



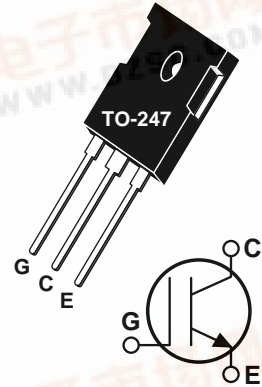
# APT20GT60BR

600V 40A

## Thunderbolt IGBT™

The Thunderbolt IGBT™ is a new generation of high voltage power IGBTs. Using Non-Punch Through Technology the Thunderbolt IGBT™ offers superior ruggedness and ultrafast switching speed.

- Low Forward Voltage Drop
- Low Tail Current
- Avalanche Rated
- High Freq. Switching to 150KHz
- Ultra Low Leakage Current
- RBSOA and SCSOA Rated



### MAXIMUM RATINGS

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

Symbol	Parameter	APT20GT60BR	UNIT
$V_{CES}$	Collector-Emitter Voltage	600	Volts
$V_{CGR}$	Collector-Gate Voltage ( $R_{GE} = 20K\Omega$ )	600	
$V_{EC}$	Emitter-Collector Voltage	15	
$V_{GE}$	Gate-Emitter Voltage	$\pm 20$	
$I_{C1}$	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	40	Amps
$I_{C2}$	Continuous Collector Current @ $T_C = 90^\circ\text{C}$	20	
$I_{CM}$	Pulsed Collector Current ① @ $T_C = 25^\circ\text{C}$	80	
$I_{LM}$	RBSOA Clamped Inductive Load Current @ $R_g = 11\Omega$ $T_C = 125^\circ\text{C}$	40	
$E_{AS}$	Single Pulse Avalanche Energy ②	40	mJ
$P_D$	Total Power Dissipation	175	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 ( $V_{GE} = 0V, I_C = 0.5mA$ )	600			Volts
$RBV_{CES}$	Collector-Emitter Reverse Breakdown Voltage ( $V_{GE} = 0V, I_C = 50mA$ )	-15			
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 500\mu A, T_j = 25^\circ\text{C}$ )	3	4	5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = I_{C2}, T_j = 25^\circ\text{C}$ )	1.6	2.0	2.5	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = I_{C2}, T_j = 125^\circ\text{C}$ )			2.8	
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25^\circ\text{C}$ )			40	$\mu A$
	Collector Cut-off Current ( $V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125^\circ\text{C}$ )			1000	
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V, V_{CE} = 0V$ )			$\pm 100$	nA

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

## DYNAMIC CHARACTERISTICS

APT20GT60BR

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
$C_{ies}$	Input Capacitance	<b>Capacitance</b> $V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{ MHz}$		1045	1200	pF
$C_{oes}$	Output Capacitance			110	160	
$C_{res}$	Reverse Transfer Capacitance			65	110	
$Q_g$	Total Gate Charge <sup>①</sup>	<b>Gate Charge</b> $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$		91	140	nC
$Q_{ge}$	Gate-Emitter Charge			5.9	10	
$Q_{gc}$	Gate-Collector ("Miller") Charge			40	60	
$t_{d(on)}$	Turn-on Delay Time	<b>Resistive Switching (25°C)</b> $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$ $R_G = 10\Omega$		9.0	20	ns
$t_r$	Rise Time			27	50	
$t_{d(off)}$	Turn-off Delay Time			112	170	
$t_f$	Fall Time			162	320	
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (150°C)</b> $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +150^\circ C$		13	26	ns
$t_r$	Rise Time			15	30	
$t_{d(off)}$	Turn-off Delay Time			170	260	
$t_f$	Fall Time			110	220	
$E_{on}$	Turn-on Switching Energy	$R_G = 10\Omega$ $T_J = +150^\circ C$		235	470	uJ
$E_{off}$	Turn-off Switching Energy			595	1190	
$E_{ts}$	Total Switching Losses			830	1660	
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (25°C)</b> $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +25^\circ C$		12	20	ns
$t_r$	Rise Time			16	30	
$t_{d(off)}$	Turn-off Delay Time			129	190	
$t_f$	Fall Time			45	90	
$E_{ts}$	Total Switching Losses			575	1150	
$g_{fe}$	Forward Transconductance	$V_{CE} = 20V, I_C = I_{C2}$	4			S

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.72	°C/W
$R_{\theta JA}$	Junction to Ambient			40	
$W_T$	Package Weight		0.22		oz
			6.1		gm
Torque	Mounting Torque (using a 6-32 or 3mm Binding Head Machine Screw)			10	lb•in
				1.1	N•m

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

②  $I_C = I_{C2}, V_{CC} = 50V, R_{GE} = 25\Omega, L = 200\mu H, T_J = 25^\circ C$

③ See MIL-STD-750 Method 3471

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

**APT20GT60BR**

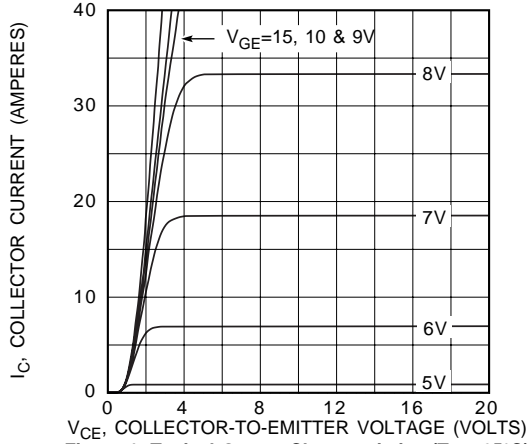


Figure 1, Typical Output Characteristics ( $T_J = 25^\circ\text{C}$ )

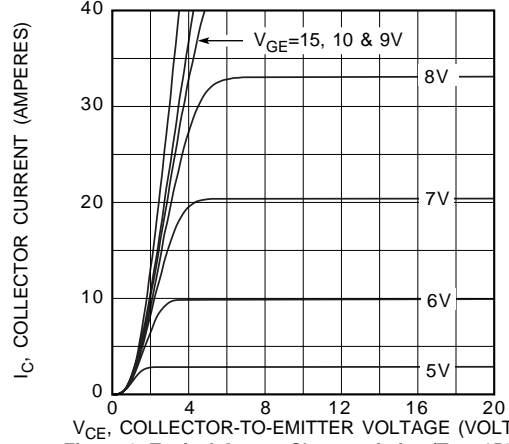


Figure 2, Typical Output Characteristics ( $T_J = 150^\circ\text{C}$ )

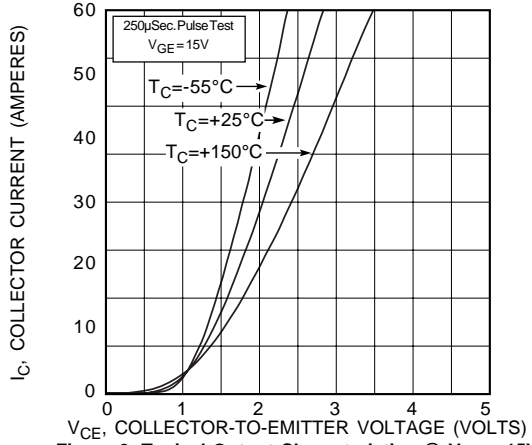


Figure 3, Typical Output Characteristics @  $V_{GE} = 15\text{V}$

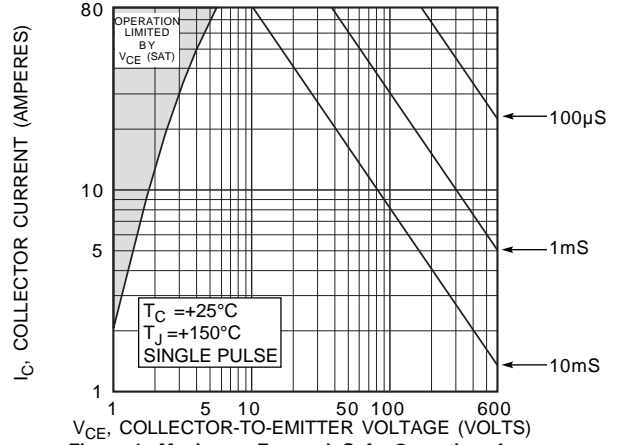


Figure 4, Maximum Forward Safe Operating Area

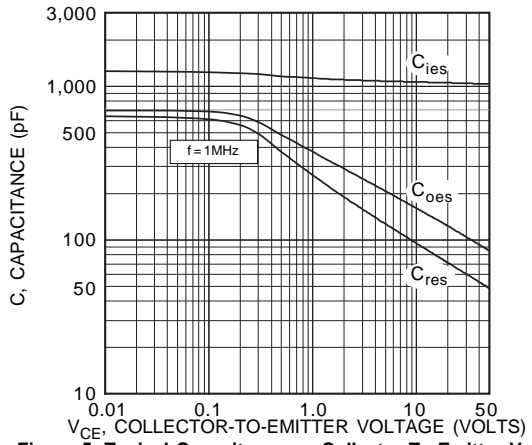


Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage

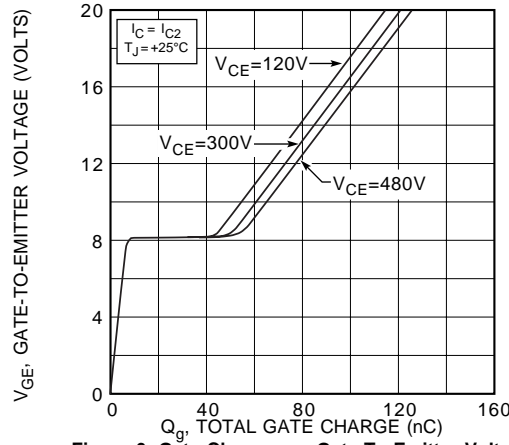


Figure 6, Gate Charges vs Gate-To-Emitter Voltage

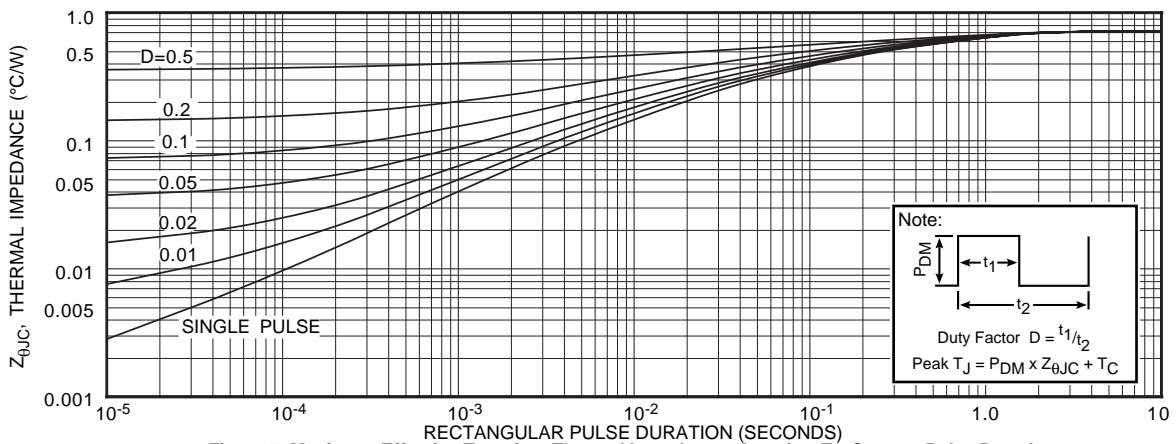


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

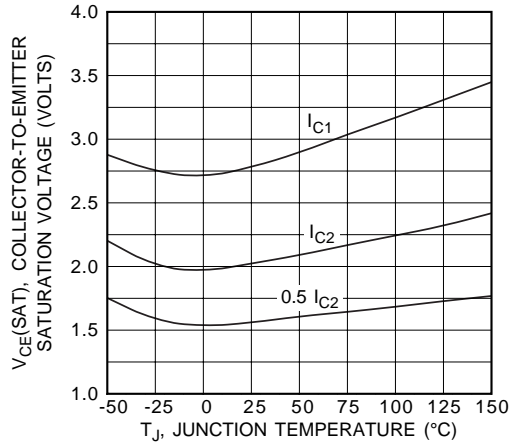


Figure 8, Typical  $V_{CE(SAT)}$  Voltage vs Junction Temperature

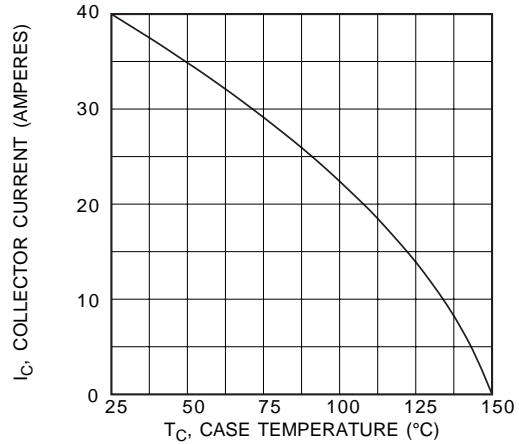


Figure 9, Maximum Collector Current vs Case Temperature

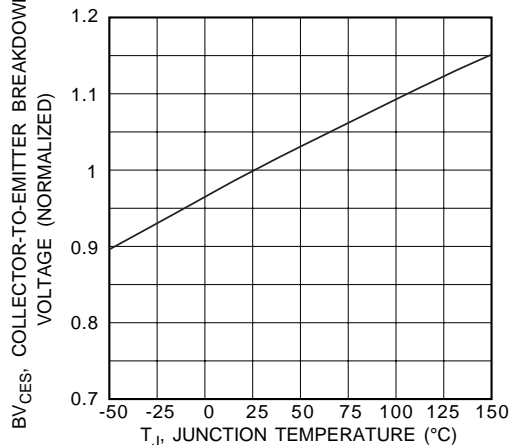


Figure 10, Breakdown Voltage vs Junction Temperature

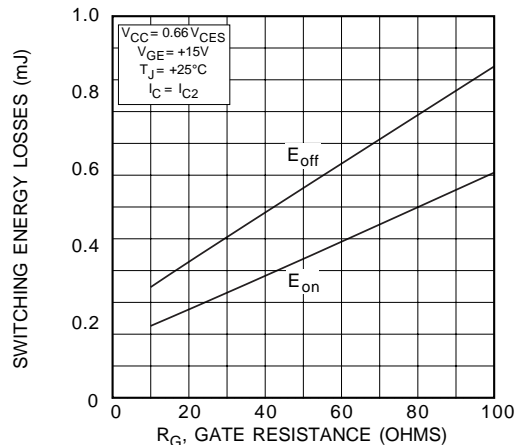


Figure 11, Typical Switching Energy Losses vs Gate Resistance

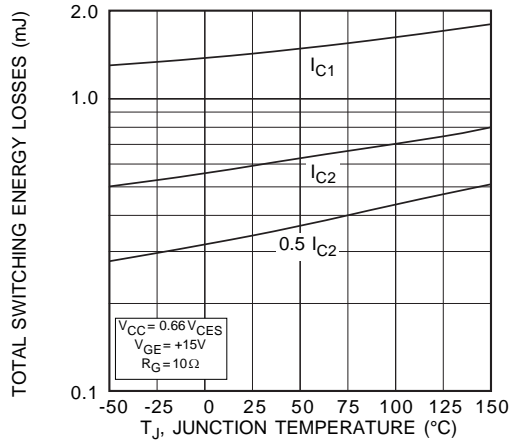


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

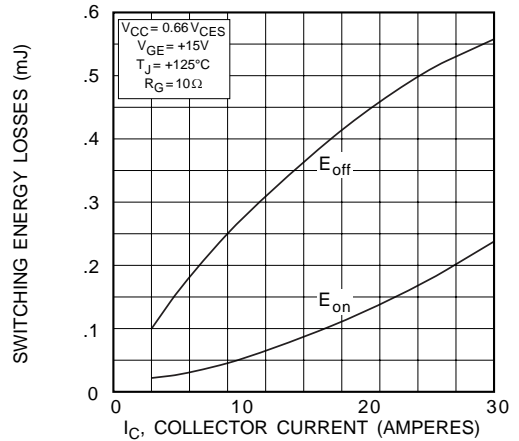


Figure 13, Typical Switching Energy Losses vs Collector Current

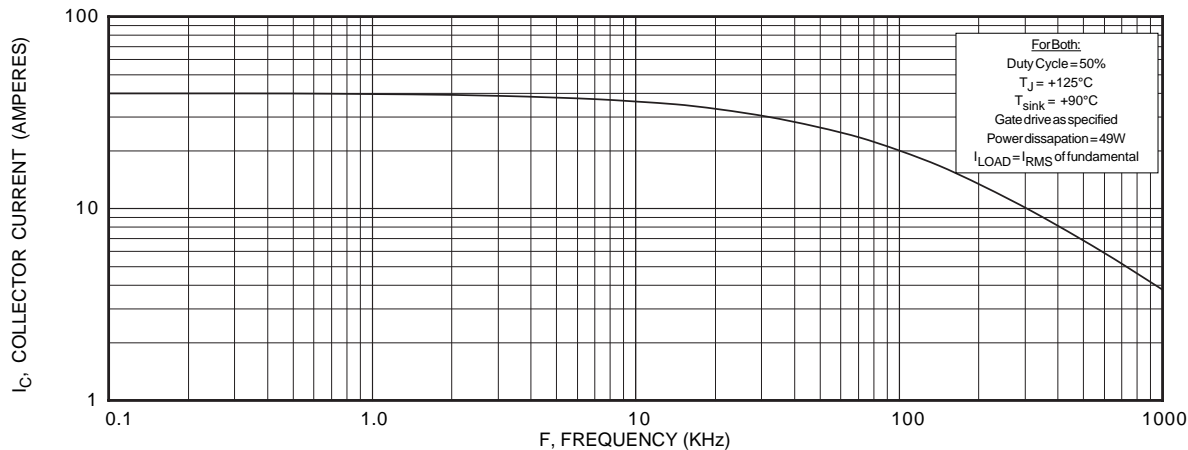


Figure 14, Typical Load Current vs Frequency

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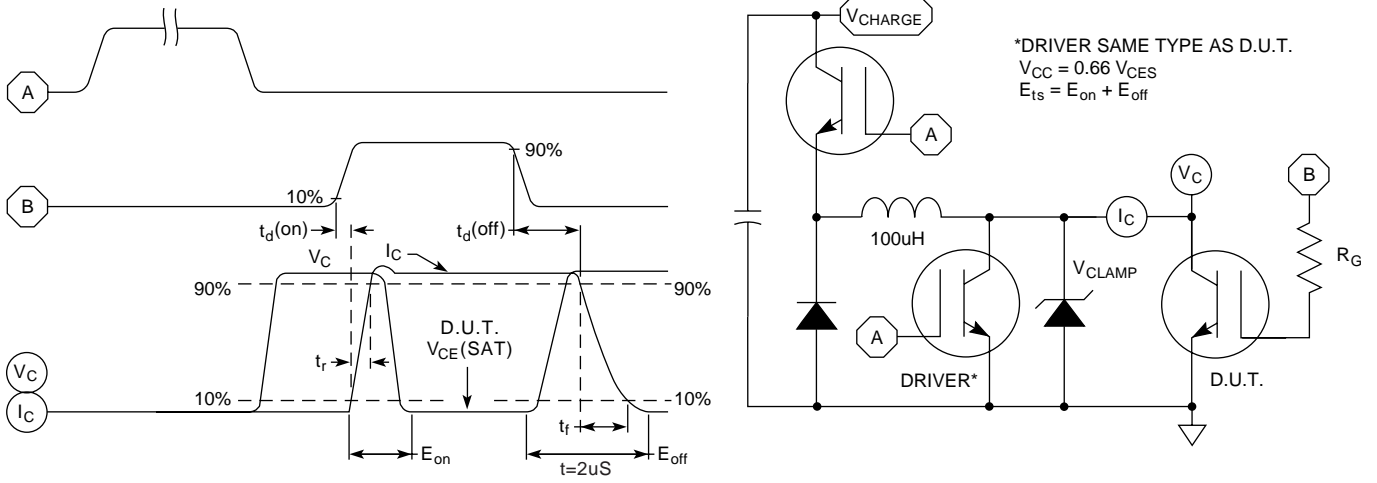


Figure 15, Switching Loss Test Circuit and Waveforms

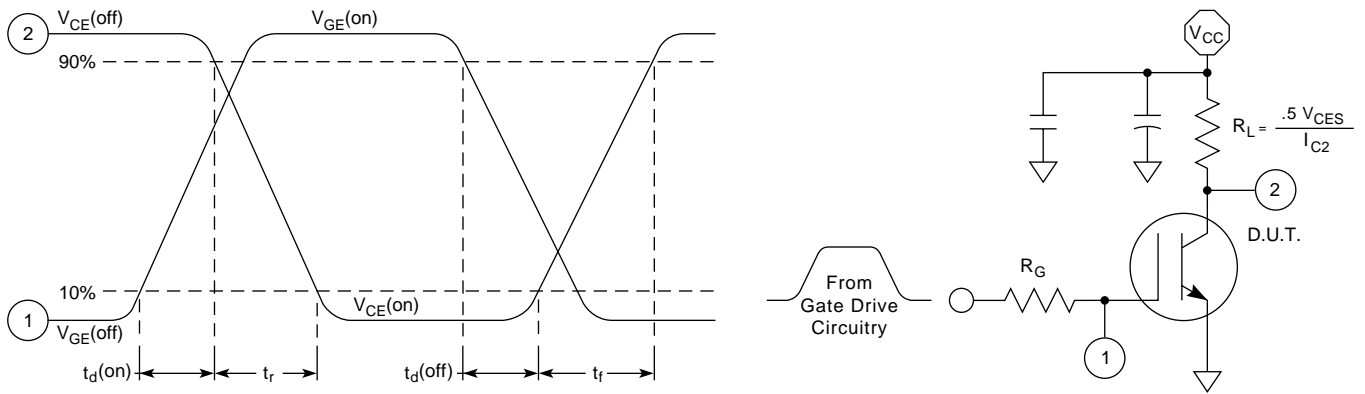


Figure 16, Resistive Switching Time Test Circuit and Waveforms

## T0-247 Package Outline

