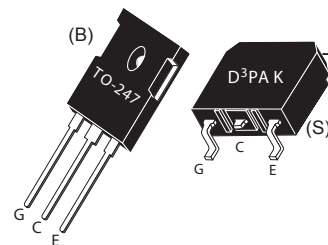


## Ultra Fast NPT - IGBT®

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



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 ( $V_{GE} = 0V$ , $I_C = 250\mu\text{A}$ )	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 ( $V_{GE} = 15V$ , $I_C = 90A$ , $T_J = 25^\circ\text{C}$ )		2.6		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 650V$ , $V_{GE} = 0V$ , $T_J = 25^\circ\text{C}$ ) <sup>②</sup>		10	250	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 650V$ , $V_{GE} = 0V$ , $T_J = 125^\circ\text{C}$ ) <sup>②</sup>		100		
$I_{GES}$	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.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1MHz$		2900		$\mu F$
$C_{oes}$	Output Capacitance			548		
$C_{res}$	Reverse Transfer Capacitance			268		
$V_{GEP}$	Gate to Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 325V$ $I_C = 45A$		7.5		V
$Q_g^{(3)}$	Total Gate Charge			150	203	nC
$Q_{ge}$	Gate-Emitter Charge			18	24	
$Q_{gc}$	Gate- Collector Charge			74	100	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C) $V_{CC} = 433V$ $V_{GE} = 15V$ $I_C = 45A$ $R_G = 4.3\Omega^{(4)}$ $T_J = +25^\circ C$		15		ns
$t_r$	Current Rise Time			32		
$t_{d(off)}$	Turn-Off Delay Time			100		
$t_f$	Current Fall Time			50		
$E_{on2}^{(5)}$	Turn-On Switching Energy			900	1350	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy			580	870	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C) $V_{CC} = 433V$ $V_{GE} = 15V$ $I_C = 45A$ $R_G = 4.3\Omega^{(4)}$ $T_J = +125^\circ C$		15		ns
$t_r$	Current Rise Time			32		
$t_{d(off)}$	Turn-Off Delay Time			123		
$t_f$	Current Fall Time			52		
$E_{on2}^{(5)}$	Turn-On Switching Energy			925	1245	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy			800	1160	

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance			0.23	$^\circ C/W$
$R_{\theta JA}$	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 < 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  $E_{on2}$  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.

## TYPICAL PERFORMANCE CURVES

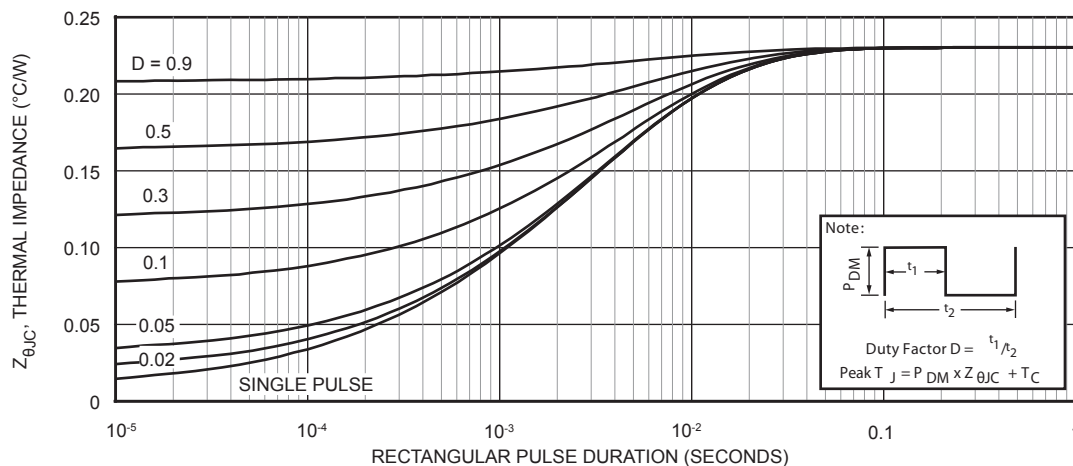


FIGURE 1. Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

# TYPICAL PERFORMANCE CURVES

APT45GR65B\_S

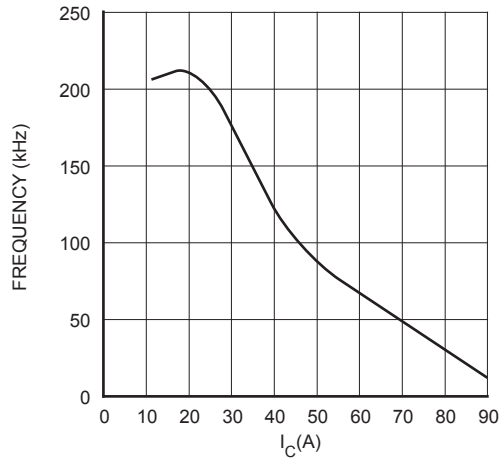


FIGURE 2. Max Frequency vs Current ( $T_{case} = 75^{\circ}\text{C}$ )

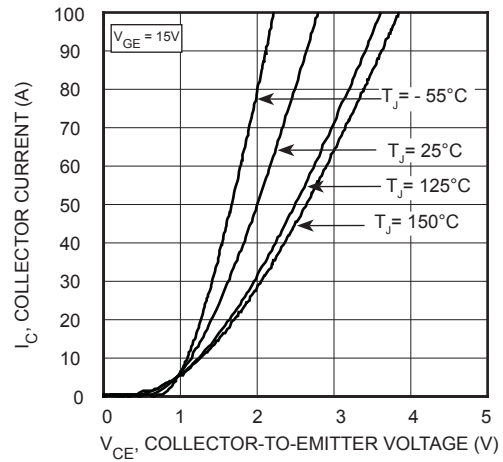


FIGURE 3. Saturation Voltage Characteristics

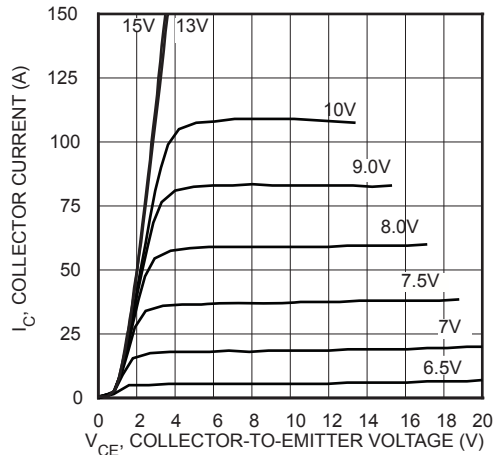


FIGURE 4. Output Characteristics ( $T_J = 25^{\circ}\text{C}$ )

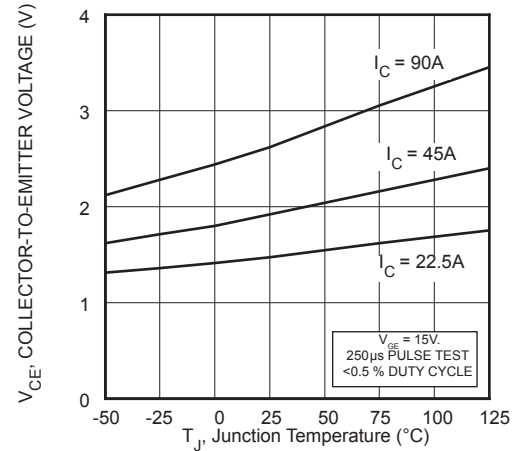


FIGURE 5. On State Voltage vs Junction Temperature

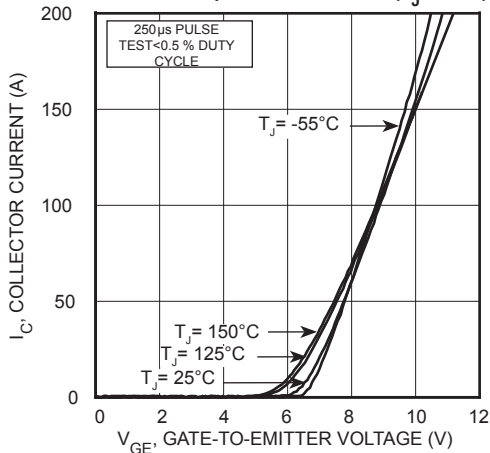


FIGURE 6. Transfer Characteristics

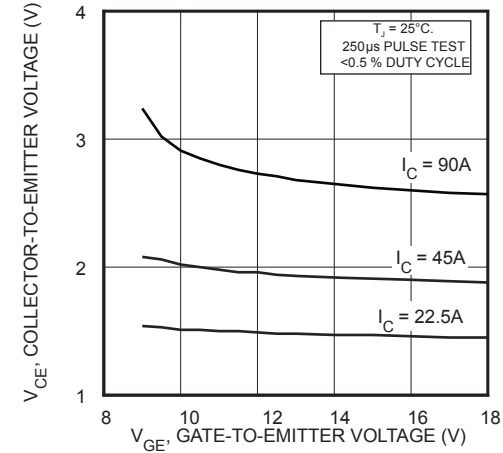


FIGURE 7. On State Voltage vs Gate-to-Emitter Voltage

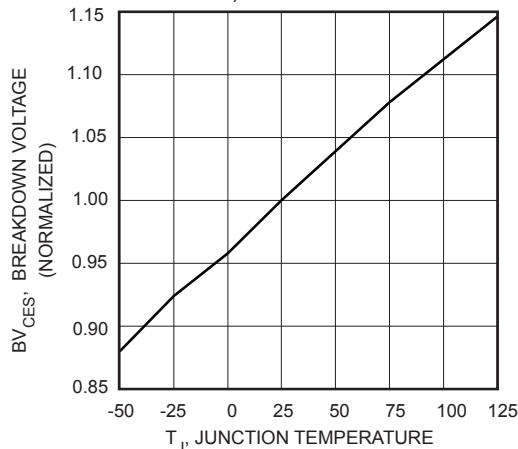


FIGURE 8. Breakdown Voltage vs Junction Temperature

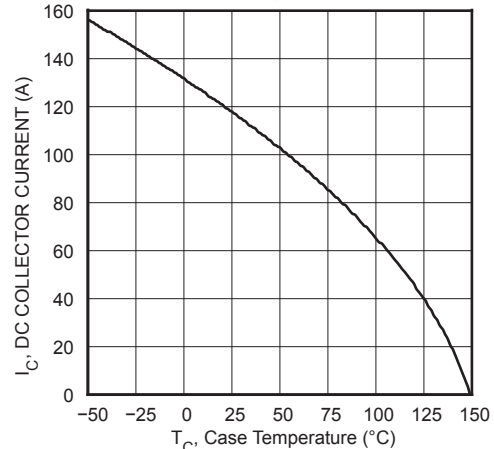


FIGURE 9. DC Collector Current vs Case Temperature

# TYPICAL PERFORMANCE CURVES

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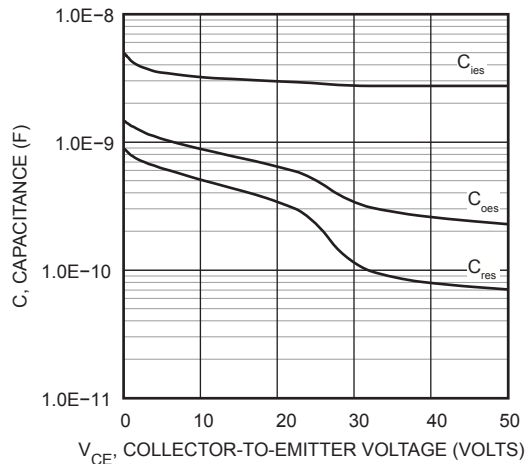


FIGURE 10. Capacitance vs Collector-To-Emitter Voltage

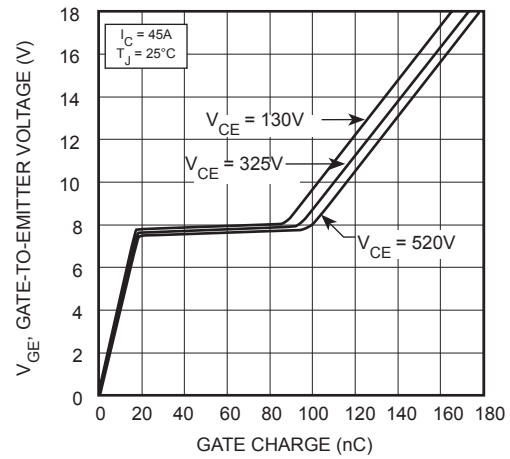


FIGURE 11. Gate Charge

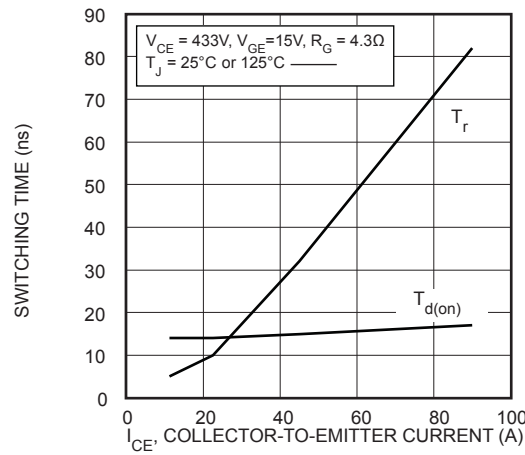


FIGURE 12. Turn-On Time vs Collector Current

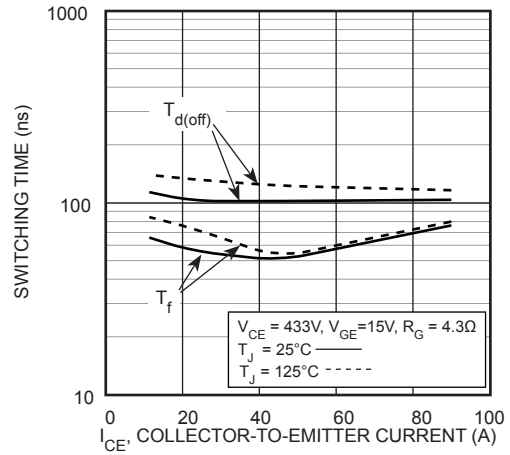


FIGURE 13. Turn-Off Time vs Collector Current

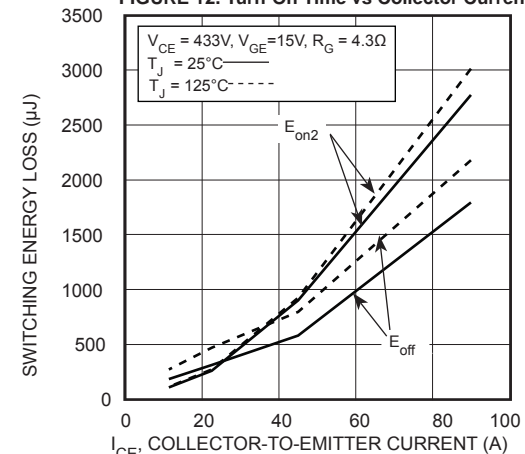


FIGURE 14. Energy Loss vs Collector Current

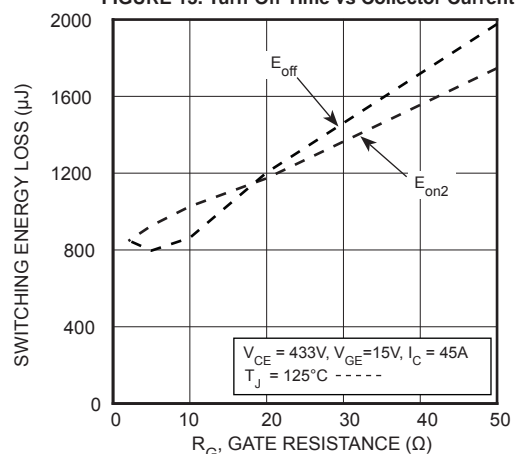


FIGURE 15. Energy Loss vs Gate Resistance

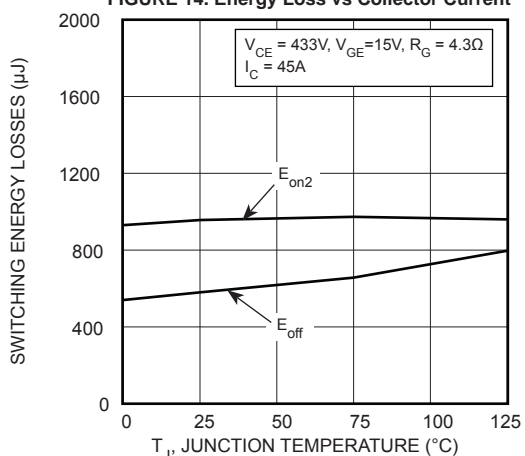


FIGURE 16. Switching Energy vs Junction Temperature

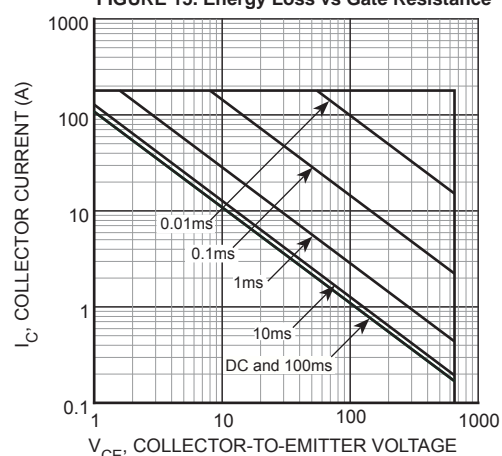
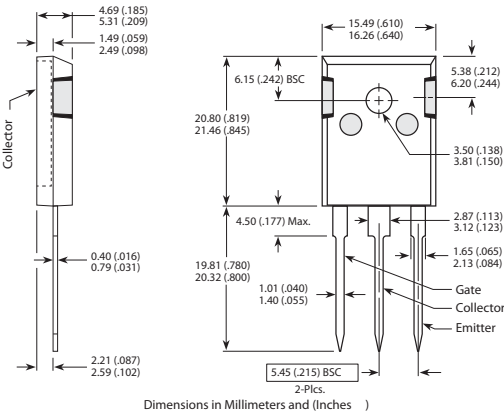


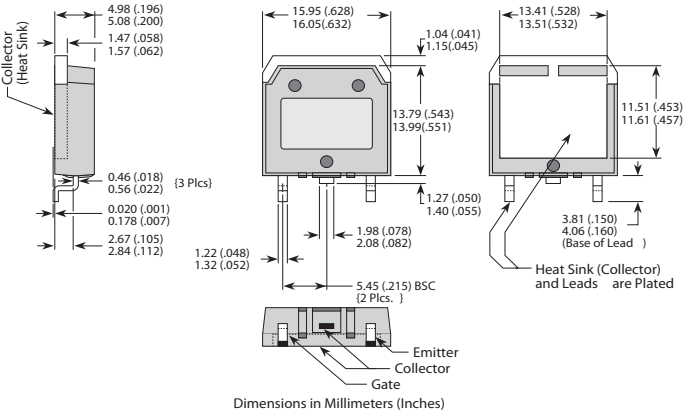
FIGURE 17. Minimum Switching Safe Operating Area

TO-247 Package Outline



D<sup>3</sup>PAK Package Outline

e3 : 100% Sn Plating



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