

## 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

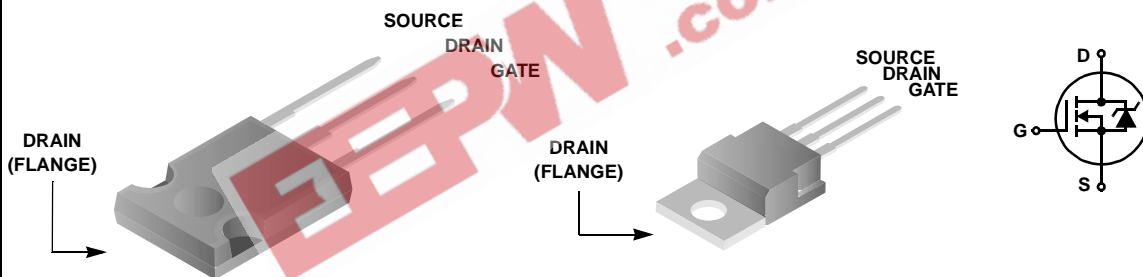
- Low Gate Charge  $Q_g$  results in Simple Drive Requirement
- Improved Gate, Avalanche and High Reapplied dv/dt Ruggedness
- Reduced  $r_{DS(ON)}$
- Reduced Miller Capacitance and Low Input Capacitance
- Improved Switching Speed with Low EMI
- 175°C Rated Junction Temperature

#### Package

JEDEC TO-247

JEDEC TO-220AB

#### Symbol



#### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

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

#### Thermal Characteristics

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

## 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 $T_C = 25^\circ\text{C}$ (unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units	
<b>Statics</b>							
$B_{VDSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$	400	-	-	V	
$\Delta B_{VDSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	$V/^\circ\text{C}$ Reference to $25^\circ\text{C}$ $I_D = 1\text{mA}$	-	0.43	-		
$r_{DS(ON)}$	Drain to Source On-Resistance	$V_{GS} = 10\text{V}$ , $I_D = 10\text{A}$	-	0.200	0.216	$\Omega$	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$	2.0	3.5	4.0	V	
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 400\text{V}$ $V_{GS} = 0\text{V}$	$T_C = 25^\circ\text{C}$	-	-	25	$\mu\text{A}$
			$T_C = 150^\circ\text{C}$	-	-	250	
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA	

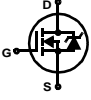
## Dynamics

$g_{fs}$	Forward Transconductance	$V_{DS} = 50\text{V}$ , $I_D = 10\text{A}$	10	-	-	S
$Q_{g(TOT)}$	Total Gate Charge at 10V	$V_{GS} = 10\text{V}$	-	35	42	nC
$Q_{gs}$	Gate to Source Gate Charge	$V_{DS} = 320\text{V}$	-	10	12	nC
$Q_{gd}$	Gate to Drain "Miller" Charge	$I_D = 20\text{A}$	-	12	14.4	nC
$t_{d(ON)}$	Turn-On Delay Time	$V_{DD} = 200\text{V}$	-	12.4	-	ns
$t_r$	Rise Time	$I_D = 20\text{A}$	-	32.5	-	ns
$t_{d(OFF)}$	Turn-Off Delay Time	$R_G = 10\Omega$	-	30	-	ns
$t_f$	Fall Time	$R_D = 15.4\Omega$	-	34	-	ns
$C_{ISS}$	Input Capacitance	$V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$	-	1840	-	pF
$C_{OSS}$	Output Capacitance	$f = 1\text{MHz}$	-	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	$I_{SD} = 20\text{A}$	-	0.9	1.2	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 20\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	351	456	ns
$Q_{RR}$	Reverse Recovered Charge	$I_{SD} = 20\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	4.5	5.85	$\mu\text{C}$

### Notes:

- 1: Repetitive rating; pulse width limited by maximum junction temperature
- 2: Starting  $T_J = 25^\circ\text{C}$ ,  $L = 5.5\text{mH}$ ,  $I_{AS} = 20\text{A}$

### Typical Characteristics

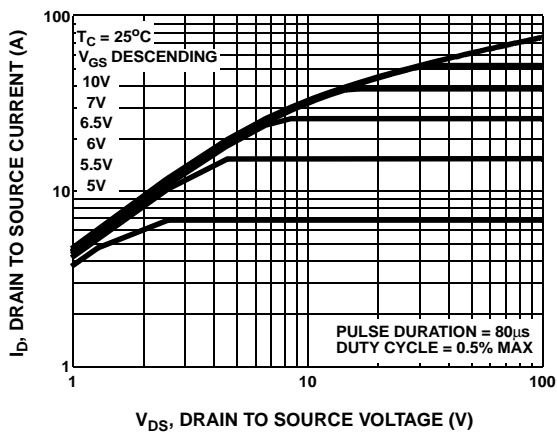


Figure 1. Output Characteristics

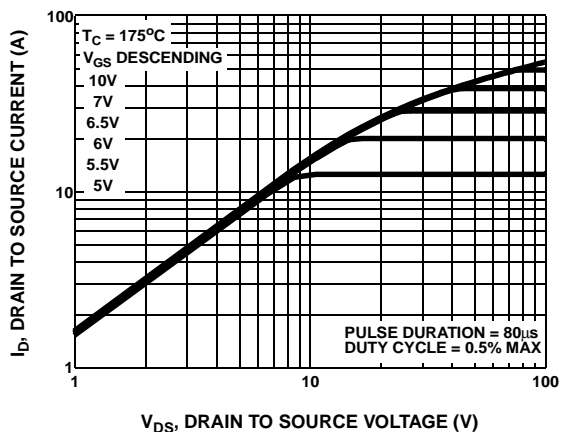


Figure 2. Output Characteristics

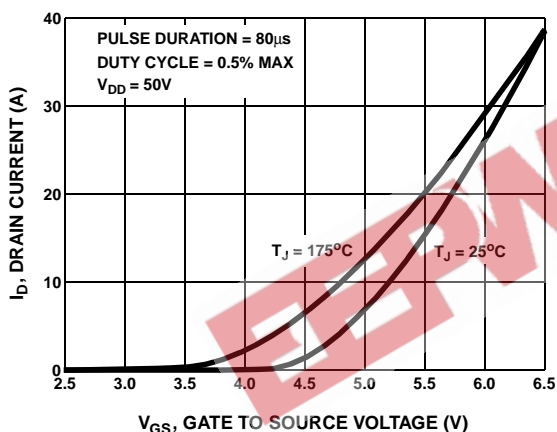


Figure 3. Transfer Characteristics

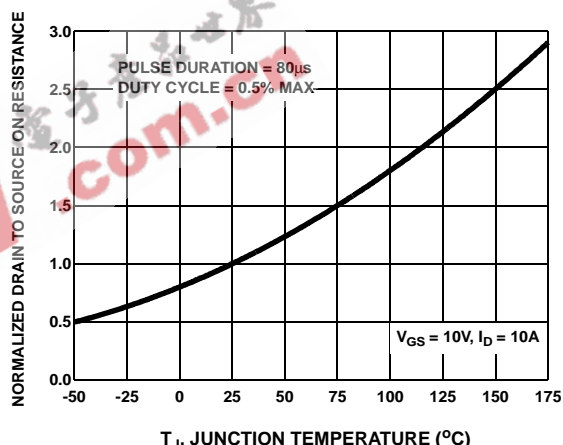


Figure 4. Normalized Drain to Source On Resistance vs Junction Temperature

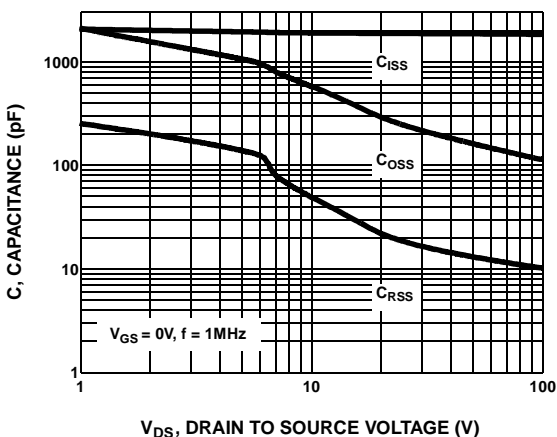


Figure 5. Capacitance vs Drain to Source Voltage

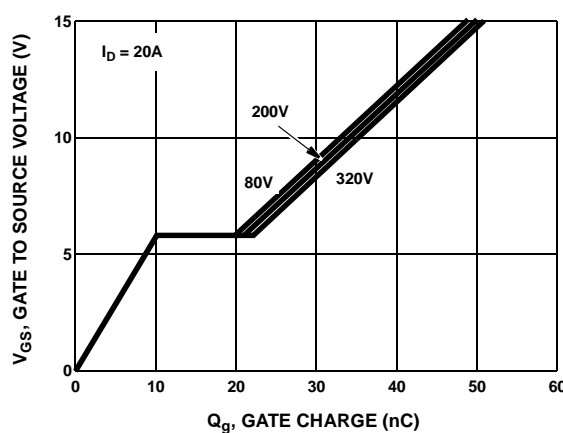


Figure 6. Gate Charge Waveforms For Constant Gate Current

Typical Characteristics

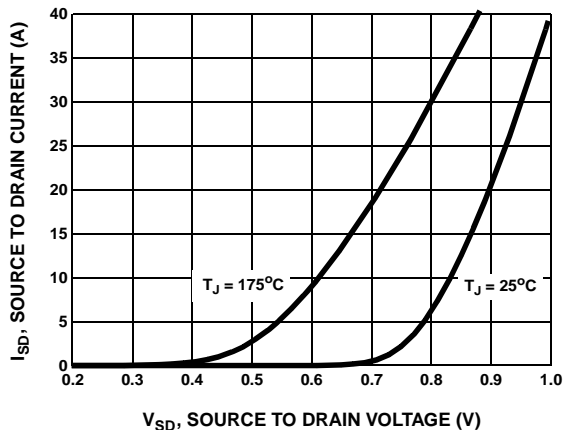


Figure 7. Source to Drain Diode Forward Voltage

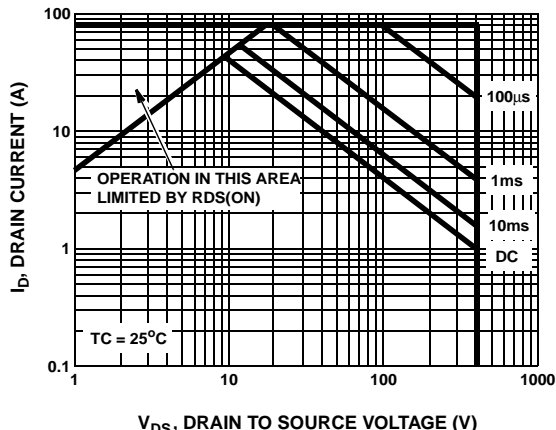


Figure 8. Maximum Safe Operating Area

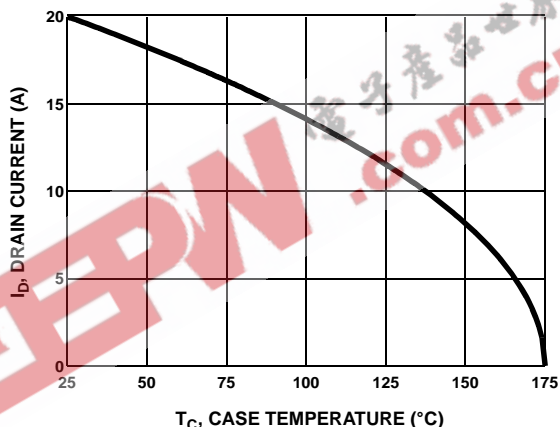


Figure 9. Maximum Drain Current vs Case Temperature

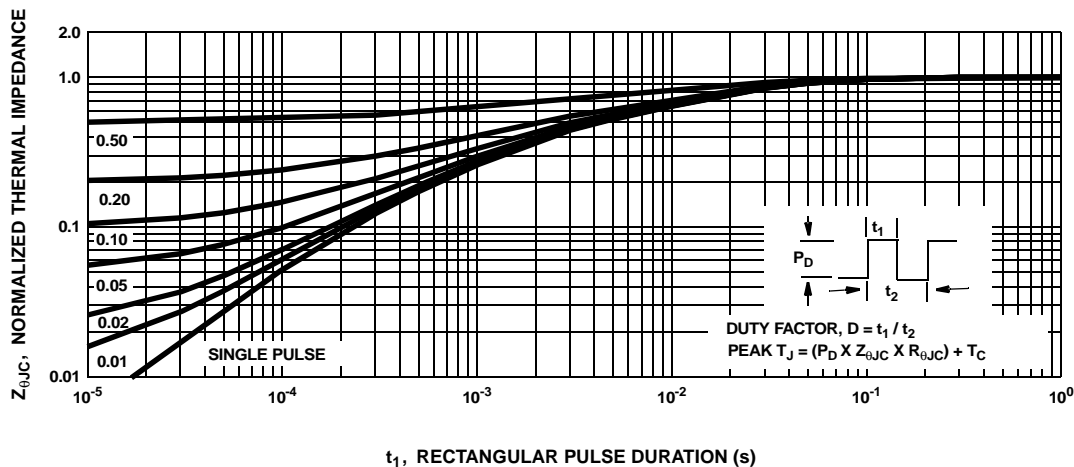


Figure 10. Normalized Maximum Transient Thermal Impedance

Test Circuits and Waveforms

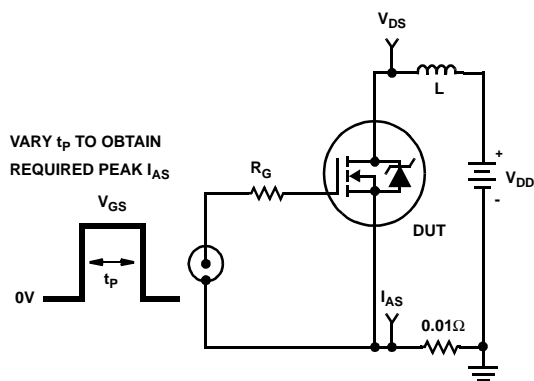


Figure 11. Unclamped Energy Test Circuit

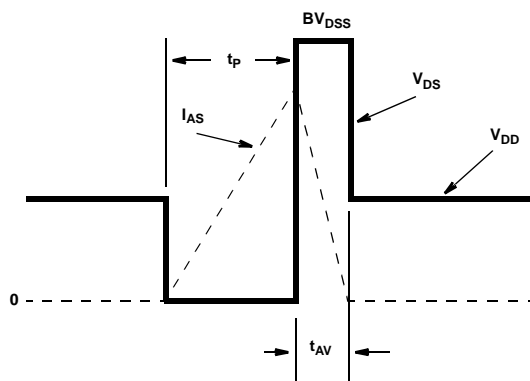


Figure 12. Unclamped Energy Waveforms

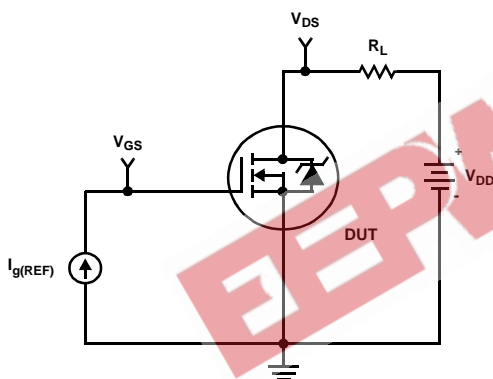


Figure 13. Gate Charge Test Circuit

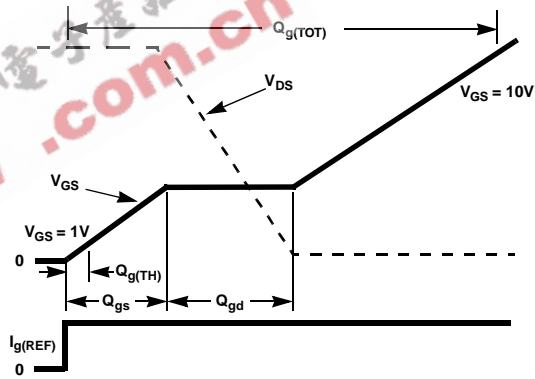


Figure 14. Gate Charge Waveforms

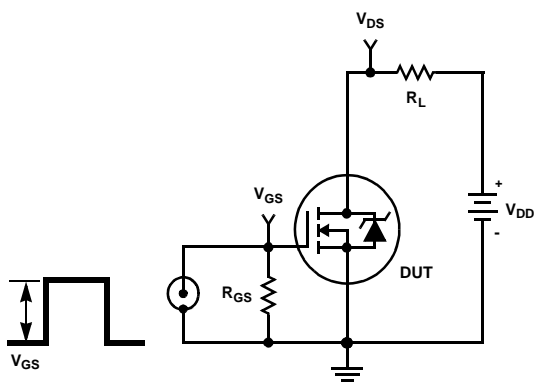


Figure 15. Switching Time Test Circuit

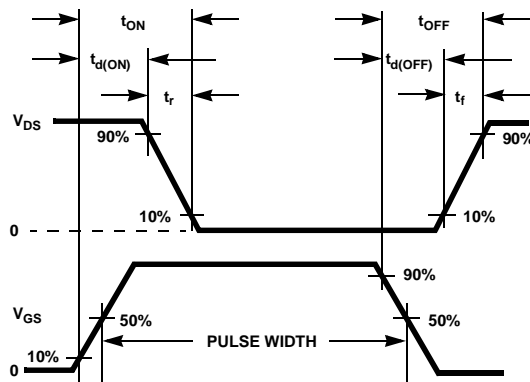


Figure 16. Switching Time Waveform

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