Microsemi
POWER PRODUCTS GROUP

Power MOS 8 Cooler!™

APT32F120J

1200V, 32A, 0.35Ω Max, $t_{rr} \leq$ 430ns

N-Channel FREDFET

Power MOS 8™ is a high speed, high voltage N-channel switch-mode power MOSFET. This 'FREDFET' version has a drain-source (body) diode that has been optimized for high reliability in ZVS phase shifted bridge and other circuits through reduced t_{rr}, soft recovery, and high recovery dv/dt capability. Low gate charge, high gain, and a greatly reduced ratio of C_{rss}/C_{iss} result in excellent niose immunity and low switching loss. The intrinsic gate resistance and capacitance of the poly-silicon gate structure help control di/dt during switching, resulting in low EMI and reliable paralleling, even when switching at very high frequency.

"UL Recognized"
file # E145592

ISOTOP®
APT32F120J

Single die FREDFET
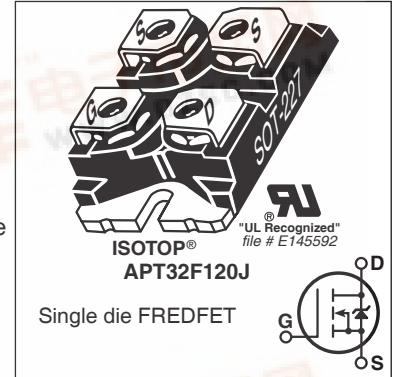
FEATURES

- Fast switching with low EMI
- Low t_{rr} for high reliability
- Ultra low C_{rss} for improved noise immunity
- Low gate charge
- Avalanche energy rated
- RoHS compliant

TYPICAL APPLICATIONS

- ZVS phase shifted and other full full bridge
- Half bridge
- PFC and other boost converter
- Buck converter
- Single and two switch forward
- Flyback

Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
I_D	Continuous Drain Current @ T_C = 25°C	32	A
	Continuous Drain Current @ T_C = 100°C	20	
I_{DM}	Pulsed Drain Current [①]	195	
V_{GS}	Gate-Source Voltage	±30	V
E_{AS}	Single Pulse Avalanche Energy [②]	2700	mJ
I_{AR}	Avalanche Current, Repetitive or Non-Repetitive	25	A

Thermal and Mechanical Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
P_D	Total Power Dissipation @ T_C = 25°C			960	W
$R_{\theta JC}$	Junction to Case Thermal Resistance			0.13	°C/W
$R_{\theta CS}$	Case to Sink Thermal Resistance, Flat, Greased Surface		0.11		
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55		150	°C
$V_{Isolation}$	RMS Voltage (50-60hHz Sinusoidal Wavefomr from Terminals to Mounting Base for 1 Min.)	2500			V
W_T	Package Weight		1.03		oz
			29.2		g
Torque	Terminals and Mounting Screws.			10	in·lbf
				1.1	N·m

Static Characteristics $T_J = 25°C$ unless otherwise specified   APT32F120J

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
$V_{BR(DSS)}$	Drain-Source Breakdown Voltage	$V_{GS} = 0V$, $I_D = 250\mu A$		1200			V
$\Delta V_{BR(DSS)}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	Reference to 25°C, $I_D = 250\mu A$			1.41		V/°C
$R_{DS(on)}$	Drain-Source On Resistance[3]	$V_{GS} = 10V$, $I_D = 25A$			0.30	0.35	Ω
$V_{GS(th)}$	Gate-Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 2.5mA$		3	4	5	V
$\Delta V_{GS(th)}/\Delta T_J$	Threshold Voltage Temperature Coefficient				-10		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 1200V$	$T_J = 25°C$			250	μA
		$V_{GS} = 0V$	$T_J = 125°C$			1000	
I_{GSS}	Gate-Source Leakage Current	$V_{GS} = \pm30V$				±100	nA

Dynamic Characteristics $T_J = 25°C$ unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
g_{fs}	Forward Transconductance	$V_{DS} = 50V$, $I_D = 25A$		58		S
C_{iss}	Input Capacitance	$V_{GS} = 0V$, $V_{DS} = 25V$ f = 1MHz		18200		pF
C_{rss}	Reverse Transfer Capacitance			215		
C_{oss}	Output Capacitance			1340		
$C_{o(cr)}$ [4]	Effective Output Capacitance, Charge Related	$V_{GS} = 0V$, $V_{DS} = 0V$ to 800V		520		
$C_{o(er)}$ [5]	Effective Output Capacitance, Energy Related			270		
Q_g	Total Gate Charge	$V_{GS} = 0$ to 10V, $I_D = 25A$, $V_{DS} = 600V$		560		nC
Q_{gs}	Gate-Source Charge			90		
Q_{gd}	Gate-Drain Charge			265		
$t_{d(on)}$	Turn-On Delay Time	**Resistive Switching** $V_{DD} = 800V$, $I_D = 25A$ $R_G = 2.2\Omega$[6], $V_{GG} = 15V$		100		ns
t_r	Current Rise Time			60		
$t_{d(off)}$	Turn-Off Delay Time			315		
t_f	Current Fall Time			90		

Source-Drain Diode Characteristics

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
I_S	Continuous Source Current (Body Diode)	MOSFET symbol showing the integral reverse p-n junction diode (body diode)				32	A
I_{SM}	Pulsed Source Current (Body Diode)[1]					195	
V_{SD}	Diode Forward Voltage	$I_{SD} = 25A$, $T_J = 25°C$, $V_{GS} = 0V$				1.1	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 25A$[3] $di_{SD}/dt = 100A/\mu s$	$T_J = 25°C$			430	ns
			$T_J = 125°C$			960	
Q_{rr}	Reverse Recovery Charge		$T_J = 25°C$		31		μC
			$T_J = 125°C$		75		
I_{rrm}	Reverse Recovery Current		$T_J = 25°C$		17		A
			$T_J = 125°C$		23		
dv/dt	Peak Recovery dv/dt	$I_{SD} \leq 25A$, di/dt $\leq 1000A/\mu s$, $V_{DD} = 100V$, $T_J = 125°C$				25	V/ns

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

② Starting at $T_J = 25°C$, L = 8.64mH, $R_G = 2.2\Omega$, $I_{AS} = 25A$.

③ Pulse test: Pulse Width < 380μs, duty cycle < 2%.

④ $C_{o(cr)}$ is defined as a fixed capacitance with the same stored charge as C_{OSS} with $V_{DS} = 67\%$ of $V_{(BR)DSS}$.

⑤ $C_{o(er)}$ is defined as a fixed capacitance with the same stored energy as C_{OSS} with $V_{DS} = 67\%$ of $V_{(BR)DSS}$. To calculate $C_{o(er)}$ for any value of V_{DS} less than $V_{(BR)DSS}$, use this equation: $C_{o(er)} = -8.27E{-}7/V_{DS}{}^2 + 1.01E{-}7/V_{DS} + 1.43E{-}10$.

⑥ R_G is external gate resistance, not including internal gate resistance or gate driver impedance. (MIC4452)

Microsemi reserves the right to change, without notice, the specifications and information contained herein.
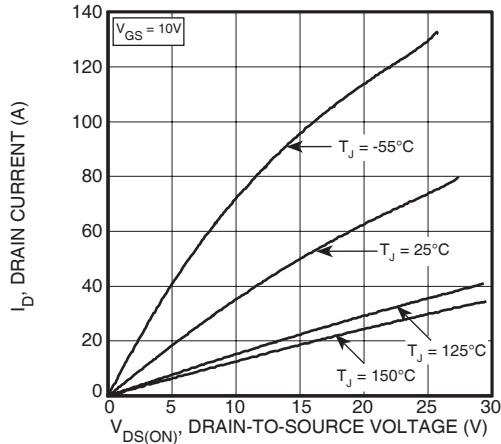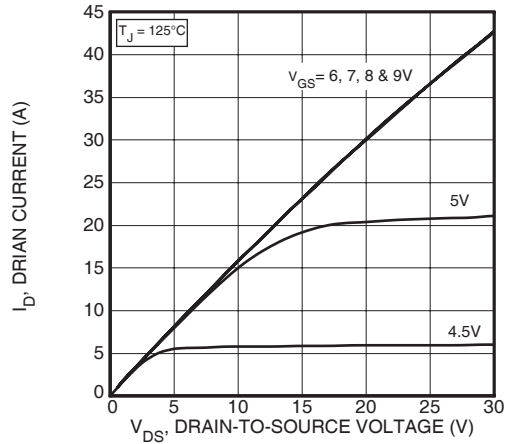
Figure 1, Output Characteristics
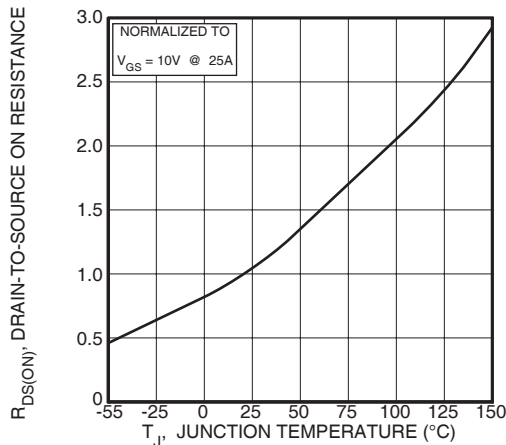
Figure 2, Output Characteristics

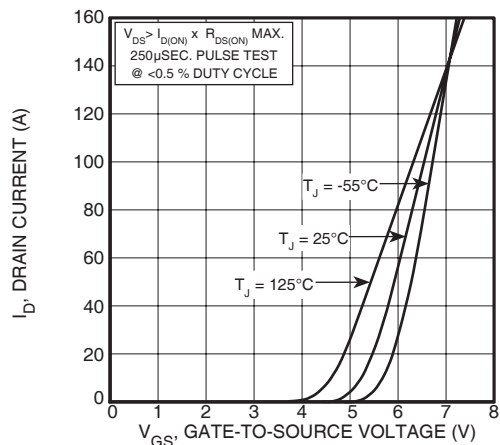**Figure 3, $R_{DS(ON)}$ vs Junction Temperature**
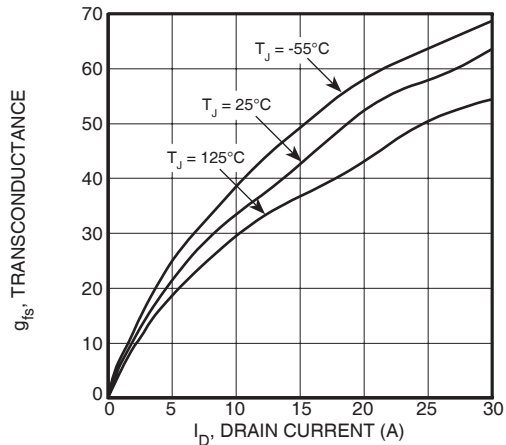
Figure 4, Transfer Characteristics
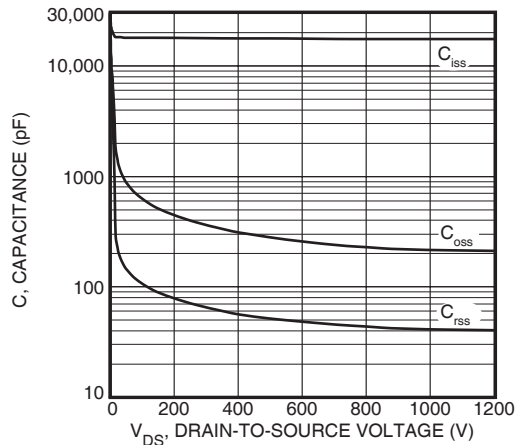
Figure 5, Gain vs Drain Current
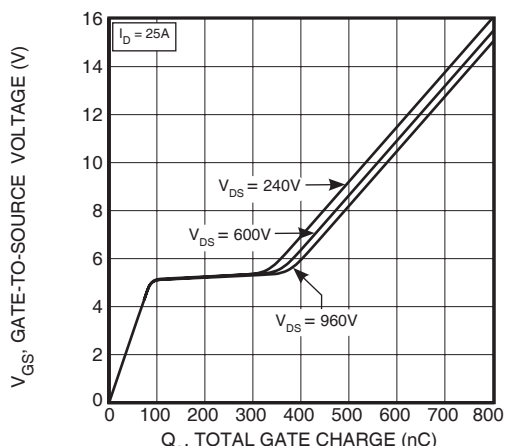
Figure 6, Capacitance vs Drain-to-Source Voltage
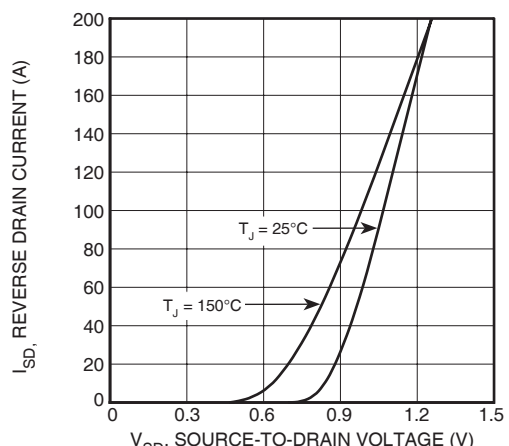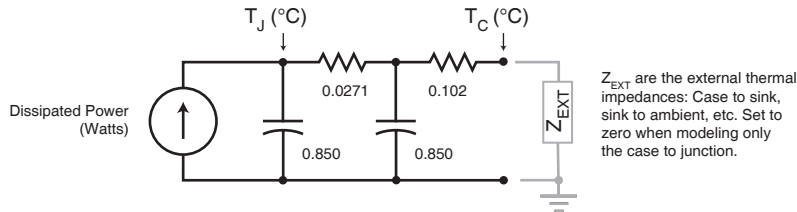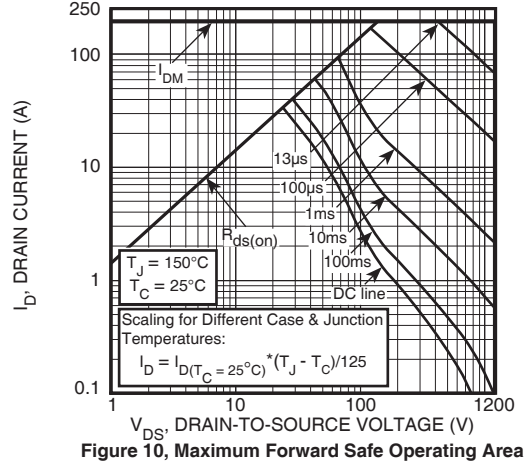
Figure 7, Gate Charge vs Gate-to-Source Voltage

Figure 8, Reverse Drain Current vs Source-to-Drain Voltage

Figure 9, Forward Safe Operating Area

Figure 9 axes: I_D, DRAIN CURRENT (A) vs V_{DS}, DRAIN-TO-SOURCE VOLTAGE (V). Curves labeled I_{DM}, 13µs, 100µs, 1ms, 10ms, 100ms, DC line, $R_{ds(on)}$. $T_J = 125°C$, $T_C = 75°C$.

Figure 10, Maximum Forward Safe Operating Area

Figure 10 axes: I_D, DRAIN CURRENT (A) vs V_{DS}, DRAIN-TO-SOURCE VOLTAGE (V). Curves labeled I_{DM}, 13µs, 100µs, 1ms, 10ms, 100ms, DC line, $R_{ds(on)}$. $T_J = 150°C$, $T_C = 25°C$.

Scaling for Different Case & Junction Temperatures:

$$I_D = I_{D(T_C = 25°C)} {}^* (T_J - T_C)/125$$

T_J (°C) T_C (°C)

Dissipated Power (Watts)

0.0271   0.102

0.850   0.850

Z_{EXT} are the external thermal impedances: Case to sink, sink to ambient, etc. Set to zero when modeling only the case to junction.

Figure 11, Transient Thermal Impedance Model

Note:

t_1 = Pulse Duration

Duty Factor D = t_1/t_2

Peak $T_J = P_{DM} \times Z_{\theta JC} + T_C$

SINGLE PULSE

D = 0.9, 0.7, 0.5, 0.3, 0.1, 0.05

$Z_{\theta JC}$, THERMAL IMPEDANCE (°C/W) vs RECTANGULAR PULSE DURATION (seconds)

Figure 12. Maximum Effective Transient Thermal Impedance Junction-to-Case vs Pulse Duration

SOT-227 (ISOTOP®) Package Outline

31.5 (1.240) / 31.7 (1.248)

7.8 (.307) / 8.2 (.322)

W=4.1 (.161) / W=4.3 (.169) / H=4.8 (.187) / H=4.9 (.193) (4 places)

r = 4.0 (.157) (2 places)

4.0 (.157) / 4.2 (.165) (2 places)

3.3 (.129) / 3.6 (.143)

14.9 (.587) / 15.1 (.594)

30.1 (1.185) / 30.3 (1.193)

38.0 (1.496) / 38.2 (1.504)

11.8 (.463) / 12.2 (.480)

8.9 (.350) / 9.6 (.378)

Hex Nut M4 (4 places)

0.75 (.030) / 0.85 (.033)   12.6 (.496) / 12.8 (.504)

25.2 (0.992) / 25.4 (1.000)

1.95 (.077) / 2.14 (.084)

* Source   Drain

* Emitter terminals are shorted internally. Current handling capability is equal for either Source terminal.

* Source   Gate

Dimensions in Millimeters and (Inches)