

## Ultra Fast NPT - IGBT®

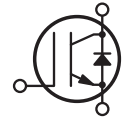
The Ultra Fast NPT - IGBT® family of products is the newest generation of planar IGBTs optimized for outstanding ruggedness and the best trade-off between conduction and switching losses.

### Features

- Low Saturation Voltage
- Low Tail Current
- RoHS Compliant 
- Short Circuit Withstand Rated
- High Frequency Switching
- Ultra Low Leakage Current



**ISOTOP®**  
Combi (IGBT and Diode)



Unless stated otherwise, Microsemi discrete IGBTs contain a single IGBT die. This device is recommended for applications such as induction heating (IH), motor control, general purpose inverters and uninterruptible power supplies (UPS).

### MAXIMUM RATINGS

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

Symbol	Parameter	Ratings	Unit
$V_{ces}$	Collector Emitter Voltage	1200	V
$V_{GE}$	Gate-Emitter Voltage	$\pm 30$	
$I_{C1}$	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	84	A
$I_{C2}$	Continuous Collector Current @ $T_C = 90^\circ\text{C}$	50	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	200	
SCWT	Short Circuit Withstand Time: $V_{CE} = 600\text{V}$ , $V_{GE} = 15\text{V}$ , $T_C = 125^\circ\text{C}$	10	$\mu\text{s}$
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	417	W
$T_J, T_{STG}$	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	Parameter	Min	Typ	Max	Unit
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ( $V_{GE} = 0\text{V}$ , $I_C = 1.1\text{mA}$ )	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}$ , $I_C = 2.5\text{mA}$ , $T_J = 25^\circ\text{C}$ )	3.5	5.0	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}$ , $I_C = 50\text{A}$ , $T_J = 25^\circ\text{C}$ )		2.5	3.2	
	Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}$ , $I_C = 50\text{A}$ , $T_J = 125^\circ\text{C}$ )		3.3		
	Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}$ , $I_C = 100\text{A}$ , $T_J = 25^\circ\text{C}$ )		3.5		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 1200\text{V}$ , $V_{GE} = 0\text{V}$ , $T_J = 25^\circ\text{C}$ ) <sup>②</sup>		20	1100	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 1200\text{V}$ , $V_{GE} = 0\text{V}$ , $T_J = 125^\circ\text{C}$ ) <sup>②</sup>		200		
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20\text{V}$ )			$\pm 250$	nA



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

DYNAMIC CHARACTERISTICS

APT50GR120JD30

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1MHz$		5550		pF
$C_{oes}$	Output Capacitance			500		
$C_{res}$	Reverse Transfer Capacitance			145		
$V_{GEP}$	Gate to Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 50A$		7.5		V
$Q_g^{(3)}$	Total Gate Charge			330	445	
$Q_{ge}$	Gate-Emitter Charge			52	72	
$Q_{gc}$	Gate- Collector Charge			156	200	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 4.3 \Omega^{(4)}$ $T_J = +25^\circ C$		28		ns
$t_r$	Current Rise Time			38		
$t_{d(off)}$	Turn-Off Delay Time			237		
$t_f$	Current Fall Time			45		
$E_{on2}^{(5)}$	Turn-On Switching Energy	Inductive Switching (25°C) $R_G = 4.3 \Omega^{(4)}$ $T_J = +25^\circ C$		2135	3200	μJ
$E_{off}^{(6)}$	Turn-Off Switching Energy			1478	2210	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 4.3 \Omega^{(4)}$ $T_J = +125^\circ C$		28		ns
$t_r$	Current Rise Time			38		
$t_{d(off)}$	Turn-Off Delay Time			270		
$t_f$	Current Fall Time			54		
$E_{on2}^{(5)}$	Turn-On Switching Energy	Inductive Switching (125°C) $R_G = 4.3 \Omega^{(4)}$ $T_J = +125^\circ C$		3157	4765	μJ
$E_{off}^{(6)}$	Turn-Off Switching Energy			1884	2820	

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance (IGBT)			.30	°C/W
	Junction to Case Thermal Resistance (Diode)			1.1	
$V_{isolation}$	RMS Voltage (50-60Hz Sinusoidal Waveform From Terminals to Mounting Base for 1 Min.)	2500			
$W_T$	Package Weight		1.03		oz
			29.2		g
Torque	Maximum Mounting Torque			10	lb•in
				1.1	N•m

- 1 Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.
  - 2 Pulse test: Pulse Width < 380μs, duty cycle < 2%.
  - 3 See Mil-Std-750 Method 3471.
  - 4  $R_G$  is external gate resistance, not including internal gate resistance or gate driver impedance. (MIC4452)
  - 5  $E_{on2}$  is the energy loss at turn-on and includes the charge stored in the freewheeling diode.
  - 6  $E_{off}$  is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1.
- Microsemi reserves the right to change, without notice, the specifications and information contained herein.

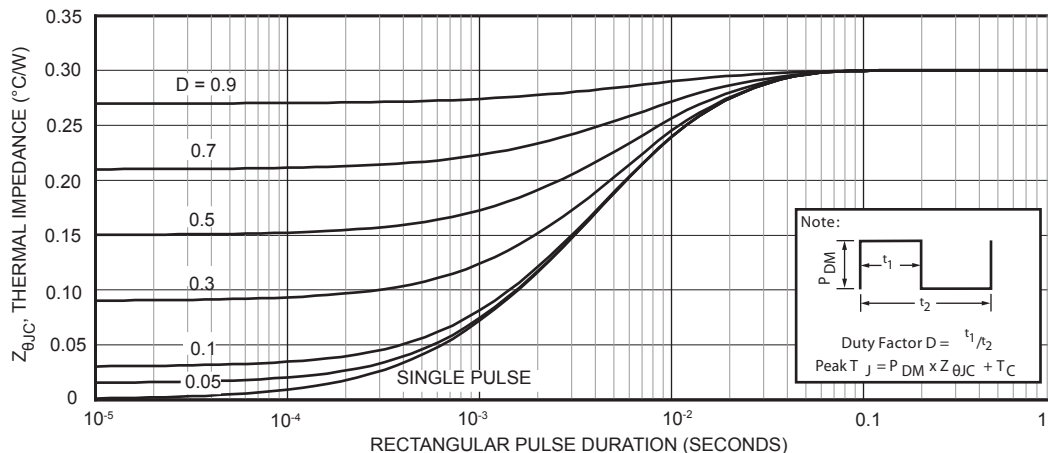
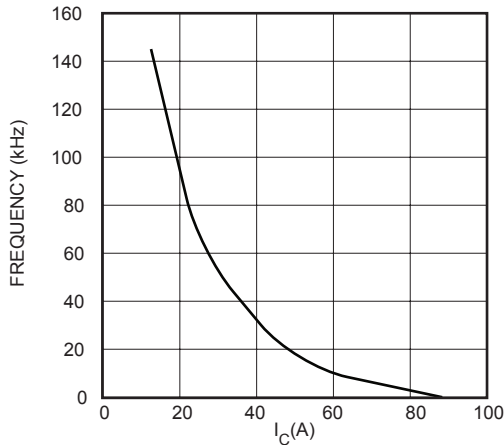


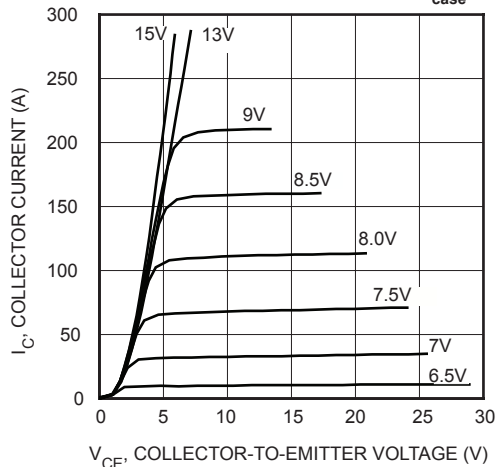
Figure 1, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

**TYPICAL PERFORMANCE CURVES**

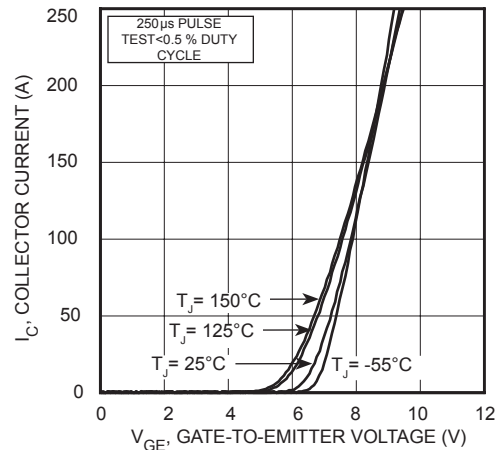
**APT50GR120JD30**



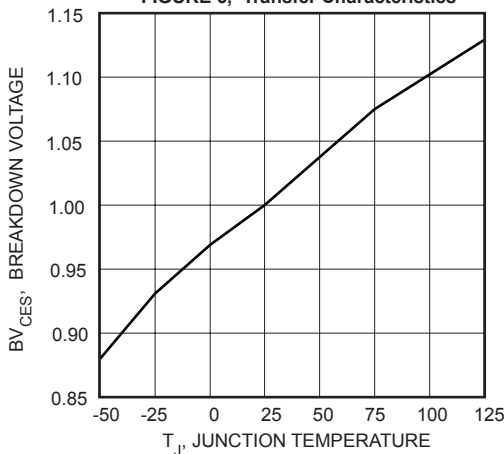
**FIGURE 2, Max Frequency vs Current ( $T_{case} = 75^{\circ}C$ )**



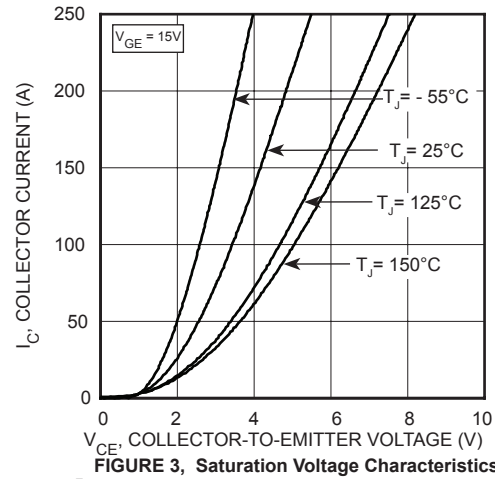
**FIGURE 4, Output Characteristics ( $T_J = 25^{\circ}C$ )**



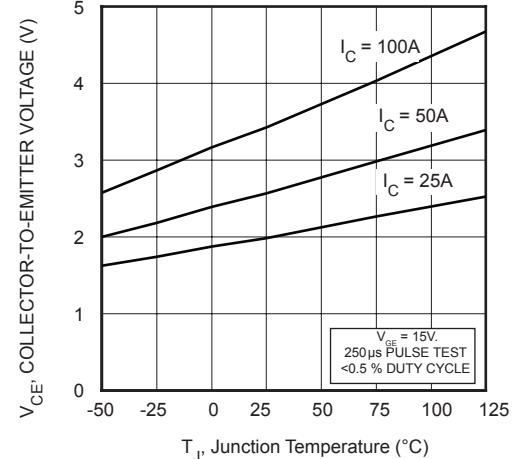
**FIGURE 6, Transfer Characteristics**



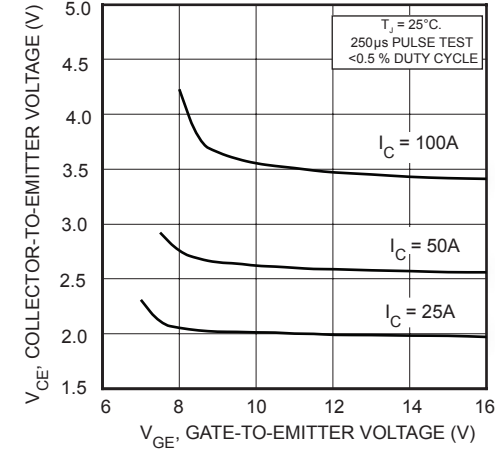
**FIGURE 8, Breakdown Voltage vs Junction Temperature**



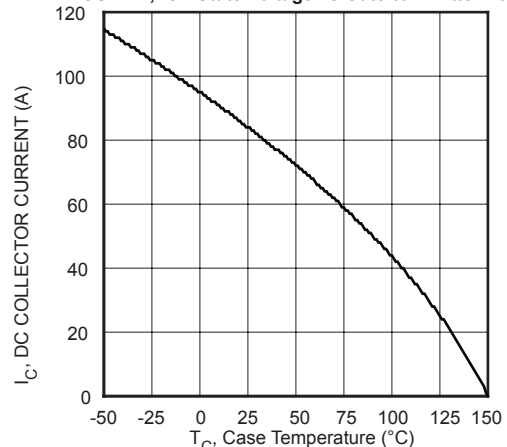
**FIGURE 3, Saturation Voltage Characteristics**



**FIGURE 5, On State Voltage vs Junction Temperature**



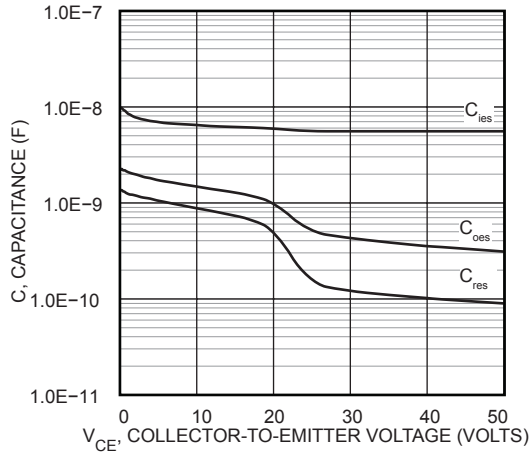
**FIGURE 7, On State Voltage vs Gate-to-Emitter Voltage**



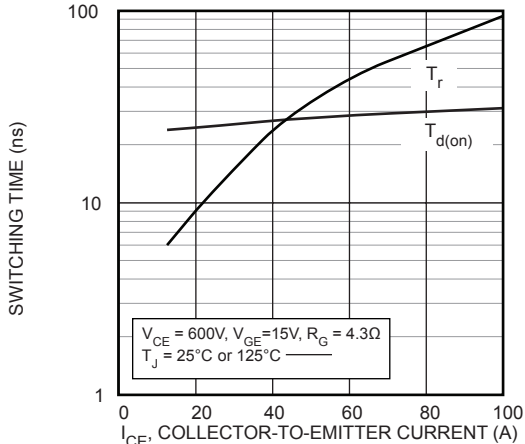
**FIGURE 9, DC Collector Current vs Case Temperature**

**TYPICAL PERFORMANCE CURVES**

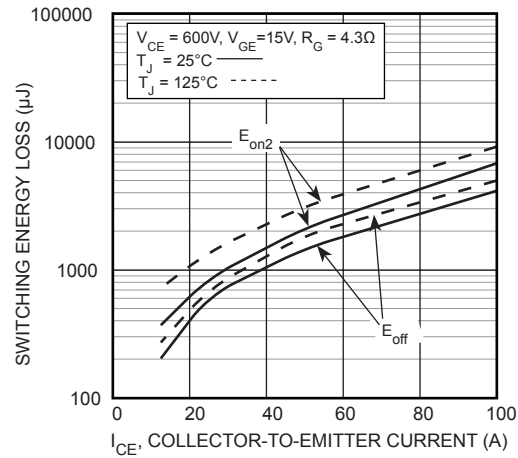
**APT50GR120JD30**



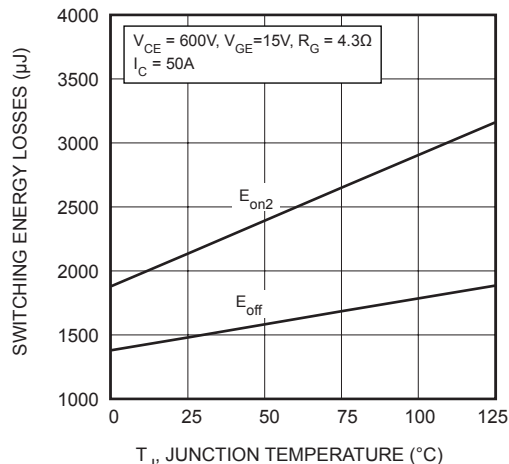
**FIGURE 10, Capacitance vs Collector-To-Emitter Voltage**



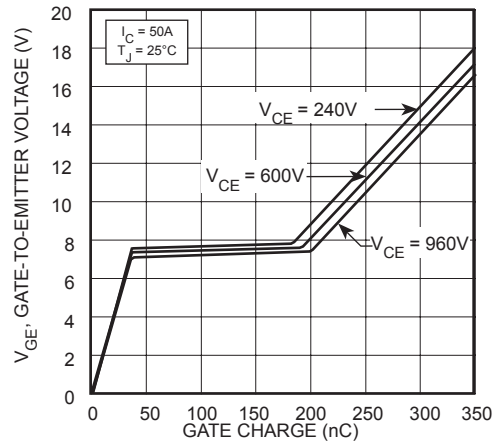
**FIGURE 12, Turn-On Time vs Collector Current**



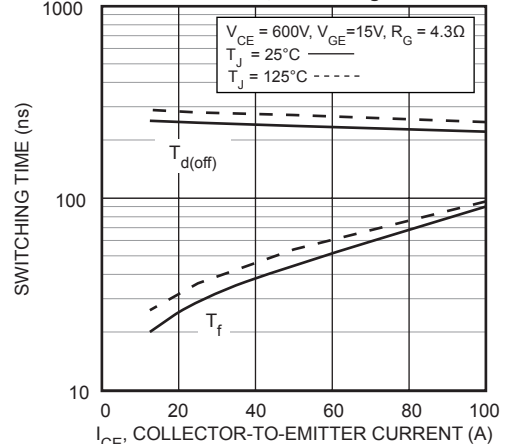
**FIGURE 14, Energy Loss vs Collector Current**



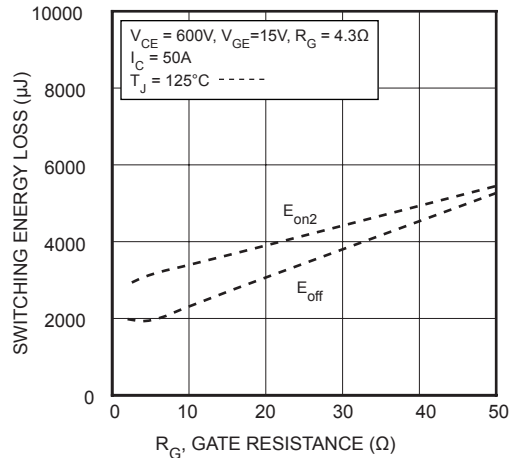
**FIGURE 16, Switching Energy vs Junction Temperature**



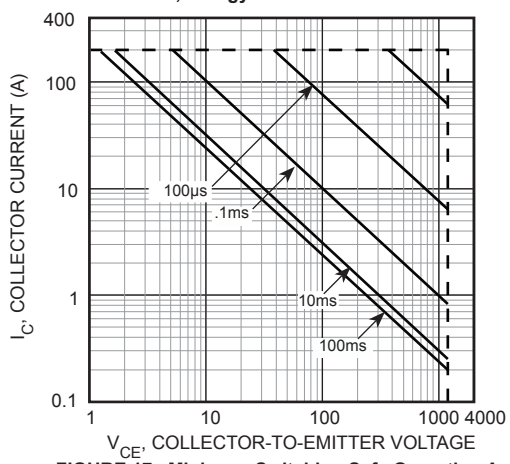
**FIGURE 11, Gate charge**



**FIGURE 13, Turn-Off Time vs Collector Current**



**FIGURE 15, Energy Loss vs Gate Resistance**



**FIGURE 17, Minimum Switching Safe Operating Area**

## ULTRAFAST SOFT RECOVERY RECTIFIER DIODE

### MAXIMUM RATINGS

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

Symbol	Characteristic / Test Conditions	APT50GR120JD30	Unit
$I_{F(AV)}$	Maximum Average Forward Current ( $T_C = 92^\circ\text{C}$ , Duty Cycle = 0.5)	30	Amps
$I_{F(RMS)}$	RMS Forward Current (Square wave, 50% duty)	39	
$I_{FSM}$	Non-Repetitive Forward Surge Current ( $T_J = 45^\circ\text{C}$ , 8.3 ms)	210	

### STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	Min	Type	Max	Unit
$V_F$	Forward Voltage		$I_F = 30\text{A}$	2.6	Volts
			$I_F = 60\text{A}$	3.25	
			$I_F = 30\text{A}, T_J = 125^\circ\text{C}$	1.8	

### DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$t_{rr}$	Reverse Recovery Time	$I_F = 1\text{A}, di_F/dt = -100\text{A}/\mu\text{s}, V_R = 30\text{V}, T_J = 25^\circ\text{C}$	-	25	-	ns
$t_{rr}$	Reverse Recovery Time	$I_F = 30\text{A}, di_F/dt = -200\text{A}/\mu\text{s}, V_R = 800\text{V}, T_C = 25^\circ\text{C}$	-	300	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	360	-	
$I_{RRM}$	Maximum Reverse Recovery Current		-	4	-	
$t_{rr}$	Reverse Recovery Time	$I_F = 30\text{A}, di_F/dt = -200\text{A}/\mu\text{s}, V_R = 800\text{V}, T_C = 125^\circ\text{C}$	-	380	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	1700	-	nC
$I_{RRM}$	Maximum Reverse Recovery Current		-	8	-	Amps
$t_{rr}$	Reverse Recovery Time	$I_F = 60\text{A}, di_F/dt = -1000\text{A}/\mu\text{s}, V_R = 800\text{V}, T_C = 125^\circ\text{C}$	-	160	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	2550	-	nC
$I_{RRM}$	Maximum Reverse Recovery Current		-	28	-	Amps

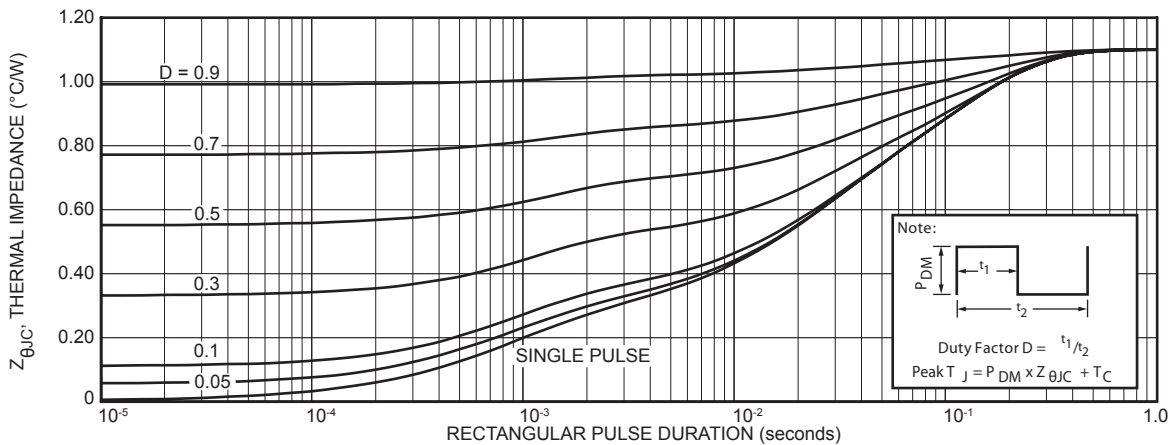


FIGURE 18. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

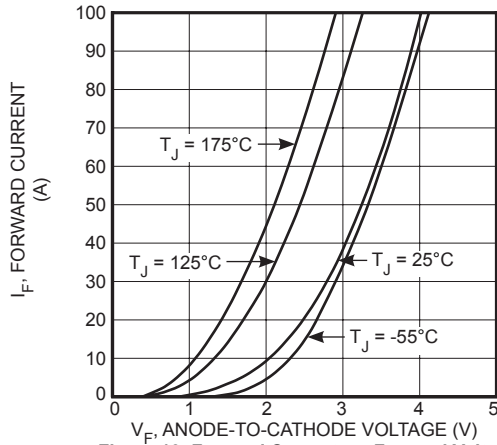


Figure 19. Forward Current vs. Forward Voltage

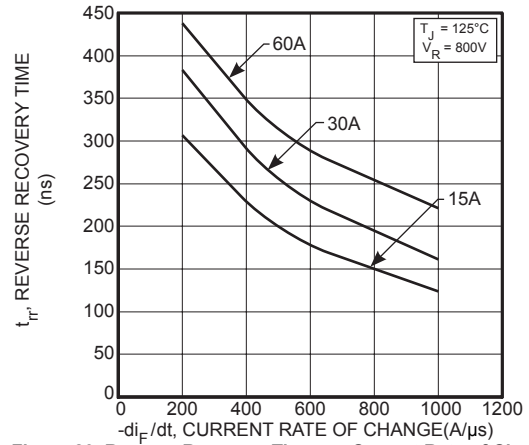


Figure 20. Reverse Recovery Time vs. Current Rate of Change

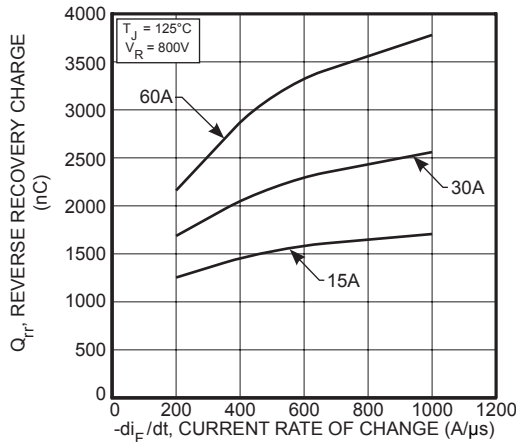


Figure 21. Reverse Recovery Charge vs. Current Rate of Change

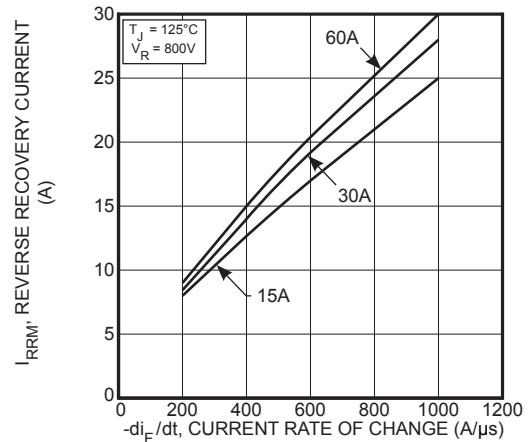


Figure 22. Reverse Recovery Current vs. Current Rate of Change

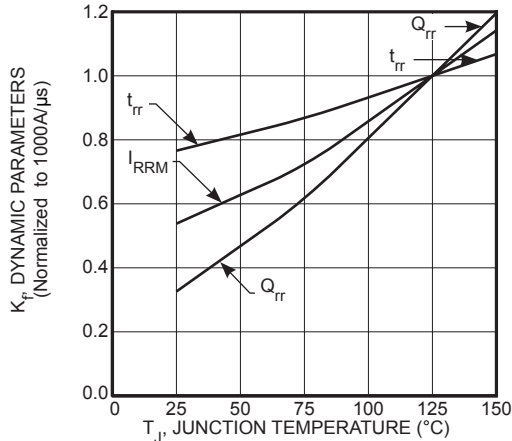


Figure 23. Dynamic Parameters vs. Junction Temperature

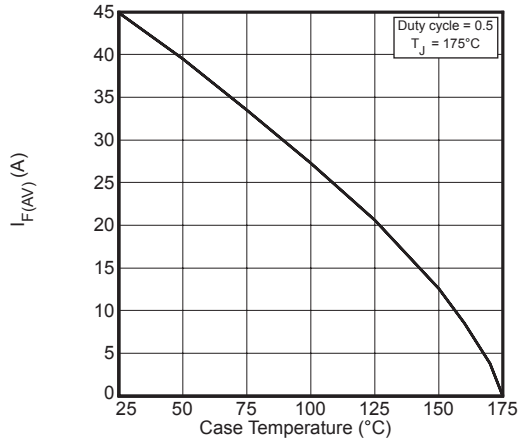


Figure 24. Maximum Average Forward Current vs. Case Temperature

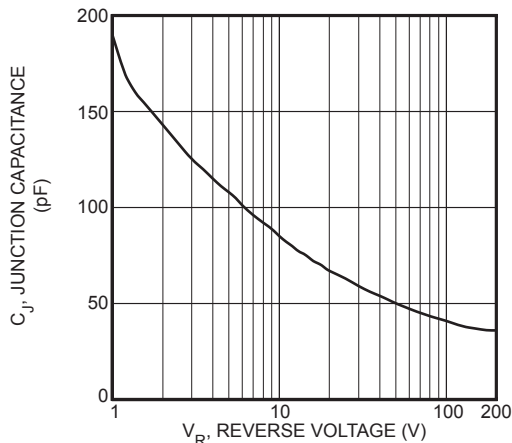


Figure 25. Junction Capacitance vs. Reverse Voltage

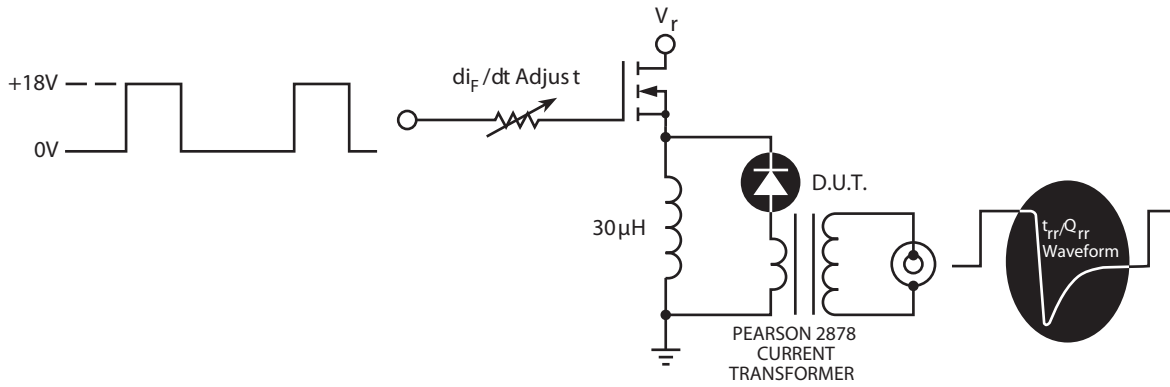


Figure 26. Diode Test Circuit

- 1  $I_F$  - Forward Conduction Current
- 2  $di_F/dt$  - Rate of Diode Current Change Through Zero Crossing.
- 3  $I_{RRM}$  - Maximum Reverse Recovery Current
- 4  $t_{rr}$  - Reverse Recovery Time measured from zero crossing where diode current goes from positive to negative, to the point at which the straight line through  $I_{RRM}$  and  $0.25 I_{RRM}$  passes through zero.
- 5  $Q_{rr}$  - Area Under the Curve Defined by  $I_{RRM}$  and  $t_{rr}$ .

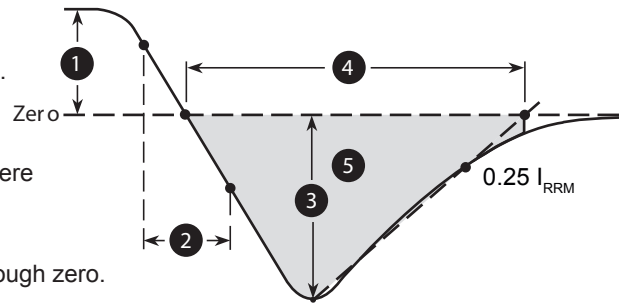
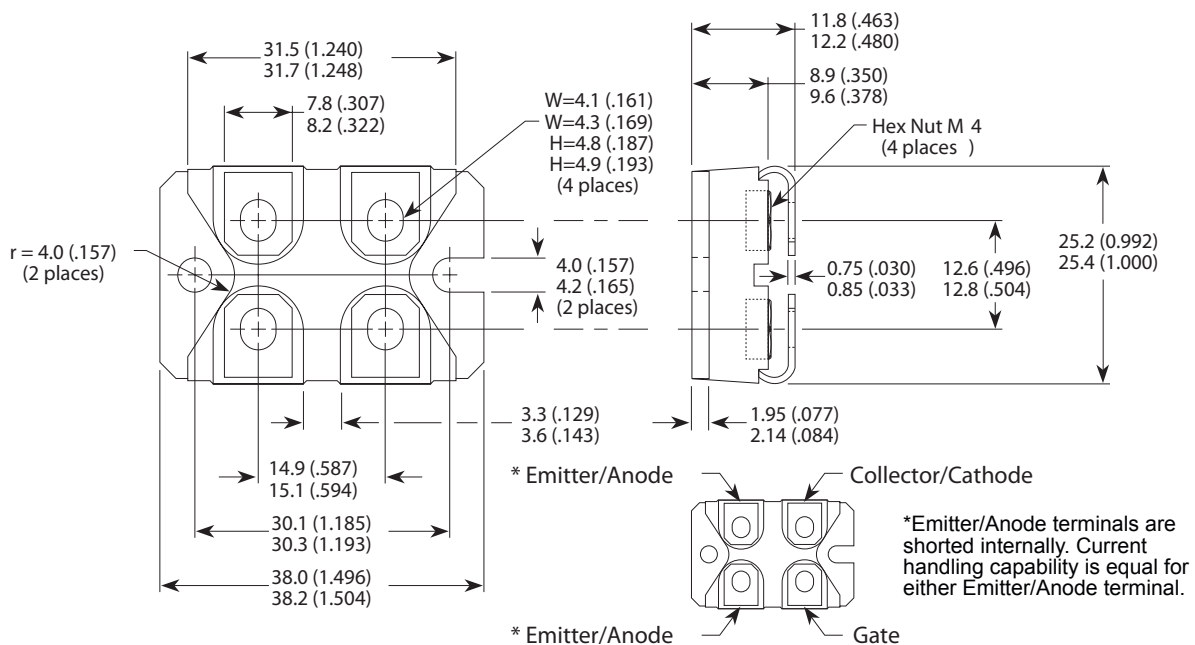


Figure 27. Diode Reverse Recovery Waveform Definition

### SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)

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