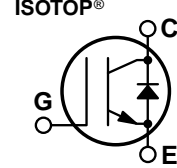
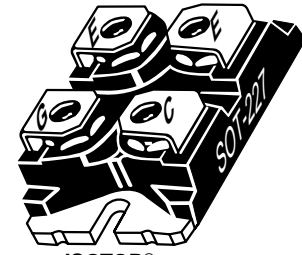


Fast IGBT & FRED

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 $V_{GE} = 0V$ $V_{CE} = 25V$ $f = 1\text{ MHz}$ | | 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) $V_{GE} = 15V$ $V_{CC} = 0.8V_{CES}$ $I_C = I_{C2}$ $R_G = 5\Omega$ | | 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) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 5\Omega$ $T_J = +150^\circ C$ | | 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 | $R_G = 5\Omega$ $T_J = +150^\circ C$ | | 4.5 | | mJ |
| E_{off} | Turn-off Switching Energy | | | 5.0 | | |
| E_{ts} | Total Switching Losses ^④ | | | 9.5 | | |
| $t_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C) $V_{CLAMP(Peak)} = 0.66V_{CES}$ $V_{GE} = 15V$ $I_C = I_{C2}$ $R_G = 5\Omega$ $T_J = +25^\circ C$ | | 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 | | mJ |
| gfe | 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) | | | 0.32 | °C/W |
| | Junction to Case (FRED) | | | 0.66 | |
| $R_{\theta JA}$ | 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 | | | 2.5 | 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 | | $T_J = 25^\circ\text{C}$ 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 | | Amps |
| 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 | nC |
| 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 | | Volts |
| 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 | | A/ μs |
| 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 | | |
| diM/dt | Rate of Fall of Recovery Current | | $T_J = 25^\circ\text{C}$ 900 | | |
| | $I_F = 60\text{A}$, $di_F/dt = -480\text{A}/\mu\text{s}$, $V_R = 650\text{V}$ | | $T_J = 100^\circ\text{C}$ 600 | | |

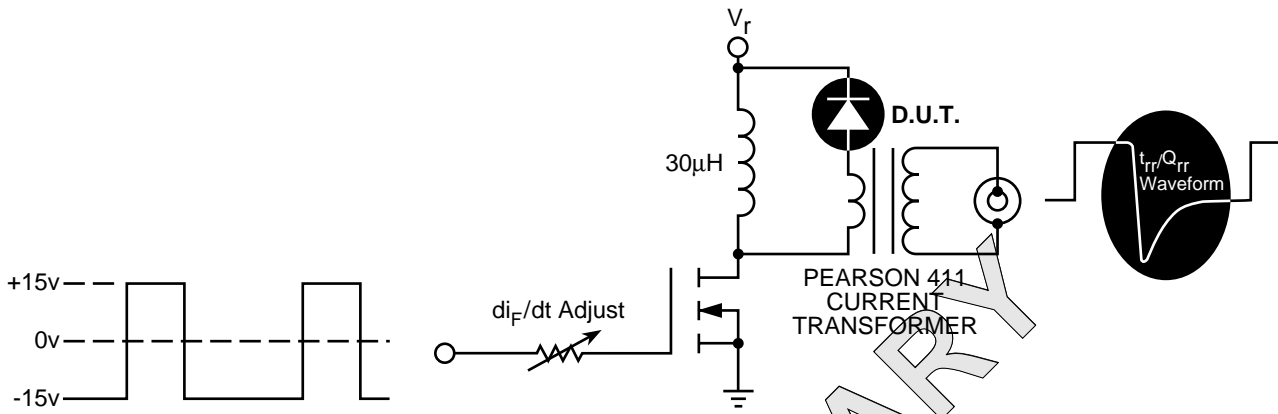
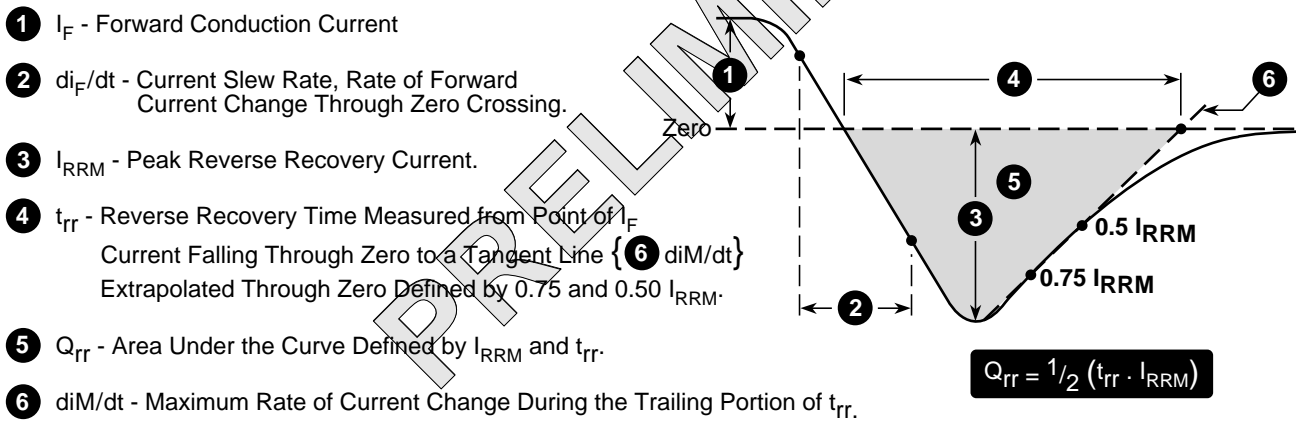
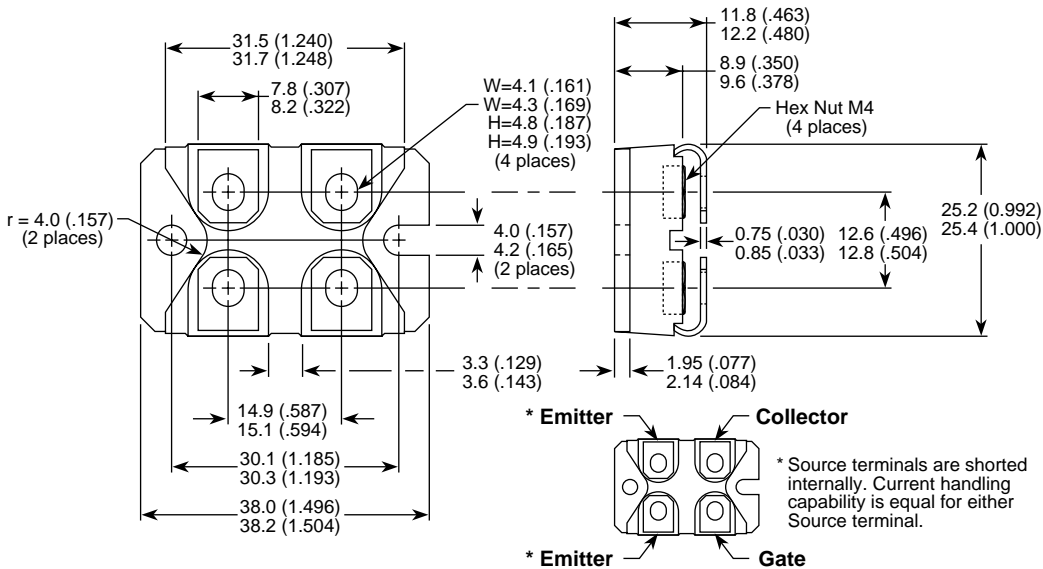


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms



SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)