

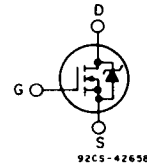
Avalanche Energy Rated N-Channel Power MOSFETs

4.5A and 5.5A, 350V-400V
 $r_{DS(on)} = 1.0\Omega$ and 1.5Ω

Features:

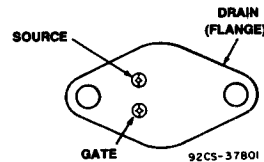
- Single pulse avalanche energy rated
- SOA is power-dissipation limited
- Nanosecond switching speeds
- Linear transfer characteristics
- High input impedance

N-CHANNEL ENHANCEMENT MODE



TERMINAL DIAGRAM

TERMINAL DESIGNATION



JEDEC TO - 204AA

The IRF330R, IRF331R, IRF332R and IRF333R are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. These are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The IRF-types are supplied in the JEDEC TO-204AA steel package.

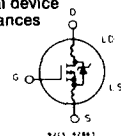
Absolute Maximum Ratings

Parameter	IRF330R	IRF331R	IRF332R	IRF333R	Units
V_{DS} Drain - Source Voltage ①	400	350	400	350	V
V_{DGR} Drain - Gate Voltage ($R_{GS} = 20\text{ K}\Omega$) ①	400	350	400	350	V
$I_D @ T_C = 25^\circ\text{C}$ Continuous Drain Current	5.5	5.5	4.5	4.5	A
$I_D @ T_C = 100^\circ\text{C}$ Continuous Drain Current	3.5	3.5	3.0	3.0	A
I_{DM} Pulsed Drain Current ③	22	22	18	18	A
V_{GS} Gate - Source Voltage	± 20				V
$P_D @ T_C = 25^\circ\text{C}$ Max. Power Dissipation	75 (See Fig. 14)				W
Linear Derating Factor	0.6 (See Fig. 14)				W/ $^\circ\text{C}$
E_{AS} Single Pulse Avalanche Energy Rating ④	300				mJ
T_J Operating Junction and Storage Temperature Range	-55 to 150				$^\circ\text{C}$
T_{stg} Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)				$^\circ\text{C}$

IRF330R, IRF331R, IRF332R, IRF333R

Electrical Characteristics @ $T_c = 25^\circ\text{C}$ (Unless Otherwise Specified)

Parameter	Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DS} Drain - Source Breakdown Voltage	IRF330R IRF332R	400	—	—	V	$V_{GS} = 0\text{V}$
	IRF331R IRF333R	350	—	—	V	$I_D = 250\mu\text{A}$
$V_{GS(th)}$ Gate Threshold Voltage	ALL	2.0	—	4.0	V	$V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$
I_{GSS} Gate-Source Leakage Forward	ALL	—	—	100	nA	$V_{GS} = 20\text{V}$
I_{GSS} Gate-Source Leakage Reverse	ALL	—	—	-100	nA	$V_{GS} = -20\text{V}$
I_{DSS} Zero Gate Voltage Drain Current	ALL	—	—	250	μA	$V_{DS} = \text{Max. Rating}$, $V_{GS} = 0\text{V}$
		—	—	1000	μA	$V_{DS} = \text{Max. Rating} \times 0.8$, $V_{GS} = 0\text{V}$, $T_c = 125^\circ\text{C}$
$I_{D(on)}$ On-State Drain Current ②	IRF330R IRF331R	5.5	—	—	A	$V_{DS} > I_{D(on)} \times R_{DS(on) \text{ max.}}$, $V_{GS} = 10\text{V}$
	IRF332R IRF333R	4.5	—	—	A	
$R_{DS(on)}$ Static Drain-Source On-State Resistance ②	IRF330R IRF331R	—	0.8	1.0	Ω	$V_{GS} = 10\text{V}$, $I_D = 3.0\text{A}$
	IRF332R IRF333R	—	1.0	1.5	Ω	
g_{fs} Forward Transconductance ②	ALL	3.0	4.0	—	S(V)	$V_{DS} > I_{D(on)} \times R_{DS(on) \text{ max.}}$, $I_D = 3.0\text{A}$
C_{iss} Input Capacitance	ALL	—	700	—	pF	$V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$, $f = 1.0\text{ MHz}$
C_{oss} Output Capacitance	ALL	—	150	—	pF	See Fig. 10
C_{rss} Reverse Transfer Capacitance	ALL	—	40	—	pF	
$t_{d(on)}$ Turn-On Delay Time	ALL	—	—	30	ns	$V_{DD} = 175\text{V}$, $I_D = 3.0\text{A}$, $Z_\theta = 15\Omega$
t_r Rise Time	ALL	—	—	35	ns	See Fig. 17
$t_{d(off)}$ Turn-Off Delay Time	ALL	—	—	55	ns	(MOSFET switching times are essentially independent of operating temperature.)
t_f Fall Time	ALL	—	—	35	ns	
Q_g Total Gate Charge (Gate-Source Plus Gate-Drain)	ALL	—	18	39	nC	$V_{GS} = 10\text{V}$, $I_D = 7.0\text{A}$, $V_{DS} = 0.8\text{V}$ Max. Rating. See Fig. 18 for test circuit. (Gate charge is essentially independent of operating temperature.)
Q_{gs} Gate-Source Charge	ALL	—	11	—	nC	
Q_{gd} Gate-Drain ("Miller") Charge	ALL	—	7.0	—	nC	
L_D Internal Drain Inductance	ALL	—	5.0	—	nH	Measured between the contact screw on header that is closer to source and gate pins and center of die.
L_S Internal Source Inductance	ALL	—	12.5	—	nH	Measured from the source pin, 6 mm (0.25 in.) from header and source bonding pad.

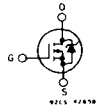


Thermal Resistance

$R_{\theta JC}$ Junction-to-Case	ALL	—	—	1.67	$^\circ\text{C/W}$	
$R_{\theta CS}$ Case-to-Sink	ALL	—	0.1	—	$^\circ\text{C/W}$	Mounting surface flat, smooth, and greased.
$R_{\theta JA}$ Junction-to-Ambient	ALL	—	—	30	$^\circ\text{C/W}$	Free Air Operation

Source-Drain Diode Ratings and Characteristics

I_S Continuous Source Current (Body Diode)	IRF330R IRF331R	—	—	5.5	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.
	IRF332R IRF333R	—	—	4.5	A	
I_{SM} Pulse Source Current (Body Diode) ③	IRF330R IRF331R	—	—	22	A	
	IRF332R IRF333R	—	—	18	A	
V_{SD} Diode Forward Voltage ②	IRF330R IRF331R	—	—	1.6	V	$T_c = 25^\circ\text{C}$, $I_S = 5.5\text{A}$, $V_{GS} = 0\text{V}$
	IRF332R IRF333R	—	—	1.5	V	$T_c = 25^\circ\text{C}$, $I_S = 4.5\text{A}$, $V_{GS} = 0\text{V}$
t_{rr} Reverse Recovery Time	ALL	—	600	—	ns	$T_J = 150^\circ\text{C}$, $I_F = 5.5\text{A}$, $dI_F/dt = 100\text{A}/\mu\text{s}$
Q_{RR} Reverse Recovered Charge	ALL	—	4.0	—	μC	$T_J = 150^\circ\text{C}$, $I_F = 5.5\text{A}$, $dI_F/dt = 100\text{A}/\mu\text{s}$
t_{on} Forward Turn-on Time	ALL	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by $L_S + L_D$.				



① $T_J = 25^\circ\text{C}$ to 150°C . ② Pulse Test: Pulse width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.

③ Repetitive Rating: Pulse width limited by max. junction temperature. See Transient Thermal Impedance Curve (Fig. 5).

④ $V_{DD} = 50\text{V}$, starting $T_J = 25^\circ\text{C}$, $L = 17\text{mH}$, $R_{DS} = 25\Omega$, $I_{peak} = 5.5\text{A}$. See figures 15, 16.

IRF330R, IRF331R, IRF332R, IRF333R

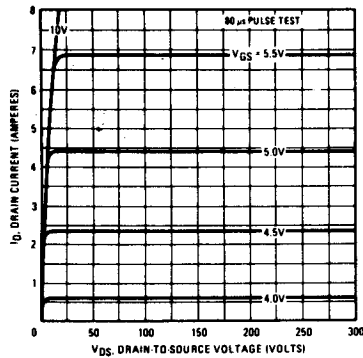


Fig. 1 - Typical Output Characteristics

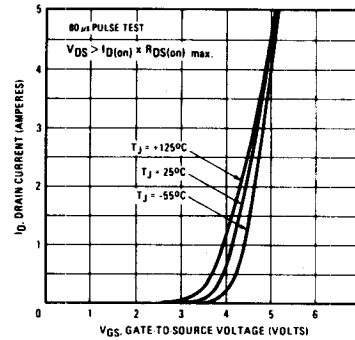


Fig. 2 - Typical Transfer Characteristics

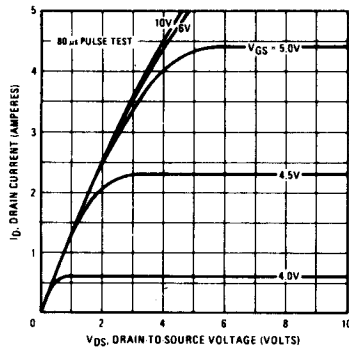


Fig. 3 - Typical Saturation Characteristics

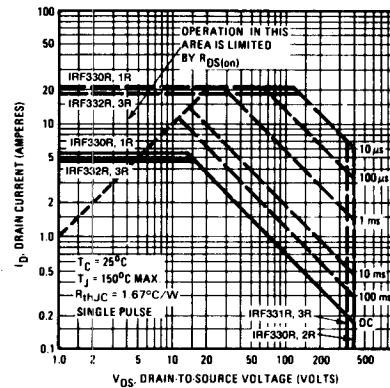


Fig. 4 - Maximum Safe Operating Area

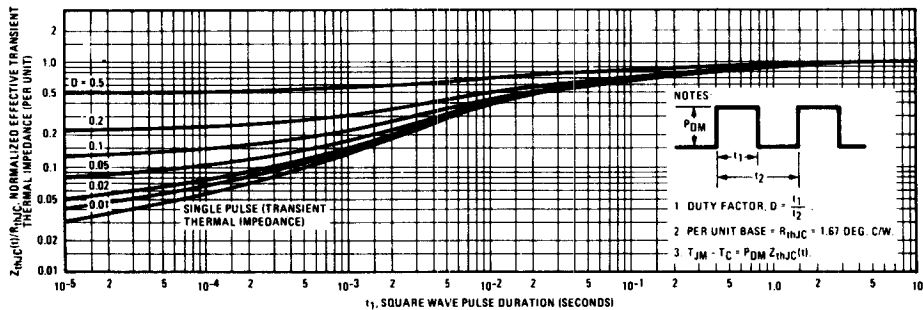


Fig. 5 - Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

IRF330R, IRF331R, IRF332R, IRF333R

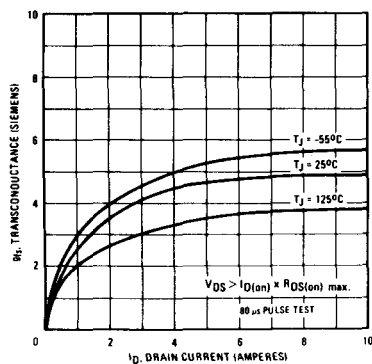


Fig. 6 - Typical Transconductance Vs. Drain Current

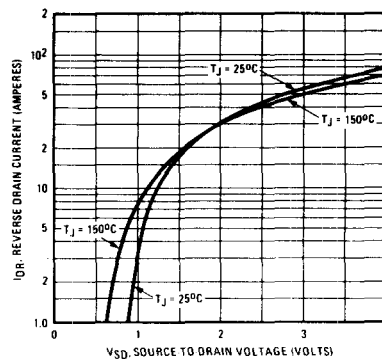


Fig. 7 - Typical Source-Drain Diode Forward Voltage

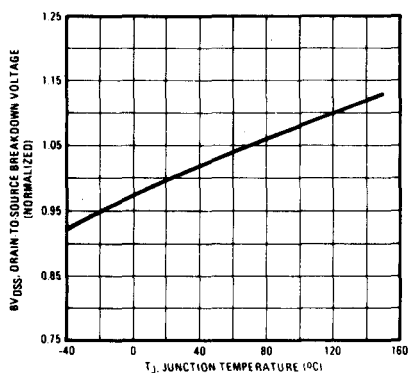


Fig. 8 - Breakdown Voltage Vs. Temperature

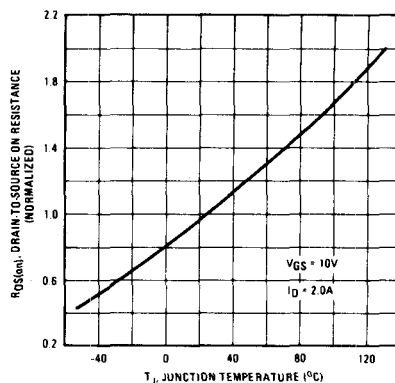


Fig. 9 - Normalized On-Resistance Vs. Temperature

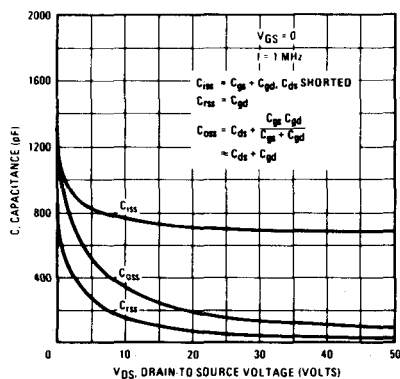


Fig. 10 - Typical Capacitance Vs. Drain-to-Source Voltage

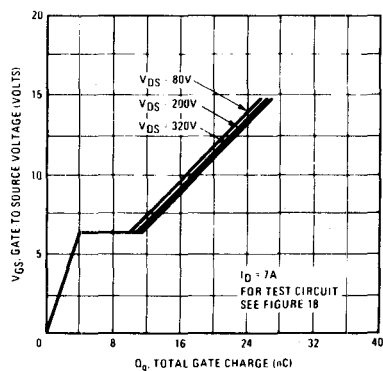


Fig. 11 - Typical Gate Charge Vs. Gate-to-Source Voltage

IRF330R, IRF331R, IRF332R, IRF333R

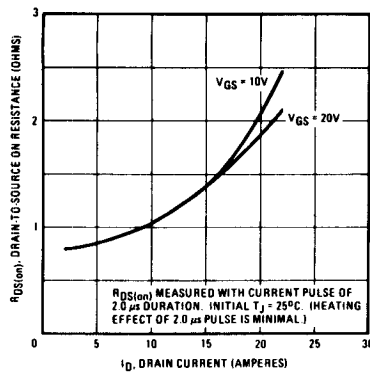


Fig. 12 - Typical On-Resistance Vs. Drain Current

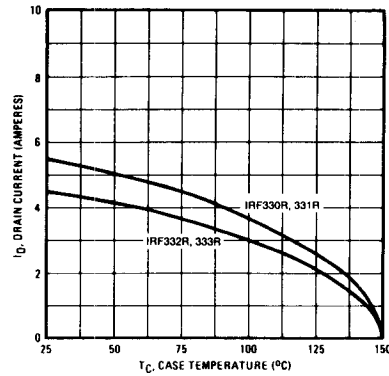


Fig. 13 - Maximum Drain Current Vs. Case Temperature

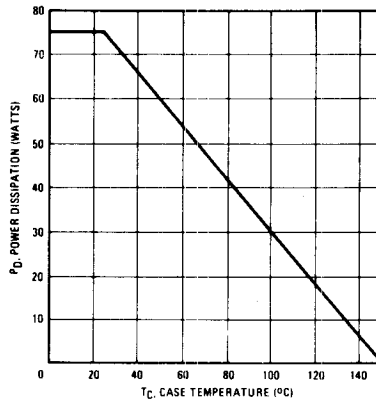


Fig. 14 - Power Vs. Temperature Derating Curve

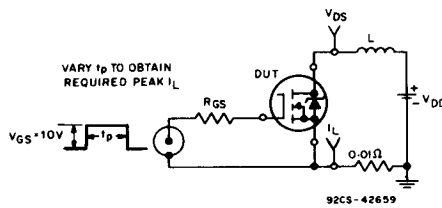


Fig. 15 - Unclamped Energy Test Circuit

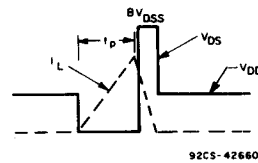


Fig. 16 - Unclamped Energy Waveforms

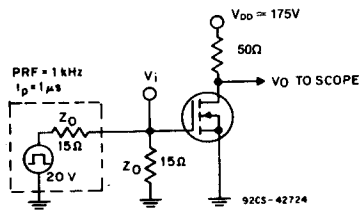


Fig. 17 - Switching Time Test Circuit

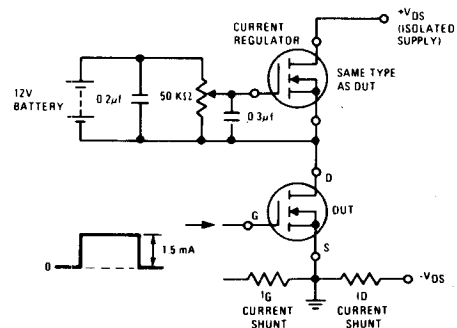


Fig. 18 - Gate Charge Test Circuit