
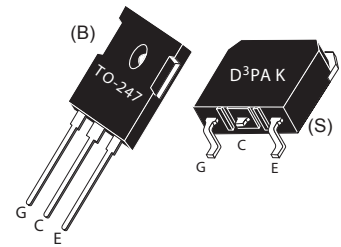


## Ultra Fast NPT - IGBT®

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 to 50KHz
- 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	1200	V
$V_{GE}$	Gate-Emitter Voltage	$\pm 30$	
$I_{C1}$	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	88	A
$I_{C2}$	Continuous Collector Current @ $T_C = 100^\circ\text{C}$	40	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	160	
SCWT	Short Circuit Withstand Time: $V_{CE} = 600V, V_{GE} = 15V, T_C = 125^\circ\text{C}$	10	$\mu\text{s}$
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	500	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 ( $V_{GE} = 0V, I_C = 1.0mA$ )	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 2.0mA, T_J = 25^\circ\text{C}$ )	3.5	5.0	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 40A, T_J = 25^\circ\text{C}$ )		2.5	3.2	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 40A, T_J = 125^\circ\text{C}$ )		3.5		
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 88A, T_J = 25^\circ\text{C}$ )		3.2		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 25^\circ\text{C}$ ) <sup>②</sup>		10	1000	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 125^\circ\text{C}$ ) <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.

## DYNAMIC CHARACTERISTICS

APT40GR120B\_S

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			320		
$C_{res}$	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		nC
$Q_{ge}$	Gate-Emitter Charge			25		
$Q_{gc}$	Gate- Collector Charge			90		
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 40A$		22		ns
$t_r$	Current Rise Time			25		
$t_{d(off)}$	Turn-Off Delay Time			163		
$t_f$	Current Fall Time			40		
$E_{on2}^{(5)}$	Turn-On Switching Energy	$R_G = 4.3 \Omega^{(4)}$ $T_J = +25^\circ C$		1375	3000	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy			906	1650	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 40A$		22		ns
$t_r$	Current Rise Time			25		
$t_{d(off)}$	Turn-Off Delay Time			185		
$t_f$	Current Fall Time			47		
$E_{on2}^{(5)}$	Turn-On Switching Energy	$R_G = 4.3 \Omega^{(4)}$ $T_J = +125^\circ C$		1916	3500	$\mu J$
$E_{off}^{(6)}$	Turn-Off Switching Energy			1186	2500	

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance			.25	$^\circ C/W$
$R_{\theta JA}$	Junction to Ambient Thermal Resistance			40	
$W_T$	Package Weight		.22 6.2		oz g
Torque	Mounting Torque (TO-247 Package), 4-40 or M3 screw			10 6.2	in-lbf 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 clamped inductive turn on energy that includes a commutating diode reverse recovery 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

APT40GR120B\_S

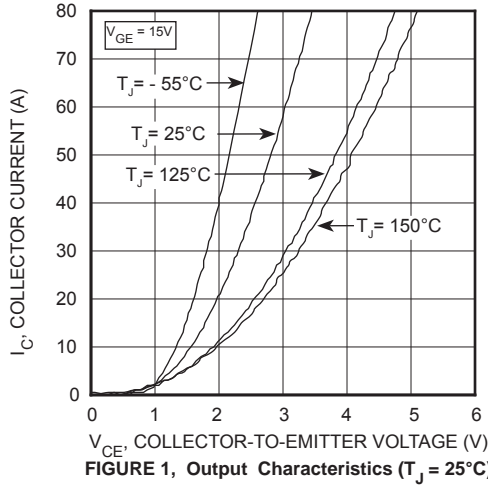


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

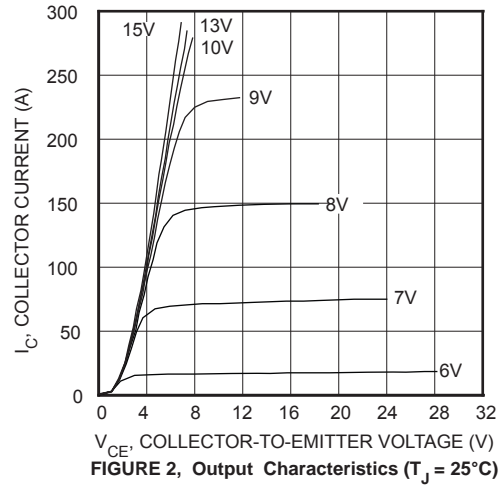


FIGURE 2, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

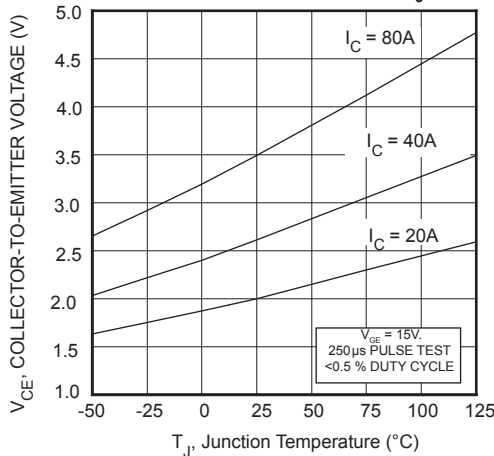


FIGURE 3, On State Voltage vs Junction Temperature

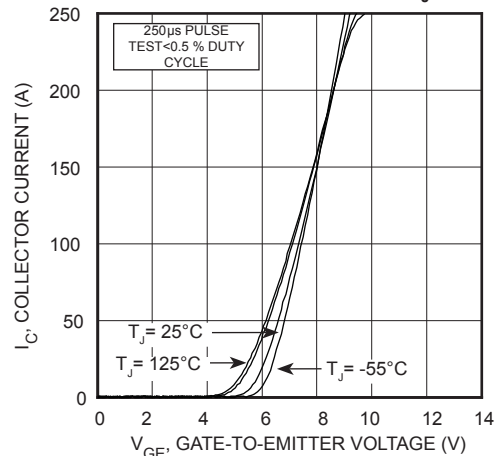


FIGURE 4, Transfer Characteristics

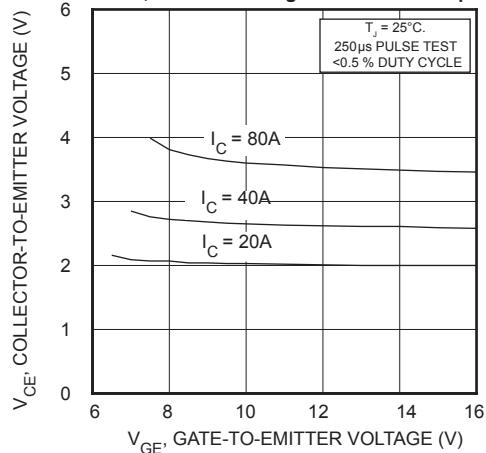


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

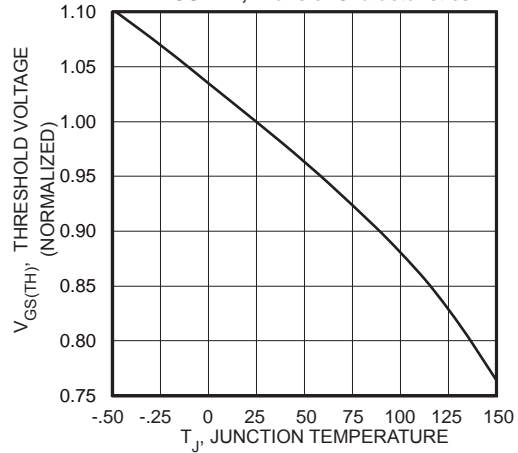


FIGURE 6, Threshold Voltage vs Junction Temperature

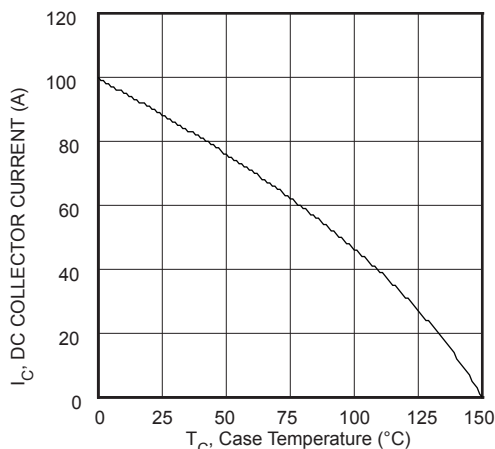


FIGURE 7, DC Collector Current vs Case Temperature

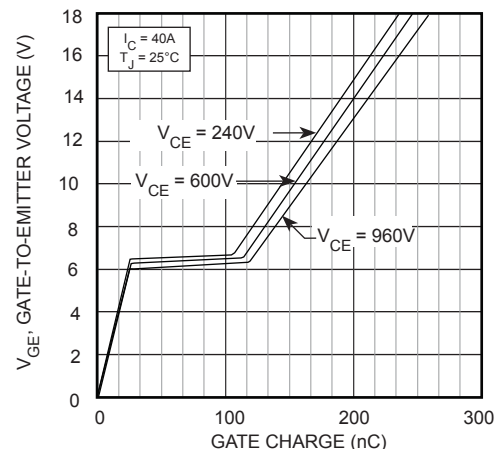
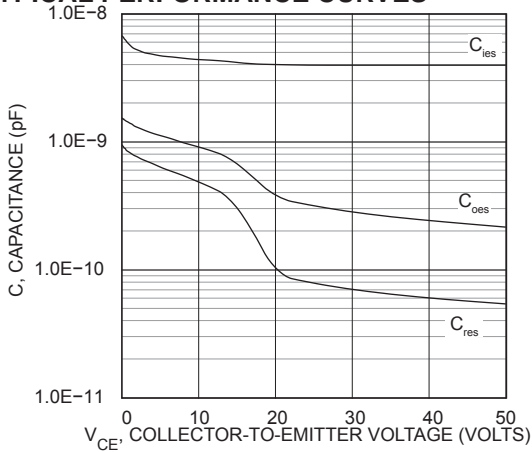
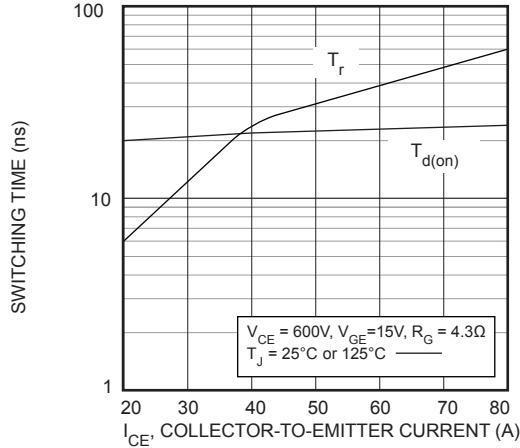


FIGURE 8, Gate charge

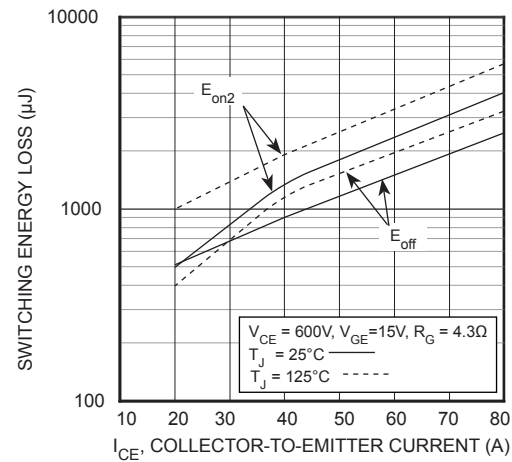
**TYPICAL PERFORMANCE CURVES**



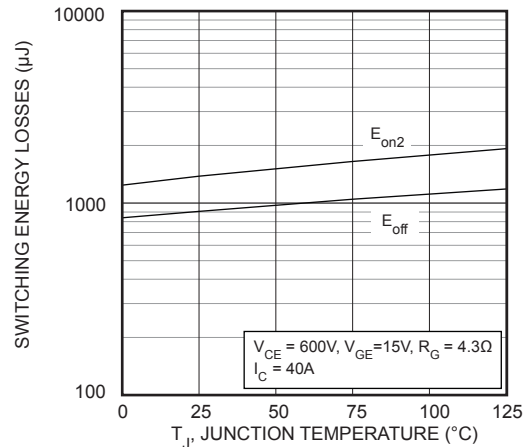
**FIGURE 9, Capacitance vs Collector-To-Emitter Voltage**



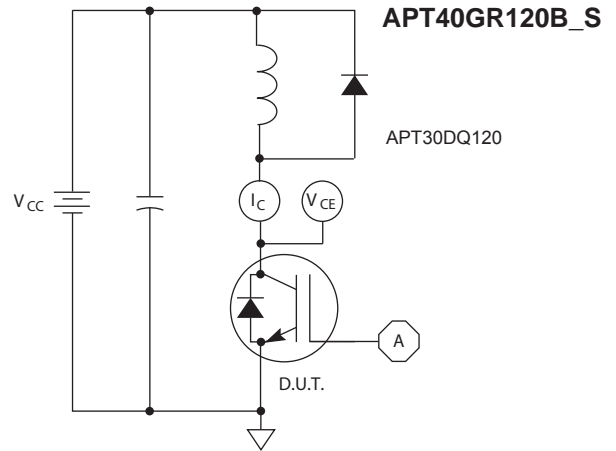
**FIGURE 11, Turn-On Time vs Collector Current**



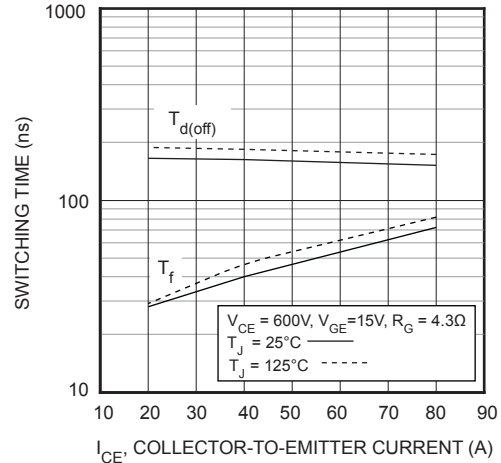
**FIGURE 13, Energy Loss vs Collector Current**



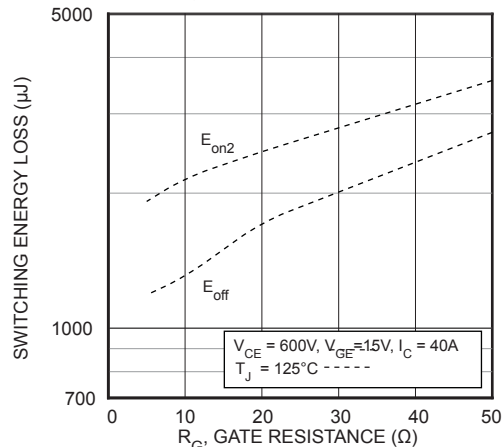
**FIGURE 15, Energy Losses vs Junction Temperature**



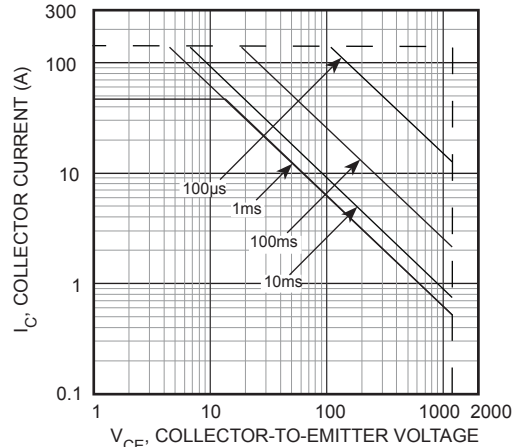
**FIGURE 10, Inductive Switching Test Circuit**



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



**FIGURE 14, Energy Loss vs Gate Resistance**



**FIGURE 16, Minimum Switching Safe Operating Area**

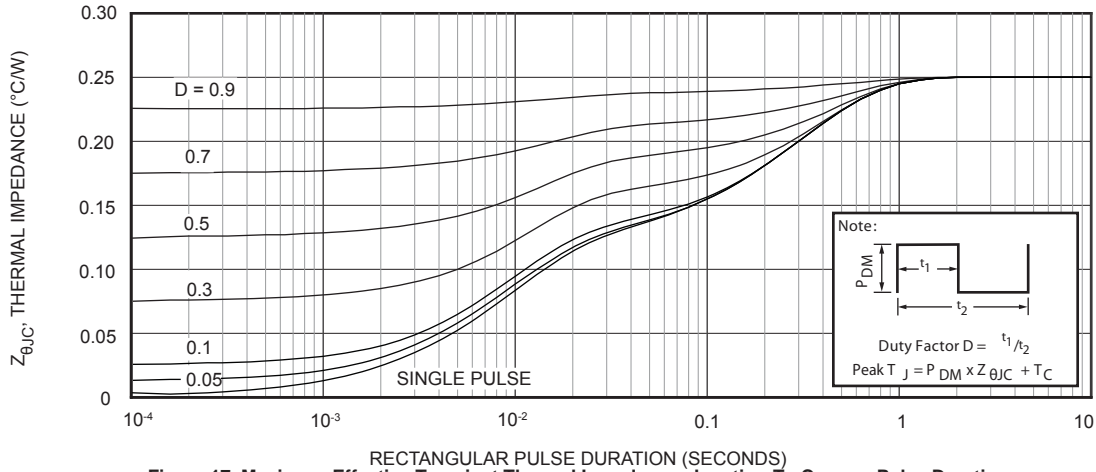
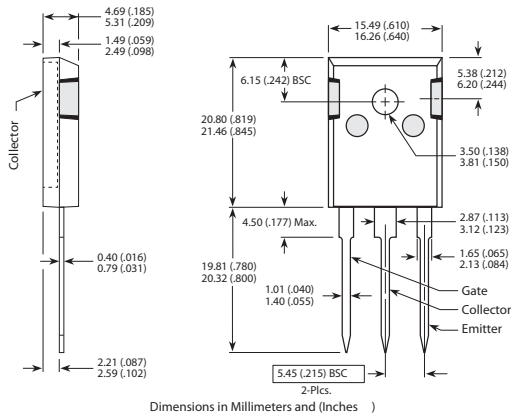


Figure 17, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

**TO-247 Package Outline**

e3 SAC: 100% Sn Plating



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

e3 SAC: 100% Sn Plating

