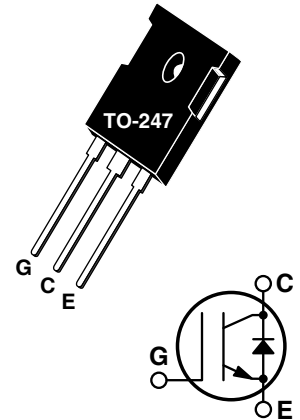


POWER MOS 7® IGBT

A new generation of high voltage power IGBTs. Using punch-through technology and a proprietary metal gate, this IGBT has been optimized for very fast switching, making it ideal for high frequency, high voltage switch-mode power supplies and tail current sensitive applications. In many cases, the POWER MOS 7® IGBT provides a lower cost alternative to a Power MOSFET.

- **Low Conduction Loss**
- **Low Gate Charge**
- **Ultrafast Tail Current shutoff**
- **100 kHz operation @ 600V, 10A**
- **50 kHz operation @ 600V, 16A**
- **RBSOA Rated**



MAXIMUM RATINGS

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

Symbol	Parameter	APT13GP120BSC	UNIT
V_{CES}	Collector-Emitter Voltage	1200	Volts
V_{GE}	Gate-Emitter Voltage	± 20	
V_{GEM}	Gate-Emitter Voltage Transient	± 30	
I_{C1}	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	41	Amps
I_{C2}	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	20	
I_{CM}	Pulsed Collector Current ^① @ $T_C = 150^\circ\text{C}$	50	
RBSOA	Reverse Bias Safe Operating Area @ $T_J = 150^\circ\text{C}$	50A @ 960V	
P_D	Total Power Dissipation	250	Watts
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	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage ($V_{GE} = 0\text{V}, I_C = 450\mu\text{A}$)	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 1\text{mA}, T_J = 25^\circ\text{C}$)	3	4.5	6	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15\text{V}, I_C = 13\text{A}, T_J = 25^\circ\text{C}$)		3.3	3.9	
	Collector-Emitter On Voltage ($V_{GE} = 15\text{V}, I_C = 13\text{A}, T_J = 125^\circ\text{C}$)		3.0		
I_{CES}	Collector Cut-off Current ($V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_J = 25^\circ\text{C}$) ^②			450	μA
	Collector Cut-off Current ($V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_J = 125^\circ\text{C}$) ^②			3500	
I_{GES}	Gate-Emitter Leakage Current ($V_{GE} = \pm 20\text{V}$)			± 100	nA

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

DYNAMIC CHARACTERISTICS
APT13GP120BSC

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT	
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		1145		pF	
C_{oes}	Output Capacitance			90			
C_{res}	Reverse Transfer Capacitance			15			
V_{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 13A$		7.5		V	
Q_g	Total Gate Charge ^③			55		nC	
Q_{ge}	Gate-Emitter Charge			8			
Q_{gc}	Gate-Collector ("Miller") Charge			26			
RBSOA	Reverse Bias Safe Operating Area	$T_J = 150^\circ\text{C}, R_G = 5\Omega, V_{GE} = 15V, L = 100\mu\text{H}, V_{CE} = 960V$	50			A	
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 13A$ $R_G = 5\Omega$ $T_J = +25^\circ\text{C}$		8		ns	
t_r	Current Rise Time			12			
$t_{d(off)}$	Turn-off Delay Time			28			
t_f	Current Fall Time			35			
E_{on1}	Turn-on Switching Energy ^④				114		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤				120		
E_{off}	Turn-off Switching Energy ^⑥				155		
$t_{d(on)}$	Turn-on Delay Time		Inductive Switching (125°C) $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 13A$ $R_G = 5\Omega$ $T_J = +125^\circ\text{C}$		8		ns
t_r	Current Rise Time			12			
$t_{d(off)}$	Turn-off Delay Time			65			
t_f	Current Fall Time			205			
E_{on1}	Turn-on Switching Energy ^④				223		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤				235		
E_{off}	Turn-off Switching Energy ^⑥				850		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.50	°C/W
$R_{\theta JC}$	Junction to Case (DIODE)			1.1	
W_T	Package Weight			5.90	gm

① Repetitive Rating: Pulse width limited by maximum junction temperature.

② For Combi devices, I_{ces} includes both IGBT and FRED leakages

③ See MIL-STD-750 Method 3471.

④ E_{on1} is the clamped inductive turn-on-energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to the IGBT turn-on loss. (See Figure 24.)

⑤ E_{on2} is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22.)

⑥ E_{off} is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See Figures 21, 23.)

APT Reserves the right to change, without notice, the specifications and information contained herein.

TYPICAL PERFORMANCE CURVES

APT13GP120BSC

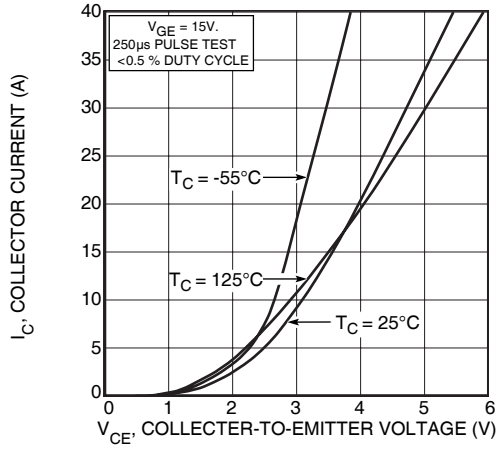


FIGURE 1, Output Characteristics ($V_{GE} = 15V$)

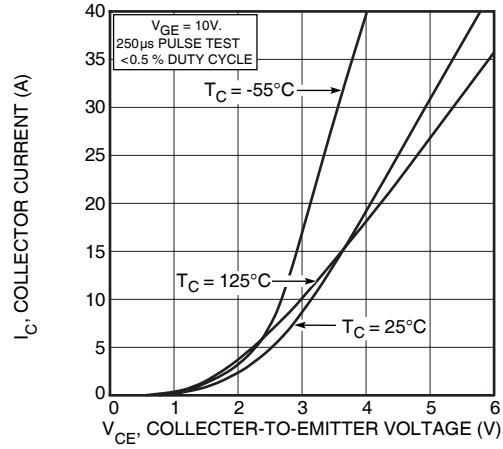


FIGURE 2, Output Characteristics ($V_{GE} = 10V$)

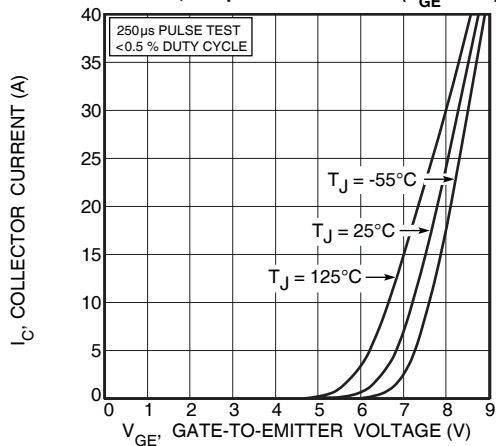


FIGURE 3, Transfer Characteristics

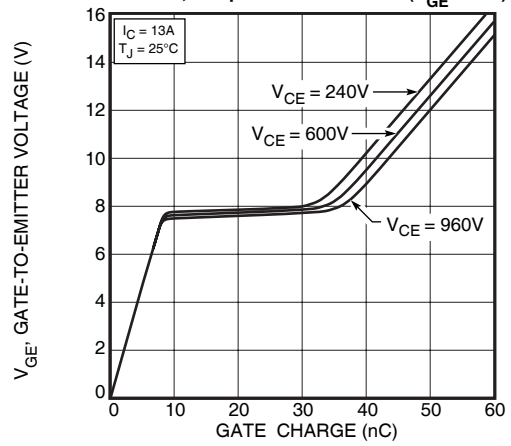


FIGURE 4, Gate Charge

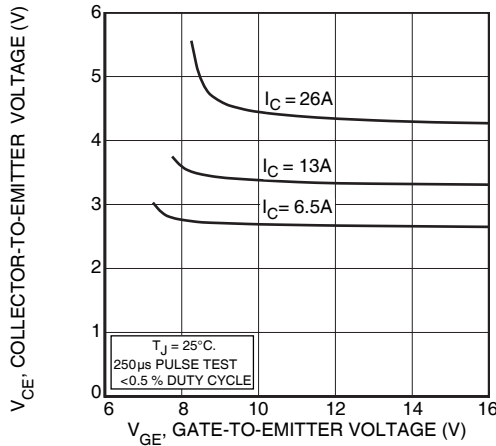


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

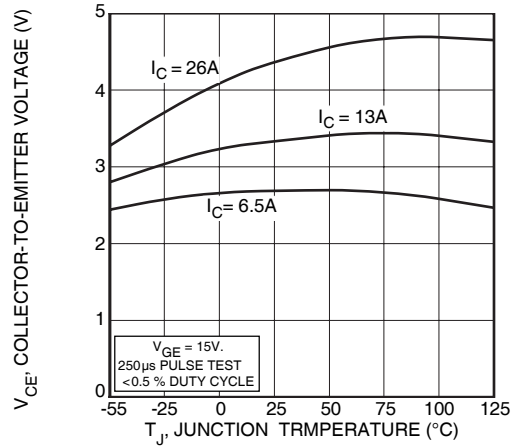


FIGURE 6, On State Voltage vs Junction Temperature

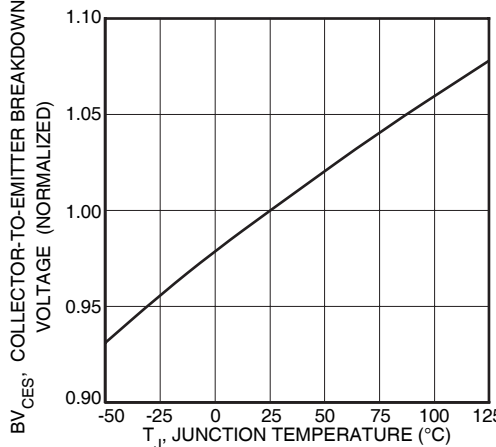


FIGURE 7, Breakdown Voltage vs. Junction Temperature

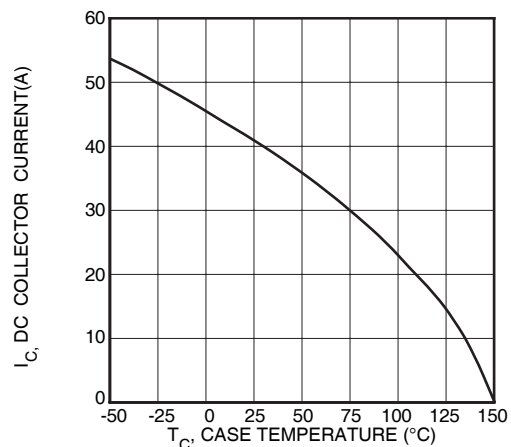


FIGURE 8, DC Collector Current vs Case Temperature

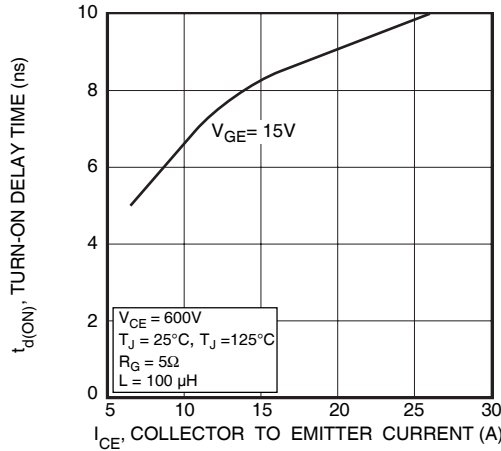


FIGURE 9, Turn-On Delay Time vs Collector Current

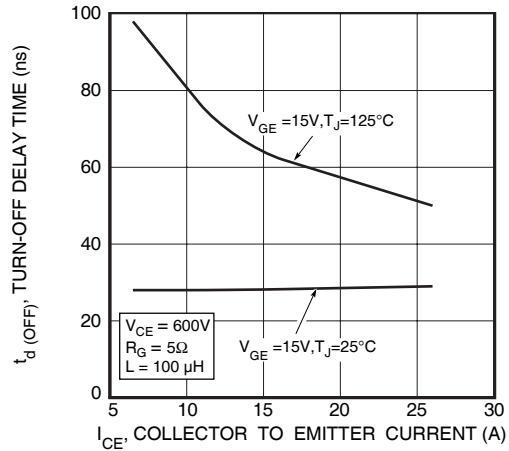


FIGURE 10, Turn-Off Delay Time vs Collector Current

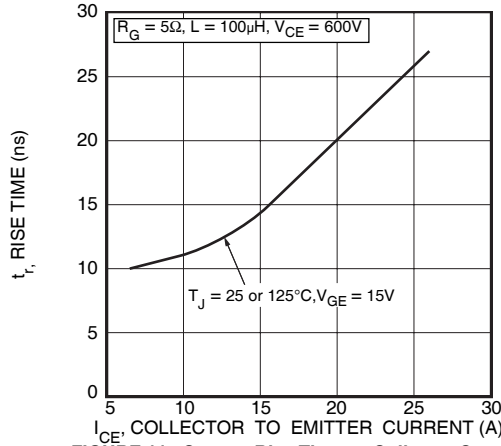


FIGURE 11, Current Rise Time vs Collector Current

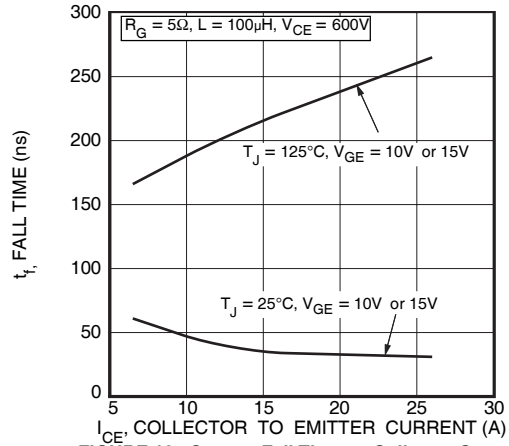


FIGURE 12, Current Fall Time vs Collector Current

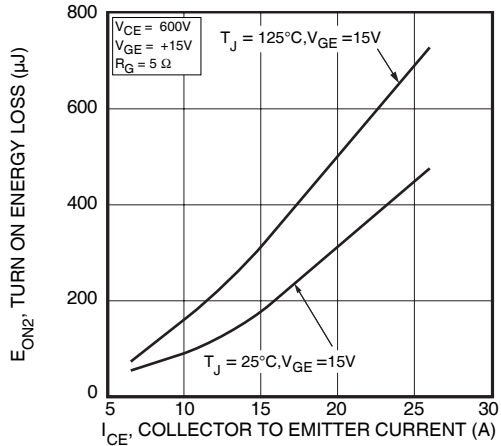


FIGURE 13, Turn-On Energy Loss vs Collector Current

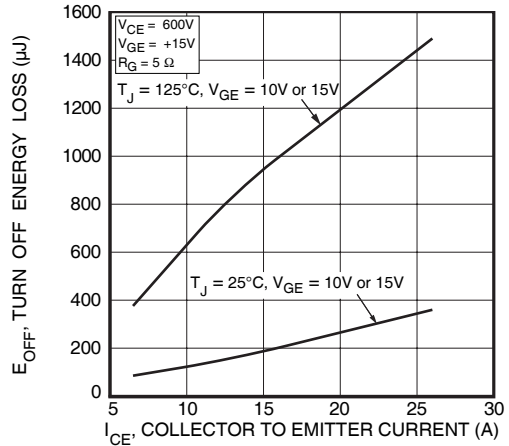


FIGURE 14, Turn Off Energy Loss vs Collector Current

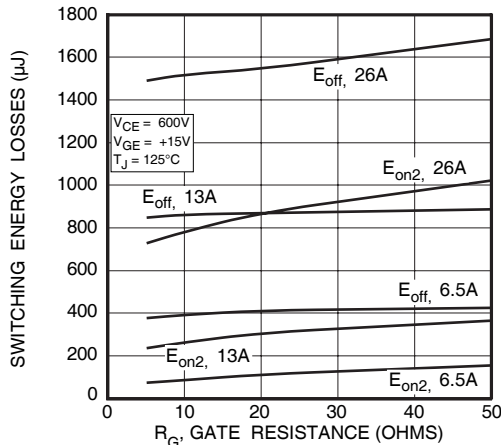


FIGURE 15, Switching Energy Losses vs. Gate Resistance

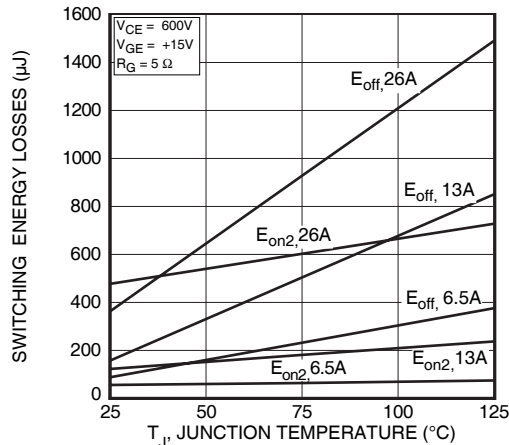


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

APT13GP120BSC

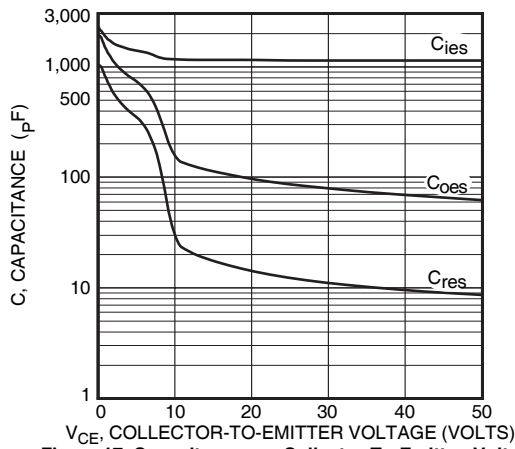


Figure 17, Capacitance vs Collector-To-Emitter Voltage

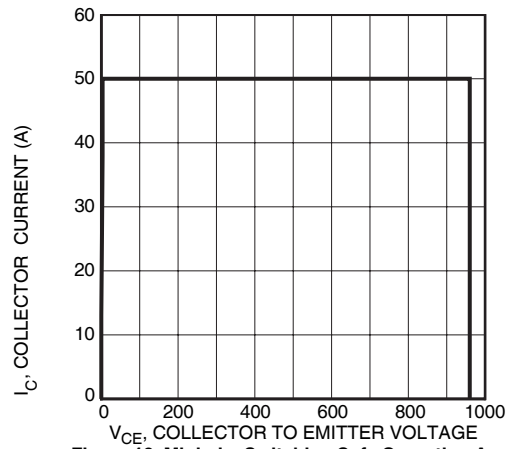


Figure 18, Minimum Switching Safe Operating Area

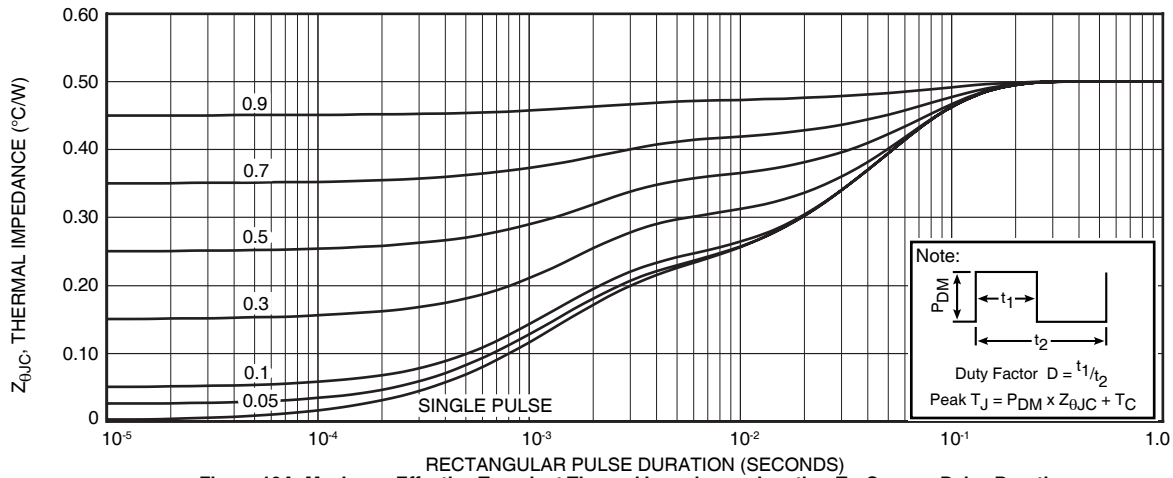


Figure 19A, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

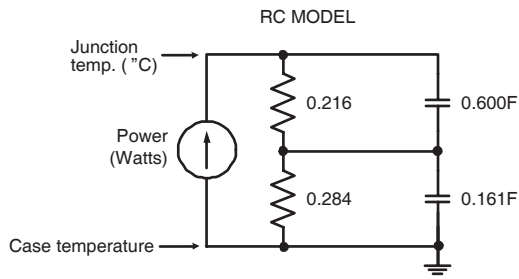


FIGURE 19B, TRANSIENT THERMAL IMPEDANCE MODEL

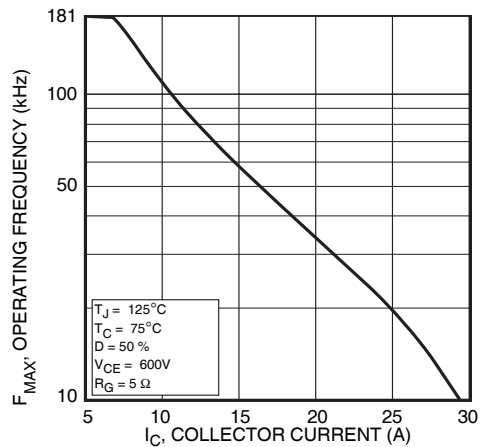


Figure 20, Operating Frequency vs Collector Current

$$F_{max} = \min(f_{max1}, f_{max2})$$

$$f_{max1} = \frac{0.05}{t_{d(on)} + t_r + t_{d(off)} + t_f}$$

$$f_{max2} = \frac{P_{diss} - P_{cond}}{E_{on2} + E_{off}}$$

$$P_{diss} = \frac{T_J - T_C}{R_{\theta JC}}$$

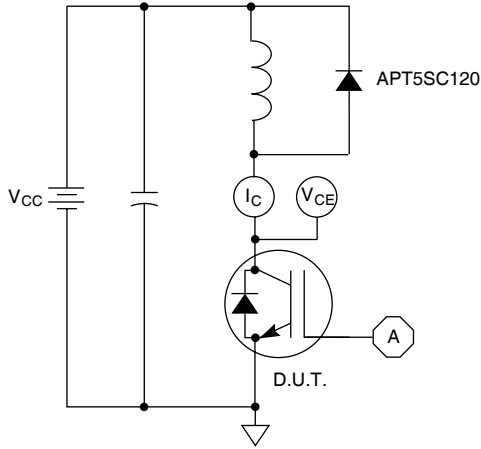


Figure 21, Inductive Switching Test Circuit

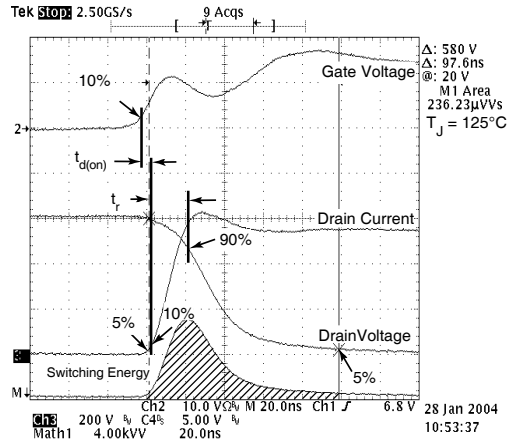


Figure 22, Turn-on Switching Waveforms and Definitions

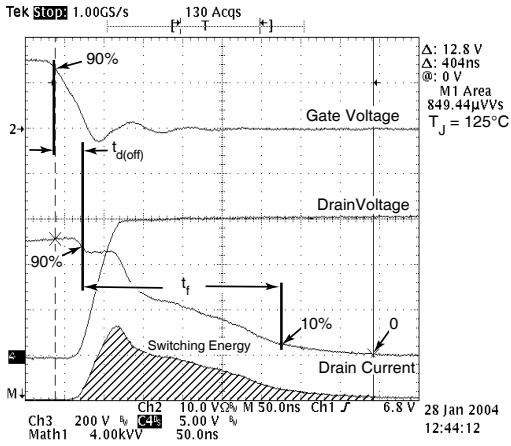


Figure 23, Turn-off Switching Waveforms and Definitions

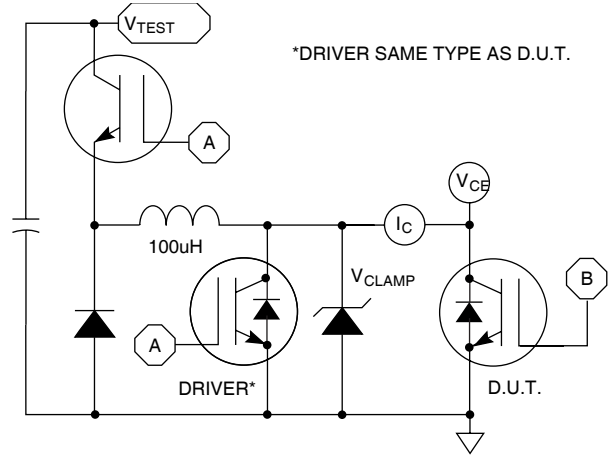


Figure 24, E_{ON1} Test Circuit

SILICON CARBIDE SCHOTTKY RECTIFIER DIODE

MAXIMUM RATINGS

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

Symbol	Characteristic / Test Conditions	APT13GP120BSC			UNIT
$I_F(\text{AV})$	Maximum Average Forward Current ($T_C = 146^\circ\text{C}$, Duty Cycle = 0.5)		5		Amps
$I_F(\text{RMS})$	RMS Forward Current		11		
I_{FSM}	Non-Repetitive Forward Surge Current ($T_J = 25^\circ\text{C}$, $t_p = 10\mu\text{s}$)		100		

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
V_F	Forward Voltage		$I_F = 13\text{A}$	2.5	Volts
			$I_F = 26\text{A}$	4.5	
			$I_F = 13\text{A}$, $T_J = 175^\circ\text{C}$	6.5	

DYNAMIC CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
C	Capacitance ($V_R = 400\text{V}$, $T_C = 25^\circ\text{C}$, $F = 1\text{MHz}$)	-	50		pF
Q_C	Total Capacitive Charge ($V_R = 1200\text{V}$, $I_F = 5\text{A}$, $di_F/dt = 500\text{A}/\mu\text{s}$, $T_C = 25^\circ\text{C}$)	-	28		nC
t_{fr}	Forward Recovery Time ^①		N/A		ns
t_{rr}	Reverse Recovery Time ^①		N/A		
dv/dt	Peak Diode Recovery ($V_R = 960\text{V}$, $di/dt = 1000\text{A}/\mu\text{s}$, $T_C = 25^\circ\text{C}$)	50			V/ns

① As a majority carrier device, there is no reverse recovery charge.

APT Reserves the right to change, without notice, the specifications and information contained herein.

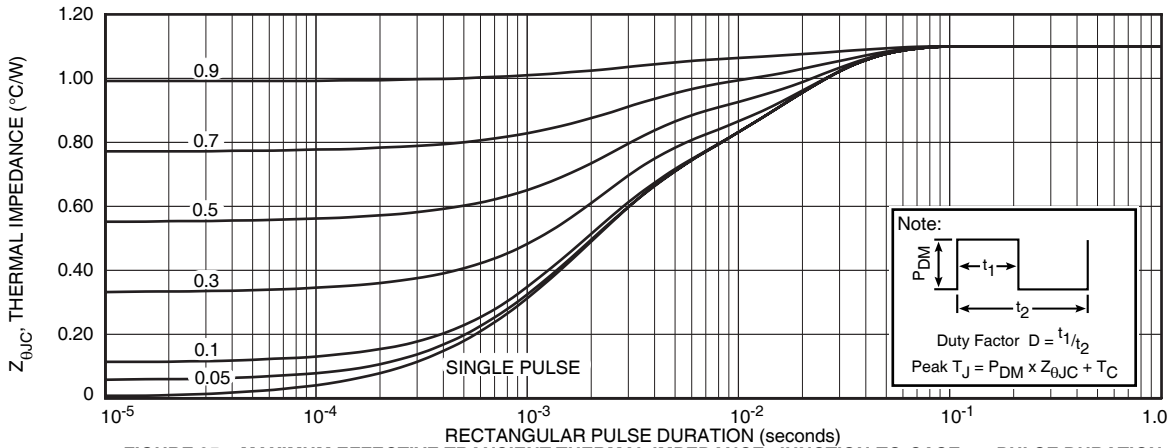


FIGURE 25a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

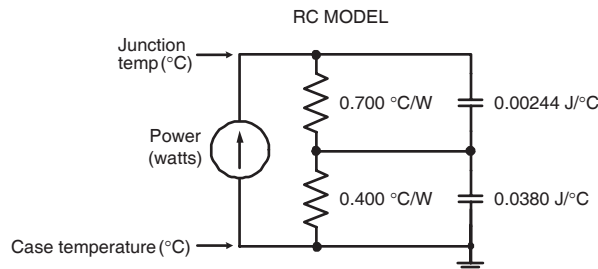


FIGURE 25b, TRANSIENT THERMAL IMPEDANCE MODEL

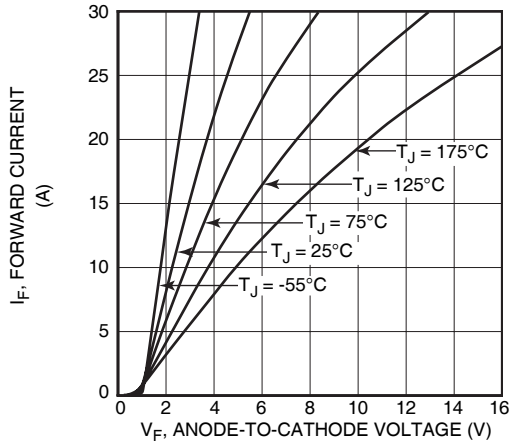


Figure 26. Forward Current vs. Forward Voltage

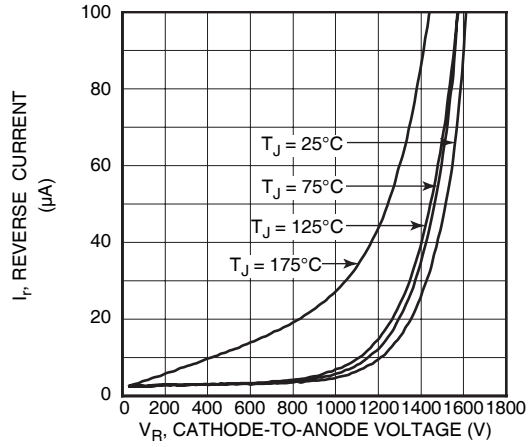


Figure 27. Reverse Current vs. Reverse Voltage

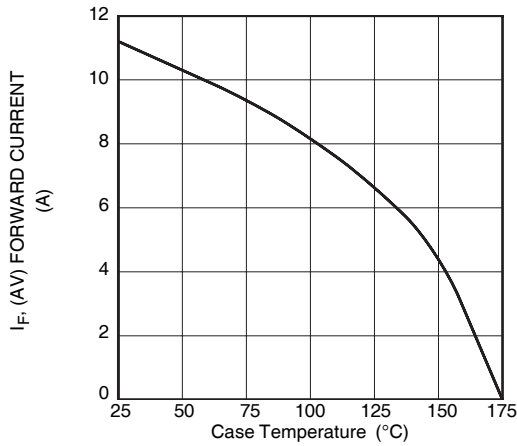


Figure 28. Current Derating

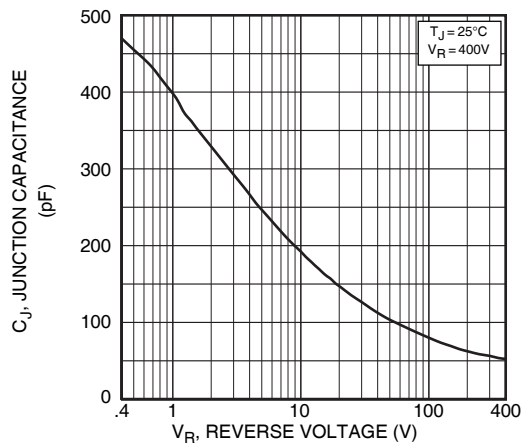
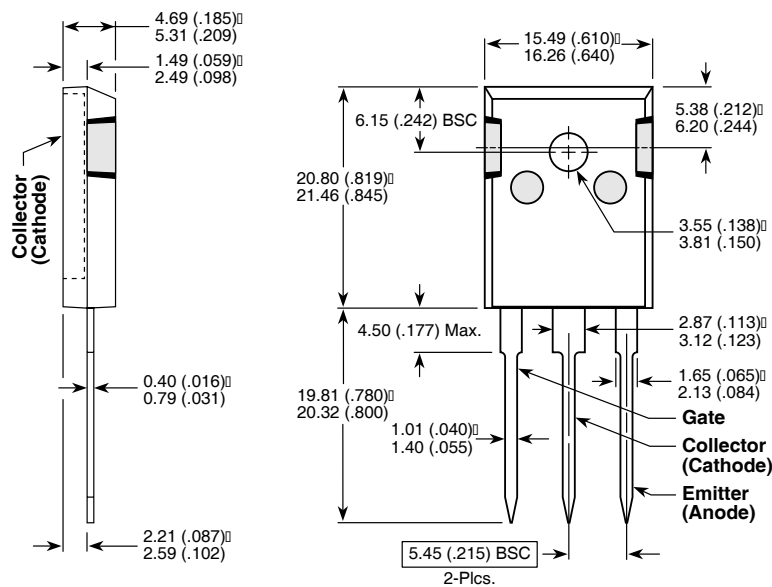


Figure 29. Junction Capacitance vs. Reverse Voltage

T0-247 Package Outline



Dimensions in Millimeters and (Inches)