

International
IR Rectifier

SMPS MOSFET

IRFB9N65A

HEXFET® Power MOSFET

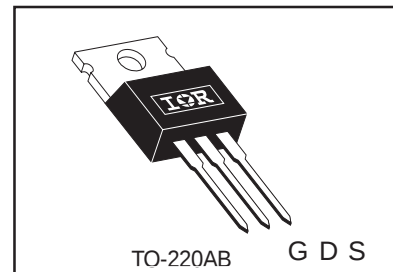
Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptable Power Supply
- High speed power switching

V_{DSS}	$R_{ds(on)}$ max	I_D
650V	0.93Ω	8.5A

Benefits

- Low Gate Charge Q_g results in Simple Drive Requirement
- Improved Gate, Avalanche and dynamic dv/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current



Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	8.5	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	5.4	
I_{DM}	Pulsed Drain Current ①	21	
P_D @ $T_C = 25^\circ\text{C}$	Power Dissipation	167	W
	Linear Derating Factor	1.3	W/°C
V_{GS}	Gate-to-Source Voltage	± 30	V
dv/dt	Peak Diode Recovery dv/dt ③	2.8	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Applicable Off Line SMPS Topologies:

- Single Transistor Flyback
- Single Transistor Forward

Notes ① through ⑤ 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	650	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.93	Ω	$V_{GS} = 10V, I_D = 5.1A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	μA	$V_{DS} = 650V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 520V, V_{GS} = 0V, T_J = 150^\circ\text{C}$
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	3.9	—	—	S	$V_{DS} = 50V, I_D = 3.1A$
Q_g	Total Gate Charge	—	—	48	nC	$I_D = 5.2A$
Q_{gs}	Gate-to-Source Charge	—	—	12		$V_{DS} = 400V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	19	ns	$V_{GS} = 10V$, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	14	—		$V_{DD} = 325V$
t_r	Rise Time	—	20	—		$I_D = 5.2A$
$t_{d(off)}$	Turn-Off Delay Time	—	34	—		$R_G = 9.1\Omega$
t_f	Fall Time	—	18	—		$R_D = 62\Omega$, See Fig. 10 ④
C_{iss}	Input Capacitance	—	1417	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	177	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	7.0	—		$f = 1.0\text{MHz}$, See Fig. 5
C_{oss}	Output Capacitance	—	1912	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	48	—		$V_{GS} = 0V, V_{DS} = 520V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	84	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 520V$ ⑤

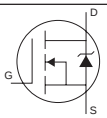
Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	—	620	mJ
I_{AR}	Avalanche Current①	—	5.2	A
E_{AR}	Repetitive Avalanche Energy①	—	16	mJ

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.75	$^\circ\text{C/W}$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	5.2	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	21		
V_{SD}	Diode Forward Voltage	—	—	1.5	V	$T_J = 25^\circ\text{C}, I_S = 5.2A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	493	739	ns	$T_J = 25^\circ\text{C}, I_F = 5.2A$
Q_{rr}	Reverse Recovery Charge	—	2.1	3.2	μC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

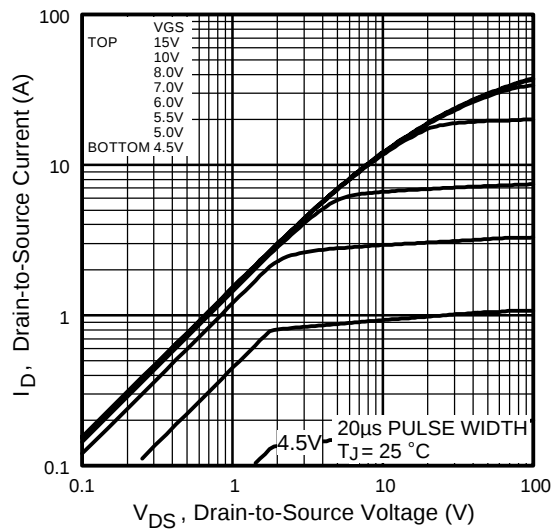


Fig 1. Typical Output Characteristics

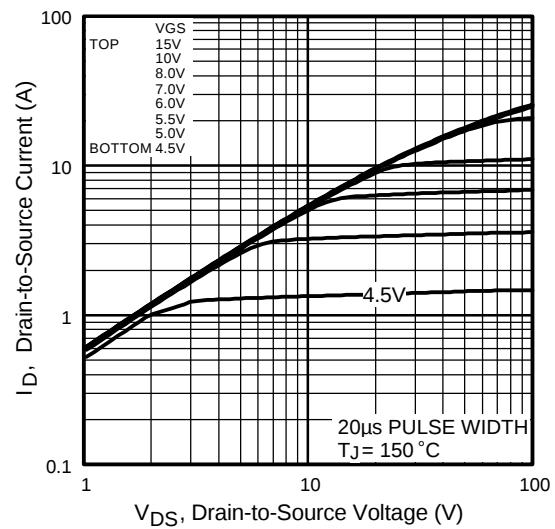


Fig 2. Typical Output Characteristics

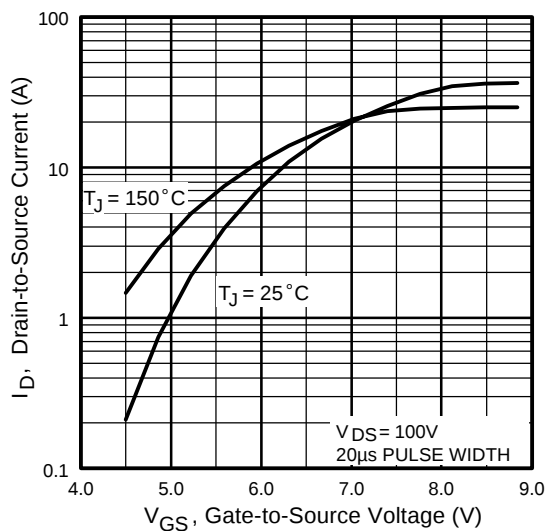


Fig 3. Typical Transfer Characteristics

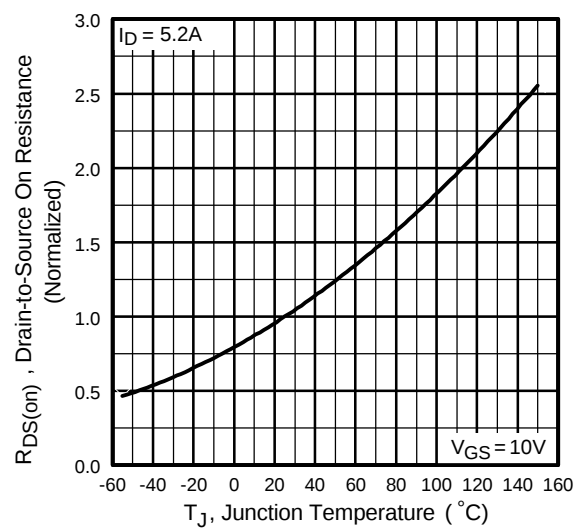


Fig 4. Normalized On-Resistance Vs. Temperature

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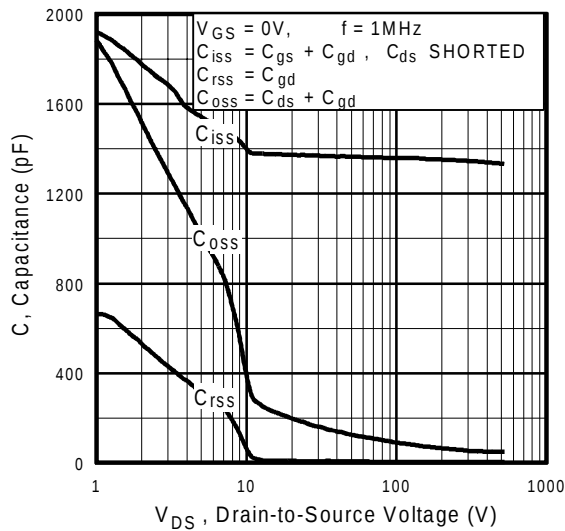


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

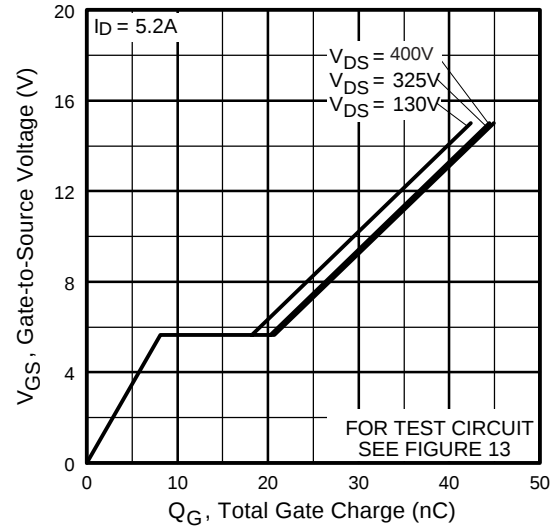


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

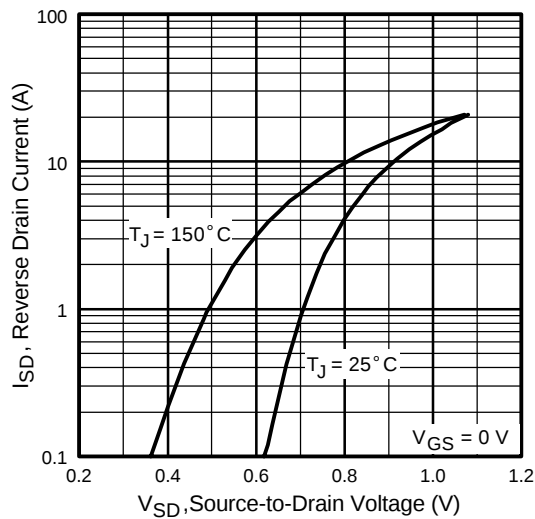


Fig 7. Typical Source-Drain Diode Forward Voltage

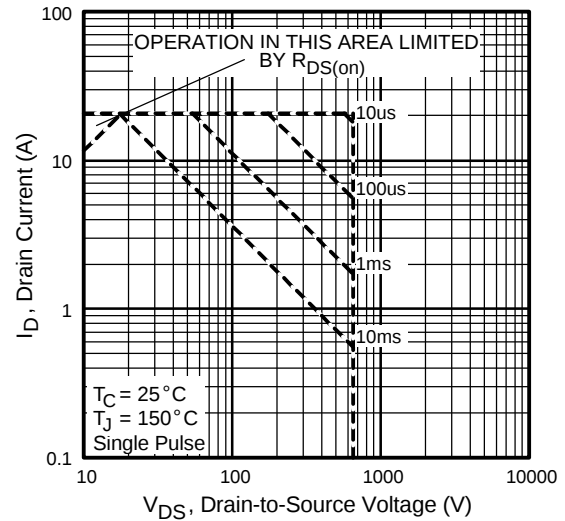


Fig 8. Maximum Safe Operating Area

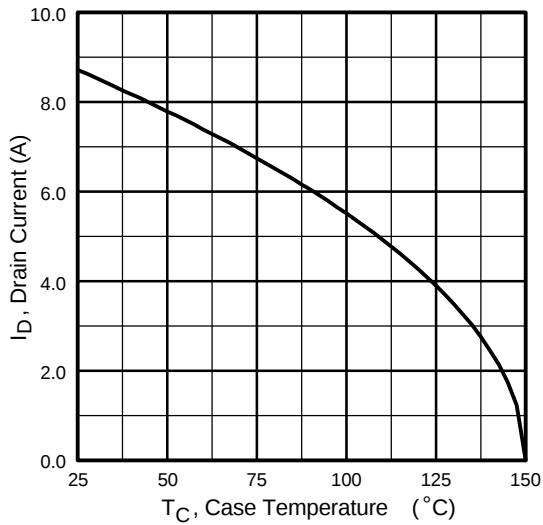


Fig 9. Maximum Drain Current Vs. Case Temperature



Fig 10a. Switching Time Test Circuit



Fig 10b. Switching Time Waveforms

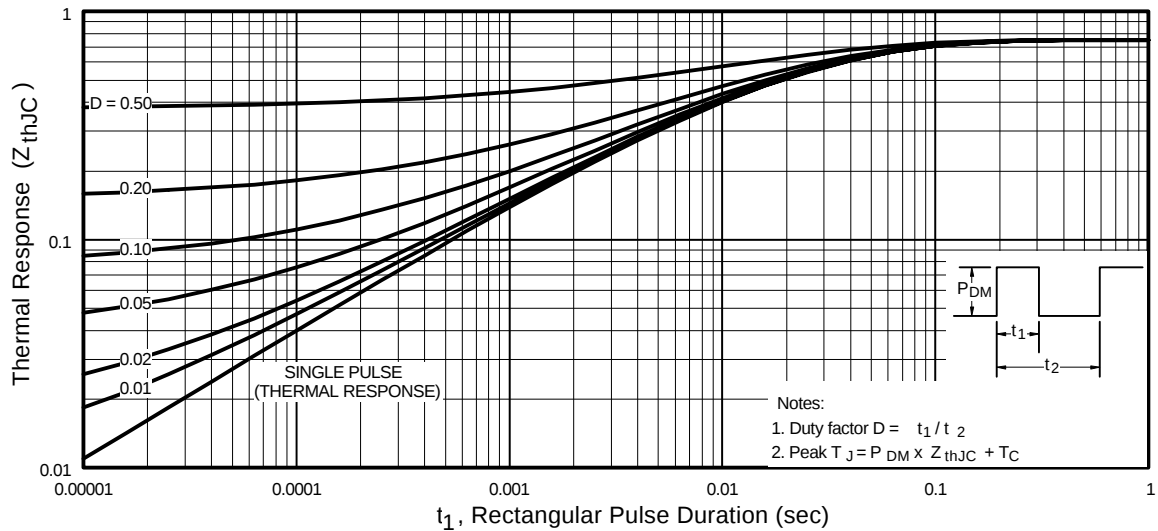


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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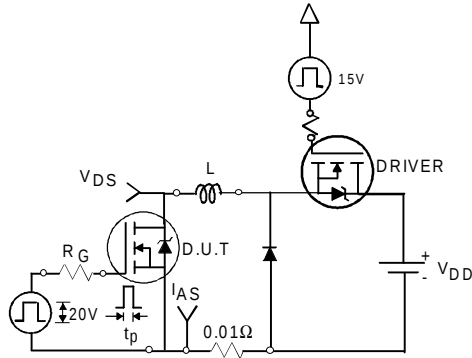


Fig 12a. Unclamped Inductive Test Circuit

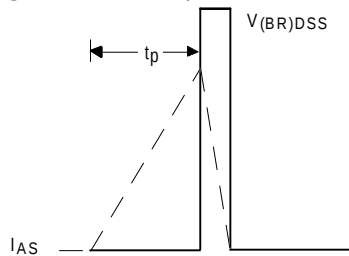


Fig 12b. Unclamped Inductive Waveforms

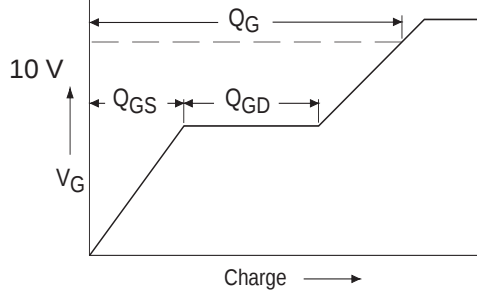


Fig 13a. Basic Gate Charge Waveform

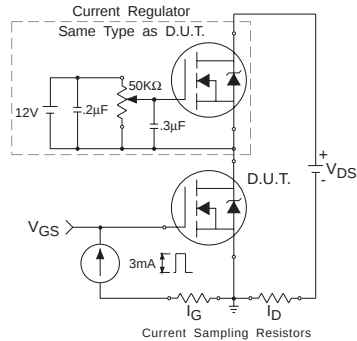


Fig 13b. Gate Charge Test Circuit

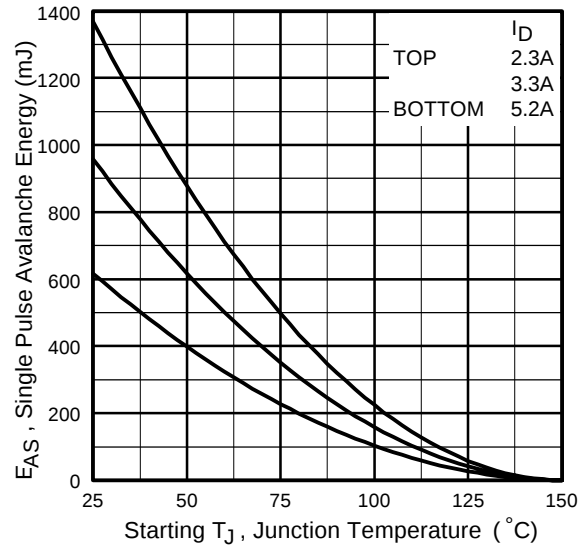


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

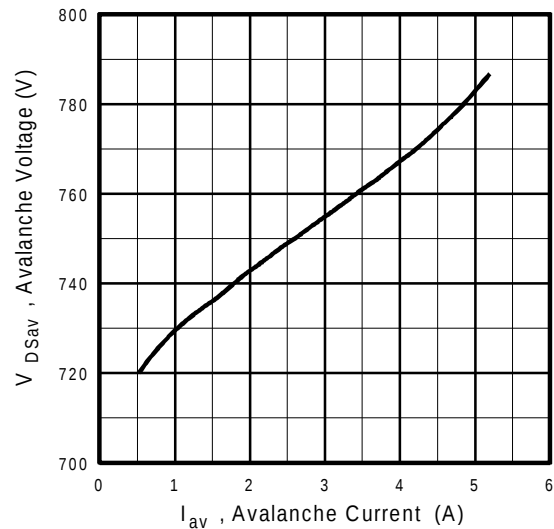
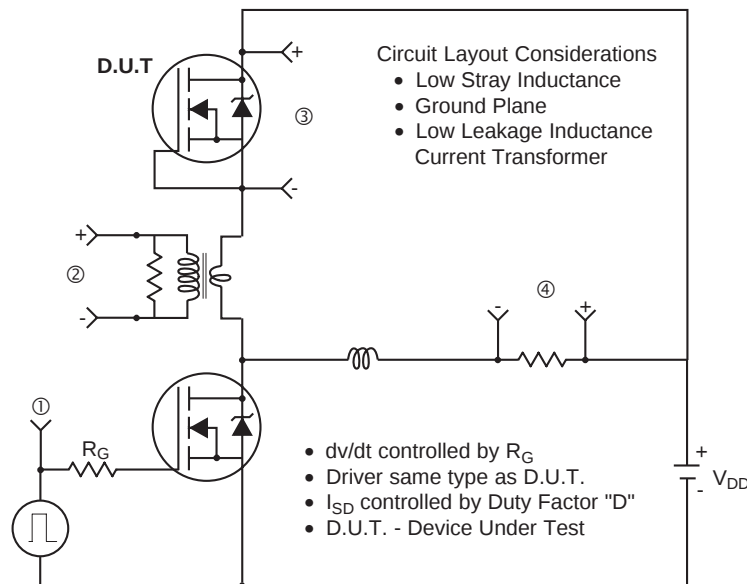


Fig 12d. Typical Drain-to-Source Voltage Vs. Avalanche Current

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Peak Diode Recovery dv/dt Test Circuit



* $V_{GS} = 5V$ for Logic Level Devices

Fig 14. For N-Channel HEXFETS

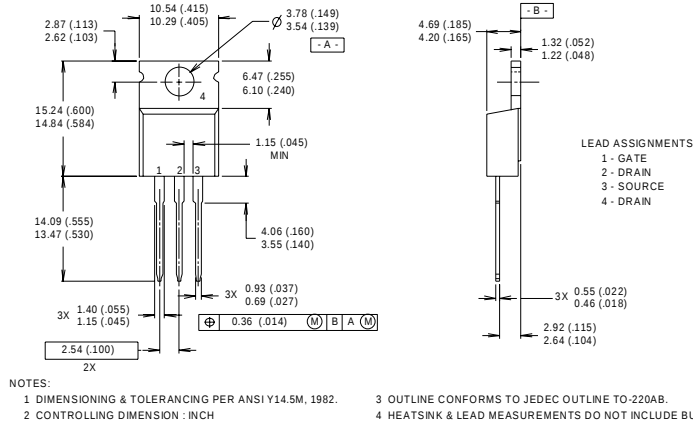
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Package Outline

TO-220AB Outline

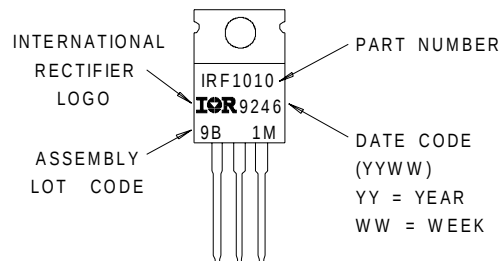
Dimensions are shown in millimeters (inches)



Part Marking Information

TO-220AB

EXAMPLE: THIS IS AN IRF1010
WITH ASSEMBLY
LOT CODE 9B1M



Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Starting $T_J = 25^\circ\text{C}$, $L = 46\text{mH}$
 $R_G = 25\Omega$, $I_{AS} = 5.2\text{A}$. (See Figure 12)
- ③ $I_{SD} \leq 5.2\text{A}$, $di/dt \leq 90\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$,
 $T_J \leq 150^\circ\text{C}$
- 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}

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