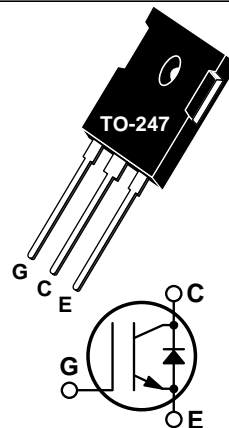


Fast IGBT & FRED

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	APT11GF120BRD	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 @ $T_C = 25^\circ\text{C}$	22	Amps
I_{C2}	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	11	
I_{CM1}	Pulsed Collector Current ^① @ $T_C = 25^\circ\text{C}$	44	
I_{CM2}	Pulsed Collector Current ^① @ $T_C = 110^\circ\text{C}$	22	
P_D	Total Power Dissipation	125	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 ($V_{GE} = 0V, I_C = 0.6mA$)	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 350\mu A, T_j = 25^\circ\text{C}$)	4.5	5.5	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = I_{C2}, T_j = 25^\circ\text{C}$)		2.5	3.0	
	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = I_{C2}, T_j = 125^\circ\text{C}$)		3.1	3.7	
I_{CES}	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25^\circ\text{C}$)			0.6	mA
	Collector Cut-off Current ($V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125^\circ\text{C}$)			3.0	
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.

DYNAMIC CHARACTERISTICS (IGBT)

APT11GF120BRD

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{ MHz}$		600	800	pF
C_{oes}	Output Capacitance			90	130	
C_{res}	Reverse Transfer Capacitance			38	65	
Q_g	Total Gate Charge ^②	Gate Charge $V_{GE} = 15V$ $V_{CC} = 0.5V_{CES}$ $I_C = I_{C2}$		60		nC
Q_{ge}	Gate-Emitter Charge			8		
Q_{gc}	Gate-Collector ("Miller") Charge			38		
$t_{d(on)}$	Turn-on Delay Time	Resistive Switching (25°C) $V_{GE} = 15V$ $V_{CC} = 0.8V_{CES}$ $I_C = I_{C2}$ $R_G = 10\Omega$		10		ns
t_r	Rise Time			50		
$t_{d(off)}$	Turn-off Delay Time			55		
t_f	Fall Time			110		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +125^\circ C$		13		ns
t_r	Rise Time			20		
$t_{d(off)}$	Turn-off Delay Time			125		
t_f	Fall Time			90		
E_{on}	Turn-on Switching Energy ^③	$R_G = 10\Omega$ $T_J = +125^\circ C$.5		mJ
E_{off}	Turn-off Switching Energy			1.0		
E_{ts}	Total Switching Losses ^③			1.5		
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 10\Omega$ $T_J = +25^\circ C$		13		ns
t_r	Rise Time			20		
$t_{d(off)}$	Turn-off Delay Time			110		
t_f	Fall Time			90		
E_{ts}	Total Switching Losses ^③			1.0		mJ
g_{fe}	Forward Transconductance	$V_{CE} = 20V, I_C = I_{C2}$	4.7			S

THERMAL AND MECHANICAL CHARACTERISTICS (IGBT and FRED)

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			1.00	°C/W
	Junction to Case (FRED)			2.0	
$R_{\theta JA}$	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 See MIL-STD-750 Method 3471

③ 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	APT11GF120BRD	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 ($T_C = 85^\circ\text{C}$, Duty Cycle = 0.5)	15	Amps
$I_F(RMS)$	RMS Forward Current	29	
I_{FSM}	Non-Repetitive Forward Surge Current ($T_J = 45^\circ\text{C}$, 8.3ms)	110	

STATIC ELECTRICAL CHARACTERISTICS (FRED)

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	$I_F = 15\text{A}$		2.5	Volts
		$I_F = 30\text{A}$		2.5	
		$I_F = 15\text{A}, T_J = 150^\circ\text{C}$		2.2	
I_{RM}	Maximum Reverse Leakage Current	$V_R = V_R \text{ Rated}$		250	μA
	Maximum Reverse Leakage Current	$V_R = V_R \text{ Rated}, T_J = 125^\circ\text{C}$		500	
L_S	Series Inductance (Lead to Lead 5mm from Base)		10		nH

DYNAMIC CHARACTERISTICS (FRED)

Symbol	Characteristic	MIN	TYP	MAX	UNIT
t_{rr1}	Reverse Recovery Time, $I_F = 1.0\text{A}$, $di_F/dt = -15\text{A}/\mu\text{s}$, $V_R = 30\text{V}$, $T_J = 25^\circ\text{C}$		48	TBD	ns
t_{rr2}	Reverse Recovery Time	$T_J = 25^\circ\text{C}$	60		
t_{rr3}	$I_F = 15\text{A}$, $di_F/dt = -100\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$	132		
t_{fr1}	Forward Recovery Time	$T_J = 25^\circ\text{C}$	192		
t_{fr2}	$I_F = 15\text{A}$, $di_F/dt = 100\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$	211		
I_{RRM1}	Reverse Recovery Current	$T_J = 25^\circ\text{C}$	4.0	TBD	Amps
I_{RRM2}	$I_F = 15\text{A}$, $di_F/dt = -100\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$	7	TBD	
Q_{rr1}	Recovery Charge	$T_J = 25^\circ\text{C}$	126		nC
Q_{rr2}	$I_F = 15\text{A}$, $di_F/dt = -100\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$	523		
V_{fr1}	Forward Recovery Voltage	$T_J = 25^\circ\text{C}$	12		Volts
V_{fr2}	$I_F = 15\text{A}$, $di_F/dt = 100\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$	18		
diM/dt	Rate of Fall of Recovery Current	$T_J = 25^\circ\text{C}$	166		$\text{A}/\mu\text{s}$
	$I_F = 15\text{A}$, $di_F/dt = -100\text{A}/\mu\text{s}$, $V_R = 650\text{V}$	$T_J = 100^\circ\text{C}$	81		

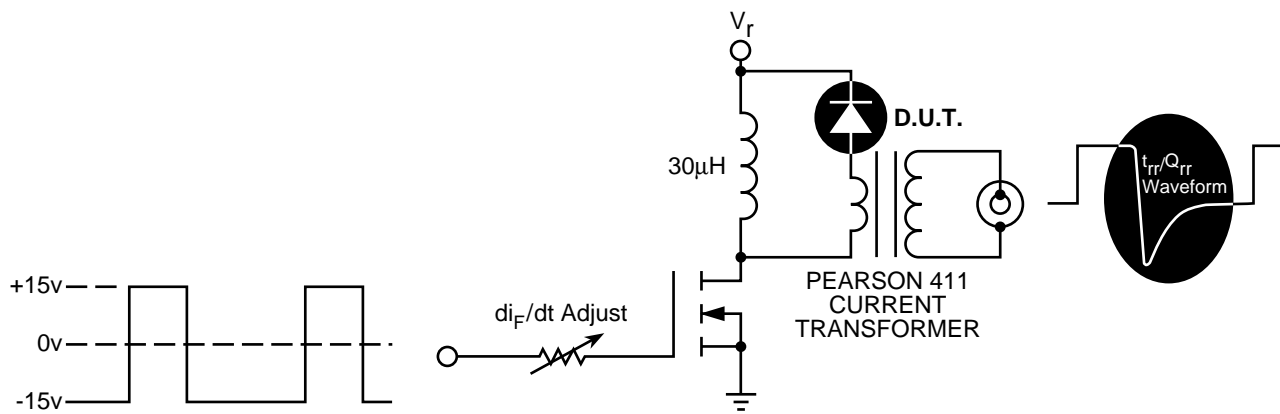


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

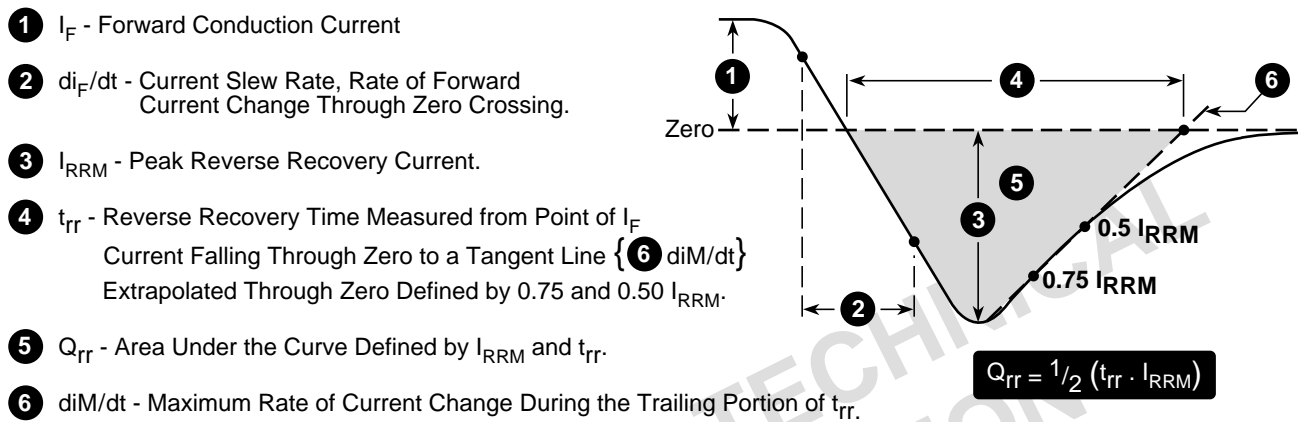


Figure 8, Diode Reverse Recovery Waveform and Definitions

TO-247 Package Outline

