FAIRCHILD SEMICONDUCTOR®

October 2002

FDH20N40 / FDP20N40

20A, 400V, 0.216 Ohm, N-Channel SMPS Power MOSFET

Applications

Switch Mode Power Supplies(SMPS), such as

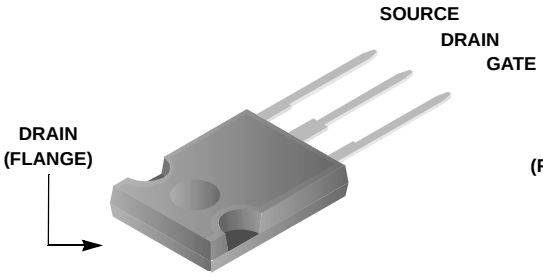
- PFC Boost
- Two-Switch Forward Converter
- Single Switch Forward Converter
- Flyback Converter
- Buck Converter
- High Speed Switching

Features

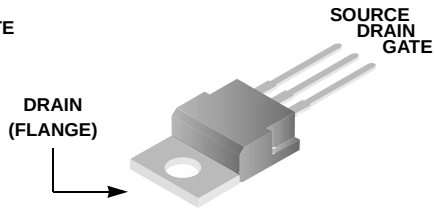
- Low Gate Charge Q_g results in Simple Drive Requirement
- Improved Gate, Avalanche and High Reapplied dv/dt Ruggedness
- Reduced $r_{DS(ON)}$
- Reduced Miller Capacitance and Low Input Capacitance
- Improved Switching Speed with Low EMI
- 175°C Rated Junction Temperature

Package

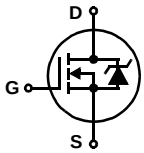
JEDEC TO-247



JEDEC TO-220AB



Symbol



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	Ratings	Units
V_{DSS}	Drain to Source Voltage	400	V
V_{GS}	Gate to Source Voltage	±30	V
I_D	Drain Current Continuous (T_C = 25°C, V_{GS} = 10V)	20	A
	Continuous (T_C = 100°C, V_{GS} = 10V)	14	A
	Pulsed (Note 1)	80	A
P_D	Power dissipation Derate above 25°C	273 1.82	W W/°C
T_J, T_{STG}	Operating and Storage Temperature	-55 to 175	°C
	Soldering Temperature for 10 seconds	300 (1.6mm from case)	°C
	Mounting Torque, 8-32 or M3 Screw	10ibf*in (1.1N*m)	

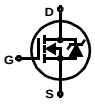
Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction to Case	0.55	°C/W
$R_{\theta CS}$	Thermal Resistance Case to Sink, Flat, Greased Surface	0.24	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient (TO-247)	40	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient (TO-220)	62	°C/W

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDH20N40	FDH20N40	TO-247	Tube	-	30
FDP20N40	FDP20N40	TO-220	Tube	-	50

Electrical Characteristics T_C = 25°C (unless otherwise noted)

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
Statics							
B_{VDSS}	Drain to Source Breakdown Voltage	I_D = 250μA, V_{GS} = 0V		400	-	-	V
$\Delta B_{VDSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	V/°C Reference to 25°C I_D = 1mA		-	0.43	-	
$r_{DS(ON)}$	Drain to Source On-Resistance	V_{GS} = 10V, I_D = 10A		-	0.200	0.216	Ω
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250μA		2.0	3.5	4.0	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 400V	T_C = 25°C	-	-	25	μA
		V_{GS} = 0V	T_C =150°C	-	-	250	
I_{GSS}	Gate to Source Leakage Current	V_{GS} = ±20V		-	-	±100	nA
Dynamics							
g_{fs}	Forward Transconductance	V_{DS} = 50V, I_D = 10A		10	-	-	S
$Q_{g(TOT)}$	Total Gate Charge at 10V	V_{GS} = 10V V_{DS} = 320V I_D = 20A		-	35	42	nC
Q_{gs}	Gate to Source Gate Charge			-	10	12	nC
Q_{gd}	Gate to Drain “Miller” Charge			-	12	14.4	nC
$t_{d(ON)}$	Turn-On Delay Time	V_{DD} = 200V I_D = 20A R_G = 10Ω R_D = 15.4Ω		-	12.4	-	ns
t_r	Rise Time			-	32.5	-	ns
$t_{d(OFF)}$	Turn-Off Delay Time			-	30	-	ns
t_f	Fall Time			-	34	-	ns
C_{ISS}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V f = 1MHz		-	1840	-	pF
C_{OSS}	Output Capacitance			-	245	-	pF
C_{RSS}	Reverse Transfer Capacitance			-	18	-	pF
Avalanche Characteristics							
E_{AS}	Single Pulse Avalanche Energy (Note 2)			1100	-	-	mJ
I_{AR}	Avalanche Current			-	-	20	A
Drain-Source Diode Characteristics							
I_S	Continuous Source Current (Body Diode)	MOSFET symbol showing the integral reverse p-n junction diode. 		-	-	20	A
I_{SM}	Pulsed Source Current (Note 1) (Body Diode)			-	-	80	A
V_{SD}	Source to Drain Diode Voltage	I_{SD} = 20A		-	0.9	1.2	V
t_{rr}	Reverse Recovery Time	I_{SD} = 20A, dI_{SD}/dt = 100A/μs		-	351	456	ns
Q_{RR}	Reverse Recovered Charge	I_{SD} = 20A, dI_{SD}/dt = 100A/μs		-	4.5	5.85	μC

Notes:

1: Repetitive rating; pulse width limited by maximum junction temperature

2: Starting T_J = 25°C, L = 5.5mH, I_{AS} = 20A

Typical Characteristics

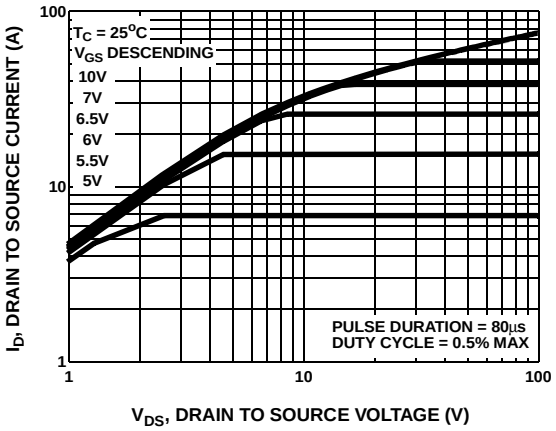


Figure 1. Output Characteristics

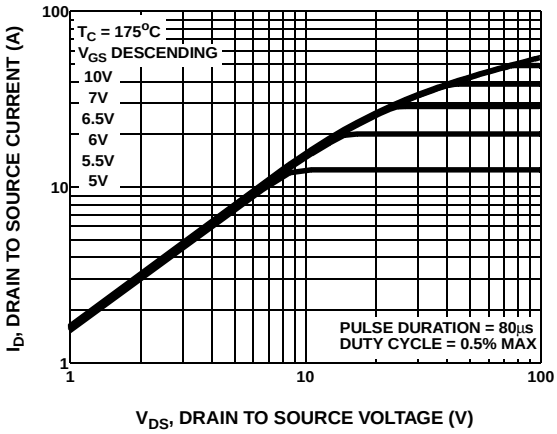


Figure 2. Output Characteristics

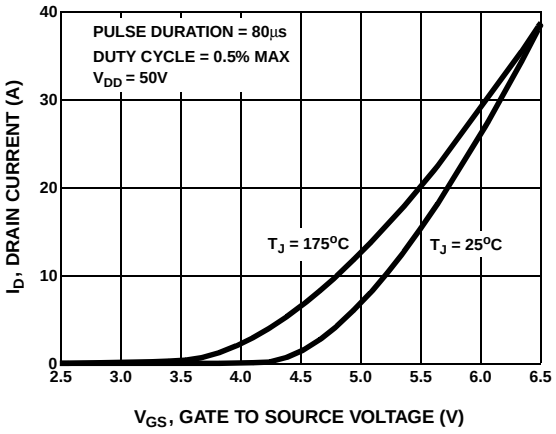


Figure 3. Transfer Characteristics

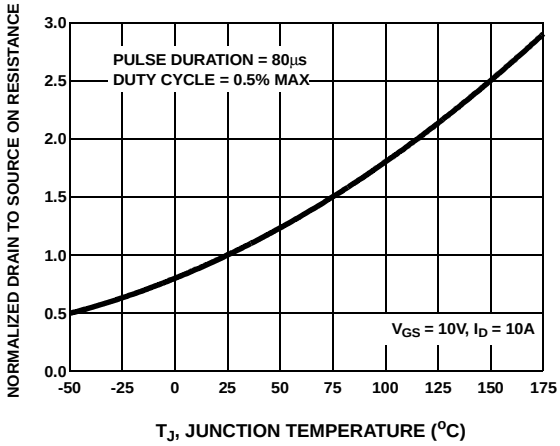


Figure 4. Normalized Drain To Source On Resistance vs Junction Temperatrue

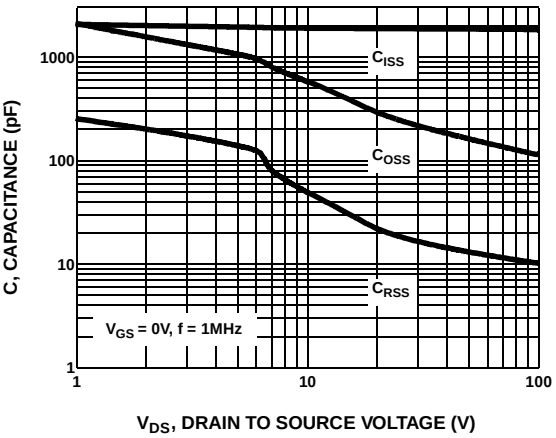


Figure 5. Capacitance vs Drain To Source Voltage

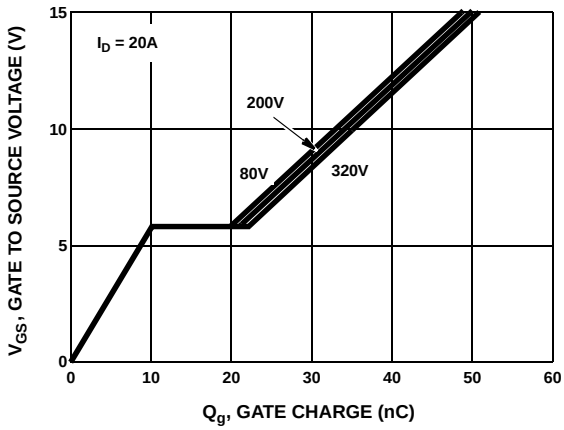


Figure 6. Gate Charge Waveforms For Constant Gate Current

Typical Characteristics

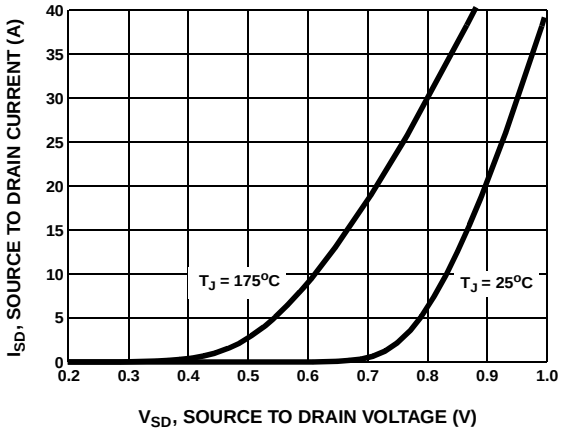


Figure 7. Source to Drain Diode Forward Voltage

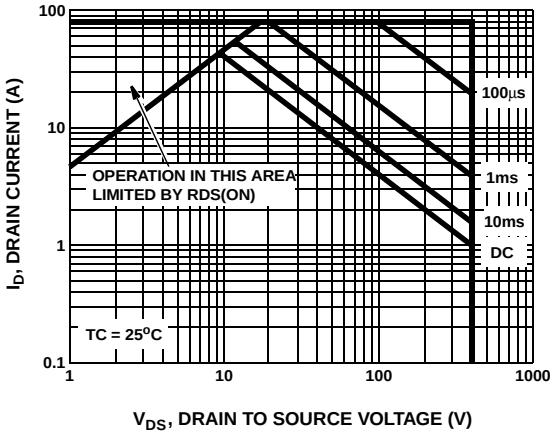


Figure 8. Maximum Safe Operating Area

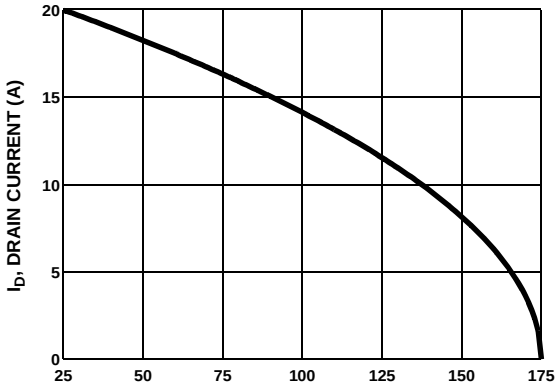


Figure 9. Maximum Drain Current vs Case Temperature

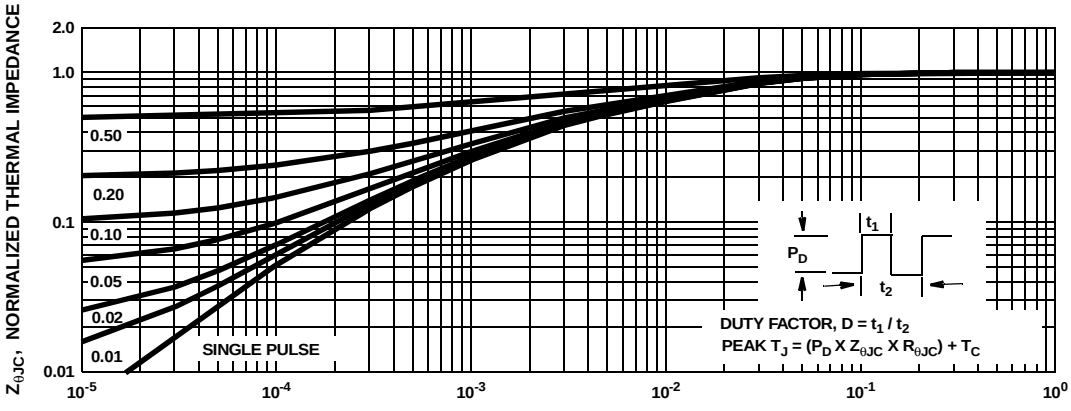


Figure 10. Normalized Maximum Transient Thermal Impedance

Test Circuits and Waveforms

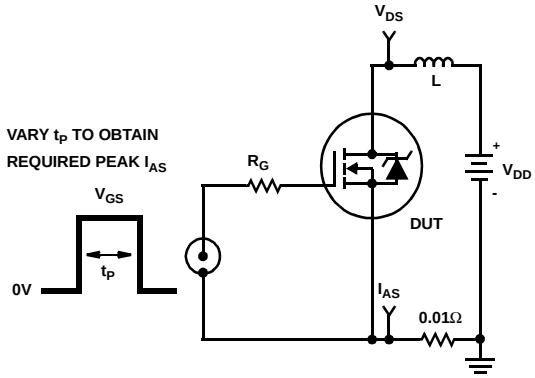


Figure 11. Unclamped Energy Test Circuit

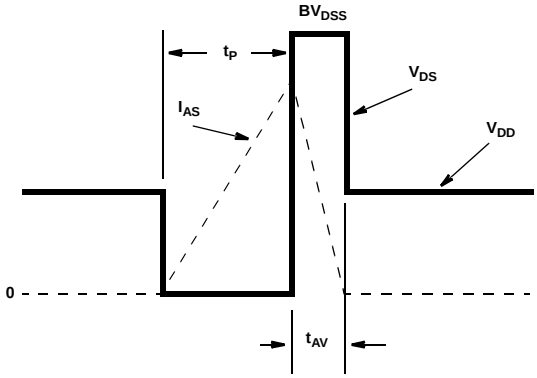


Figure 12. Unclamped Energy Waveforms

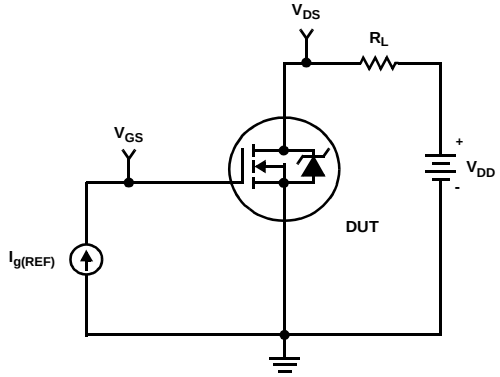


Figure 13. Gate Charge Test Circuit

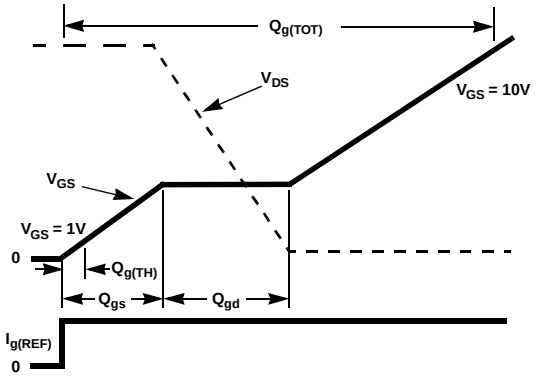


Figure 14. Gate Charge Waveforms

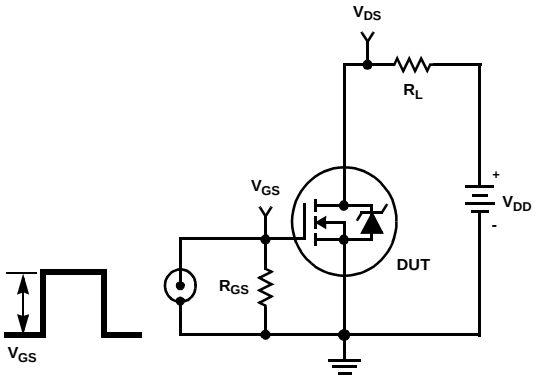


Figure 15. Switching Time Test Circuit

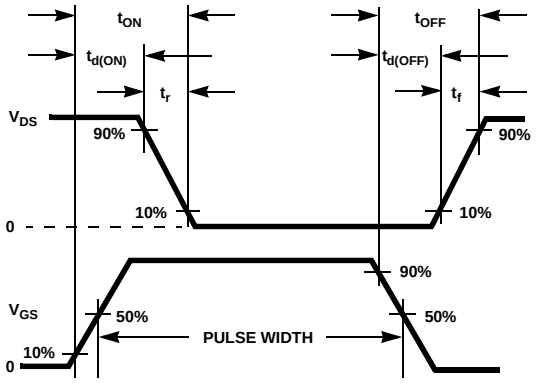


Figure 16. Switching Time Waveform

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