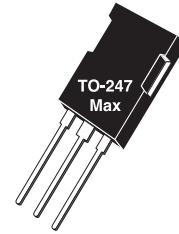


## Ultra Fast NPT - IGBT®

The Ultra Fast NPT - IGBT® is a new generation of high voltage power IGBTs. Using Non-Punch-Through Technology, the Ultra Fast NPT-IGBT® offers superior ruggedness and ultrafast switching speed.



### Features

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

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:  $T_C = 25^\circ C$  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 @ $T_C = 25^\circ C$	88	A
$I_{C2}$	Continuous Collector Current @ $T_C = 110^\circ C$	40	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	160	
SCWT	Short Circuit Withstand Time: $V_{CE} = 600V, V_{GE} = 15V, T_C = 125^\circ C$	10	$\mu s$
$P_D$	Total Power Dissipation @ $T_C = 25^\circ C$	500	W
$T_J, T_{STG}$	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	Parameter	Min	Typ	Max	Unit
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V, I_C = 1.0mA$ )	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 2.0mA, T_J = 25^\circ C$ )	3	5.0	6.0	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 40A, T_J = 25^\circ C$ )		2.5	3.2	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 40A, T_J = 125^\circ C$ )		3.5		
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 88A, T_J = 25^\circ C$ )		3.5		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 25^\circ C$ ) <sup>②</sup>			1200	$\mu A$
	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 125^\circ C$ ) <sup>②</sup>		300		
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )			$\pm 250$	nA

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

## DYNAMIC CHARACTERISTICS

APT40GR120B2SCD10

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1MHz$		3980		pF
$C_{oes}$	Output Capacitance			510		
$C_{res}$	Reverse Transfer Capacitance			80		
$V_{GEP}$	Gate to Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 40A$		7		V
$Q_g^{(3)}$	Total Gate Charge			210		
$Q_{ge}$	Gate-Emitter Charge			25		
$Q_{gc}$	Gate- Collector Charge			90		
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 40A$		20		ns
$t_r$	Current Rise Time			21		
$t_{d(off)}$	Turn-Off Delay Time			166		
$t_f$	Current Fall Time			42		
$E_{on}^{(5)}$	Turn-On Switching Energy	$R_G = 4.3 \Omega^{(4)}$ $T_J = +25^\circ C$		929	1800	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy			1070	1650	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 40A$		20		ns
$t_r$	Current Rise Time			20		
$t_{d(off)}$	Turn-Off Delay Time			187		
$t_f$	Current Fall Time			48		
$E_{on}^{(5)}$	Turn-On Switching Energy	$R_G = 4.3 \Omega^{(4)}$ $T_J = +125^\circ C$		971	2000	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy			1042	2500	

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance (IGBT)			.25	$^\circ C/W$
	Junction to Case Thermal Resistance (Diode)			1.00	
$R_{\theta JA}$	Junction to Ambient Thermal Resistance			40	
$W_T$	Package Weight		.22		oz
			6.2		g

- 1 Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.
  - 2 Pulse test: Pulse Width < 380 $\mu s$ , 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  $E_{on}$  is the clamped inductive turn on energy that includes a commutating diode reverse transient current in the IGBT turn on energy loss. A combi device is used for the clamping 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.

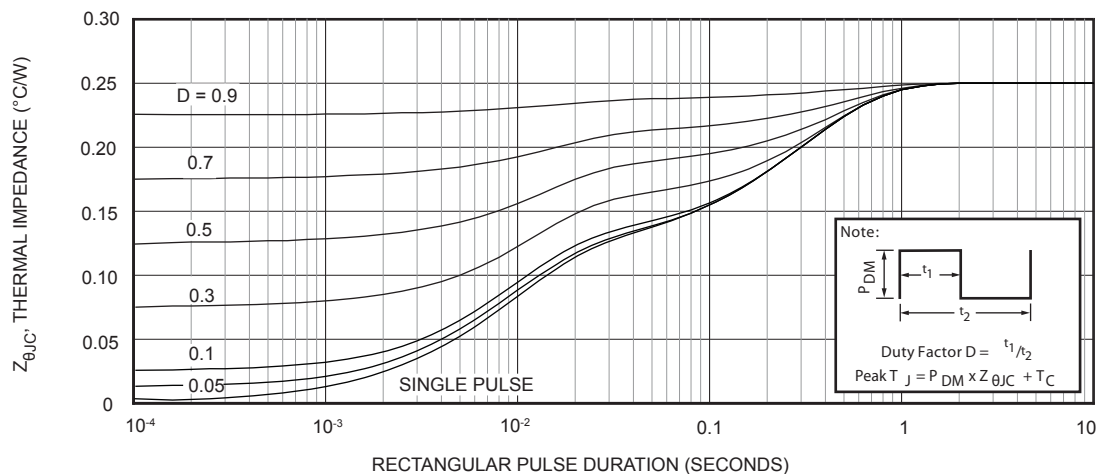
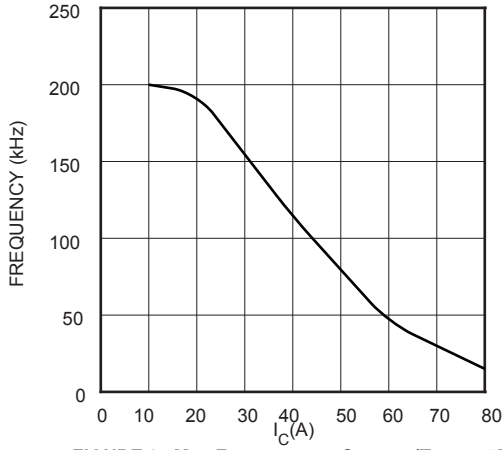


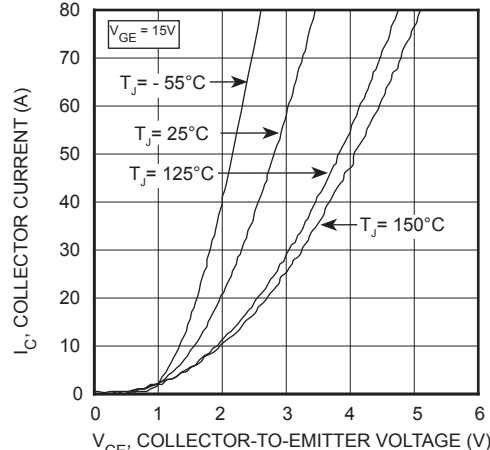
Figure 1, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

**TYPICAL PERFORMANCE CURVES**

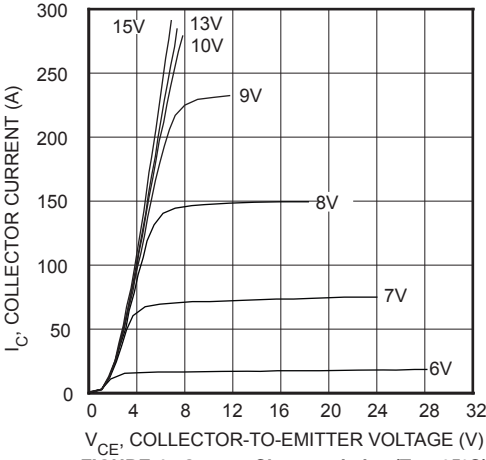
**APT40GR120B2SCD10**



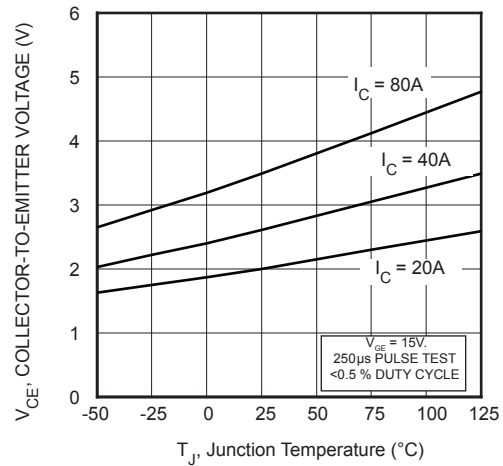
**FIGURE 2, Max Frequency vs Current ( $T_{case} = 75^{\circ}C$ )**



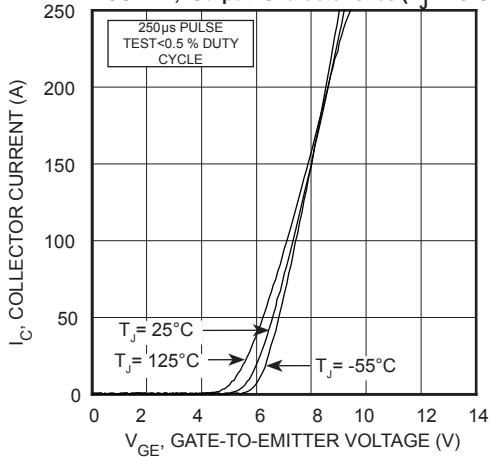
**FIGURE 3, Output Characteristics ( $T_J = 25^{\circ}C$ )**



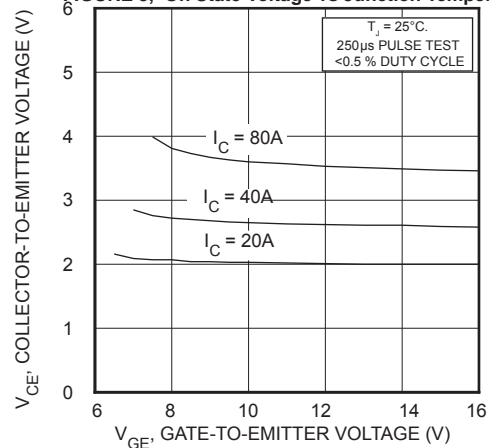
**FIGURE 4, Output Characteristics ( $T_J = 25^{\circ}C$ )**



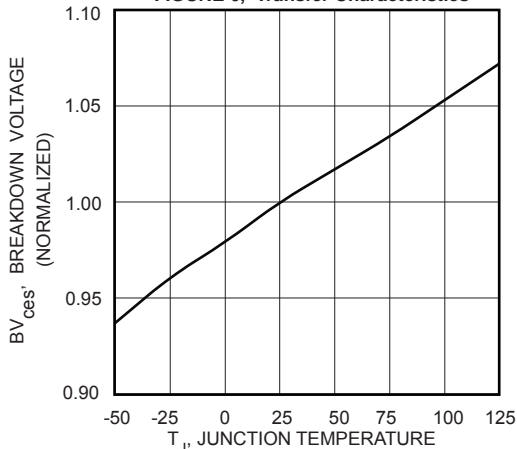
**FIGURE 5, On State Voltage vs Junction Temperature**



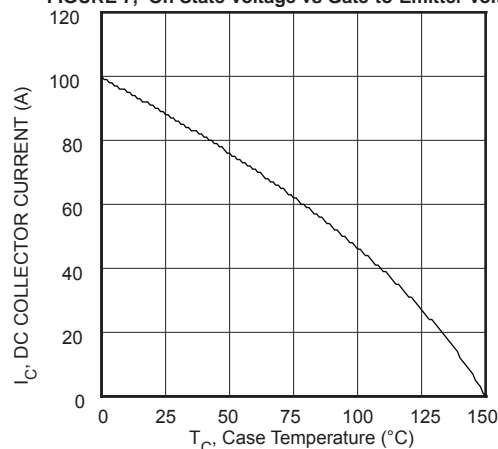
**FIGURE 6, Transfer Characteristics**



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

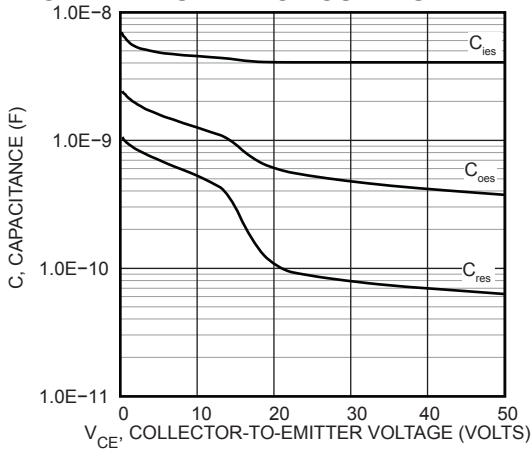


**FIGURE 8, Breakdown Voltage vs Junction Temperature**

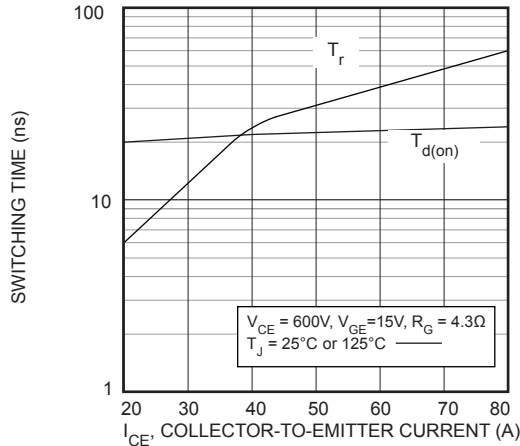


**FIGURE 9, DC Collector Current vs Case Temperature**

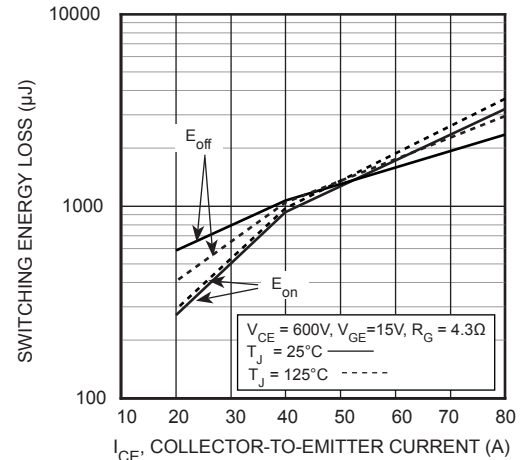
**TYPICAL PERFORMANCE CURVES**



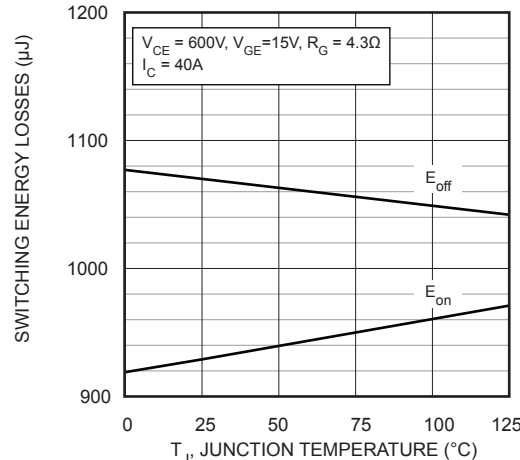
**FIGURE 10, Capacitance vs Collector-To-Emitter Voltage**



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

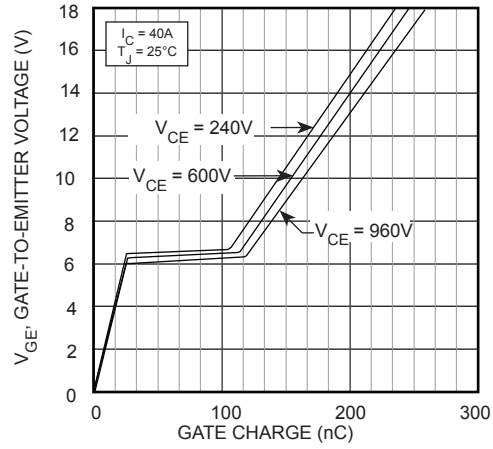


**FIGURE 14, Energy Loss vs Collector Current**

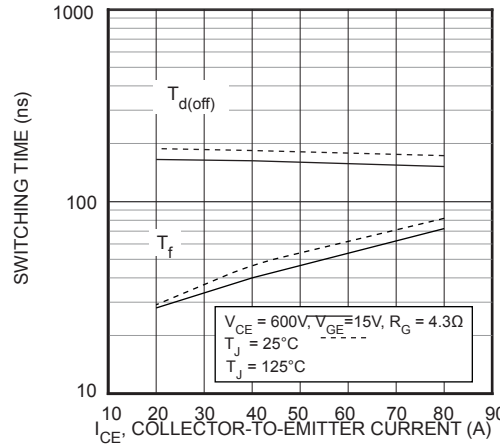


**FIGURE 16, Energy Losses vs Junction Temperature**

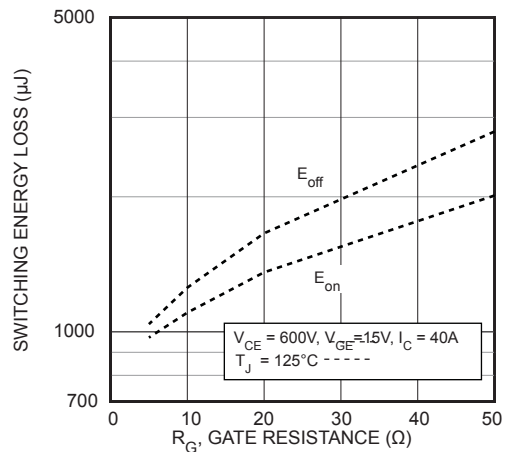
**APT40GR120B2SCD10**



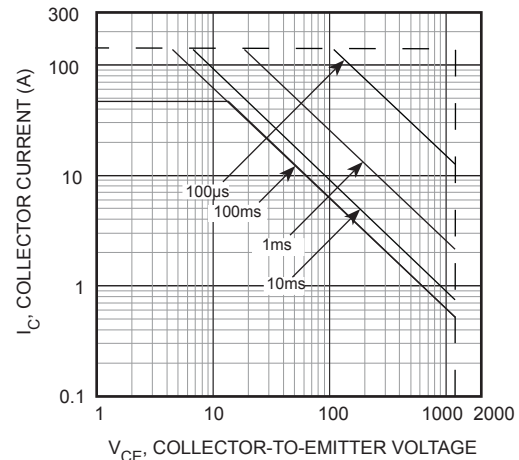
**FIGURE 11, Gate charge vs. Gate-to-Emitter Voltage**



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



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



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

# ZERO RECOVERY LOW LEAKAGE SIC ANTI-PARALLEL DIODE

**MAXIMUM RATINGS**

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

Symbol	Characteristic / Test Conditions	Ratings	Unit
$I_F$	Maximum D.C. Forward Current	$T_C = 25^\circ\text{C}$	36
		$T_C = 135^\circ\text{C}$	10
$I_{FRM}$	Repetitive Peak Forward Surge Current ( $T_J = 45^\circ\text{C}$ , $t_p = 10\text{ms}$ , Half Sine Wave)	50	Amps
$I_{FSM}$	Non-Repetitive Forward Surge Current ( $T_J = 25^\circ\text{C}$ , $t_p = 10\text{ms}$ , Half Sine)	110	

**STATIC ELECTRICAL CHARACTERISTICS**

Symbol	Characteristic / Test Conditions	Min	Typ	Max	Unit
$V_F$	Forward Voltage		$I_F = 10\text{A}$ , $T_J = 25^\circ\text{C}$	1.5	Volts
			$I_F = 10\text{A}$ , $T_J = 150^\circ\text{C}$	2.1	
$Q_c$	Total Capacitive Charge $V_R = 800\text{V}$ , $I_F = 10\text{A}$ , $di/dt = -100\text{A}/\mu\text{s}$ , $T_J = 25^\circ\text{C}$		30		nC
$C_T$	Junction Capacitance $V_R = 0\text{V}$ , $T_J = 25^\circ\text{C}$ , $f = 1\text{MHz}$		600		pF
	Junction Capacitance $V_R = 200\text{V}$ , $T_J = 25^\circ\text{C}$ , $f = 1\text{MHz}$		71		
	Junction Capacitance $V_R = 400\text{V}$ , $T_J = 25^\circ\text{C}$ , $f = 1\text{MHz}$		52		

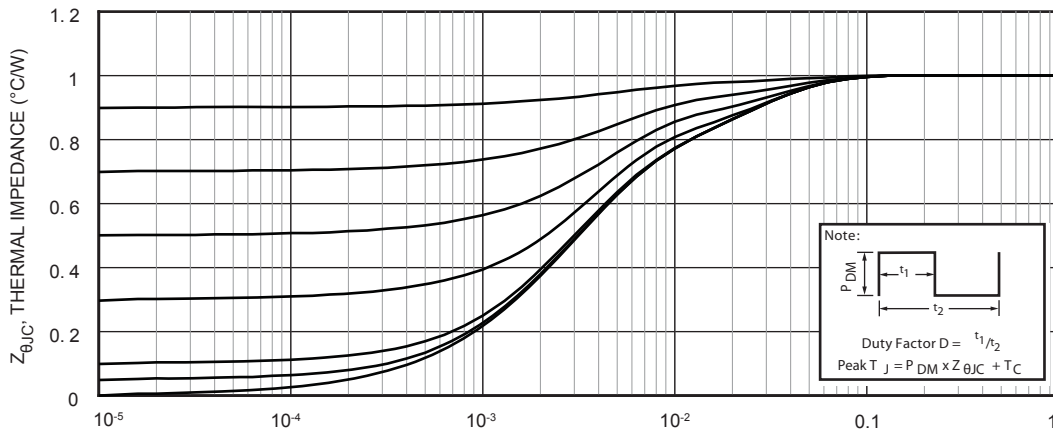


FIGURE 18. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

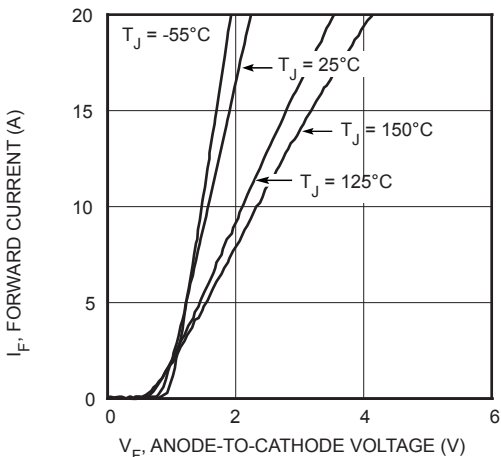


FIGURE 19. Forward Current vs. Forward Voltage

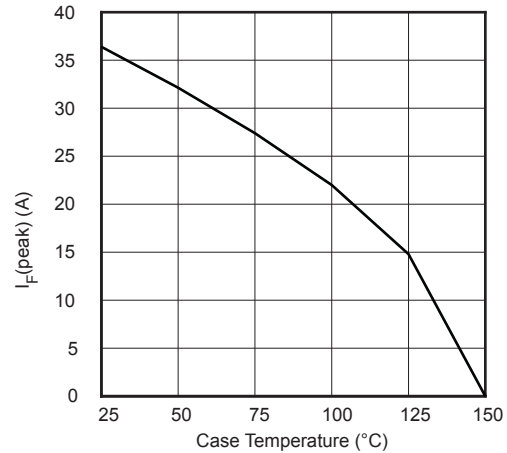


FIGURE 20. Maximum Forward Current vs. Case Temperature

# TYPICAL PERFORMANCE CURVES

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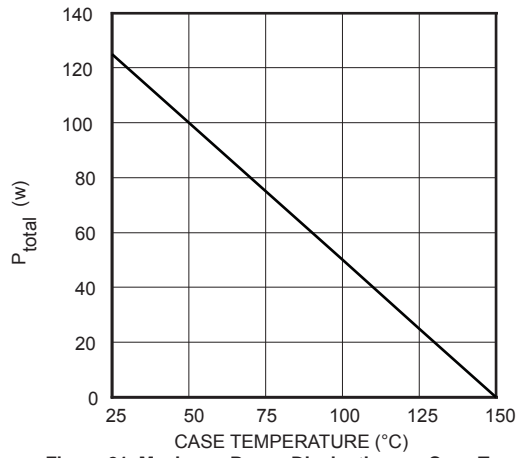


Figure 21. Maximum Power Dissipation vs. Case Temperature

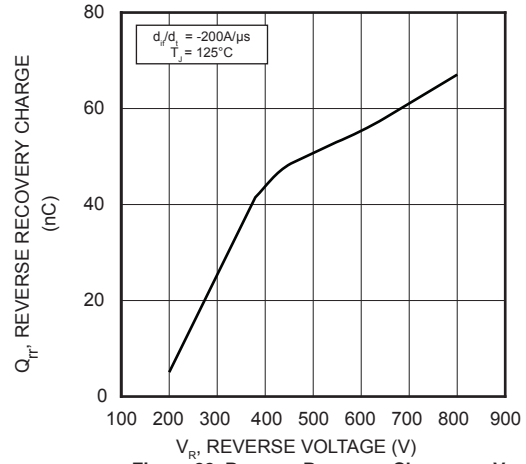


Figure 22. Reverse Recovery Charge vs. V<sub>R</sub>

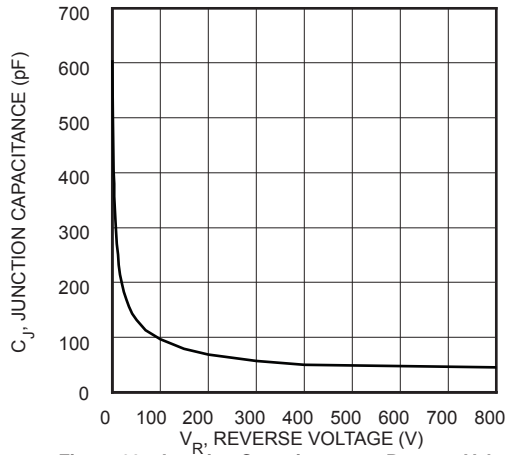
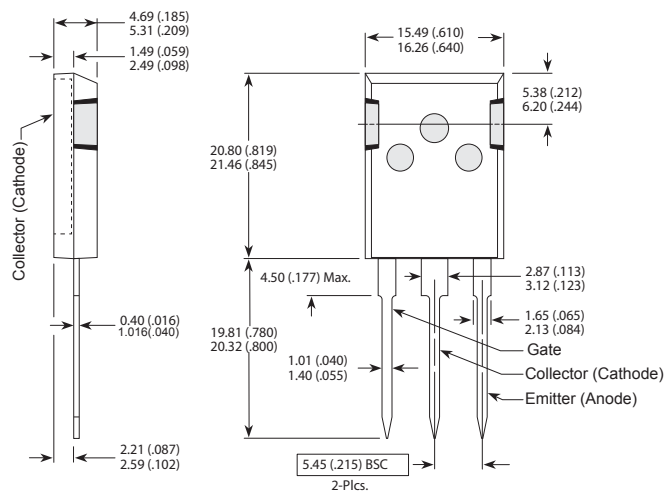


Figure 23. Junction Capacitance vs. Reverse Voltage

## T-MAX<sup>®</sup> (B2) Package Outline



These dimensions are equal to the TO-247 without the mounting hole.  
Dimensions in Millimeters and (Inches)

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