IRF9140

PD-93976E

Repetitive Avalanche and dv/dt Rated Power MOSFET
Thru-Hole (TO-204AA)
-100V, -18A, P-channel

Features

- Repetitive avalanche ratings
- Dynamic dv/dt rating
- Hermetically sealed
- Simple drive requirements
- ESD rating: Class 2 per MIL-STD-750, Method 1020

Product Summary

- **BV_{DSS}:** -100V
- **I_D:** -18A
- **$R_{DS(on),max}$:** 0.2Ω
- **$Q_{G,max}$:** 60nC

TO-3 (TO-204AA)

Potential Applications

- DC-DC converter
- Motor drives

Product Validation

Adhered to JANTX screening flow according to MIL-PRF-19500 for high-reliability applications

Description

HEXFET POWER MOSFET technology is the key to IR Hirel advanced line of power MOSFET transistors. The efficient geometry and unique processing of this latest “State of the Art” design achieves: very low on-state resistance combined with high transconductance; superior reverse energy and diode recovery dv/dt capability. The HEXFET transistors also feature all of the well-established advantages of MOSFETs such as voltage control, very fast switching and temperature stability of the electrical parameters. They are well suited for applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers and high energy pulse circuits.

Ordering Information

Table 1 Ordering options

Part number	Package	Screening Level
IRF9140	TO-3 (TO-204AA)	COTS
IRF9140SCX	TO-3 (TO-204AA)	JANTX

Table of contents

1 Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
I_{D1} @ V_{GS} = -10V, T_C = 25°C	Continuous Drain Current	-18	A
I_{D2} @ V_{GS} = -10V, T_C = 100°C	Continuous Drain Current	-11	A
I_{DM} @ T_C = 25°C	Pulsed Drain Current [1]	-72	A
P_D @ T_C = 25°C	Maximum Power Dissipation	125	W
	Linear Derating Factor	1.0	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy [2]	500	mJ
I_{AR}	Avalanche Current [1]	-18	A
E_{AR}	Repetitive Avalanche Energy [1]	12.5	mJ
dv/dt	Peak Diode Reverse Recovery [3]	-5.5	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)	
	Weight	11.5 (Typical)	g

[1] Repetitive Rating; Pulse width limited by maximum junction temperature.

[2] V_{DD} = -25V, starting T_J = 25°C, L = 3.09mH, Peak I_L = -18A, V_{GS} = -10V

[3] $I_{SD} \leq$ -18A, di/dt ≤ -100A/µs, $V_{DD} \leq$ -100V, $T_J \leq$ 150°C

2 Device Characteristics

2.1 Electrical Characteristics

Table 3 Static and Dynamic Electrical Characteristics @ T_j = 25°C (Unless Otherwise Specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	-100	—	—	V	V_{GS} = 0V, I_D =-1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.087	—	V/°C	Reference to 25°C, I_D = -1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.2	Ω	V_{GS} = -10V, I_{D2} =-11A [1]
		—	—	0.23		V_{GS} = -10V, I_{D2} = -18A [1]
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	—	-4.0	V	V_{DS} = V_{GS}, I_D = -250µA
Gfs	Forward Transconductance	6.2	—	—	S	V_{DS} = -15V, I_{D2} = -11A [1]
I_{DSS}	Zero Gate Voltage Drain Current	—	—	-25	µA	V_{DS} = -80V, V_{GS} = 0V
		—	—	-250		V_{DS} = -80V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Leakage Forward	—	—	-100	nA	V_{GS} = -20V
	Gate-to-Source Leakage Reverse	—	—	100		V_{GS} = 20V
Q_G	Total Gate Charge	31	—	60	nC	I_{D1} = -18A V_{DS} = -50V V_{GS} = -10V
Q_{GS}	Gate-to-Source Charge	3.7	—	13		
Q_{GD}	Gate-to-Drain (‘Miller’) Charge	7.0	—	35.2		
$t_{d(on)}$	Turn-On Delay Time	—	—	35	ns	I_{D1} = -18A ** V_{DD} = -50V R_G = 9.1Ω V_{GS} = -10V
t_r	Rise Time	—	—	200		
$t_{d(off)}$	Turn-Off Delay Time	—	—	85		
t_f	Fall Time	—	—	65		
L_s +L_D	Total Inductance	—	6.1	—	nH	Measured from Drain lead (6mm /0.25 in from package) to Source lead (6mm/ 0.25 in from package
C_{iss}	Input Capacitance	—	1400	—	pF	V_{GS} = 0V V_{DS} = -25V f = 1.0MHz
C_{oss}	Output Capacitance	—	600	—		
C_{rss}	Reverse Transfer Capacitance	—	200	—		

** Switching speed maximum limits are based on manufacturing test equipment and capability.

[1] Pulse width ≤ 300 µs; Duty Cycle ≤ 2%

2.2 Source-Drain Diode Ratings and Characteristics

Table 4 Source-Drain Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-18	A	
I_{SM}	Pulsed Source Current (Body Diode) [1]	—	—	-72	A	
V_{SD}	Diode Forward Voltage	—	—	-5.0	V	T_J = 25°C, I_S = -18A, V_{GS} = 0V [2]
t_{rr}	Reverse Recovery Time	—	170	280	ns	T_J = 25°C, I_F = -18A, V_{DD} ≤ -50V di/dt = -100A/µs [2]
Q_{rr}	Reverse Recovery Charge	—	2.4	—	µC	
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

2.3 Thermal Characteristics

Table 5 Thermal Resistance

Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{\theta JC}$	Junction-to-Case	—	—	1.0	°C/W
$R_{\theta JA}$	Junction-to-Ambient (Typical socket mount)	—	—	30	

[1] Repetitive Rating; Pulse width limited by maximum junction temperature.

[2] Pulse width ≤ 300 µs; Duty Cycle ≤ 2%

3 Electrical Characteristics Curves

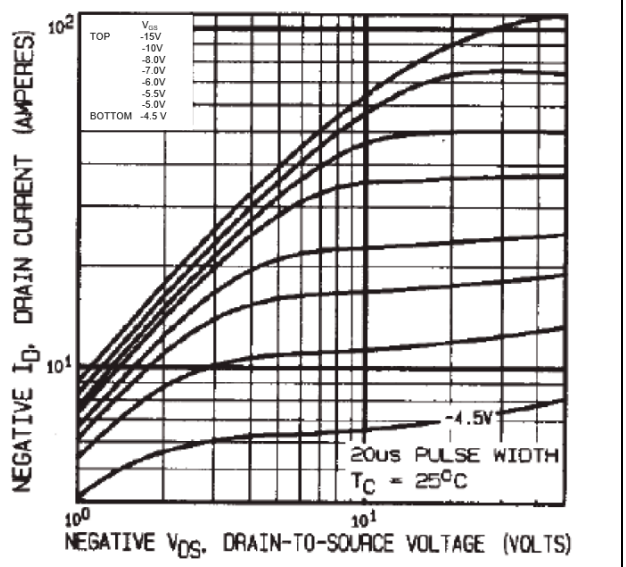


Figure 1 Typical Output Characteristics

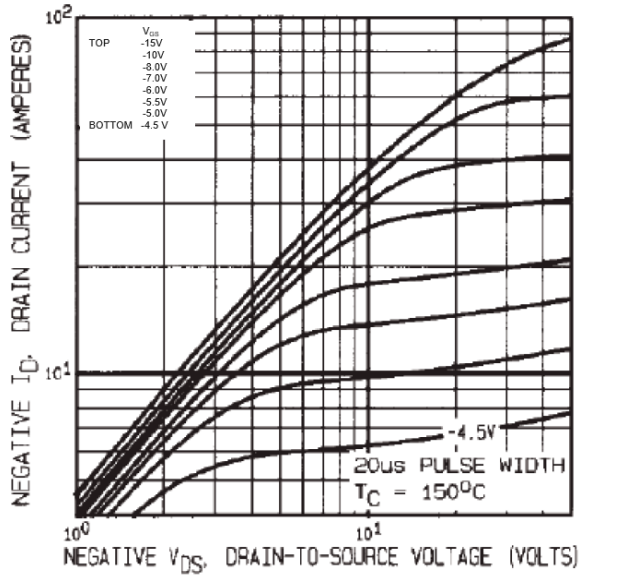


Figure 2 Typical Output Characteristics

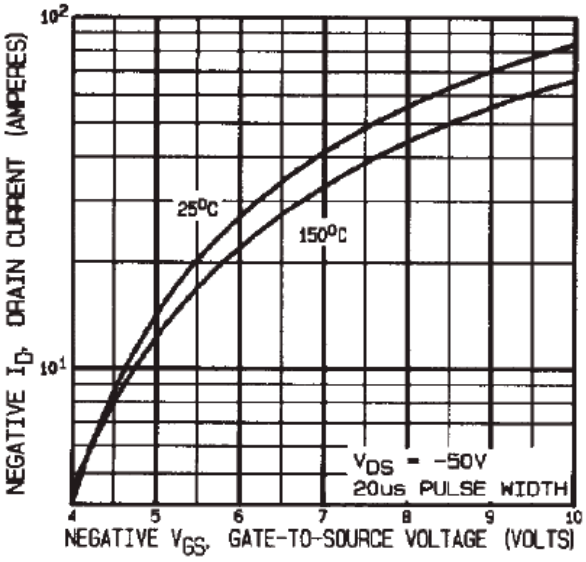


Figure 3 Typical Transfer Characteristics

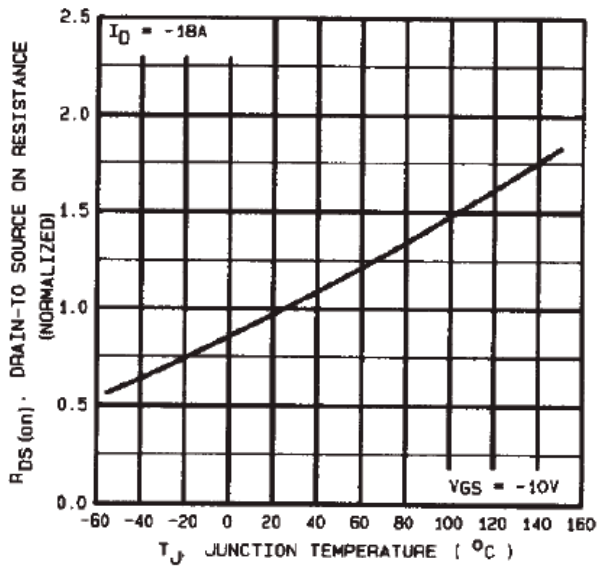


Figure 4 Normalized On-Resistance Vs. Temperature

Electrical Characteristics Curves

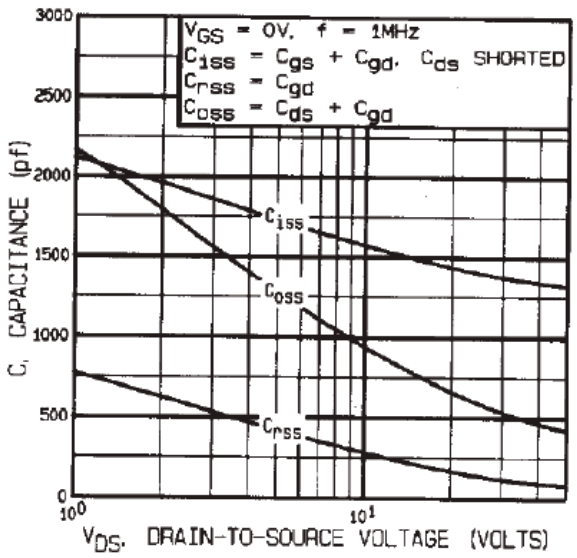


Figure 5 **Typical Capacitance Vs. Drain-to-Source Voltage**

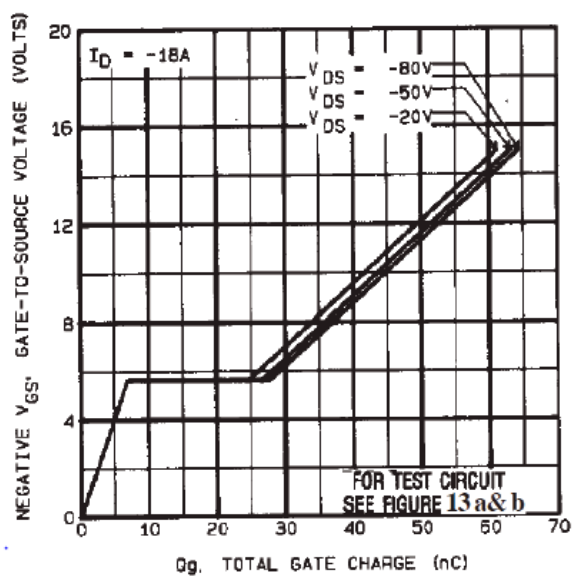


Figure 6 **Typical Gate Charge Vs. Gate-to-Source Voltage**

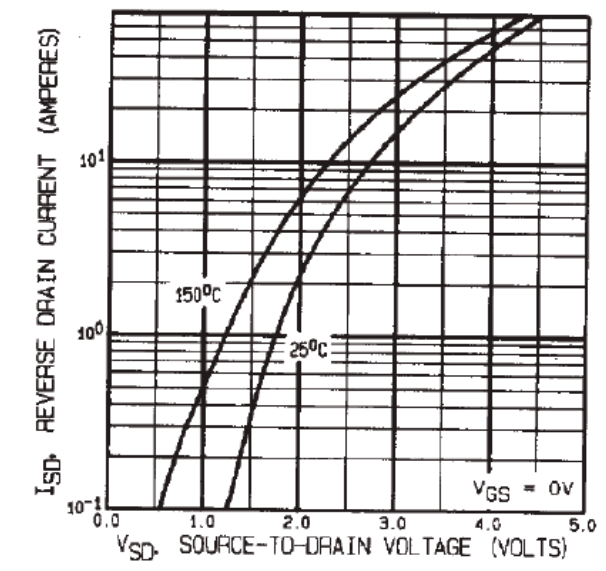


Figure 7 **Typical Source-Drain Diode Forward Voltage**

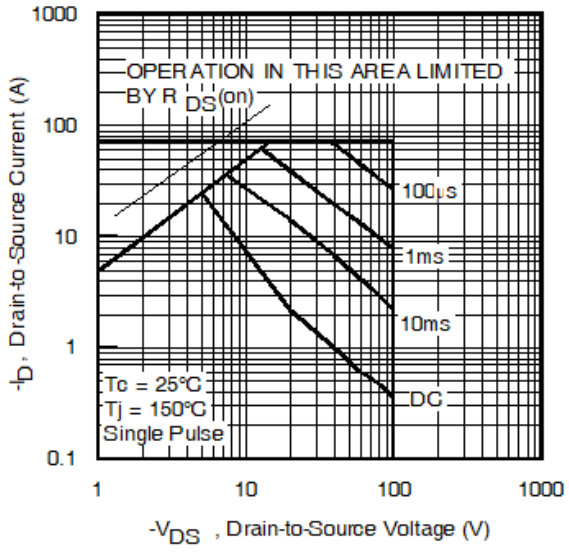


Figure 8 **Maximum Safe Operating Area**

Electrical Characteristics Curves

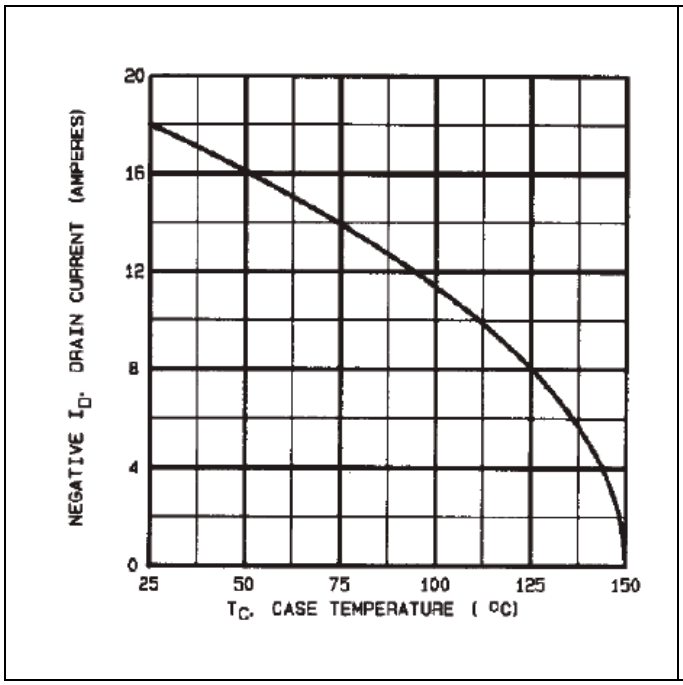


Figure 9 **Maximum Drain Current Vs. Case Temperature**

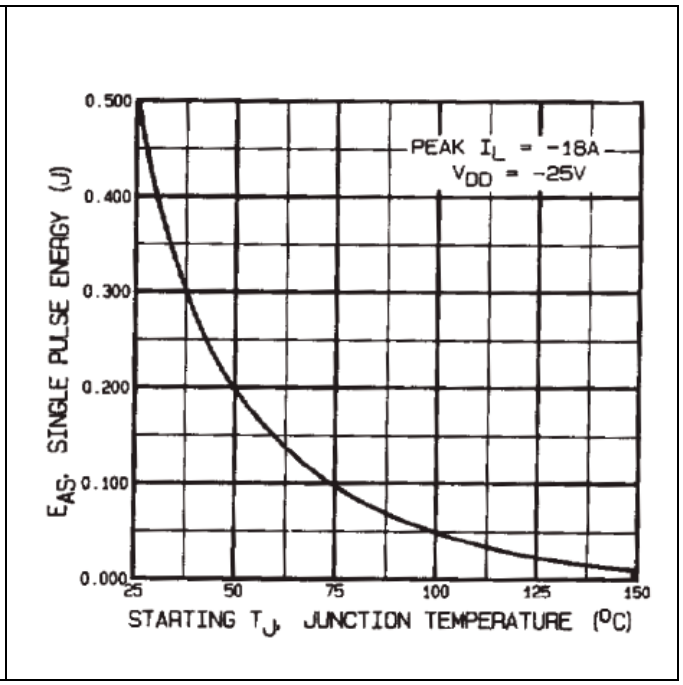


Figure 10 **Maximum Avalanche Energy Vs. Junction Temperature**

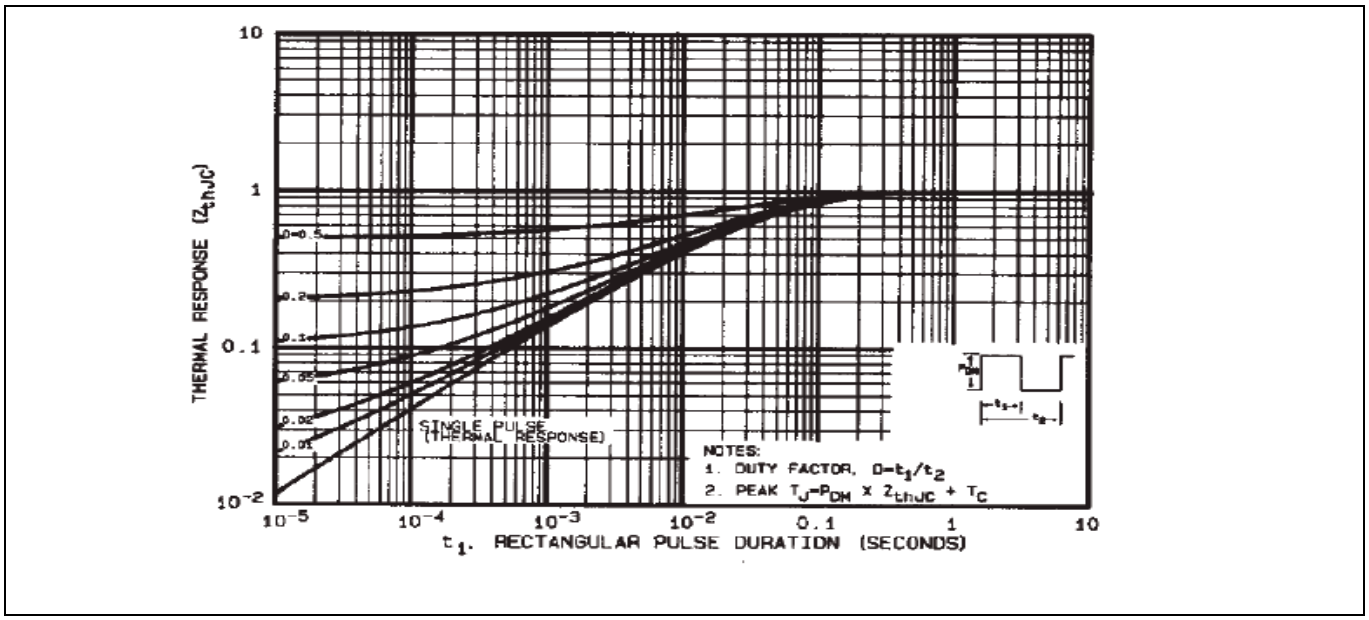


Figure 11 **Maximum Effective Transient Thermal Impedance, Junction-to-Case**

4 Test Circuits

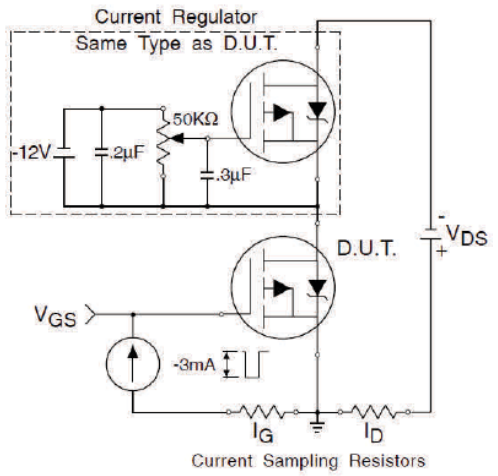


Figure 12 Gate Charge Test Circuit

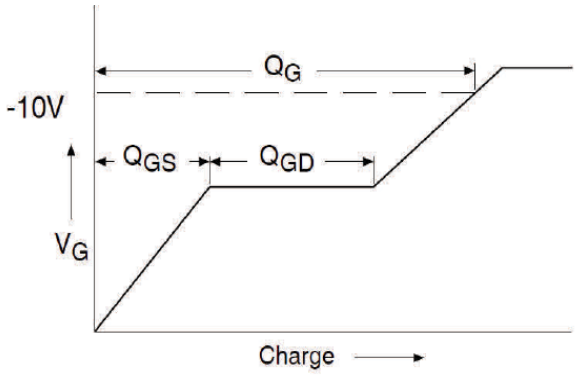


Figure 13 Gate Charge Waveform

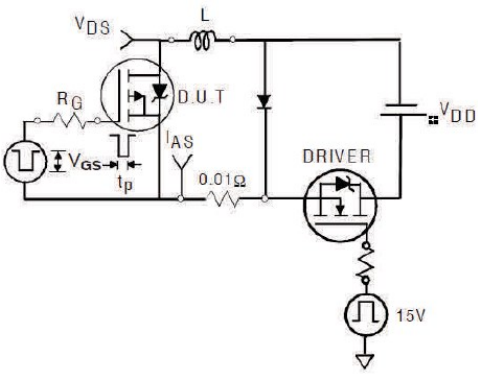


Figure 14 Unclamped Inductive Test Circuit

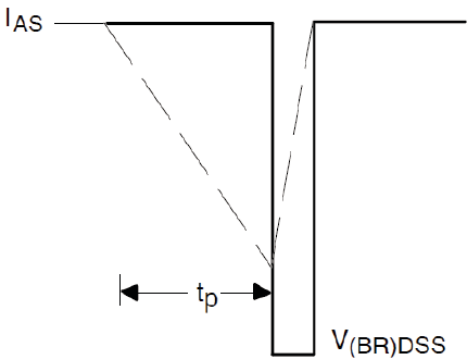


Figure 15 Unclamped Inductive Waveform

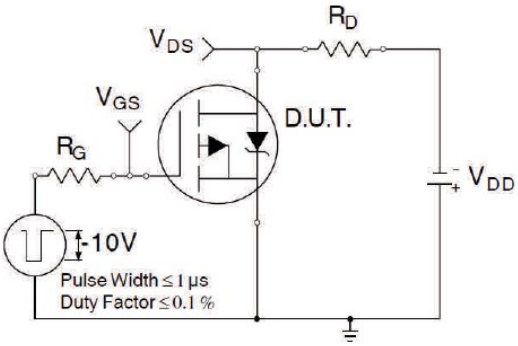


Figure 16 Switching Time Test Circuit

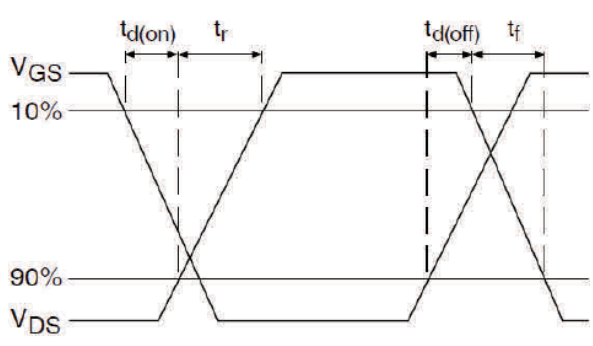
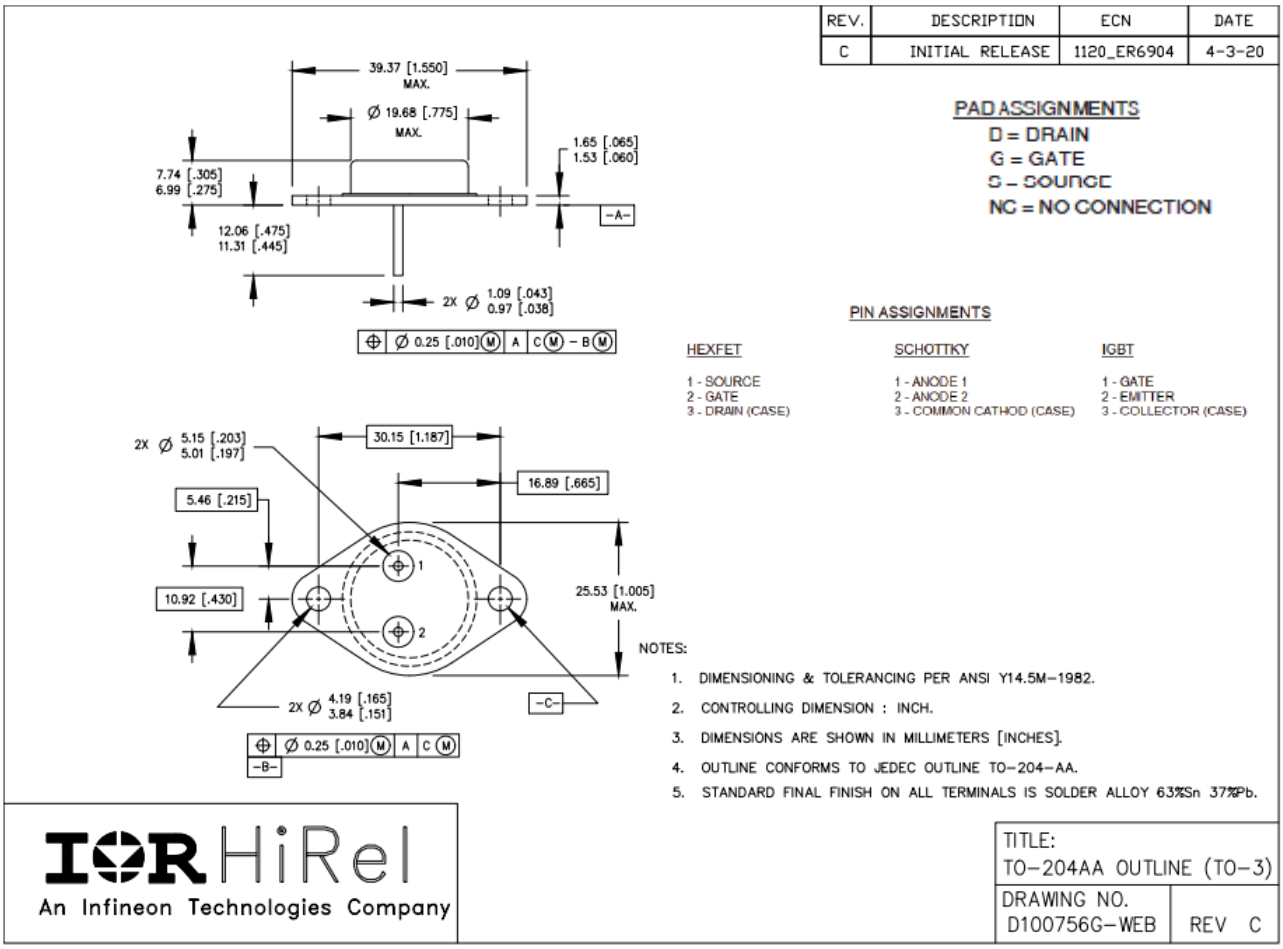


Figure 17 Switching Time Waveforms

5 Package Outline

Note: For the most updated package outline, please see the website: TO-3 (TO-204AA)



Revision history

Document version	Date of release	Description of changes
	01/26/2001	Datasheet (PD-93976A)
Rev B	09/22/2003	Updated based on ECN-11069
Rev C	07/24/2019	Updated based on ECN-1120_06844
Rev D	01/09/2023	Updated based on ECN-1120_09252
Rev E	12/06/2024	Updated based on ECN-1120_10102

Trademarks
All referenced product or service names and trademarks are the property of their respective owners.

Edition 2024-12-06

Published by

International Rectifier HiRel Products, Inc.

An Infineon Technologies company

El Segundo, California 90245 USA

Do you have a question about this document?

Email: erratum@infineon.com

Document reference

IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics (“Beschaffenheitsgarantie”).

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer’s compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer’s products and any use of the product of Infineon Technologies in customer’s applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer’s technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (**www.infineon.com**).

WARNINGS

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest International Rectifier HiRel Products, Inc., an Infineon Technologies company, office.

International Rectifier HiRel Components may only be used in life-support devices or systems with the expressed written approval of International Rectifier HiRel Products, Inc., an Infineon Technologies company, if failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety and effectiveness of that device or system.

Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.