International
IOR Rectifier

PD - 91846

SMPS MOSFET

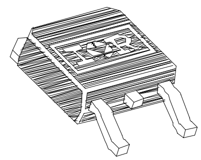
IRFR1N60A

HEXFET® Power MOSFET

Applications
- Switch Mode Power Supply (SMPS)
- Uninterruptable Power Supply
- Power Factor Correction

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

V_{DSS}	Rds(on) max	I_D
600V	**7.0Ω**	**1.4A**



TO-252AA G D S

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	1.4	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	0.89	
I_{DM}	Pulsed Drain Current ①	5.6	
P_D @T_C = 25°C	Power Dissipation	36	W
	Linear Derating Factor	0.28	W/°C
V_{GS}	Gate-to-Source Voltage	± 30	V
dv/dt	Peak Diode Recovery dv/dt ③	3.8	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)	

Applicable Off Line SMPS Topologies:

- Low Power Single Transistor Flyback

Notes ① through ⑤ are on page 9

Static @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	600	——	——	V	V_{GS} = 0V, I_D = 250µA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	——	——	7.0	Ω	V_{GS} = 10V, I_D = 0.84A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	——	4.0	V	V_{DS} = V_{GS}, I_D = 250µA
I_{DSS}	Drain-to-Source Leakage Current	——	——	25	µA	V_{DS} = 600V, V_{GS} = 0V
		——	——	250		V_{DS} = 480V, V_{GS} = 0V, T_J = 150°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°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
g_{fs}	Forward Transconductance	0.88	——	——	S	V_{DS} = 50V, I_D = 0.84A
Q_g	Total Gate Charge	——	——	14	nC	I_D = 1.4A
Q_{gs}	Gate-to-Source Charge	——	——	2.7		V_{DS} = 400V
Q_{gd}	Gate-to-Drain ("Miller") Charge	——	——	8.1		V_{GS} = 10V, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	——	9.8	——	ns	V_{DD} = 250V
t_r	Rise Time	——	14	——		I_D = 36A
$t_{d(off)}$	Turn-Off Delay Time	——	18	——		R_G = 2.15Ω
t_f	Fall Time	——	20	——		R_D = 7.0Ω,See Fig. 10 ④
C_{iss}	Input Capacitance	——	229	——	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	——	32.6	——		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	——	2.4	——		f = 1.0MHz, See Fig. 5
C_{oss}	Output Capacitance	——	320	——		V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0MHz
C_{oss}	Output Capacitance	——	11.5	——		V_{GS} = 0V, V_{DS} = 480V, f = 1.0MHz
C_{oss} eff.	Effective Output Capacitance	——	130	——		V_{GS} = 0V, V_{DS} = 0V to 480V ⑤

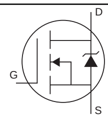
Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E_{AS}	Single Pulse Avalanche Energy②	——	93	mJ
I_{AR}	Avalanche Current①	——	1.4	A
E_{AR}	Repetitive Avalanche Energy①	——	3.6	mJ

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	3.5	°C/W
$R_{\theta JA}$	Junction-to-Ambient (PCB mount)**	——	50	
$R_{\theta JA}$	Junction-to-Ambient	——	110	

Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	——	——	1.4	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	——	——	5.6		
V_{SD}	Diode Forward Voltage	——	——	1.6	V	T_J = 25°C, I_S = 1.4A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	——	290	440	ns	T_J = 25°C, I_F = 1.4A
Q_{rr}	Reverse RecoveryCharge	——	510	760	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)				

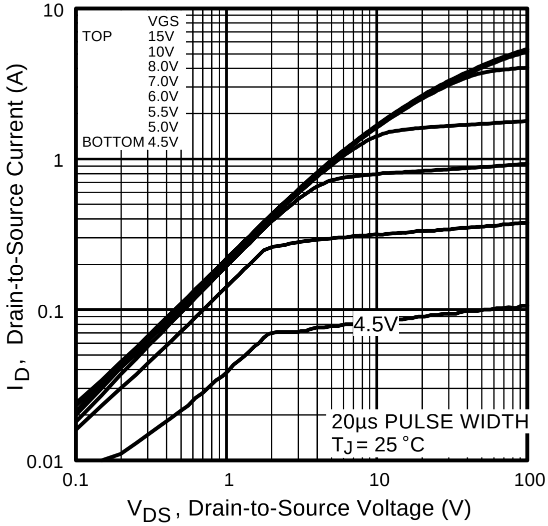


Fig 1. Typical Output Characteristics

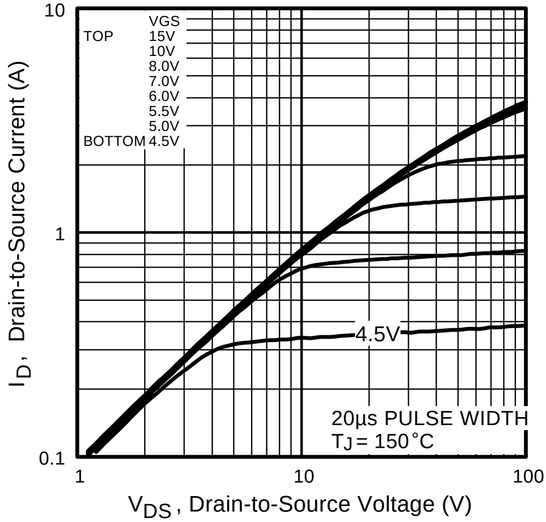


Fig 2. Typical Output Characteristics

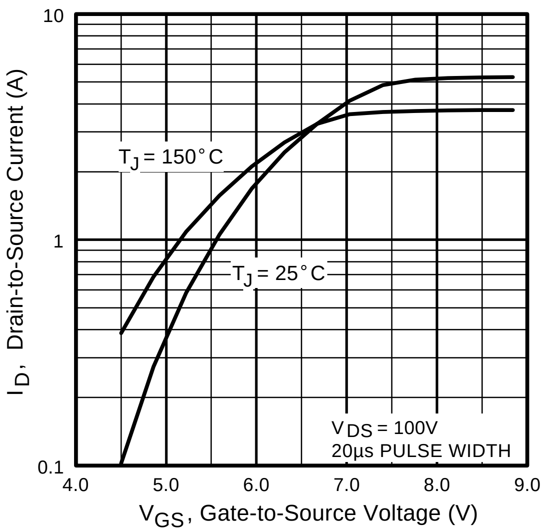


Fig 3. Typical Transfer Characteristics

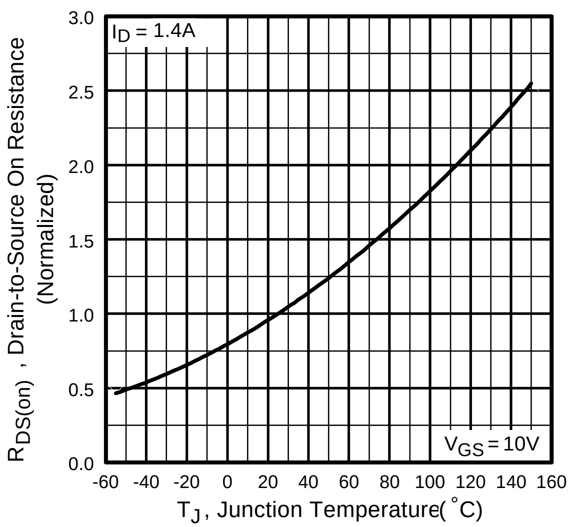


Fig 4. Normalized On-Resistance Vs. Temperature

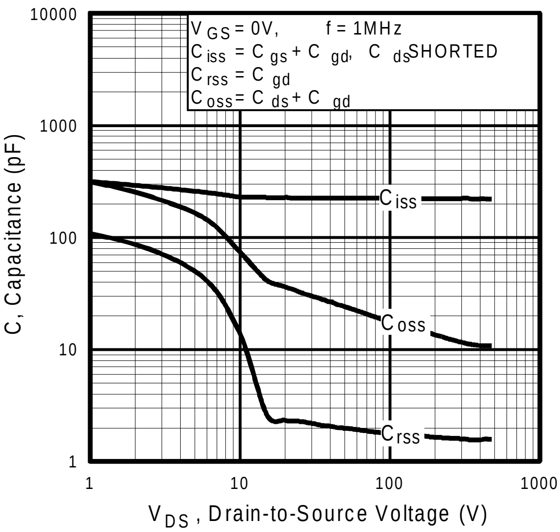


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

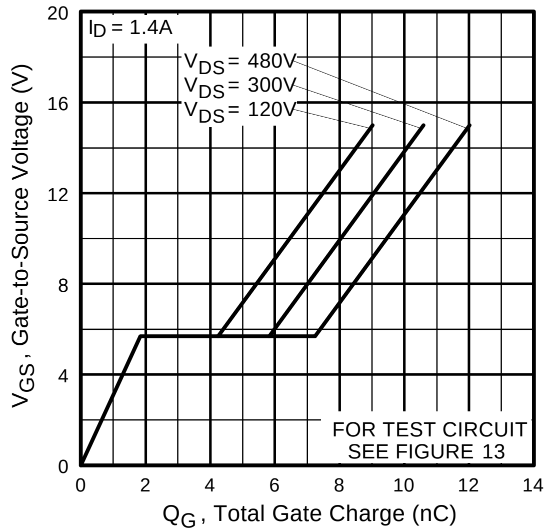


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

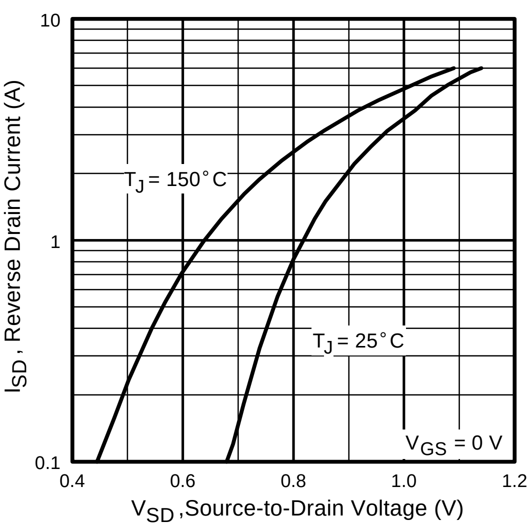


Fig 7. Typical Source-Drain Diode Forward Voltage

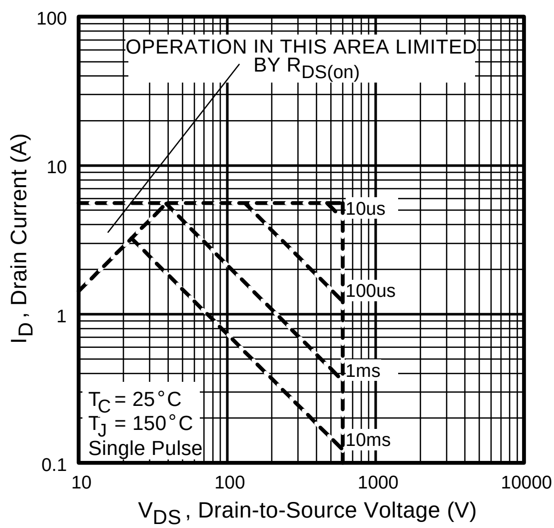


Fig 8. Maximum Safe Operating Area

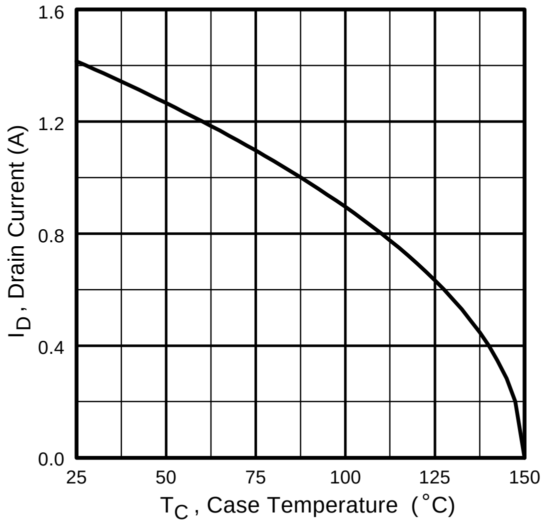


Fig 9. Maximum Drain Current Vs. Case Temperature

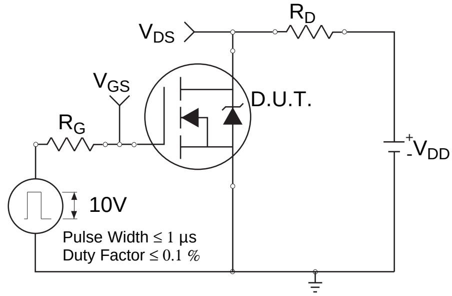


Fig 10a. Switching Time Test Circuit

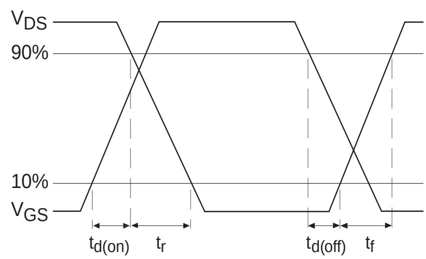


Fig 10b. Switching Time Waveforms

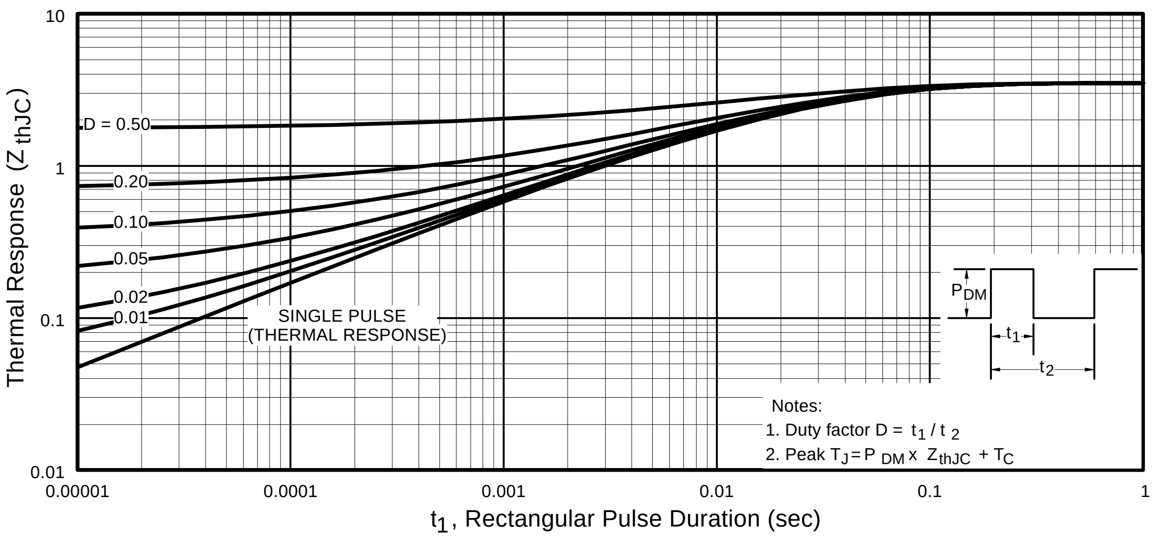


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

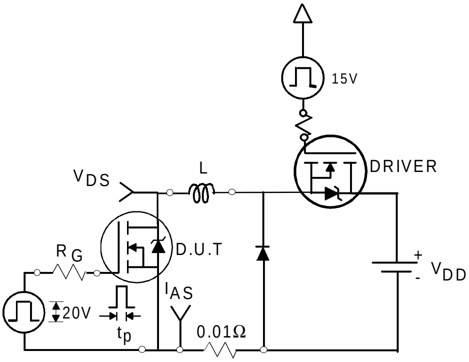


Fig 12a. Unclamped Inductive Test Circuit

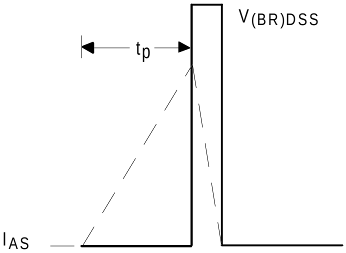


Fig 12b. Unclamped Inductive Waveforms

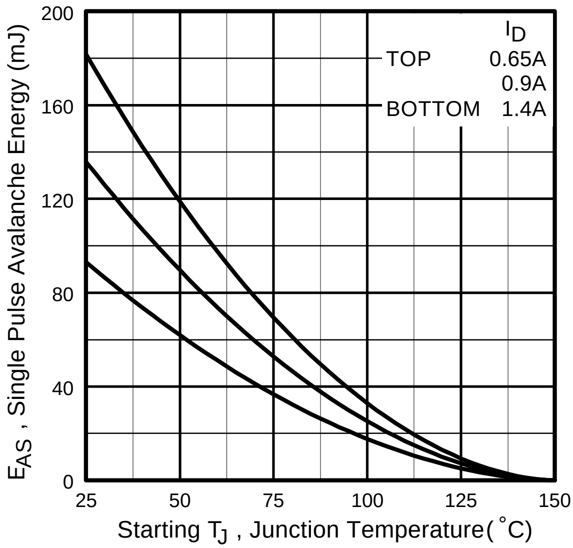


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

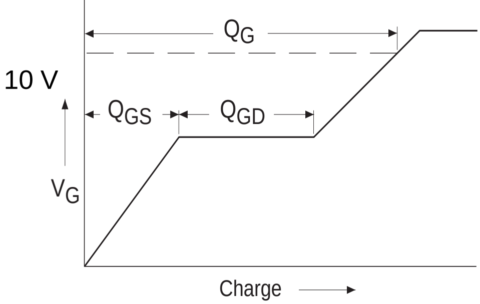


Fig 13a. Basic Gate Charge Waveform

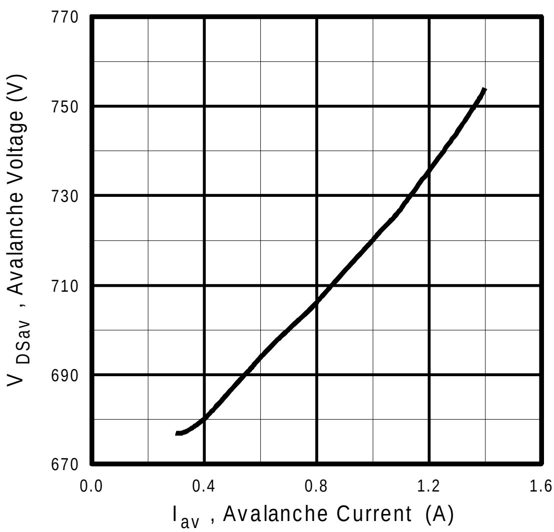


Fig 12d. Typical Drain-to-Source Voltage Vs. Avalanche Current

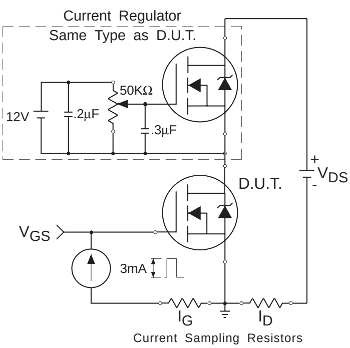
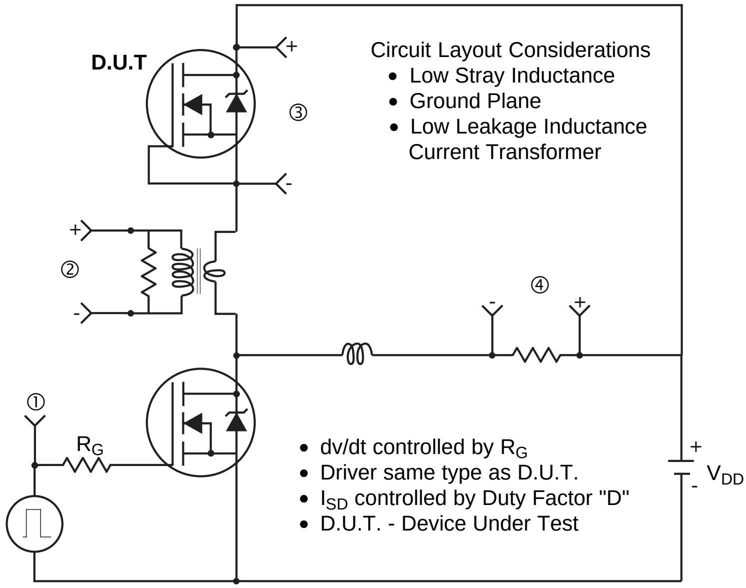
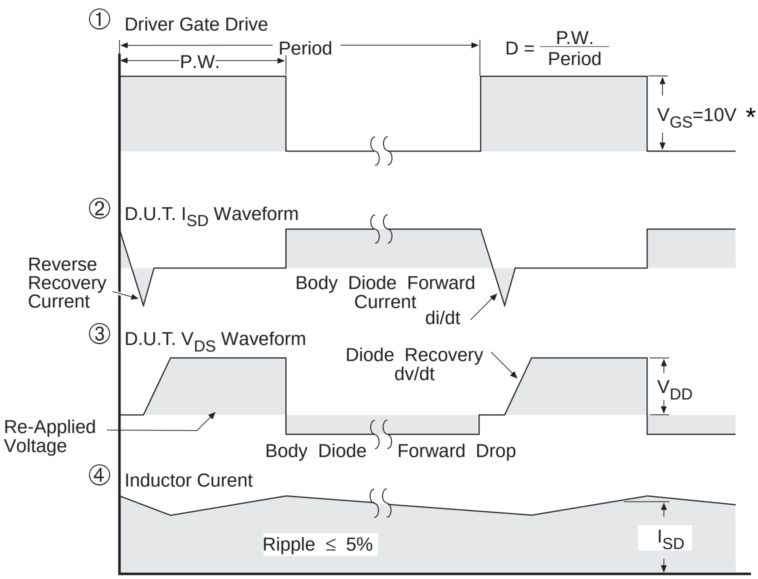


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



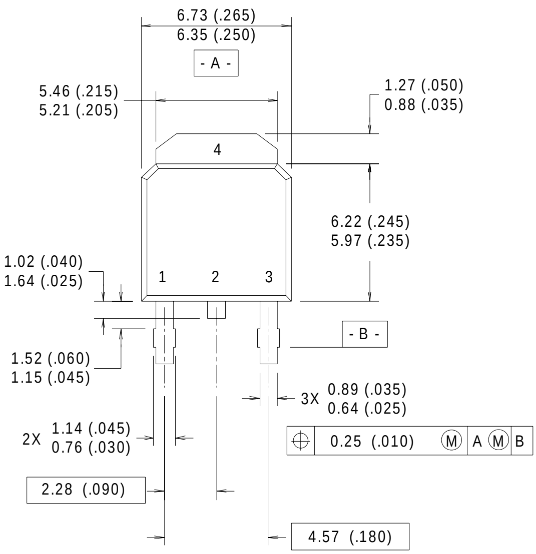


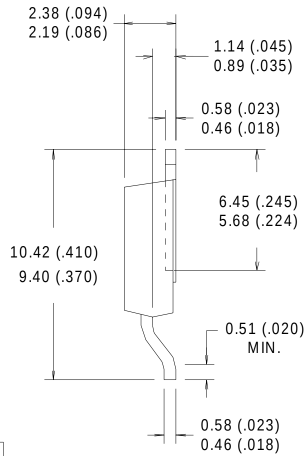
* V_{GS} = 5V for Logic Level Devices

Fig 14. For N-Channel HEXFETS

Package Outline

TO-252AA Outline
Dimensions are shown in millimeters (inches)





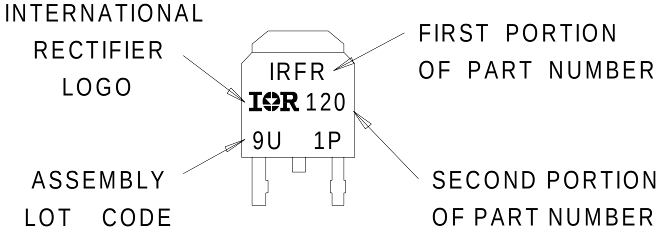
LEAD ASSIGNMENTS
1 - GATE
2 - DRAIN
3 - SOURCE
4 - DRAIN

NOTES:
1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH.
3 CONFORMS TO JEDEC OUTLINE TO-252AA.
4 DIMENSIONS SHOWN ARE BEFORE SOLDER DIP, SOLDER DIP MAX. +0.16 (.006).

Part Marking Information

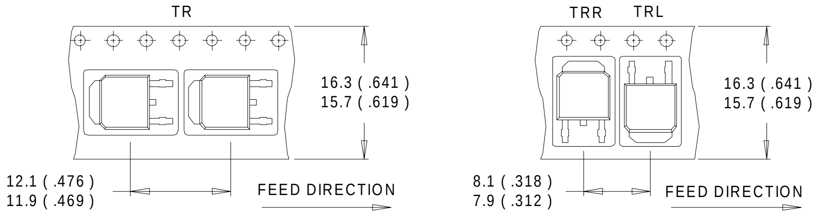
TO-252AA (D-PARK)

EXAMPLE : THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 9U1P

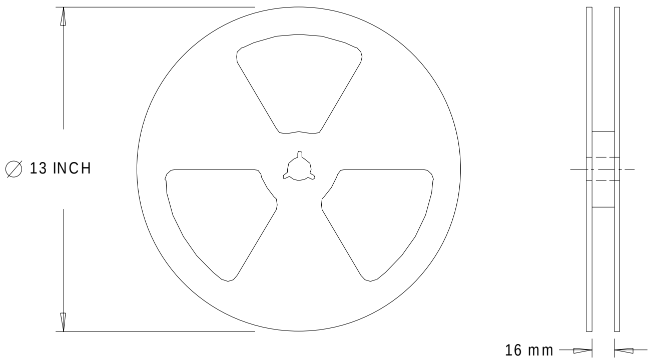


Tape & Reel Information

TO-252AA



NOTES :
1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :
1. OUTLINE CONFORMS TO EIA-481.

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

② Starting T_J = 25°C, L = 95mH R_G = 25Ω, I_{AS} = 1.4A. (See Figure 12)

③ $I_{SD} \le$ 1.4A, di/dt $\le$ 180A/µs, $V_{DD} \le V_{(BR)DSS}$, $T_J \le$ 150°C

④ Pulse width $\le$ 300µs; duty cycle $\le$ 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}

** When mounted on 1" square PCB (FR-4 or G-10 Material) .
For recommended footprint and soldering techniques refer to application note #AN-994

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