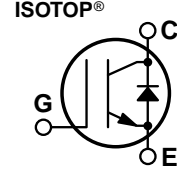
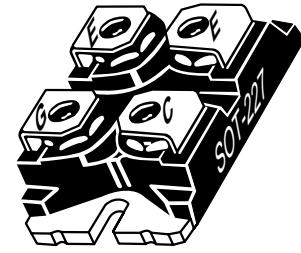


Fast IGBT & FRED

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	APT40GF120JRD	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 @ $T_C = 25^\circ\text{C}$	60	Amps
I_{C2}	Continuous Collector Current @ $T_C = 90^\circ\text{C}$	40	
I_{CM1}	Pulsed Collector Current ^① @ $T_C = 25^\circ\text{C}$	120	
I_{CM2}	Pulsed Collector Current ^① @ $T_C = 90^\circ\text{C}$	80	
P_D	Total Power Dissipation	390	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 ($V_{GE} = 0V, I_C = 0.8mA$)	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			0.8	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)

APT40GF120JRD

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C _{ies}	Input Capacitance	Capacitance V _{GE} = 0V V _{CE} = 25V f = 1 MHz		3500	4700	pF
C _{oes}	Output Capacitance			490	700	
C _{res}	Reverse Transfer Capacitance			230	345	
Q _g	Total Gate Charge ^③	Gate Charge V _{GE} = 15V V _{CC} = 0.5V _{CES} I _C = I _{C2}		320		nC
Q _{ge}	Gate-Emitter Charge			30		
Q _{gc}	Gate-Collector ("Miller") Charge			200		
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 = 5Ω		35		ns
t _r	Rise Time			130		
t _{d(off)}	Turn-off Delay Time			215		
t _f	Fall Time			145		
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 = 5Ω T _J = +150°C		35		ns
t _r	Rise Time			90		
t _{d(off)}	Turn-off Delay Time			400		
t _f	Fall Time			140		
E _{on}	Turn-on Switching Energy ^④			4.5		
E _{off}	Turn-off Switching Energy		5.0		mJ	
E _{ts}	Total Switching Losses ^④		9.5			
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 = 5Ω T _J = +25°C		35		ns
t _r	Rise Time			100		
t _{d(off)}	Turn-off Delay Time			340		
t _f	Fall Time			105		
E _{ts}	Total Switching Losses ^④			8.0		
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 _{θJC}	Junction to Case (IGBT)			0.32	°C/W
	Junction to Case (FRED)			0.66	
R _{θJA}	Junction to Ambient			20	
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	APT40GF120JRD	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		2.0	2.5	Volts
				$I_F = 60\text{A}$	
				$I_F = 120\text{A}$	
	$I_F = 60\text{A}, T_J = 150^\circ\text{C}$			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		70		
t_{rr3}	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$		130		
t_{fr1}	Forward Recovery Time		170		Volts
t_{fr2}	$I_F = 60\text{A}$, $di_F/dt = 480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$		170		
I_{RRM1}	Reverse Recovery Current		18	30	Amps
I_{RRM2}	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$		29	40	
Q_{rr1}	Recovery Charge		630		nC
Q_{rr2}	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$		1820		
V_{fr1}	Forward Recovery Voltage		12		Volts
V_{fr2}	$I_F = 60\text{A}$, $di_F/dt = 480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$		12		
diM/dt	Rate of Fall of Recovery Current		900		A/ μs
	$I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$		600		

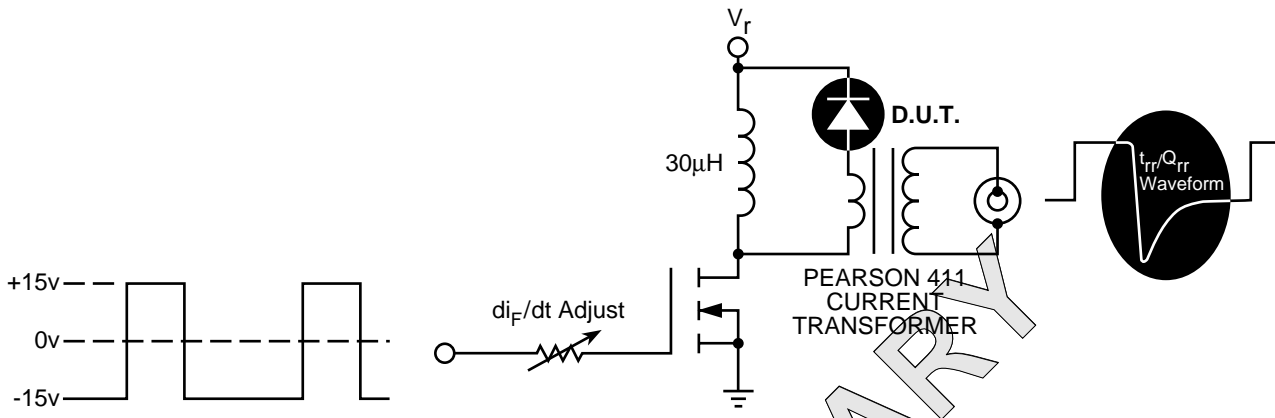
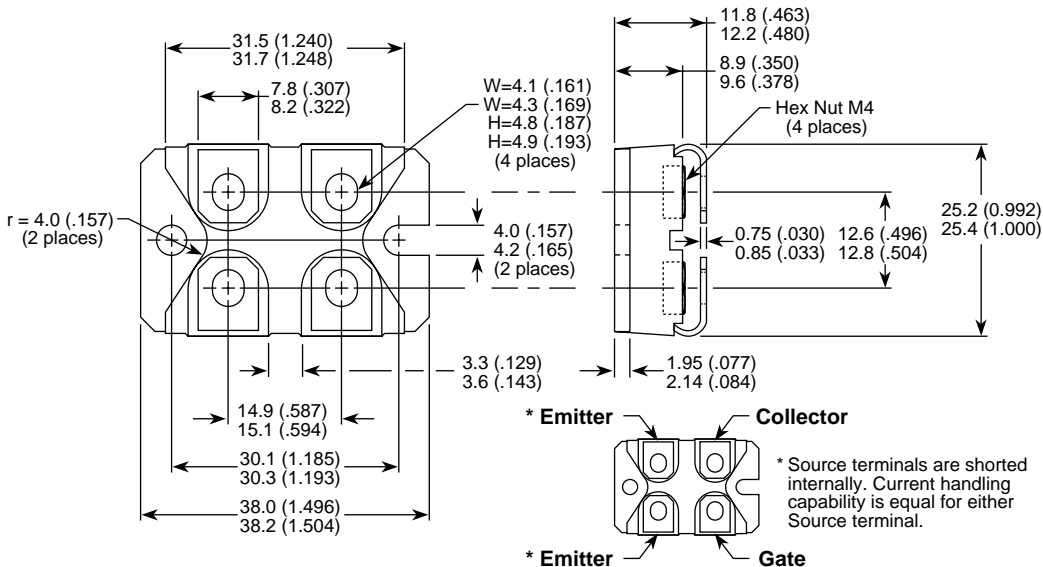


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

- 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)