

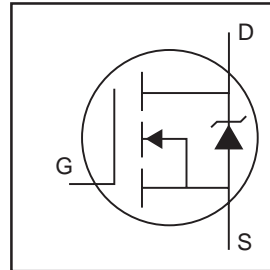
AUTOMOTIVE MOSFET

IRF1704

HEXFET® Power MOSFET

Benefits

- 200°C Operating Temperature
- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- Fast Switching
- Repetitive Avalanche Allowed up to Tj Max
- Automotive Qualified (Q101)

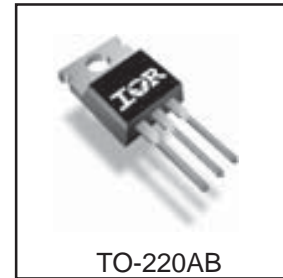


$V_{DSS} = 40V$
$R_{DS(on)} = 0.004\Omega$
$I_D = 170A\text{⑥}$

Description

Specifically designed for Automotive applications, this HEXFET® power MOSFET has a 200°C max operating temperature with a Stripe Planar design that utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this HEXFET® power MOSFET are fast switching speed and improved repetitive avalanche rating.

The continuing technology leadership of International Rectifier provides 200°C operating temperature in a plastic package. At high ambient temperatures, the IRF1704 can carry up to 20% more current than similar 175 °C Tj max devices in the same package outline. This makes this part ideal for existing and emerging under-the-hood automotive applications such as Electric Power Steering (EPS), Fuel / Water Pump Control and wide variety of other applications.



Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	170⑥	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	120	
I_{DM}	Pulsed Drain Current ①	680	
$P_D @ T_C = 25^\circ C$	Power Dissipation	230	W
	Linear Derating Factor	1.3	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy②	670	mJ
I_{AR}	Avalanche Current①	100	A
E_{AR}	Repetitive Avalanche Energy①	23	mJ
dv/dt	Peak Diode Recovery dv/dt ③	1.9	V/ns
T_J	Operating Junction and	-55 to + 200	°C
T_{STG}	Storage Temperature Range		
T_{LEAD}	Lead Temperature⑦	175	
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	°C
	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	—	0.75	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	62	

IRF1704

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	40	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.036	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.004	Ω	$V_{GS} = 10V, I_D = 100A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
		1.0	—	—		$V_{DS} = V_{GS}, I_D = 5.0\text{mA}, T_J = 200^\circ\text{C}$
g_{fs}	Forward Transconductance	110	—	—	S	$V_{DS} = 25V, I_D = 100A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	$V_{DS} = 40V, V_{GS} = 0V$
		—	—	250		$V_{DS} = 32V, V_{GS} = 0V, T_J = 175^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$
Q_g	Total Gate Charge	—	170	260	nC	$I_D = 100A$
Q_{gs}	Gate-to-Source Charge	—	42	63		$V_{DS} = 32V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	39	59		$V_{GS} = 10V$, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	16	—	ns	$V_{DD} = 20V$
t_r	Rise Time	—	120	—		$I_D = 100A$
$t_{d(off)}$	Turn-Off Delay Time	—	73	—		$R_G = 2.5\Omega$
t_f	Fall Time	—	37	—		$V_{GS} = 10V$, See Fig. 10 ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
L_S	Internal Source Inductance	—	7.5	—		
C_{iss}	Input Capacitance	—	6950	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1660	—		$V_{DS} = 25V$
C_{riss}	Reverse Transfer Capacitance	—	200	—		$f = 1.0\text{MHz}$, See Fig. 5
C_{oss}	Output Capacitance	—	6250	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
C_{oss}	Output Capacitance	—	1470	—		$V_{GS} = 0V, V_{DS} = 32V, f = 1.0\text{MHz}$
$C_{oss\ eff.}$	Effective Output Capacitance ⑤	—	2320	—		$V_{GS} = 0V, V_{DS} = 0V$ to $32V$

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	170⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	680		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 100A, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	73	110	ns	$T_J = 25^\circ\text{C}, I_F = 100A$
Q_{rr}	Reverse Recovery Charge	—	200	300	nC	$di/dt = 100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$)				

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See Fig. 11)
- ② Starting $T_J = 25^\circ\text{C}$, $L = 0.13\text{mH}$, $V_{GS} = 10V$, $R_G = 25\Omega$, $I_{AS} = 100A$. (See Figure 12)
- ③ $I_{SD} \leq 100A$, $di/dt \leq 150A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 200^\circ\text{C}$
- ④ Pulse width $\leq 400\mu s$; 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 75A
- ⑦ At the point of termination of the leads at the PCB, the temp. should be limited to 175°C . The device case temperature is allowed to be higher

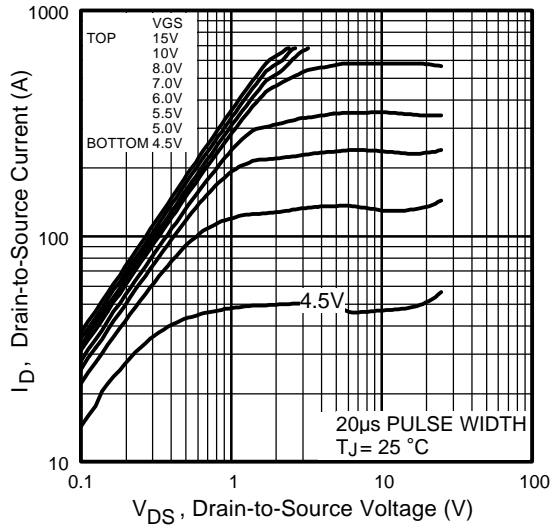


Fig 1. Typical Output Characteristics

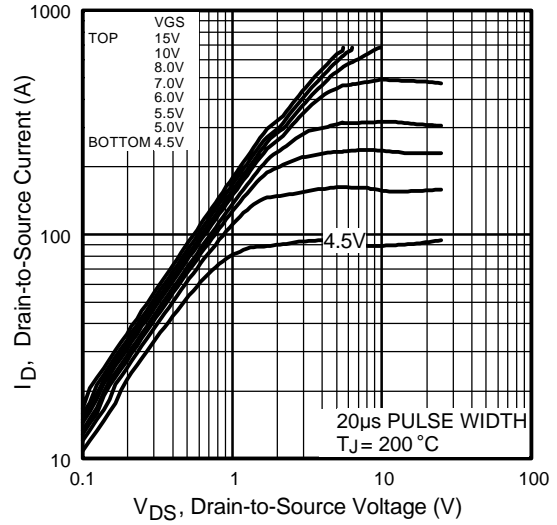


Fig 2. Typical Output Characteristics

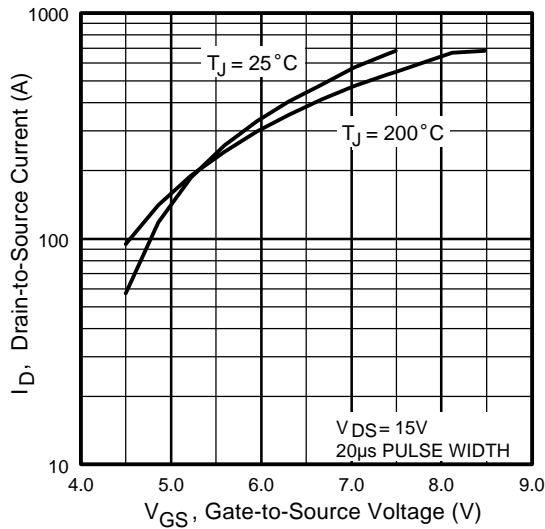


Fig 3. Typical Transfer Characteristics

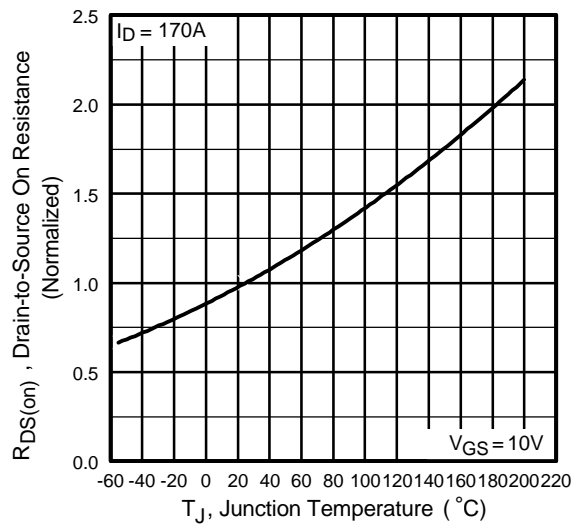


Fig 4. Normalized On-Resistance Vs. Temperature

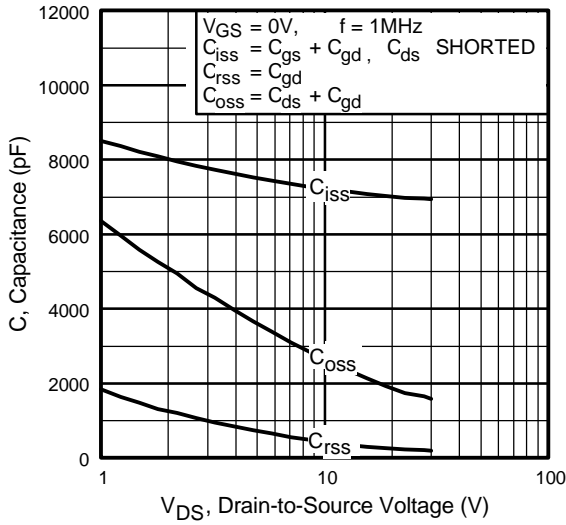


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

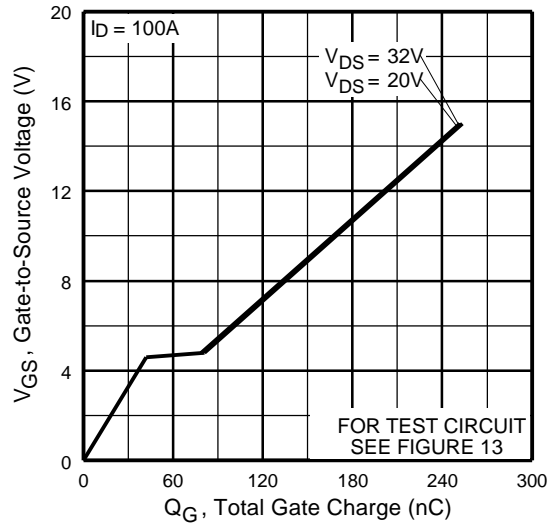


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

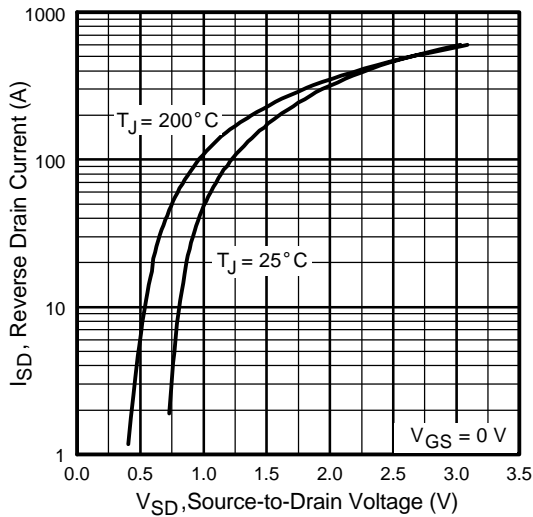


Fig 7. Typical Source-Drain Diode Forward Voltage

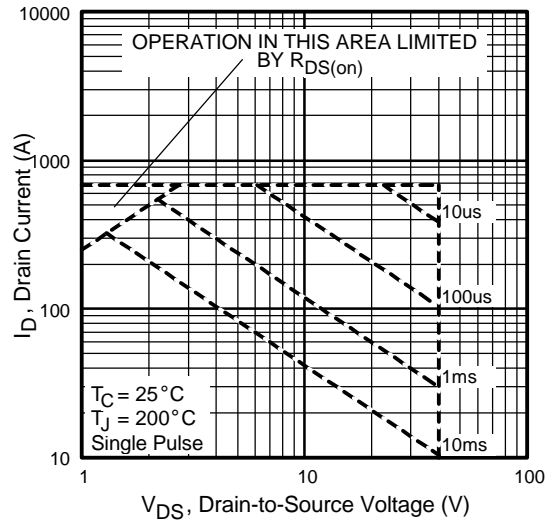


Fig 8. Maximum Safe Operating Area

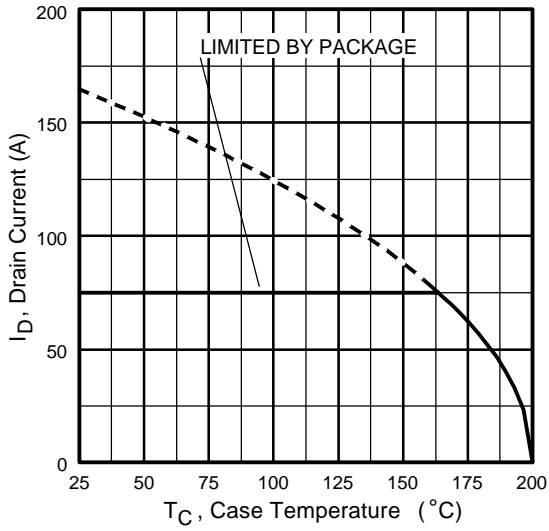


Fig 9. Maximum Drain Current Vs. Case Temperature

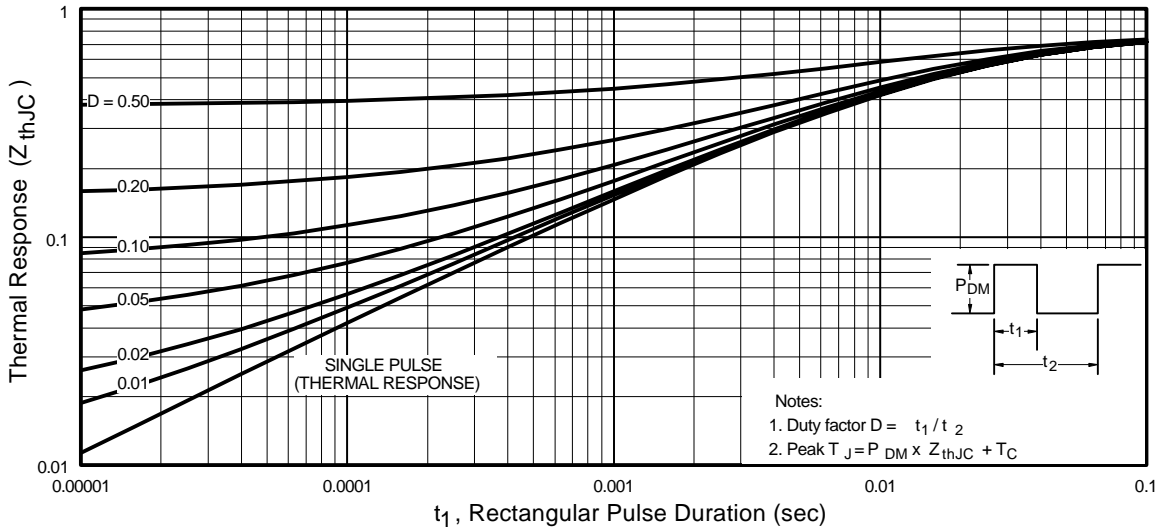
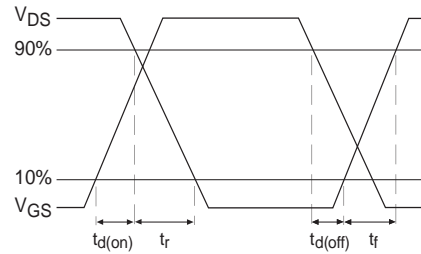
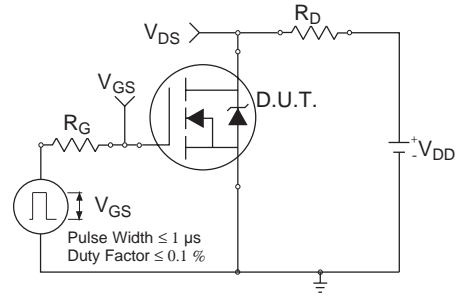


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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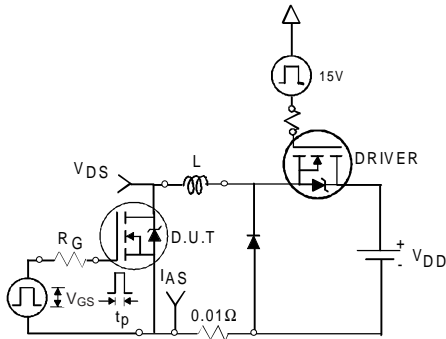


Fig 12a. Unclamped Inductive Test Circuit

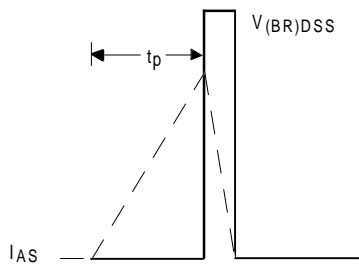


Fig 12b. Unclamped Inductive Waveforms

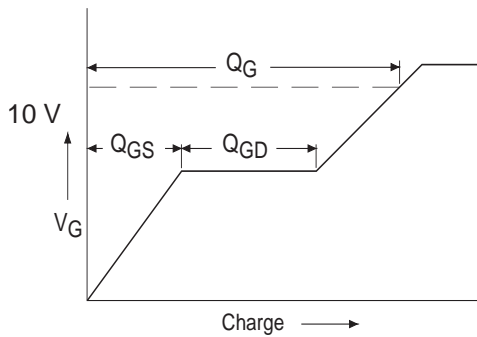


Fig 13a. Basic Gate Charge Waveform

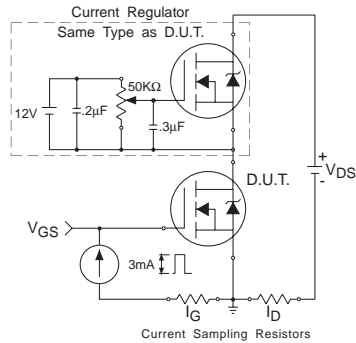


Fig 13b. Gate Charge Test Circuit

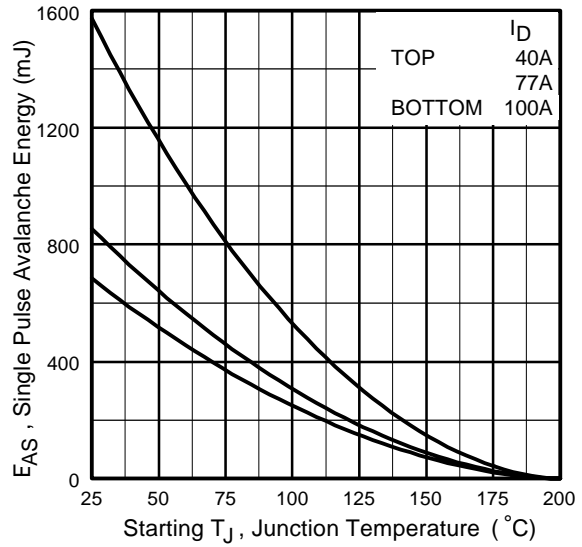


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

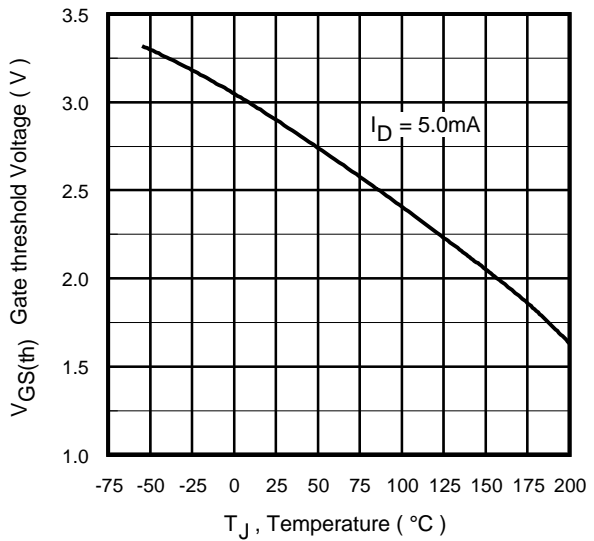
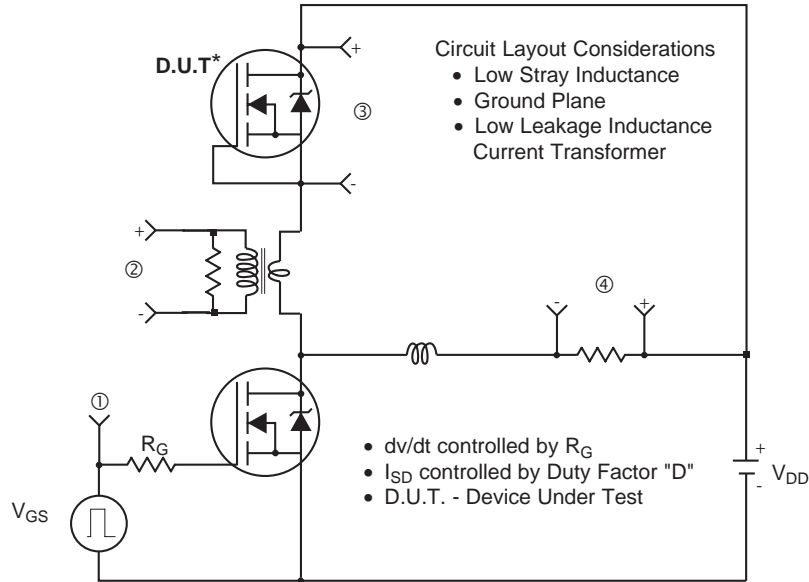
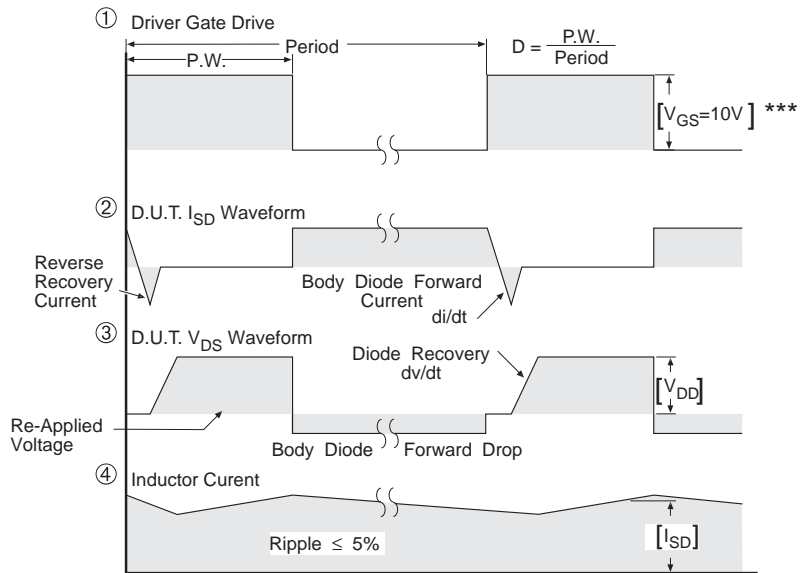


Fig 14. Threshold Voltage Vs Temperature

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity of D.U.T for P-Channel



*** $V_{GS} = 5.0V$ for Logic Level and 3V Drive Devices

Fig 14. For N-channel HEXFET® power MOSFETs

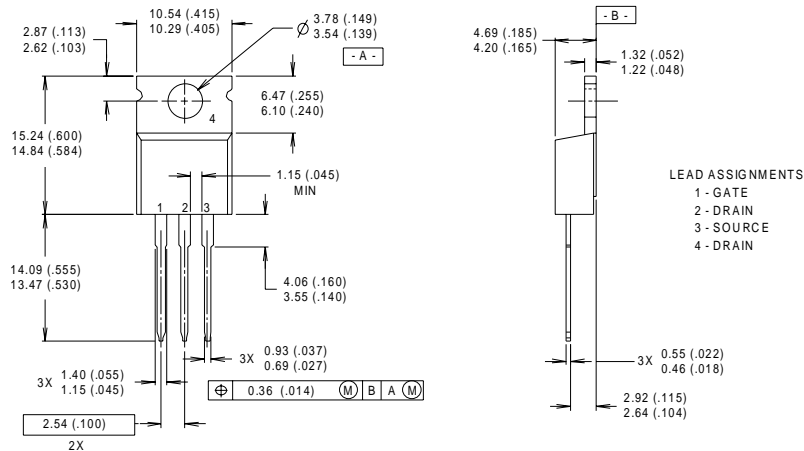
IRF1704

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Package Outline

TO-220AB

Dimensions are shown in millimeters (inches)



NOTES:

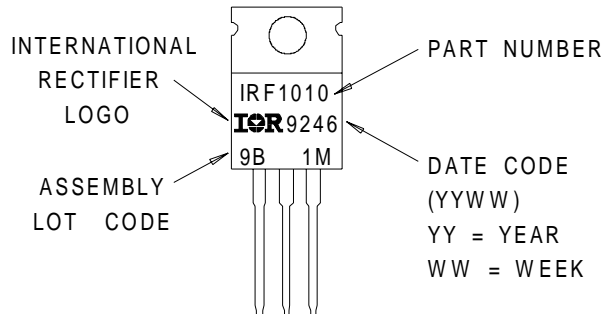
1 DIMENSIONING & TOLERANCING PER ANSII Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH

3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

Part Marking Information

TO-220AB

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



Data and specifications subject to change without notice.
This product has been designed and qualified for the Automotive [Q101]market.
Qualification Standards can be found on IR's Web site.

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