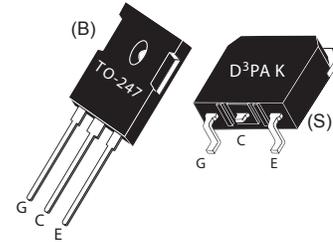


## Ultra Fast NPT - IGBT®

The Ultra Fast 650V NPT-IGBT® family of products is the newest generation of IGBTs optimized for outstanding ruggedness and 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



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	650	V
$V_{GE}$	Gate-Emitter Voltage	$\pm 30$	
$I_{C1}$	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	118	A
$I_{C2}$	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	56	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	224	
SCWT	Short Circuit Withstand Time: $V_{CE} = 325V, V_{GE} = 15V, T_C = 125^\circ\text{C}$	10	$\mu\text{s}$
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	543	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 ( $V_{GE} = 0V, I_C = 450\mu\text{A}$ )	650			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 1.0\text{mA}, T_J = 25^\circ\text{C}$ )	3.5	5.0	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 45A, T_J = 25^\circ\text{C}$ )		1.9	2.4	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 45A, T_J = 125^\circ\text{C}$ )		2.4		
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 90A, T_J = 25^\circ\text{C}$ )		2.5		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 650V, V_{GE} = 0V, T_J = 25^\circ\text{C}$ ) <sup>②</sup>		20	450	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 650V, V_{GE} = 0V, T_J = 125^\circ\text{C}$ ) <sup>②</sup>		200		
$I_{GES}$	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**

**APT45GR65B\_SSCD10**

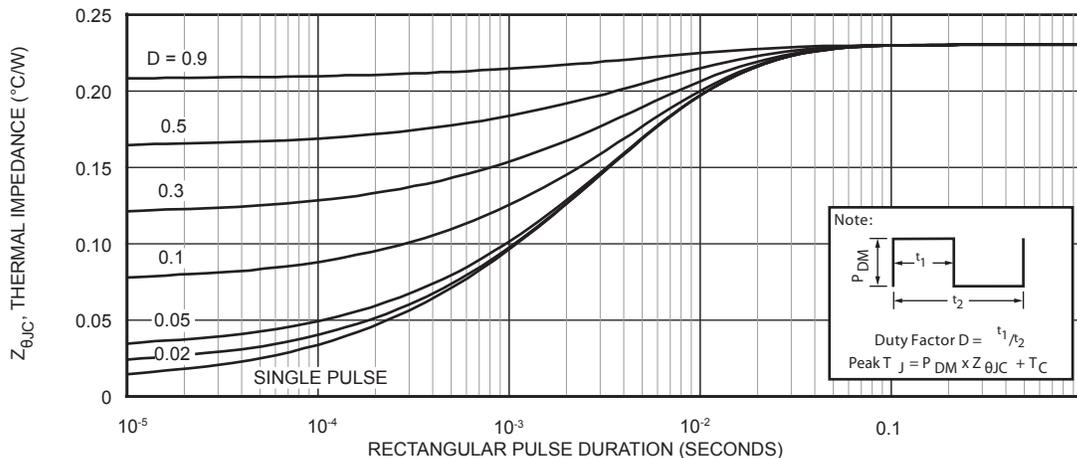
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1MHz$		2900		pF
$C_{oes}$	Output Capacitance			548		
$C_{res}$	Reverse Transfer Capacitance			268		
$V_{GEP}$	Gate to Emitter Plateau Voltage	Gate Charge		7.5		V
$Q_g^{(3)}$	Total Gate Charge	$V_{GE} = 15V$		150	203	nC
$Q_{ge}$	Gate-Emitter Charge	$V_{CE} = 325V$		18	24	
$Q_{gc}$	Gate- Collector Charge	$I_C = 45A$		74	100	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C) $V_{CC} = 433V$ $V_{GE} = 15V$ $I_C = 45A$		15		ns
$t_r$	Current Rise Time			32		
$t_{d(off)}$	Turn-Off Delay Time			100		
$t_f$	Current Fall Time			50		
$E_{on}^{(5)}$	Turn-On Switching Energy	$R_G = 5\Omega^{(4)}$		830	1245	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy	$T_J = +25^\circ C$		580	875	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C) $V_{CC} = 433V$ $V_{GE} = 15V$ $I_C = 45A$		15		ns
$t_r$	Current Rise Time			32		
$t_{d(off)}$	Turn-Off Delay Time			123		
$t_f$	Current Fall Time			52		
$E_{on}^{(5)}$	Turn-On Switching Energy	$R_G = 5\Omega^{(4)}$		850	1275	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy	$T_J = +125^\circ C$		800	1160	

**THERMAL AND MECHANICAL CHARACTERISTICS**

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance (IGBT)			0.23	$^\circ C/W$
	Junction to Case Thermal Resistance (Diode)			2.0	
$R_{\theta JA}$	Junction to Ambient Thermal Resistance			40	
$W_T$	Package Weight		0.22		oz
			6.2		g
Torque	Mounting Torque (TO-247 Package), 4-40 or M3 screw			10	in-lbf
				6.2	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  $E_{on}$  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.**

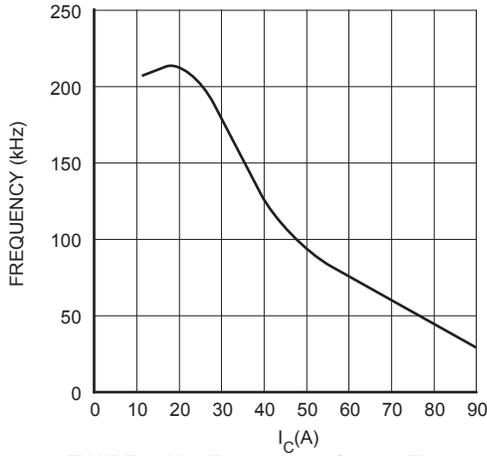
**TYPICAL PERFORMANCE CURVES**



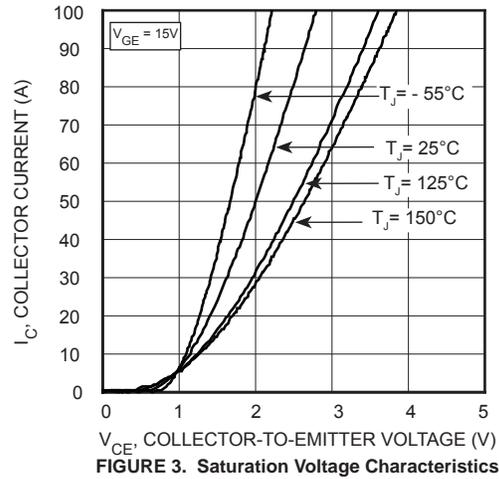
**FIGURE 1. Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration**

**TYPICAL PERFORMANCE CURVES**

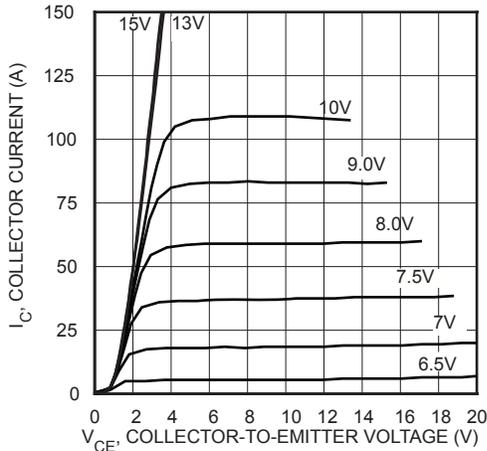
**APT45GR65B\_SSCD10**



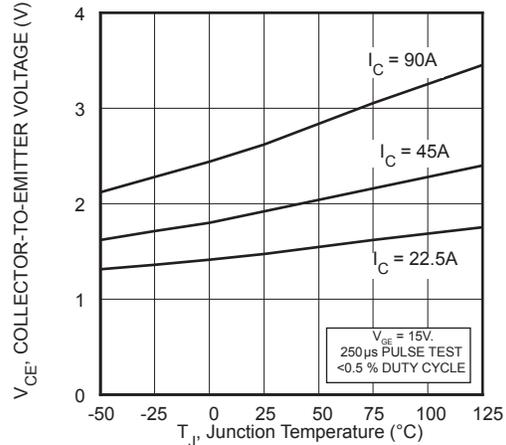
**FIGURE 2. Max Frequency vs Current ( $T_{case} = 75^{\circ}C$ )**



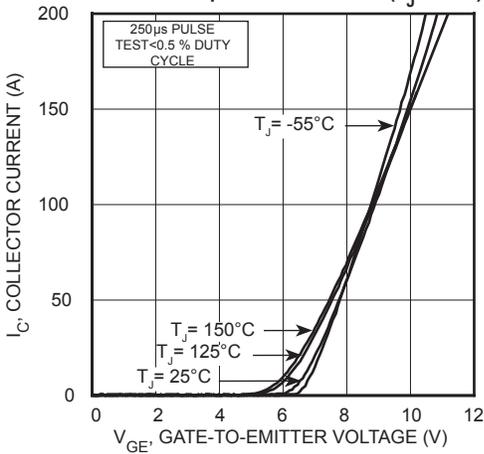
**FIGURE 3. Saturation Voltage Characteristics**



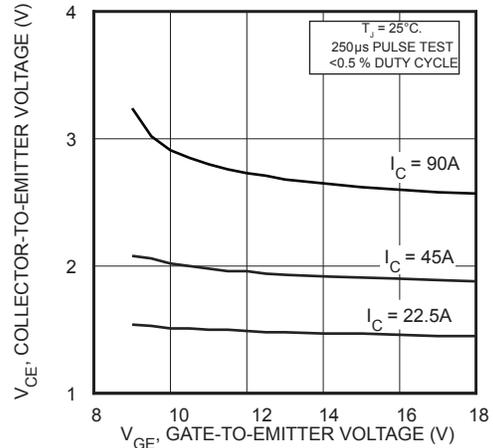
**FIGURE 4. Output Characteristics ( $T_J = 25^{\circ}C$ )**



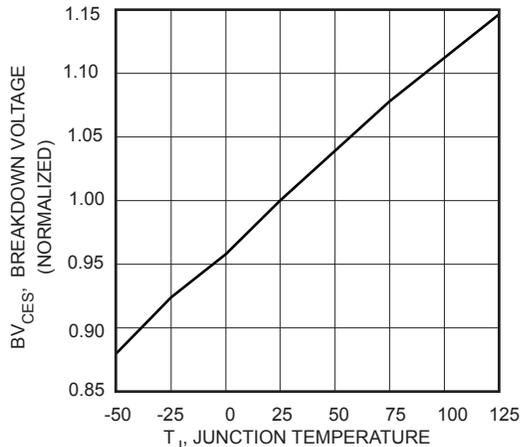
**FIGURE 5. On State Voltage vs Junction Temperature**



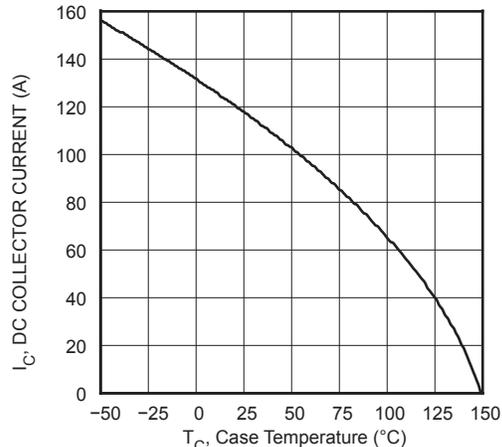
**FIGURE 6. Transfer Characteristics**



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



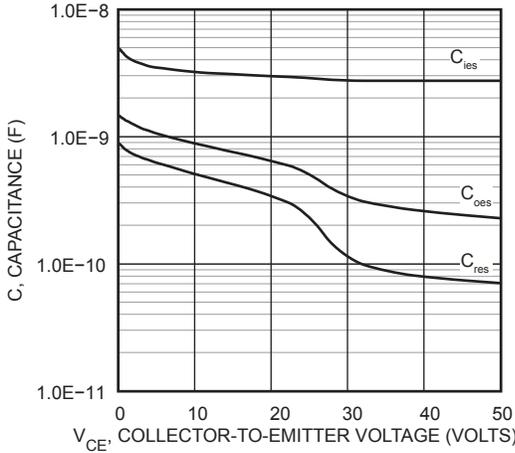
**FIGURE 8. Breakdown Voltage vs Junction Temperature**



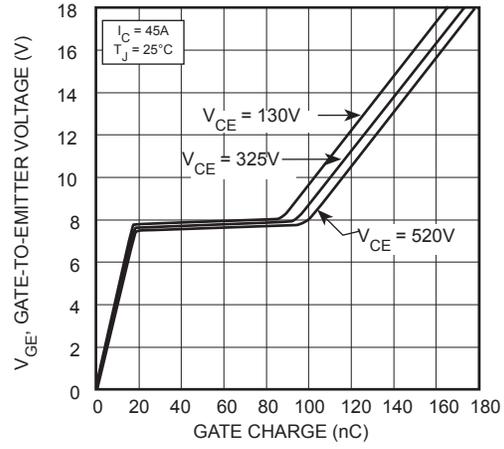
**FIGURE 9. DC Collector Current vs Case Temperature**

**TYPICAL PERFORMANCE CURVES**

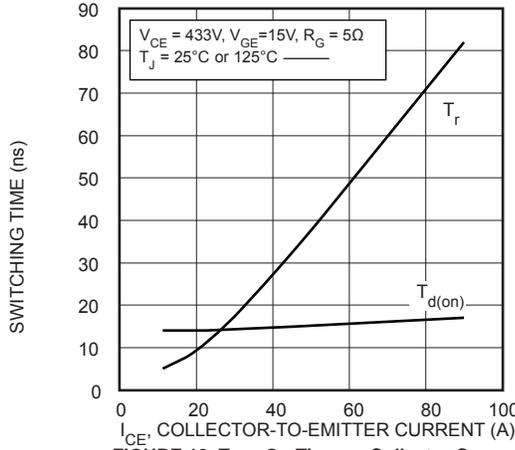
**APT45GR65B\_SSCD10**



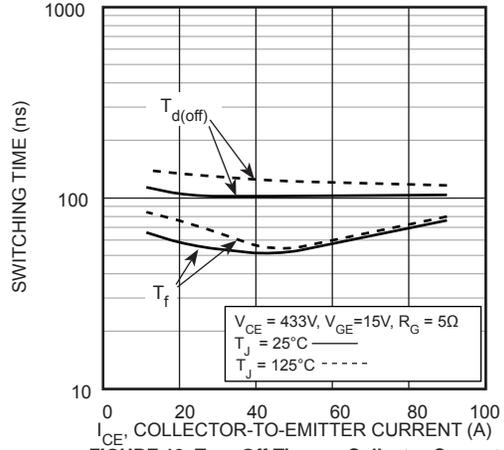
**FIGURE 10. Capacitance vs Collector-To-Emitter Voltage**



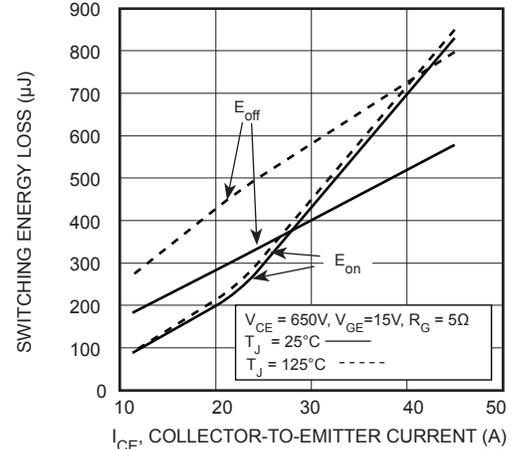
**FIGURE 11. Gate charge**



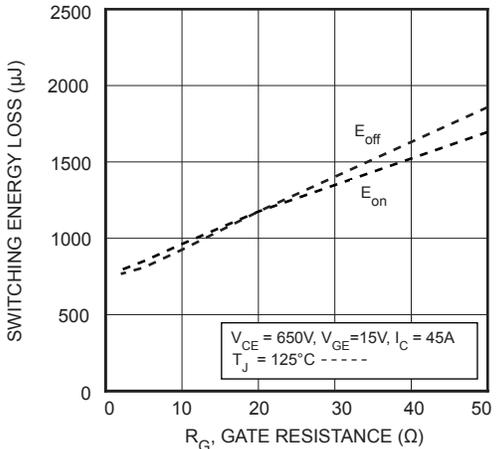
**FIGURE 12. Turn-On Time vs Collector Current**



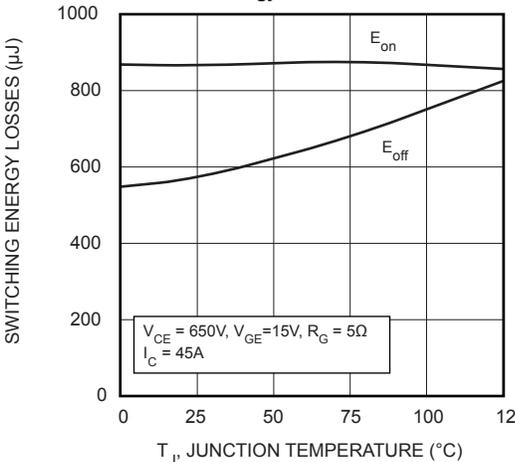
**FIGURE 13. Turn-Off Time vs Collector Current**



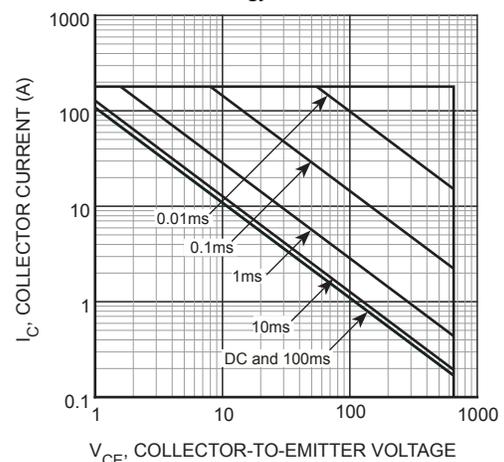
**FIGURE 14. Energy Loss vs Collector Current**



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



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



**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	$T_C = 25^\circ\text{C}$	17
		$T_C = 100^\circ\text{C}$	9
$I_{FRM}$	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
			$I_F = 10\text{A}$ , $T_J = 150^\circ\text{C}$	2.0	
$Q_c$	Total Capacitive Charge $V_R = 300\text{V}$ , $I_F = 10\text{A}$ , $di/dt = -500\text{A}/\mu\text{s}$ , $T_J = 25^\circ\text{C}$		80		nC

## TYPICAL PERFORMANCE CURVES

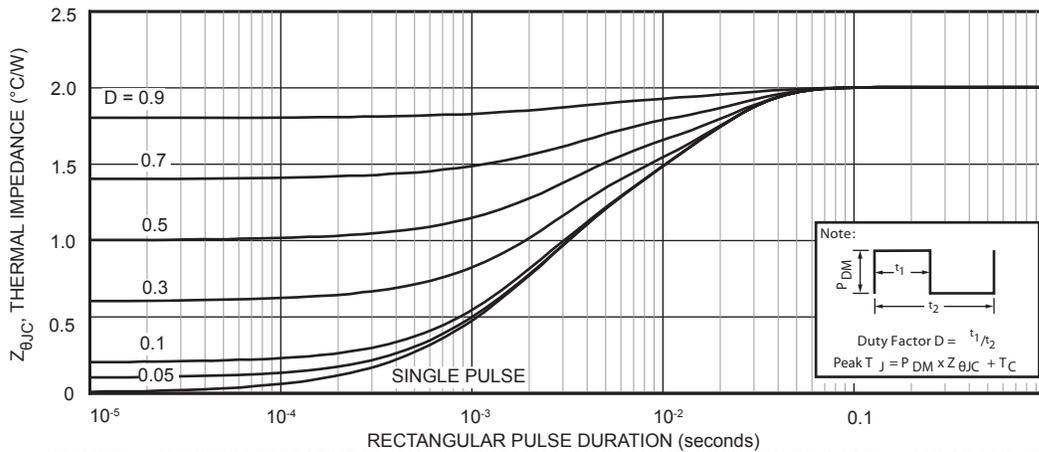


FIGURE 18. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

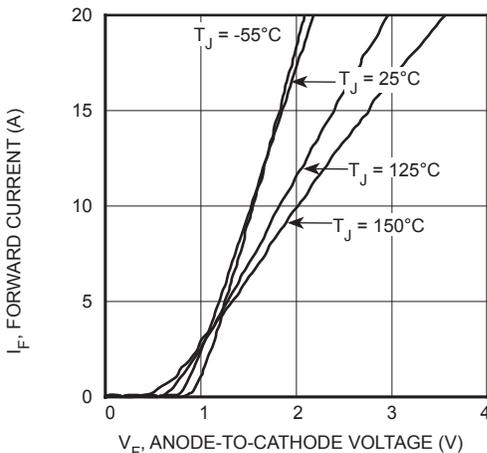


FIGURE 19. Forward Current vs. Forward Voltage

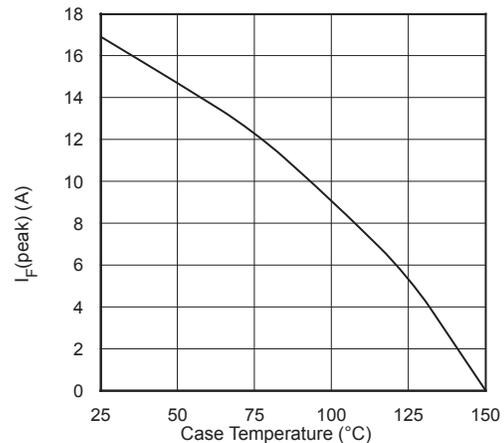


FIGURE 20. Maximum Forward Current vs. Case Temperature



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