

IRFP90N20DPbF

HEXFET® Power MOSFET

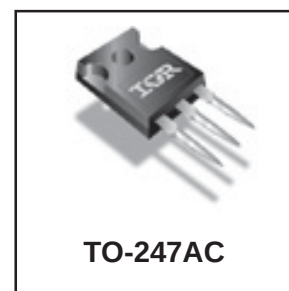
Applications

- High frequency DC-DC converters
- Lead-Free

V_{DSS}	$R_{DS(on) \text{ max}}$	I_D
200V	0.023Ω	94A ^⑥

Benefits

- Low Gate-to-Drain Charge to Reduce Switching Losses
- Fully Characterized Capacitance Including Effective C_{OSS} to Simplify Design, (See App. Note AN1001)
- Fully Characterized Avalanche Voltage and Current



Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	94 ^⑥	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	66	
I_{DM}	Pulsed Drain Current ^①	380	
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation	580	W
	Linear Derating Factor	3.8	W/°C
V_{GS}	Gate-to-Source Voltage	± 30	V
dv/dt	Peak Diode Recovery dv/dt ^③	6.7	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.26	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient	—	40	

Notes ^① through ^⑥ are on page 8

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Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	200	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.24	—	V/ $^\circ\text{C}$	Reference to 25°C , $I_D = 1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.023	Ω	$V_{GS} = 10V, I_D = 56A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	5.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 200V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 160V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -30V$

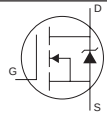
Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	39	—	—	S	$V_{DS} = 50V, I_D = 56A$
Q_g	Total Gate Charge	—	180	270	nC	$I_D = 56A$
Q_{gs}	Gate-to-Source Charge	—	45	67		$V_{DS} = 160V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	87	130		$V_{GS} = 10V$, ④
$t_{d(on)}$	Turn-On Delay Time	—	23	—	ns	$V_{DD} = 100V$
t_r	Rise Time	—	160	—		$I_D = 56A$
$t_{d(off)}$	Turn-Off Delay Time	—	43	—		$R_G = 1.2\Omega$
t_f	Fall Time	—	79	—		$V_{GS} = 10V$, ④
C_{iss}	Input Capacitance	—	6040	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1070	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	170	—		$f = 1.0MHz$
C_{oss}	Output Capacitance	—	8350	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz$
C_{oss}	Output Capacitance	—	420	—		$V_{GS} = 0V, V_{DS} = 160V, f = 1.0MHz$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	870	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 160V$ ⑤

Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	—	1010	mJ
I_{AR}	Avalanche Current①	—	56	A
E_{AR}	Repetitive Avalanche Energy①	—	58	mJ

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	94⑥	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	380		
V_{SD}	Diode Forward Voltage	—	—	1.5	V	$T_J = 25^\circ\text{C}, I_S = 56A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	230	340	ns	$T_J = 25^\circ\text{C}, I_F = 56A$
Q_{rr}	Reverse Recovery Charge	—	1.9	2.8	μC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

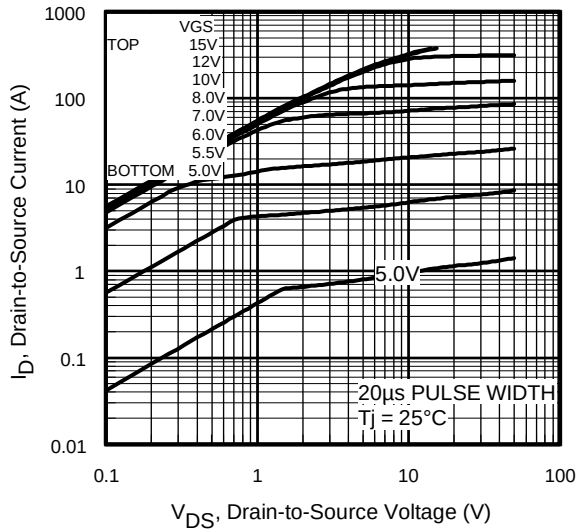


Fig 1. Typical Output Characteristics

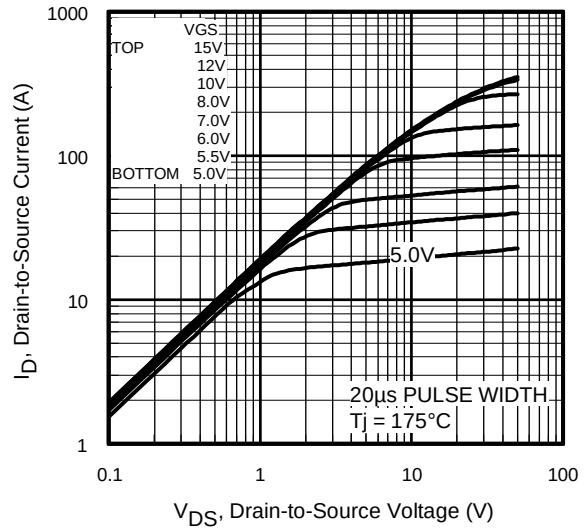


Fig 2. Typical Output Characteristics

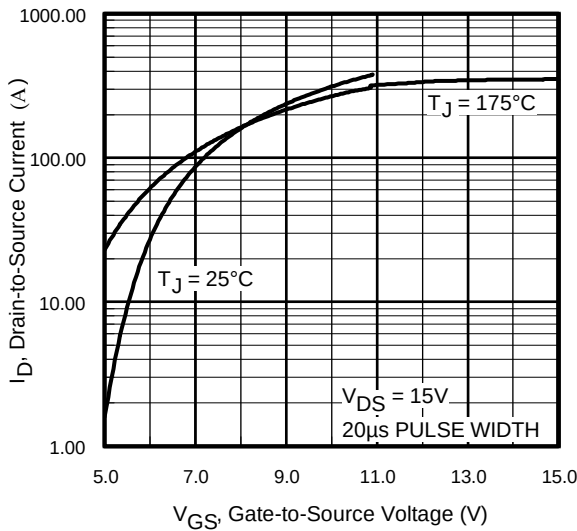


Fig 3. Typical Transfer Characteristics

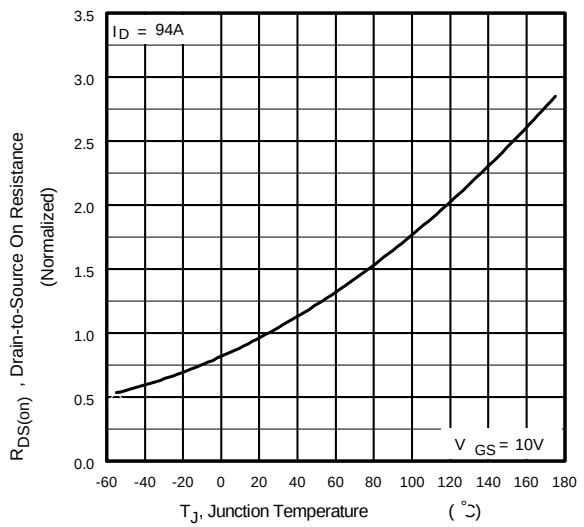


Fig 4. Normalized On-Resistance
vs. Temperature

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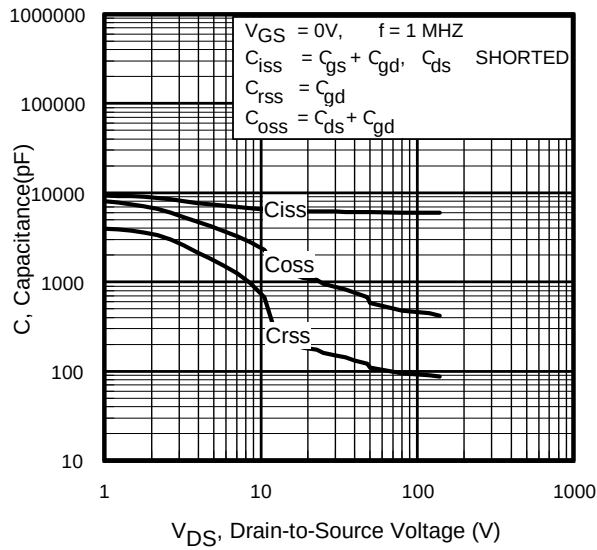


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

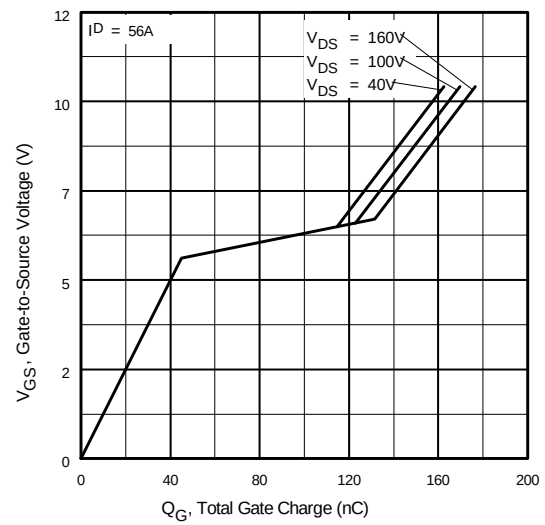


Fig 6. Typical Gate Charge vs. Gate-to-Source Voltage

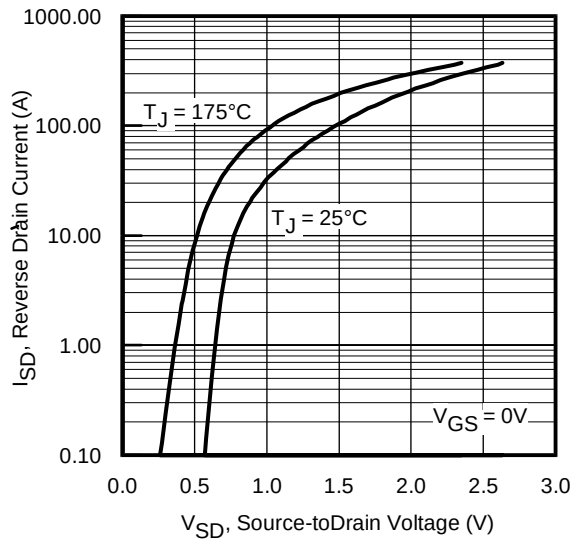


Fig 7. Typical Source-Drain Diode Forward Voltage

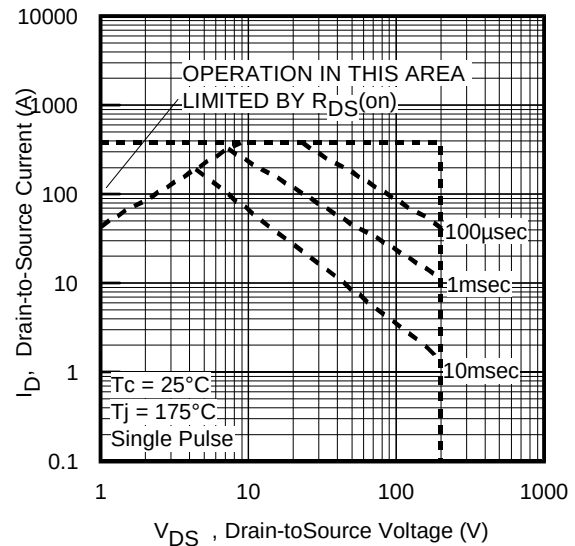


Fig 8. Maximum Safe Operating Area

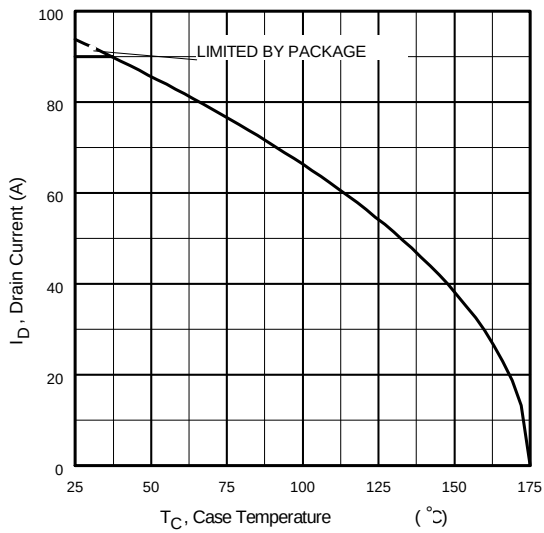


Fig 9. Maximum Drain Current vs. Case Temperature

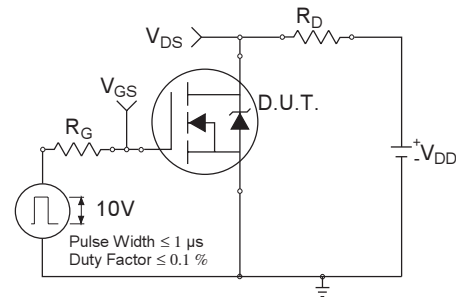


Fig 10a. Switching Time Test Circuit

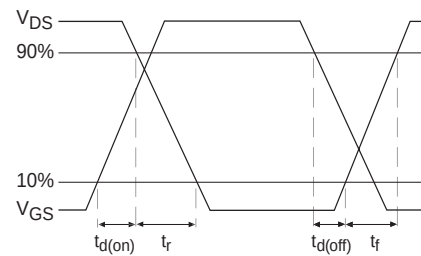


Fig 10b. Switching Time Waveforms

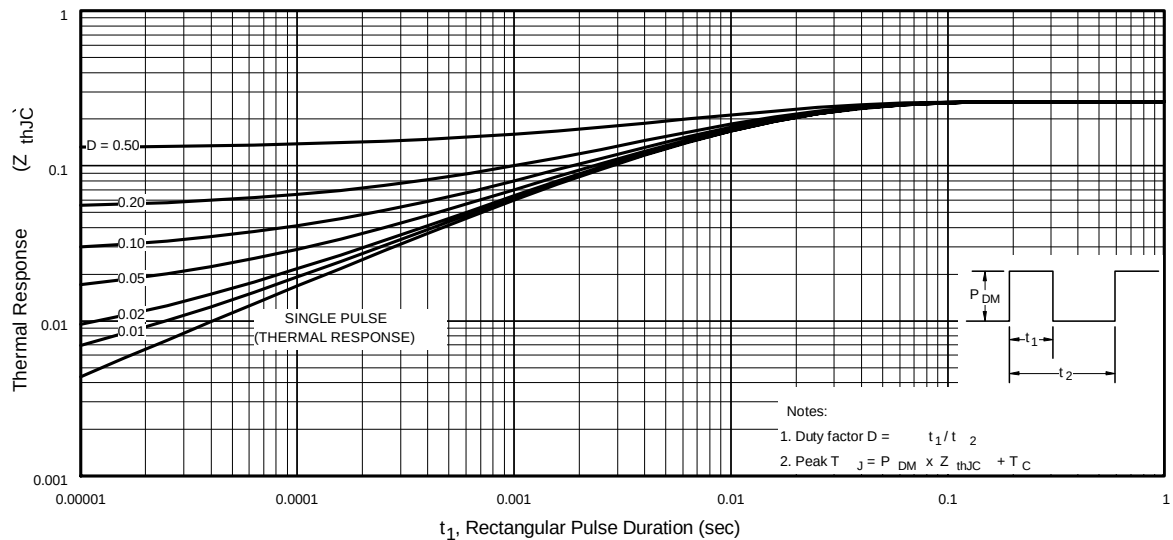


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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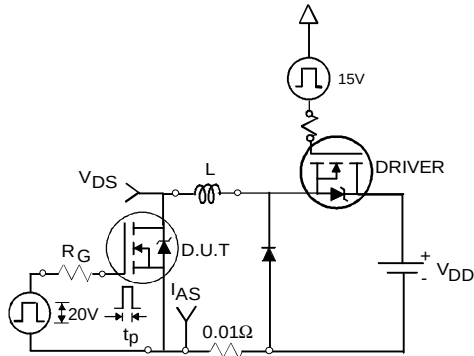


Fig 12a. Unclamped Inductive Test Circuit

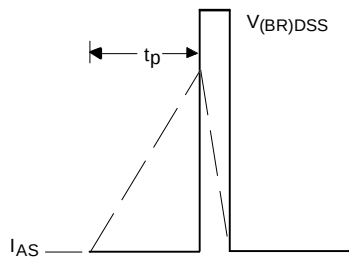


Fig 12b. Unclamped Inductive Waveforms

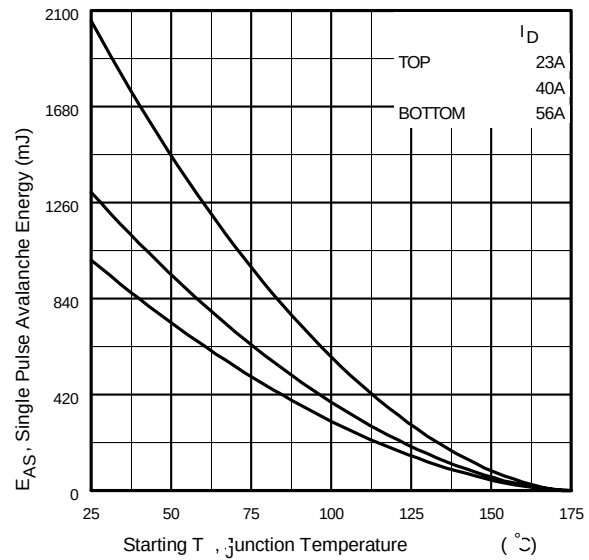


Fig 12c. Maximum Avalanche Energy vs. Drain Current

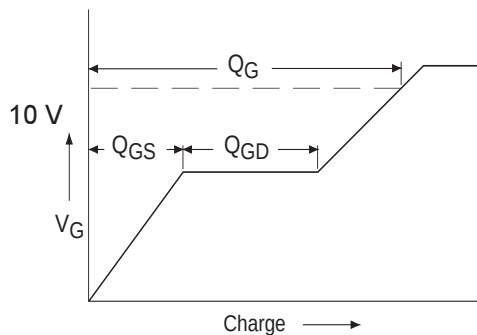


Fig 13a. Basic Gate Charge Waveform

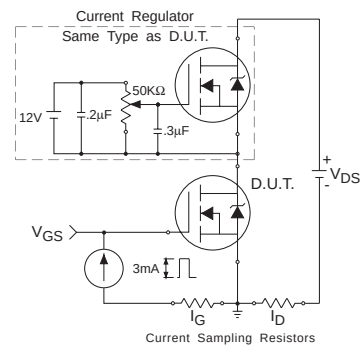


Fig 13b. Gate Charge Test Circuit

The diagram shows a Class D amplifier circuit. A square-wave voltage source (1) is connected in series with a gate resistor R_G to the gate of a MOSFET (D.U.T.). The MOSFET's source is grounded, and its drain is connected to a load network consisting of a transformer (2) in series with a series combination of an inductor and a parallel LC network (3). The output of the LC network is connected to the D.U.T. (4). The D.U.T. is represented by a MOSFET symbol with a circle around it. The output of the D.U.T. is connected to a load resistor and a DC voltage source V_{DD} .

Circuit Layout Considerations

- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance

Current Transformer

• dv/dt controlled by R_G

• Driver same type as D.U.T.

• I_{SD} controlled by Duty Factor "D"

• D.U.T. - Device Under Test

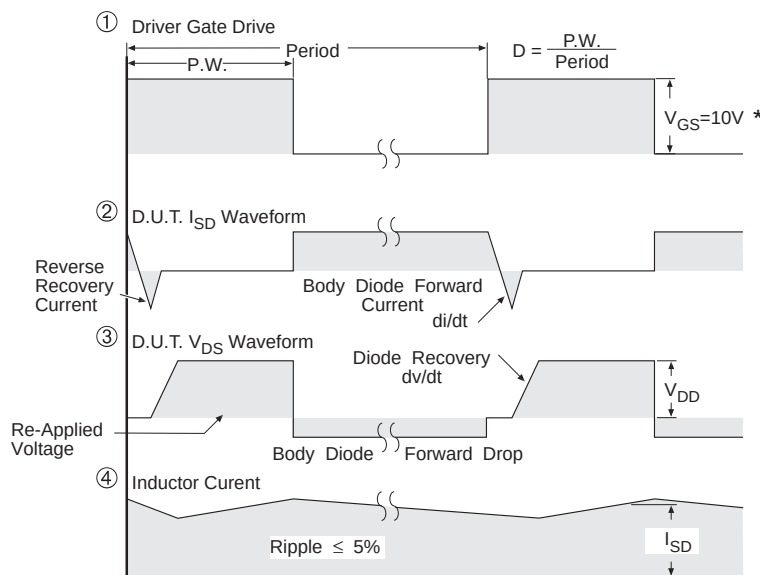
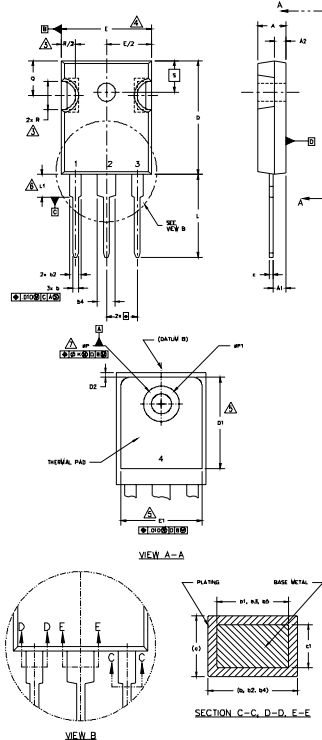


Fig 14. For N-Channel HEXFET® Power MOSFETs

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TO-247AC Package Outline Dimensions are shown in millimeters (inches)

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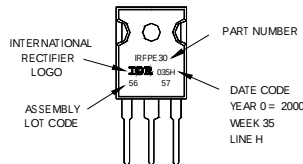
NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M 1994.
- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
- CONTOUR OF SLOT OPTIONAL.
- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
- LEAD FINISH UNCONTROLLED IN L1.
- #P TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154" [3.91]
- OUTLINE CONFORMS TO JEDEC OUTLINE TO-247 WITH THE EXCEPTION OF DIMENSION c.

SYMBOL	INCHES		MILLIMETERS		NOTES	
	MIN.	MAX.	MIN.	MAX.		
A	.183	.209	4.65	5.31	LEAD ASSIGNMENTS	
A1	.087	.102	2.21	2.59		
A2	.059	.098	1.50	2.49		
b	.039	.055	0.99	1.40		
b1	.039	.053	0.99	1.35	HEXFET	
b2	.065	.094	1.65	2.39		
b3	.065	.092	1.65	2.37		
b4	.102	.135	2.59	3.43		
b5	.102	.133	2.59	3.38	IGBTs, CoPACK	
c	.015	.034	0.38	0.86		
c1	.015	.030	0.38	0.76		
D	.776	.815	19.71	20.70		
D1	.515	-	13.08	-	LEAD ASSIGNMENTS	
D2	.020	.030	0.51	0.76		
E	.602	.625	15.29	15.87		
E1	.540	-	13.72	-		
e	215 BSC		5.46 BSC		IGBTs, CoPACK	
#P	.010		2.54			
L	.559	.634	14.20	16.10		
L1	.146	.169	3.71	4.29	DIODES	
N	3		7.62 BSC			
#P	.140	.144	3.56	3.66		
#P1	-	.275	-	6.98	LEAD ASSIGNMENTS	
O	.209	.224	5.31	5.69		
R	.178	.216	4.52	5.49		
S	217 BSC		5.51 BSC			

TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFP90N20DPbF
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON VWV35, 2000
IN THE ASSEMBLY LINE "H"
Note: "P" in assembly line
position indicates "Lead-Free"



Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting $T_J = 25^\circ\text{C}$, $L = 0.64\text{mH}$
 $R_G = 25\Omega$, $I_{AS} = 56\text{A}$.
- ③ $I_{SD} \leq 56\text{A}$, $di/dt \leq 470\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$,
 $T_J \leq 175^\circ\text{C}$

- ④ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$.
- ⑤ C_{OSS} eff. is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 80% V_{DSS}
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 90A.

Data and specifications subject to change without notice.
This product has been designed and qualified for the Industrial market.

Qualification Standards can be found on IR's Web site.

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Visit us at www.irf.com for sales contact information.07/04

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Note: For the most current drawings please refer to the IR website at:
<http://www.irf.com/package/>

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