

International
IR Rectifier

AUTOMOTIVE MOSFET

IRF1704

PD -94012B

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)

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.

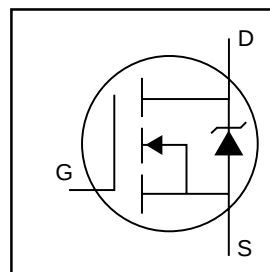
Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	170⑥	A
I_D @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, V_{GS} @ 10V	120	
I_{DM}	Pulsed Drain Current ①	680	
P_D @ $T_C = 25^\circ\text{C}$	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)	

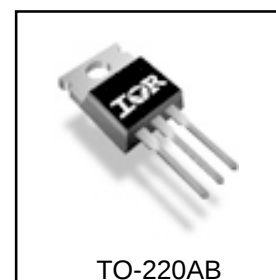
Thermal Resistance

	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	

HEXFET® Power MOSFET



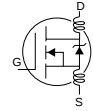
$V_{DSS} = 40V$
$R_{DS(on)} = 0.004\Omega$
$I_D = 170A⑥$



TO-220AB

Electrical Characteristics @ T_J = 25°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 = 250μA
ΔV _{(BR)DSS} /ΔT _J	Breakdown Voltage Temp. Coefficient	—	0.036	—	V/°C	Reference to 25°C, I _D = 1mA
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 = 250μA
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°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		I _D = 100A
Q _{gs}	Gate-to-Source Charge	—	42	63	nC	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 = 2.5Ω
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 _{rss}	Reverse Transfer Capacitance	—	200	—		f = 1.0MHz, See Fig. 5
C _{oss}	Output Capacitance	—	6250	—		V _{GS} = 0V, V _{DS} = 1.0V, f = 1.0MHz
C _{oss}	Output Capacitance	—	1470	—		V _{GS} = 0V, V _{DS} = 32V, f = 1.0MHz
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°C, I _S = 100A, V _{GS} = 0V ④
t _{rr}	Reverse Recovery Time	—	73	110	ns	T _J = 25°C, I _F = 100A
Q _{rr}	Reverse Recovery Charge	—	200	300	nC	di/dt = 100A/μs 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°C, L = 0.13mH, V_{GS} = 10V, R_G = 25Ω, I_{AS} = 100A. (See Figure 12)
- ③ I_{SD} ≤ 100A, di/dt ≤ 150A/μs, V_{DD} ≤ V_{(BR)DSS}, T_J ≤ 200°C
- ④ Pulse width ≤ 400μs; duty cycle ≤ 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

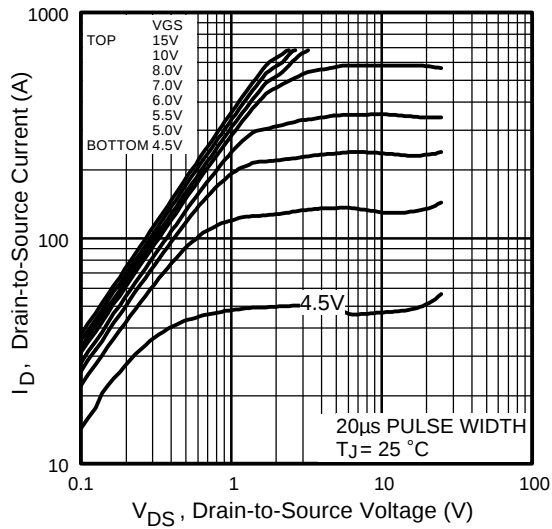


Fig 1. Typical Output Characteristics

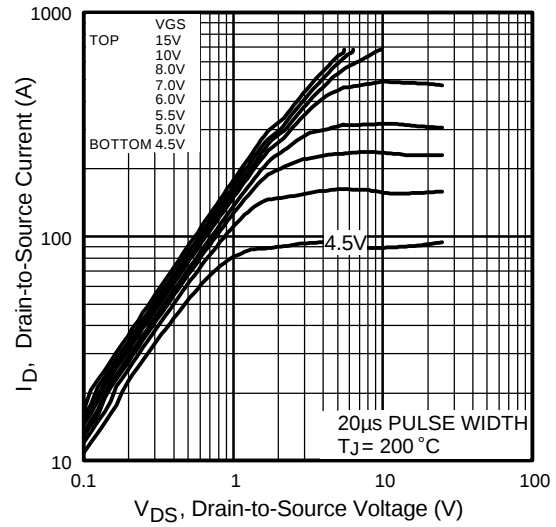


Fig 2. Typical Output Characteristics

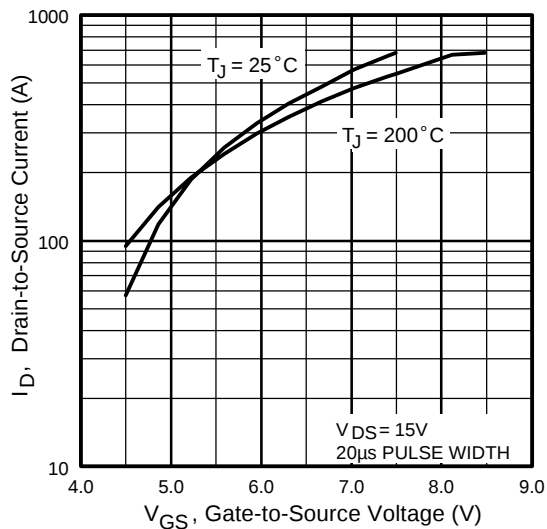


Fig 3. Typical Transfer Characteristics

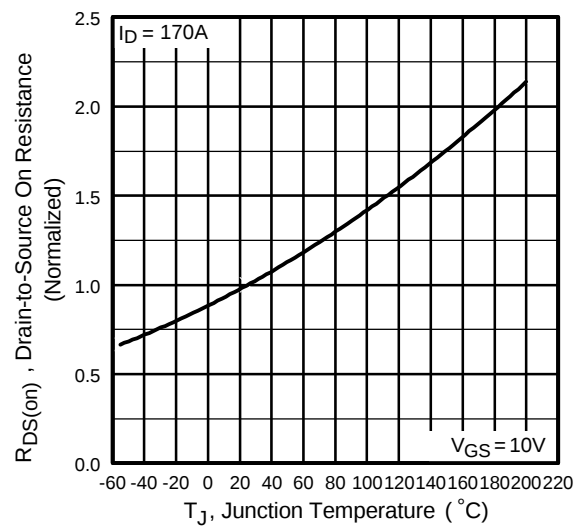
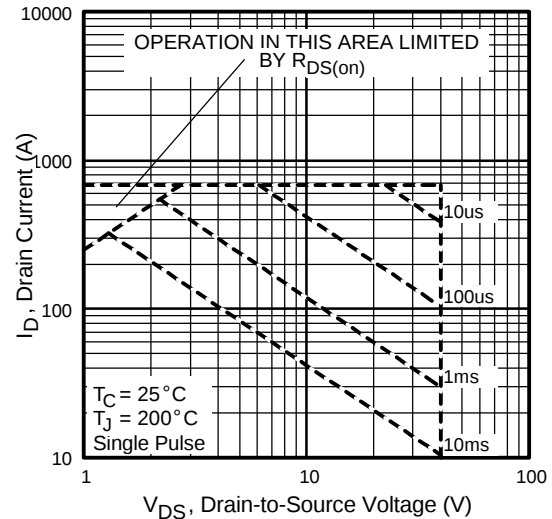
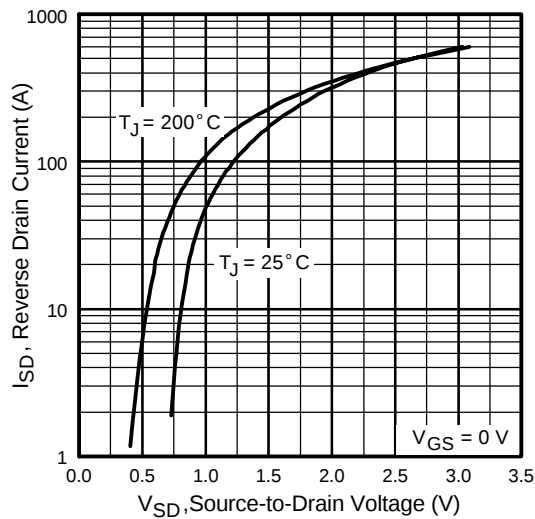
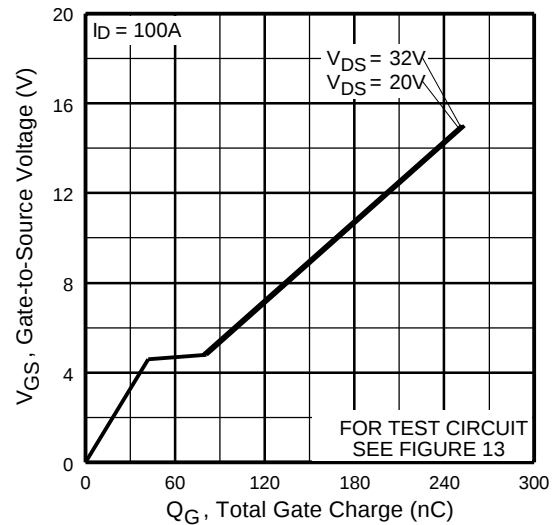
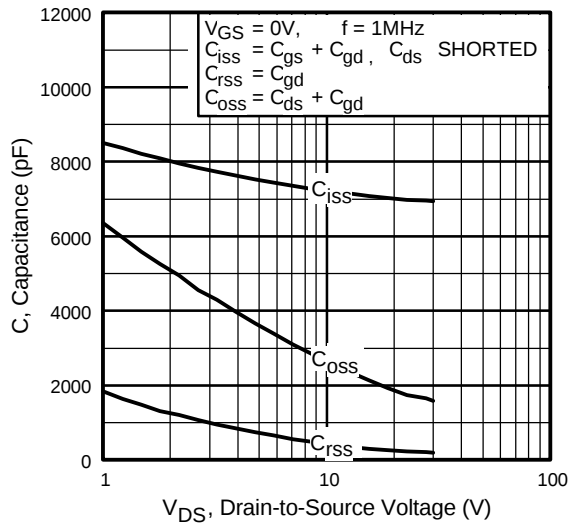


Fig 4. Normalized On-Resistance Vs. Temperature



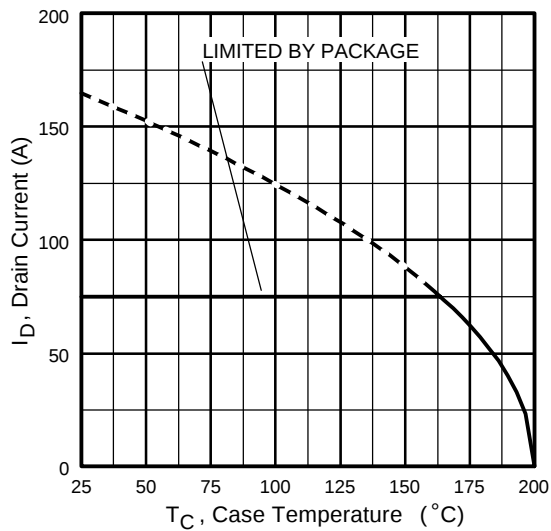


Fig 9. Maximum Drain Current Vs. Case Temperature

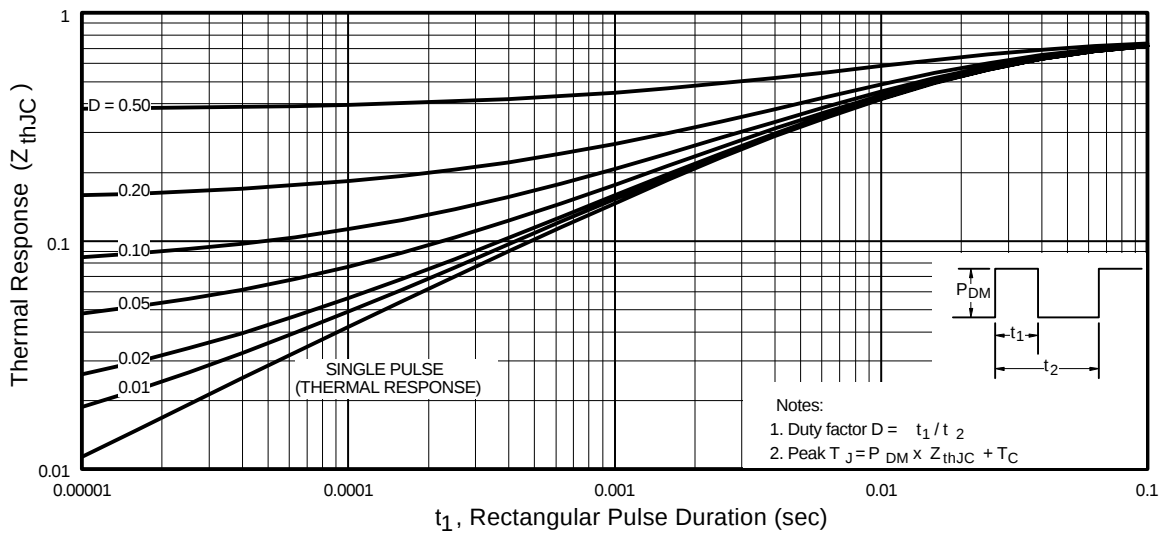
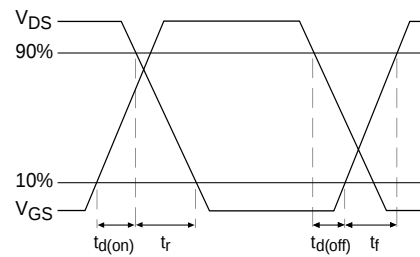
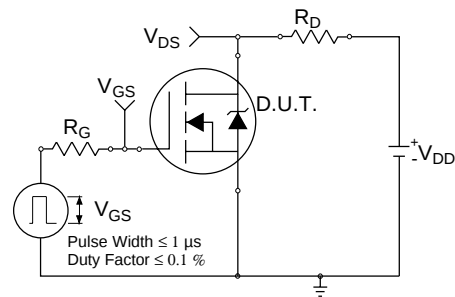


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

IRF1704

International
IR Rectifier

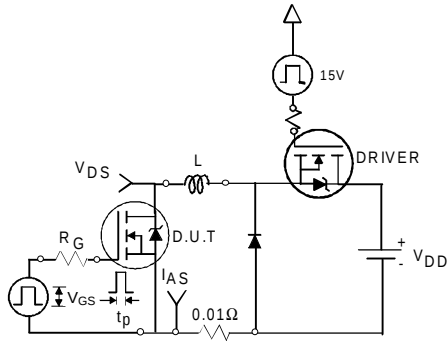


Fig 12a. Unclamped Inductive Test Circuit

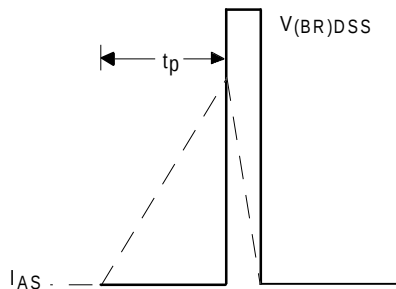


Fig 12b. Unclamped Inductive Waveforms

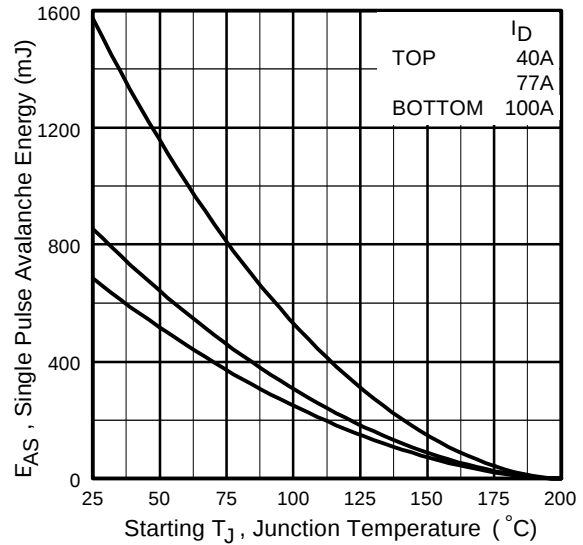


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

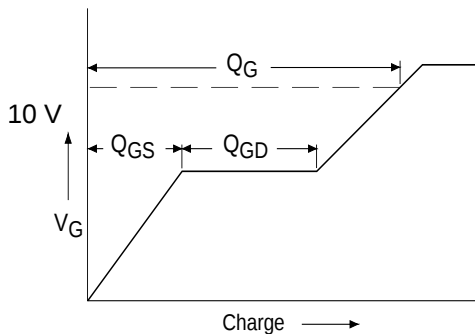


Fig 13a. Basic Gate Charge Waveform

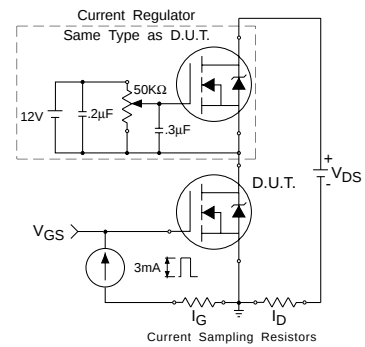
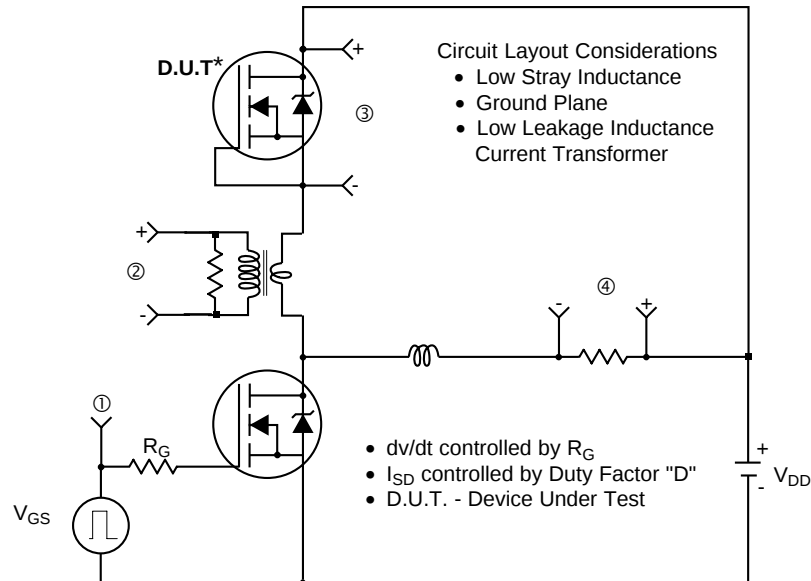
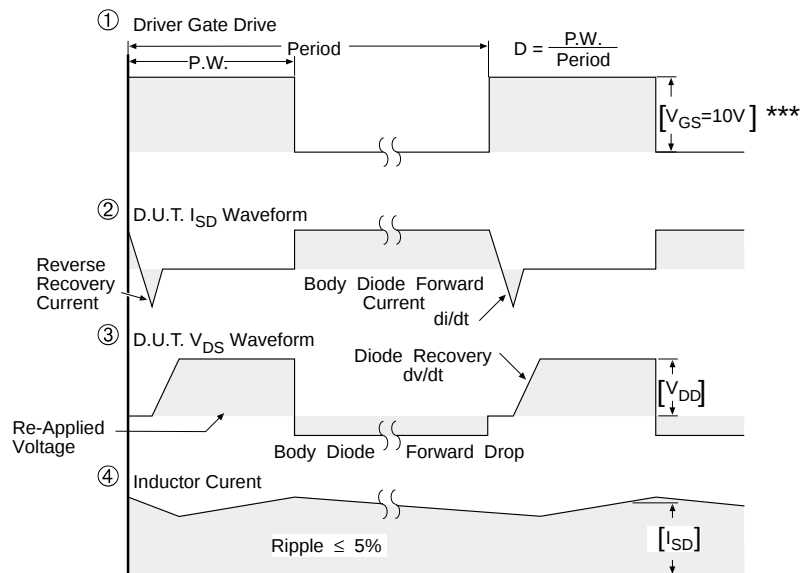


Fig 13b. Gate Charge Test Circuit

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

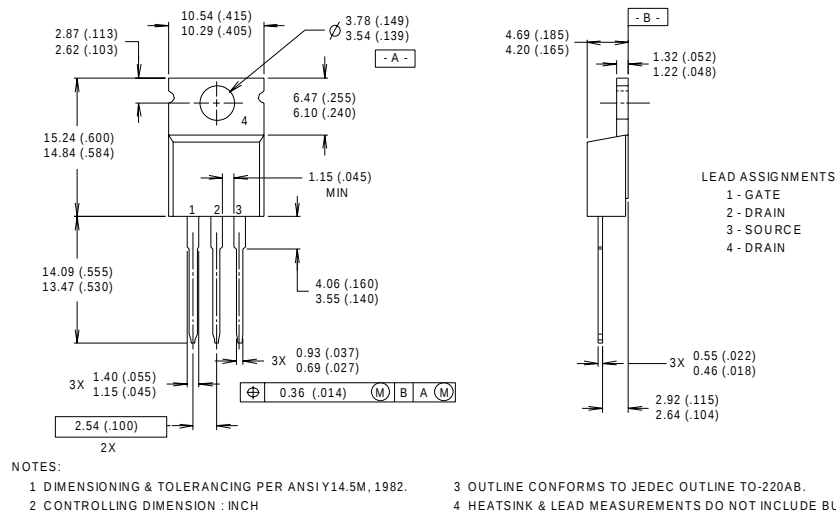
IRF1704

International
IR Rectifier

Package Outline

TO-220AB

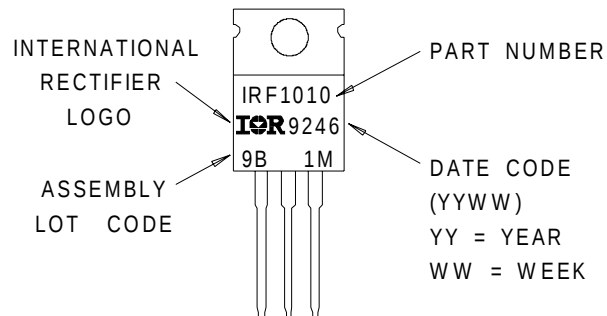
Dimensions are shown in millimeters (inches)



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.

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information. 02/02

www.irf.com