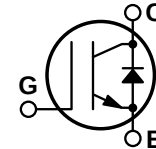
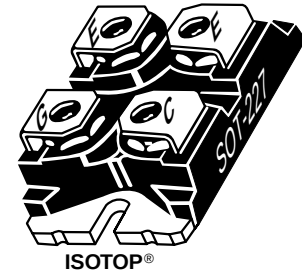


Fast IGBT & FRED

The Fast IGBT™ is a new generation of high voltage power IGBTs. Using Non-Punch Through Technology the Fast IGBT™ combined with an APT free-wheeling ultraFast Recovery Epitaxial Diode (FRED) offers superior ruggedness and fast switching speed.

- Low Forward Voltage Drop
- Low Tail Current
- RBSOA and SCSOA Rated
- Ultrafast Soft Recovery Antiparallel Diode
- High Freq. Switching to 20KHz
- Ultra Low Leakage Current



MAXIMUM RATINGS (IGBT)

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

Symbol	Parameter	APT60GF120JRD	UNIT
V_{CES}	Collector-Emitter Voltage	1200	Volts
V_{CGR}	Collector-Gate Voltage ($R_{GE} = 20K\Omega$)	1200	
V_{GE}	Gate-Emitter Voltage	± 20	
I_{C1}	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	100	Amps
I_{C2}	Continuous Collector Current @ $T_C = 90^\circ\text{C}$	60	
I_{CM1}	Pulsed Collector Current ^① @ $T_C = 25^\circ\text{C}$	200	
I_{CM2}	Pulsed Collector Current ^① @ $T_C = 90^\circ\text{C}$	120	
P_D	Total Power Dissipation	520	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 (IGBT)

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage ($V_{GE} = 0V, I_C = 1.0mA$)	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 700\mu A, T_J = 25^\circ\text{C}$)	4.5	5.5	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = 40A, T_J = 25^\circ\text{C}$)		2.9	3.4	
	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = 40A, T_J = 125^\circ\text{C}$)		3.5	4.1	
I_{CES}	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_J = 25^\circ\text{C}$) ^②			1.0	mA
	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_J = 125^\circ\text{C}$) ^②			TBD	
I_{GES}	Gate-Emitter Leakage Current ($V_{GE} = \pm 20V, V_{CE} = 0V$)			± 100	nA

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

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DYNAMIC CHARACTERISTICS (IGBT)

APT60GF120JRD

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{ MHz}$		7200	9600	pF
C_{oes}	Output Capacitance			790	1100	
C_{res}	Reverse Transfer Capacitance			420	630	
Q_g	Total Gate Charge ^③	Gate Charge $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$		690		nC
Q_{ge}	Gate-Emitter Charge			55		
Q_{gc}	Gate-Collector ("Miller") Charge			390		
$t_{d(on)}$	Turn-on Delay Time	Resistive Switching (25°C) $V_{GE} = 15V$ $V_{CC} = 0.8V_{CES}$ $I_C = I_{C2}$ $R_G = 5\Omega$		60		ns
t_r	Rise Time			205		
$t_{d(off)}$	Turn-off Delay Time			295		
t_f	Fall Time			210		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (150°C) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 5\Omega$ $T_J = +150^\circ C$		55		ns
t_r	Rise Time			130		
$t_{d(off)}$	Turn-off Delay Time			750		
t_f	Fall Time			80		
E_{on}	Turn-on Switching Energy ^④			9		mJ
E_{off}	Turn-off Switching Energy			10		
E_{ts}	Total Switching Losses ^④			19		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 5\Omega$ $T_J = +25^\circ C$		55		ns
t_r	Rise Time			145		
$t_{d(off)}$	Turn-off Delay Time			650		
t_f	Fall Time			70		
E_{ts}	Total Switching Losses ^④			17		mJ
g_{fe}	Forward Transconductance	$V_{CE} = 20V, I_C = I_{C2}$	6			S

THERMAL AND MECHANICAL CHARACTERISTICS (IGBT and FRED)

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			0.24	°C/W
	Junction to Case (FRED)			0.66	
$R_{\theta JA}$	Junction to Ambient			40	
W_T	Package Weight		1.03		oz
			29.2		gm
Torque	Mounting Torque (Mounting = 8-32 or 4mm Machine and Terminals = 4mm Machine)			10	lb•in
				1.1	N•m

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

② Leakages include the FRED and IGBT.

③ See MIL-STD-750 Method 3471

④ Switching losses include the FRED and IGBT.

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

ULTRAFAST SOFT RECOVERY PARALLEL DIODE

MAXIMUM RATINGS (FRED)

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

Symbol	Characteristic / Test Conditions	APT60GF120JRD	UNIT
V_R	Maximum D.C. Reverse Voltage	1200	Volts
V_{RRM}	Maximum Peak Repetitive Reverse Voltage		
V_{RWM}	Maximum Working Peak Reverse Voltage		
$I_F(AV)$	Maximum Average Forward Current ($T_C = 60^\circ\text{C}$, Duty Cycle = 0.5)	60	Amps
$I_F(RMS)$	RMS Forward Current	100	
I_{FSM}	Non-Repetitive Forward Surge Current ($T_J = 45^\circ\text{C}$, 8.3ms)	540	

STATIC ELECTRICAL CHARACTERISTICS (FRED)

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage $I_F = 60\text{A}$			2.5	Volts
	$I_F = 120\text{A}$		2.0		
	$I_F = 60\text{A}$, $T_J = 150^\circ\text{C}$			2.0	

DYNAMIC CHARACTERISTICS (FRED)

Symbol	Characteristic	MIN	TYP	MAX	UNIT
t_{rr1}	Reverse Recovery Time, $I_F = 1.0\text{A}$, $di_F/dt = -15\text{A}/\mu\text{s}$, $V_R = 30\text{V}$, $T_J = 25^\circ\text{C}$		70	85	ns
t_{rr2}	Reverse Recovery Time $T_J = 25^\circ\text{C}$		70		
t_{rr3}	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ $T_J = 100^\circ\text{C}$		130		
t_{fr1}	Forward Recovery Time $T_J = 25^\circ\text{C}$		170		
t_{fr2}	$I_F = 60\text{A}$, $di_F/dt = 480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ $T_J = 100^\circ\text{C}$		170		
I_{RRM1}	Reverse Recovery Current $T_J = 25^\circ\text{C}$		18	30	Amps
I_{RRM2}	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ $T_J = 100^\circ\text{C}$		29	40	
Q_{rr1}	Recovery Charge $T_J = 25^\circ\text{C}$		630		nC
Q_{rr2}	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ $T_J = 100^\circ\text{C}$		1820		
V_{fr1}	Forward Recovery Voltage $T_J = 25^\circ\text{C}$		12		Volts
V_{fr2}	$I_F = 60\text{A}$, $di_F/dt = 480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ $T_J = 100^\circ\text{C}$		12		
di_M/dt	Rate of Fall of Recovery Current $T_J = 25^\circ\text{C}$		900		$\text{A}/\mu\text{s}$
	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ $T_J = 100^\circ\text{C}$		600		

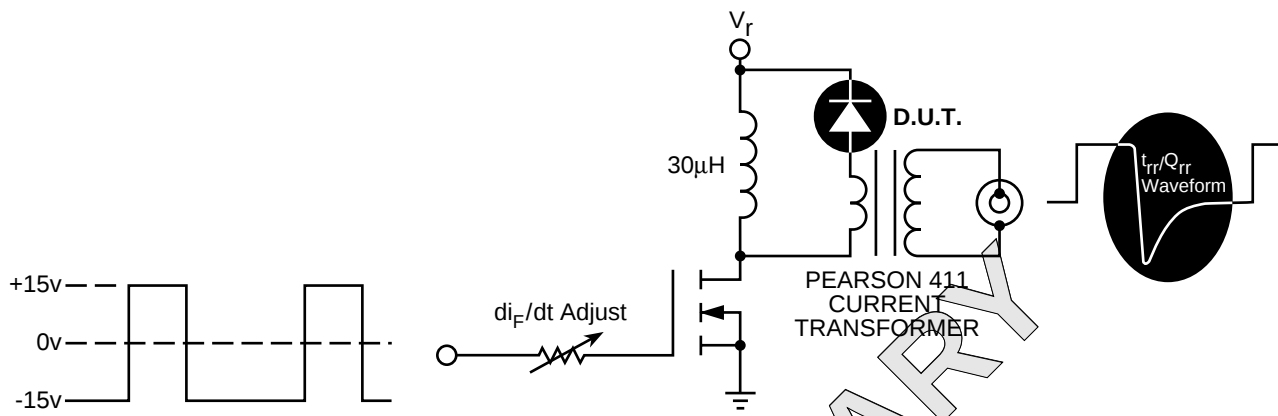
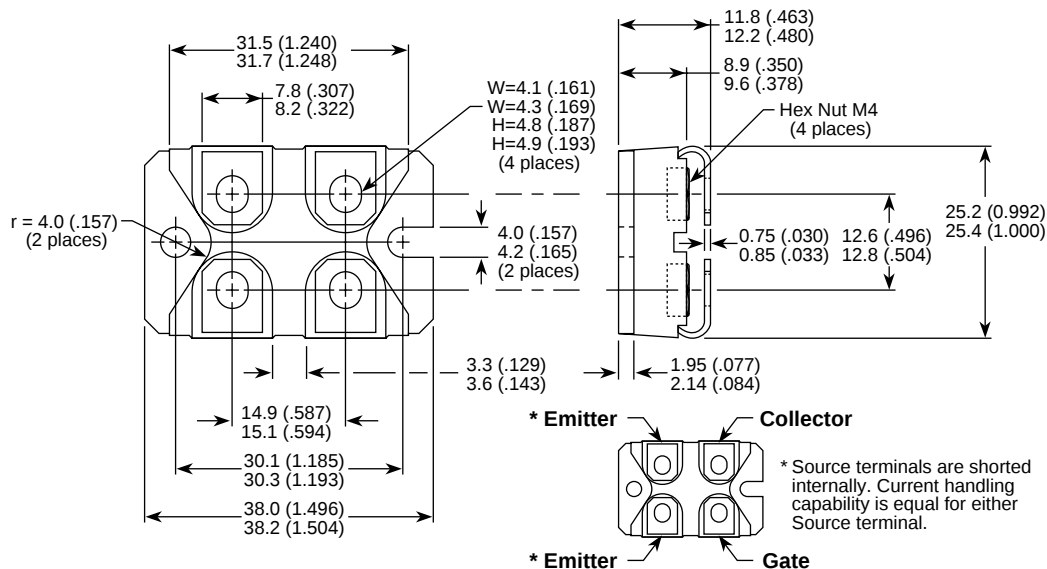


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

- 1 I_F - Forward Conduction Current
 - 2 di_F/dt - Current Slew Rate, Rate of Forward Current Change Through Zero Crossing.
 - 3 I_{RRM} - Peak Reverse Recovery Current.
 - 4 t_{rr} - Reverse Recovery Time Measured from Point of I_F Current Falling Through Zero to a Tangent Line {6} di_M/dt Extrapolated Through Zero Defined by 0.75 and 0.50 I_{RRM} .
 - 5 Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{rr} .
 - 6 di_M/dt - Maximum Rate of Current Change During the Trailing Portion of t_{rr} .
- $Q_{rr} = \frac{1}{2} (t_{rr} \cdot I_{RRM})$

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)