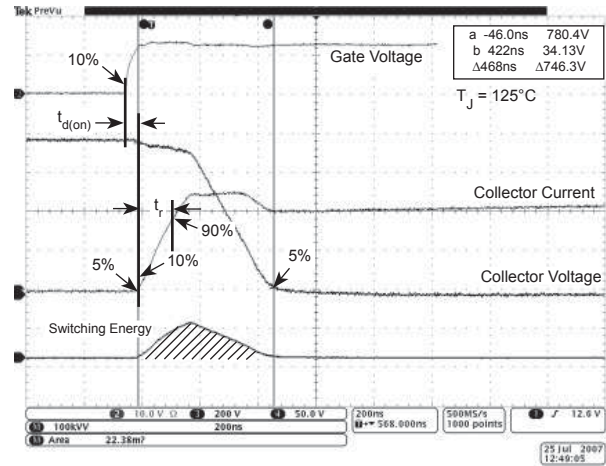


Figure 22, Turn-on Switching Waveforms and Definitions

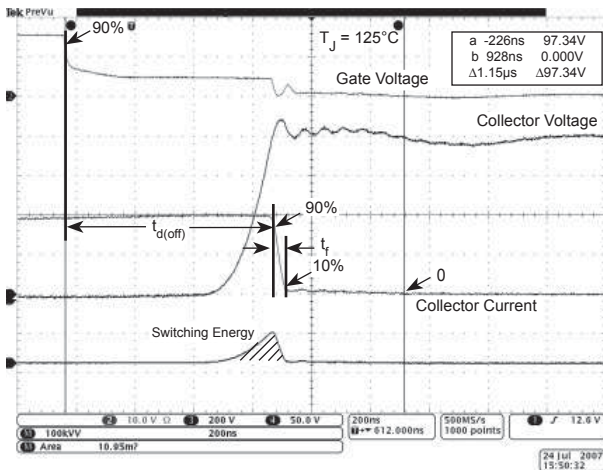
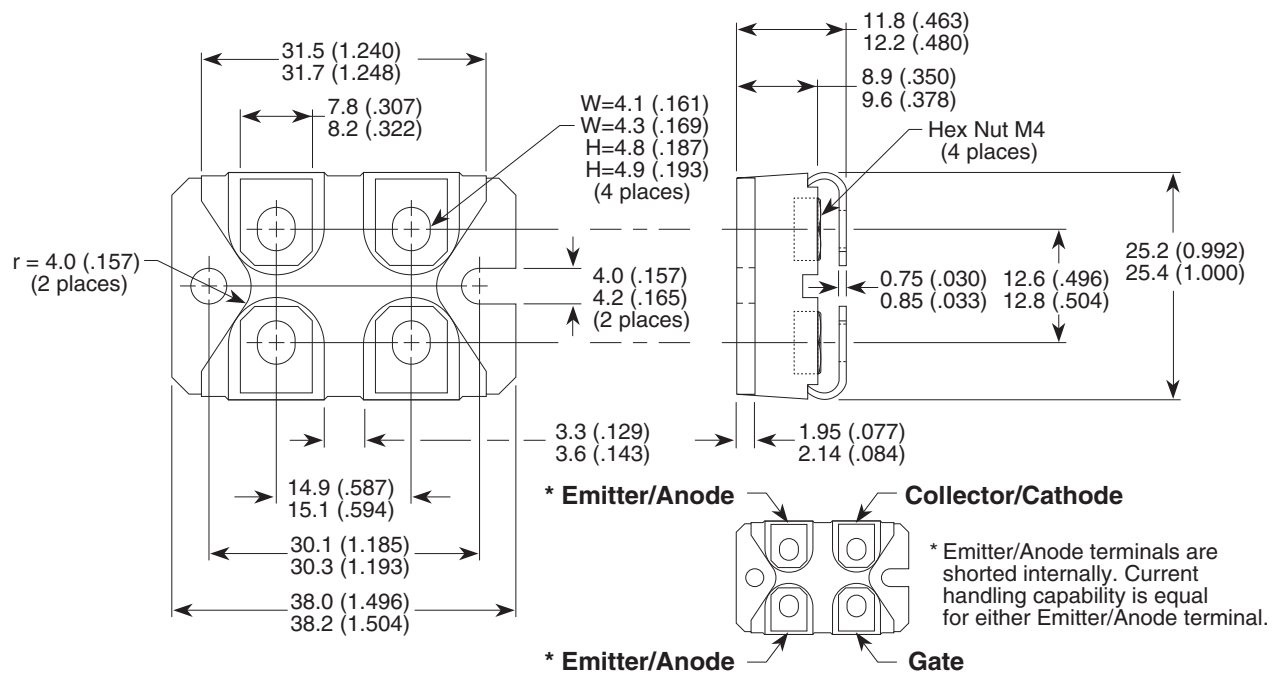


Figure 23, Turn-off Switching Waveforms and Definitions

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)