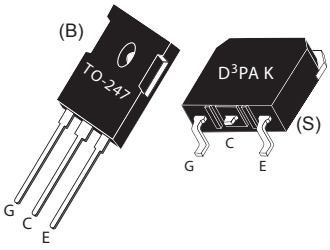
650V, 45A, $V_{CE(on)}$= 1.9V Typical

Ultra Fast NPT - IGBT®

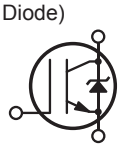
The Ultra Fast 650V NPT-IGBT® family of products is the newest generation of IGBTs optimized for outstanding ruggedness and best trade-off between conduction and switching losses.



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°C unless otherwise specified.

Symbol	Parameter	Ratings	Unit
V_{CES}	Collector Emitter Voltage	650	V
V_{GE}	Gate-Emitter Voltage	±30	
I_{C1}	Continuous Collector Current @ T_C = 25°C	118	A
I_{C2}	Continuous Collector Current @ T_C = 110°C	56	
I_{CM}	Pulsed Collector Current ①	224	
SCWT	Short Circuit Withstand Time: V_{CE} = 325V, V_{GE} = 15V, T_C=125°C	10	µs
P_D	Total Power Dissipation @ T_C = 25°C	543	W
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	Parameter	Min	Typ	Max	Unit
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 450µA)	650			Volts
$V_{GE(TH)}$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 1.0mA, T_j = 25°C)	3.5	5.0	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 45A, T_j = 25°C)		1.9	2.4	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 45A, T_j = 125°C)		2.4		
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 90A, T_j = 25°C)		2.5		
I_{CES}	Collector Cut-off Current (V_{CE} = 650V, V_{GE} = 0V, T_j = 25°C) ②		20	450	µA
	Collector Cut-off Current (V_{CE} = 650V, V_{GE} = 0V, T_j = 125°C) ②		200		
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			±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		2900		pF
C_{oes}	Output Capacitance	V_{GE} = 0V, V_{CE} = 25V		548		
C_{res}	Reverse Transfer Capacitance	f = 1MHz		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)		15		ns
t_r	Current Rise Time	V_{CC} = 433V		32		
$t_{d(off)}$	Turn-Off Delay Time	V_{GE} = 15V		100		
t_f	Current Fall Time	I_C = 45A		50		
E_{on} ⑤	Turn-On Switching Energy	R_G = 5Ω④		830	1245	µJ
E_{off} ⑥	Turn-Off Switching Energy	T_J = +25°C		580	875	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C)		15		ns
t_r	Current Rise Time	V_{CC} = 433V		32		
$t_{d(off)}$	Turn-Off Delay Time	V_{GE} = 15V		123		
t_f	Current Fall Time	I_C = 45A		52		
E_{on} ⑤	Turn-On Switching Energy	R_G = 5Ω④		850	1275	µJ
E_{off} ⑥	Turn-Off Switching Energy	T_J = +125°C		800	1160	

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance (IGBT)			0.23	°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.

TYPICAL PERFORMANCE CURVES

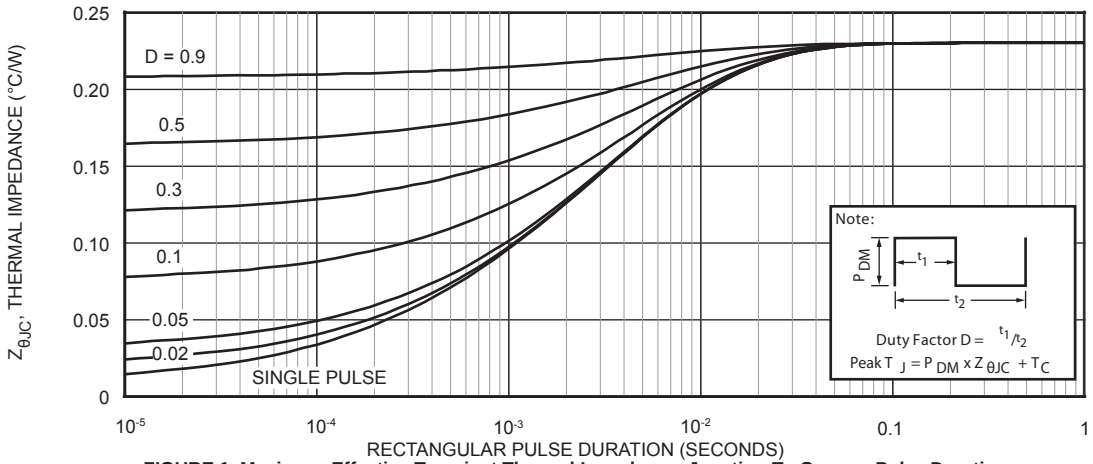


FIGURE 1. Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

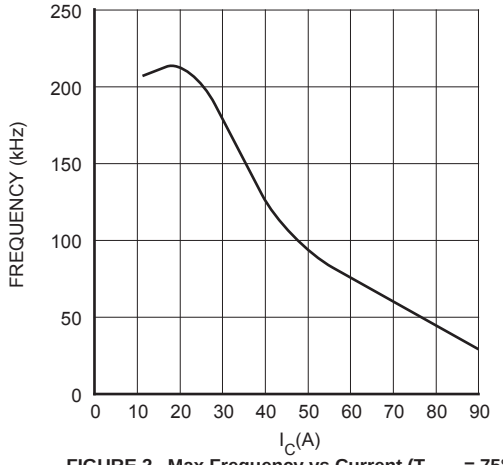


FIGURE 2. Max Frequency vs Current (T_{case} = 75°C)

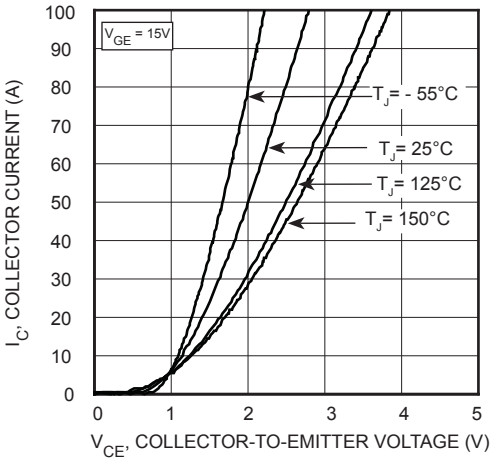


FIGURE 3. Saturation Voltage Characteristics

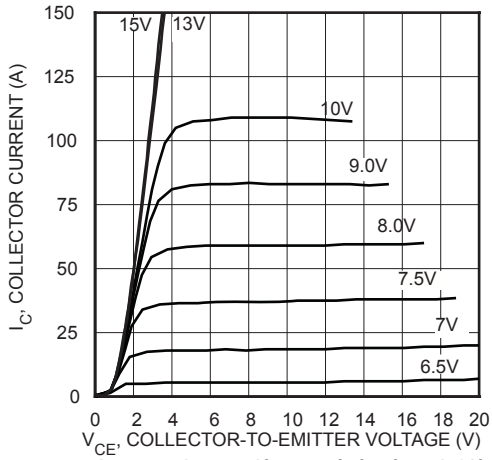


FIGURE 4. Output Characteristics (T_J = 25°C)

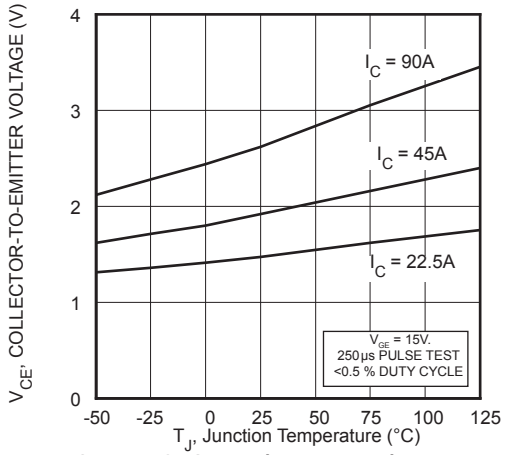


FIGURE 5. On State Voltage vs Junction Temperature

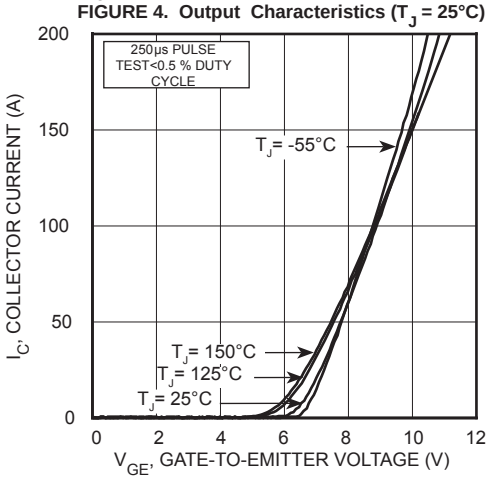


FIGURE 6. Transfer Characteristics

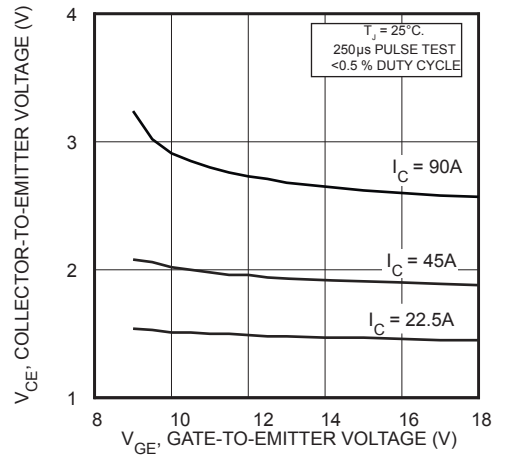


FIGURE 7. On State Voltage vs Gate-to-Emitter Voltage

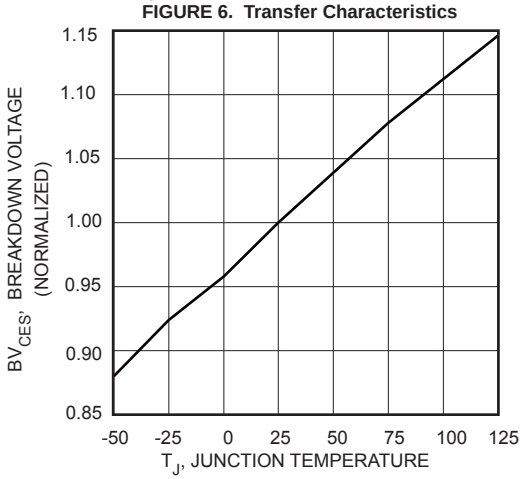


FIGURE 8. Breakdown Voltage vs Junction Temperature

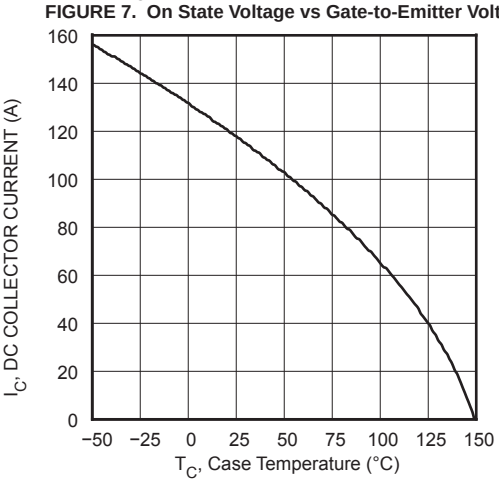


FIGURE 9. DC Collector Current vs Case Temperature

052-6417 Rev B 5-2014

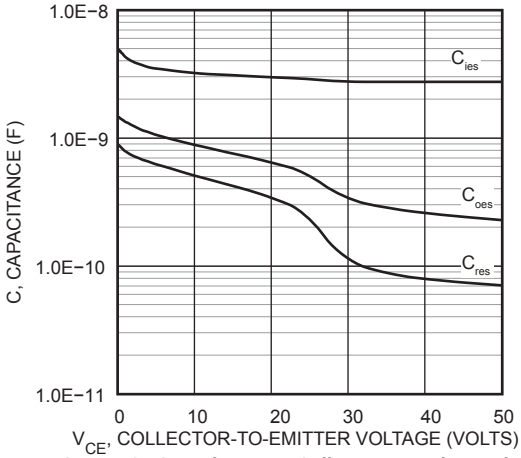


FIGURE 10. Capacitance vs Collector-To-Emitter Voltage

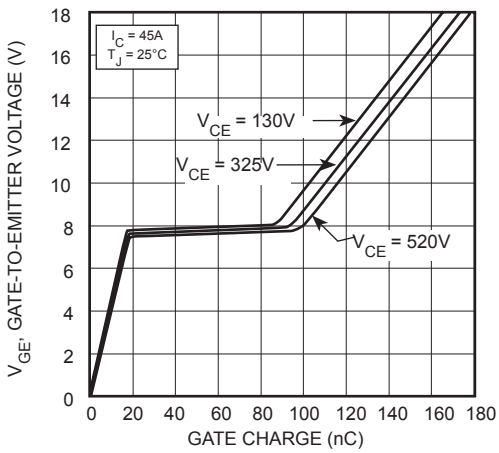


FIGURE 11. Gate charge

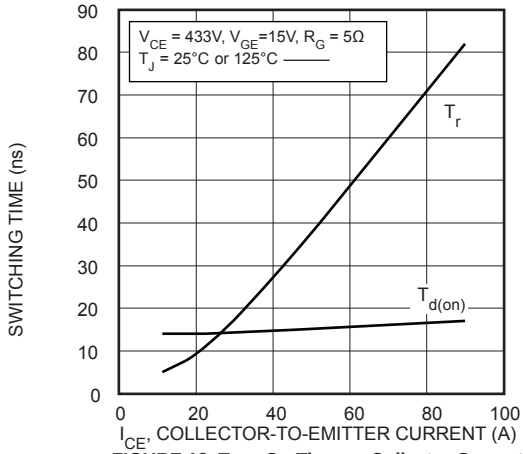


FIGURE 12. Turn-On Time vs Collector Current

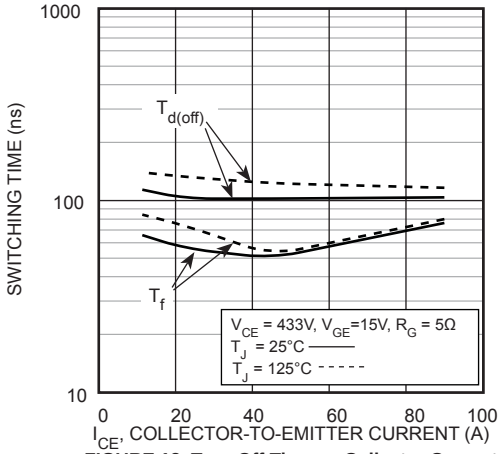


FIGURE 13. Turn-Off Time vs Collector Current

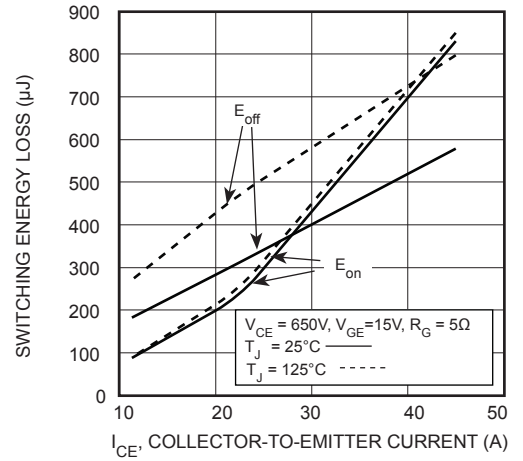


FIGURE 14. Energy Loss vs Collector Current

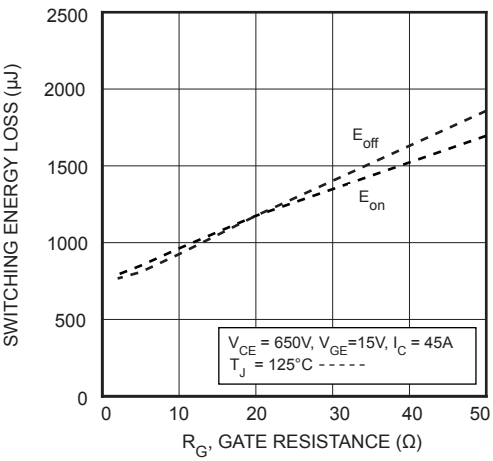


FIGURE 15. Energy Loss vs Gate Resistance

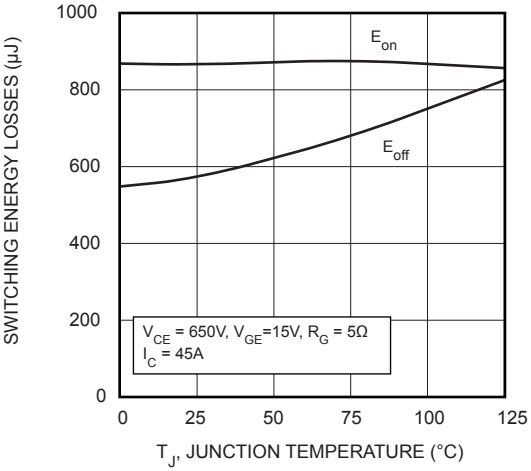


FIGURE 16. Energy Losses vs Junction Temperature

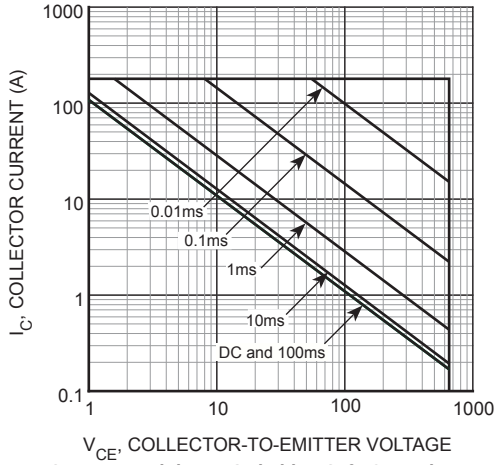


FIGURE 17. Minimum Switching Safe Operating Area

ZERO RECOVERY LOW LEAKAGE SIC ANTI-PARALLEL DIODE

MAXIMUM RATINGS

All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Characteristic / Test Conditions		Ratings	Unit
I_F	Maximum D.C. Forward Current	T_C = 25°C	17	Amps
		T_C = 100°C	9	
I_{FRM}	Repetitive Peak Forward Surge Current (T_J = 45°C, t_p = 10ms, Half Sine Wave)		50	
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 25°C, t_p = 10ms, Half Sine)		110	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions		Min	Typ	Max	Unit
V_F	Forward Voltage	I_F = 10A T_J = 25°C		1.5		Volts
		I_F = 10A, T_J = 150°C		2.0		
Q_c	Total Capactive Charge V_R = 300V, I_F = 10A, di/dt = -500A/µs, T_J = 25°C			80		nC

TYPICAL PERFORMANCE CURVES

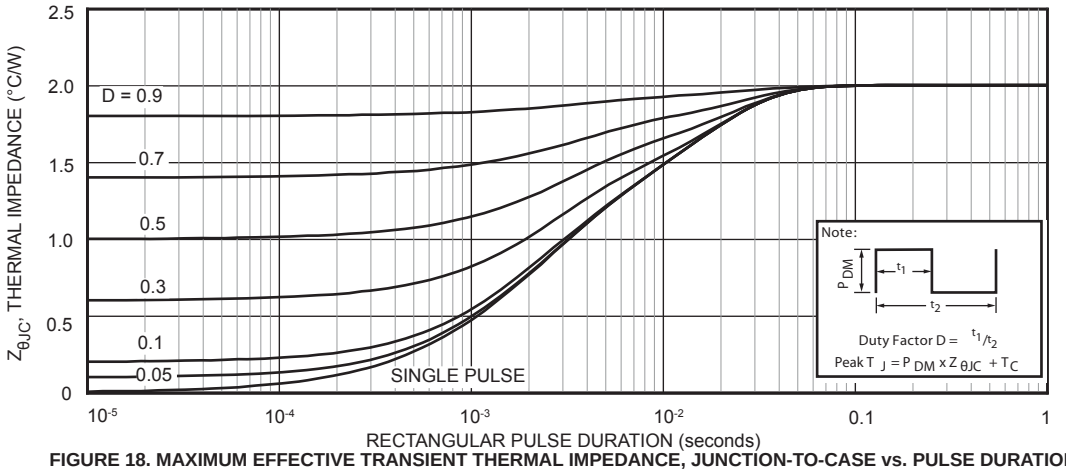


FIGURE 18. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

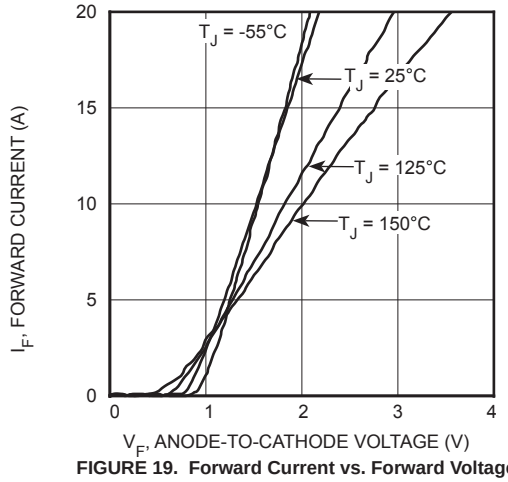


FIGURE 19. Forward Current vs. Forward Voltage

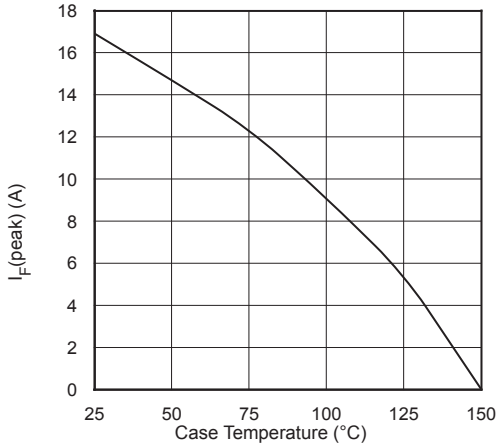


FIGURE 20. Maximum Forward Current vs. Case Temperature

052-6417 Rev B 5-2014

TYPICAL PERFORMANCE CURVES

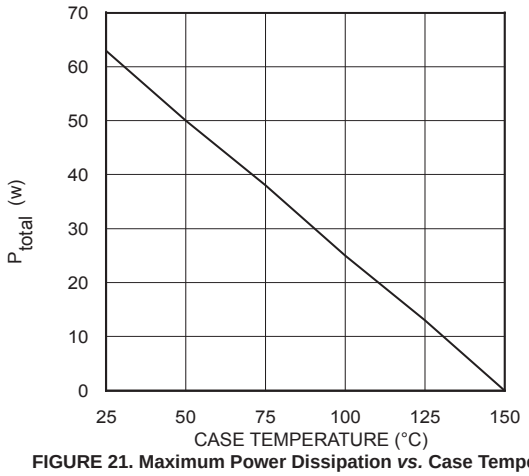


FIGURE 21. Maximum Power Dissipation *vs.* Case Temperature

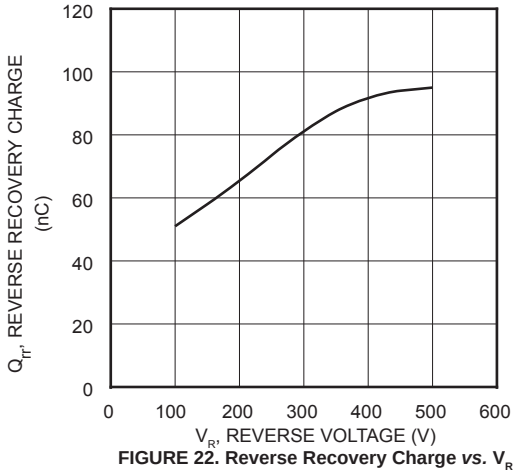


FIGURE 22. Reverse Recovery Charge *vs.* V_R

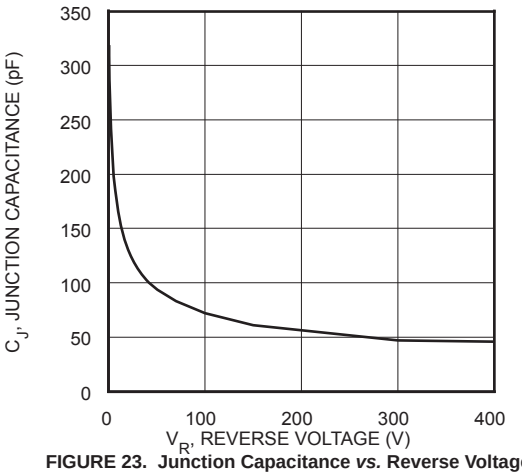
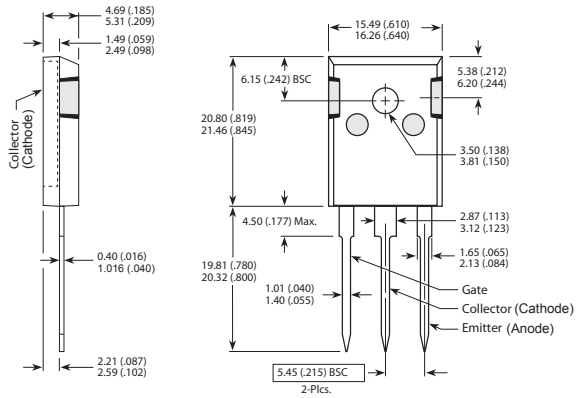


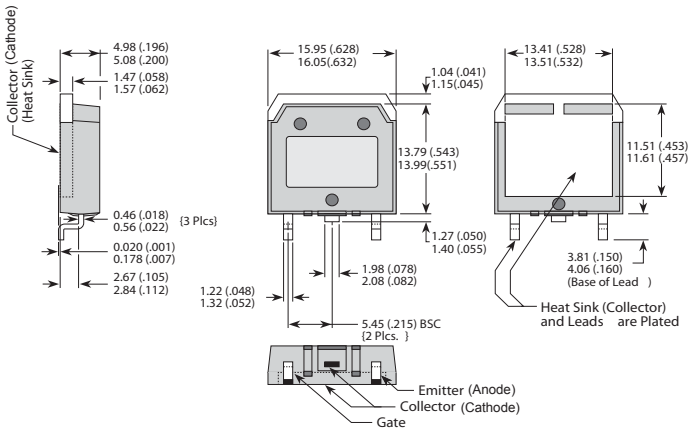
FIGURE 23. Junction Capacitance *vs.* Reverse Voltage

TO-247 Package Outline



Dimensions in Millimeters (Inches)

D³PAK Package Outline



Dimensions in Millimeters (Inches)

052-6417 Rev B 5-2014