

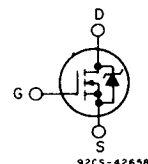
Avalanche Energy Rated N-Channel Power MOSFETs

12A and 13A, 450V-500V
 $r_{DS(on)} = 0.4\Omega$ and 0.5Ω

Features:

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

N-CHANNEL ENHANCEMENT MODE



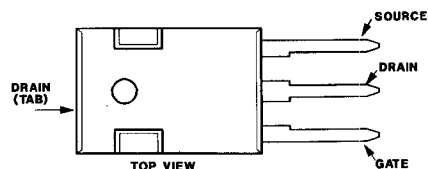
TERMINAL DIAGRAM

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The IRFP450R, IRFP451R, IRFP452R and IRFP453R 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 IRFP-types are supplied in the JEDEC TO-247 plastic package.

TERMINAL DESIGNATION



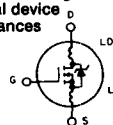
JEDEC TO-247

Absolute Maximum Ratings

Parameter	IRFP450R	IRFP451R	IRFP452R	IRFP453R	Units
V_{DS} Drain - Source Voltage ①	500	450	500	450	V
V_{DGR} Drain - Gate Voltage ($R_{GS} = 20\text{ K}\Omega$) ①	500	450	500	450	V
$I_D @ T_C = 25^\circ\text{C}$ Continuous Drain Current	13	13	12	12	A
$I_D @ T_C = 100^\circ\text{C}$ Continuous Drain Current	8.0	8.0	7.0	7.0	A
I_{DM} Pulsed Drain Current ③	52	52	48	48	A
V_{GS} Gate - Source Voltage	± 20				V
$P_D @ T_C = 25^\circ\text{C}$ Max. Power Dissipation	150 (See Fig. 14)				W
Linear Derating Factor	1.2 (See Fig. 14)				W/ $^\circ\text{C}$
E_{AS} Single Pulse Avalanche Energy Rating ④	860				mJ
T_J Operating Junction and Storage Temperature Range	-55 to 150				$^\circ\text{C}$
Lead Temperature	300 (0.063 in. (1.6mm) from case for 10s)				$^\circ\text{C}$

IRFP450R, IRFP451R, IRFP452R, IRFP453R

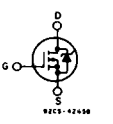
Electrical Characteristics @ $T_C = 25^\circ\text{C}$ (Unless Otherwise Specified)

Parameter	Type	Min.	Typ.	Max.	Units	Test Conditions	
BV _{DSS} Drain - Source Breakdown Voltage	IRFP450R	500	—	—	V	V _{GS} = 0V I _D = 250 μ A	
	IRFP452R	—	—	—	—		
	IRFP451R	450	—	—	V		
	IRFP453R	—	—	—	—		
V _{GS(th)} Gate Threshold Voltage	ALL	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 250 μ A	
I _{GSS} Gate-Source Leakage Forward	ALL	—	—	100	nA	V _{GS} = 20V	
I _{GSS} Gate-Source Leakage Reverse	ALL	—	—	-100	nA	V _{GS} = -20V	
I _{DSS} Zero Gate Voltage Drain Current	ALL	—	—	250	μ A	V _{DS} = Max. Rating, V _{GS} = 0V	
		—	—	1000	μ A	V _{DS} = Max. Rating x 0.8, V _{GS} = 0V, T _C = 125 $^\circ$ C	
I _{D(on)} On-State Drain Current ②	IRFP450R	13	—	—	A	V _{DS} > I _{D(on)} x R _{DS(on)} max., V _{GS} = 10V	
	IRFP451R	—	—	—	—		
	IRFP452R	12	—	—	A		
	IRFP453R	—	—	—	—		
R _{DS(on)} Static Drain-Source On-State Resistance ②	IRFP450R	—	0.3	0.4	Ω	V _{GS} = 10V, I _D = 7.0A	
	IRFP451R	—	—	—	—		
	IRFP452R	—	0.4	0.5	Ω		
	IRFP453R	—	—	—	—		
g _{fs} Forward Transconductance ②	ALL	6.0	11	—	S(Ω)	V _{DS} > I _{D(on)} x R _{DS(on)} max., I _D = 7.0A	
C _{iss} Input Capacitance	ALL	—	2000	—	pF	V _{GS} = 0V, V _{DS} = 25V, f = 1.0 MHz	
C _{oss} Output Capacitance	ALL	—	400	—	pF	See Fig. 10	
C _{rss} Reverse Transfer Capacitance	ALL	—	100	—	pF		
t _{d(on)} Turn-On Delay Time	ALL	—	—	35	ns	V _{DD} = 210V, I _D = 7.0A, Z _o = 4.7 Ω	
t _r Rise Time	ALL	—	—	50	ns	See Fig. 17	
t _{d(off)} Turn-Off Delay Time	ALL	—	—	150	ns	(MOSFET switching times are essentially independent of operating temperature.)	
t _f Fall Time	ALL	—	—	70	ns		
Q _g Total Gate Charge (Gate-Source Plus Gate-Drain)	ALL	—	82	140	nC	V _{GS} = 10V, I _D = 16A, V _{DS} = 0.8V Max. Rating. See Fig. 18 for test circuit. (Gate charge is essentially independent of operating temperature.)	
Q _{gs} Gate-Source Charge	ALL	—	40	—	nC		
Q _{gd} Gate-Drain ("Miller") Charge	ALL	—	42	—	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 _{thJC} Junction-to-Case	ALL	—	—	0.83	$^\circ\text{C/W}$	
R _{thCS} Case-to-Sink	ALL	—	0.1	—	$^\circ\text{C/W}$	Mounting surface flat, smooth, and greased.
R _{thJA} 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)	IRFP450R	—	—	13	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.	
	IRFP451R	—	—	—	—		
	IRFP452R	—	—	12	A		
I _{SM} Pulse Source Current (Body Diode) ③	IRFP450R	—	—	52	A		
	IRFP451R	—	—	—	—		
	IRFP452R	—	—	48	A		
V _{SD} Diode Forward Voltage ②	IRFP450R	—	—	1.4	V	T _C = 25 $^\circ$ C, I _S = 13A, V _{GS} = 0V	
	IRFP451R	—	—	—	—		
	IRFP452R	—	—	1.3	V		
t _{rr} Reverse Recovery Time	ALL	—	1300	—	ns	T _J = 150 $^\circ$ C, I _F = 13A, dI _F /dt = 100A/ μ s	
Q _{RR} Reverse Recovered Charge	ALL	—	7.4	—	μ C	T _J = 150 $^\circ$ C, I _F = 13A, dI _F /dt = 100A/ μ 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 $^\circ$ C to 150 $^\circ$ C. ② Pulse Test: Pulse width $\leq$ 300 μ 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} = 25V, starting T_J = 25 $^\circ$ C, L = 9.2mH, R_{DS} = 25 Ω , I_{peak} = 13A. See figures 15, 16.

IRFP450R, IRFP451R, IRFP452R, IRFP453R

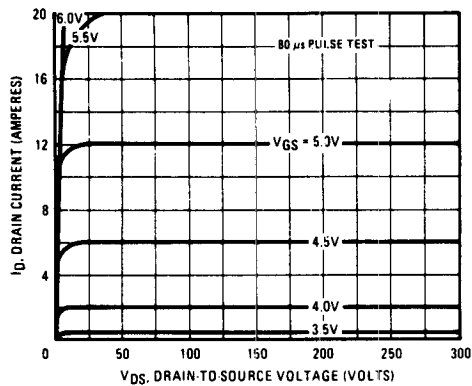


Fig. 1 – Typical Output Characteristics

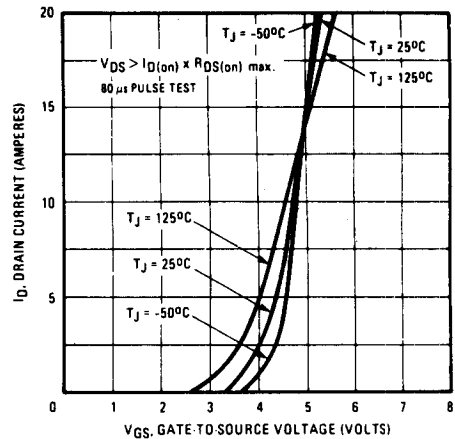


Fig. 2 – Typical Transfer Characteristics

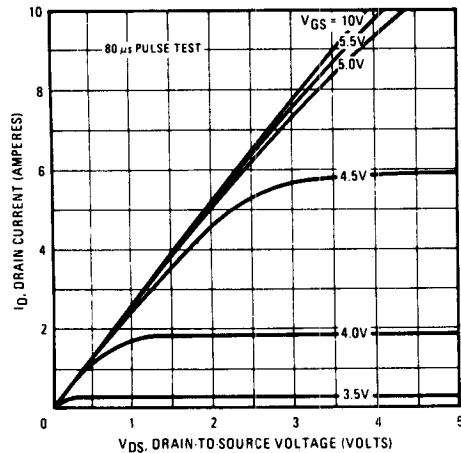


Fig. 3 – Typical Saturation Characteristics

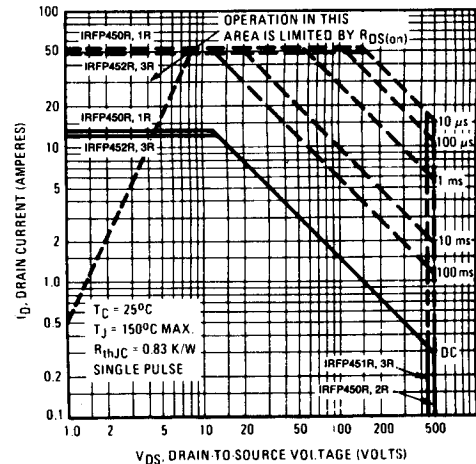


Fig. 4 – Maximum Safe Operating Area

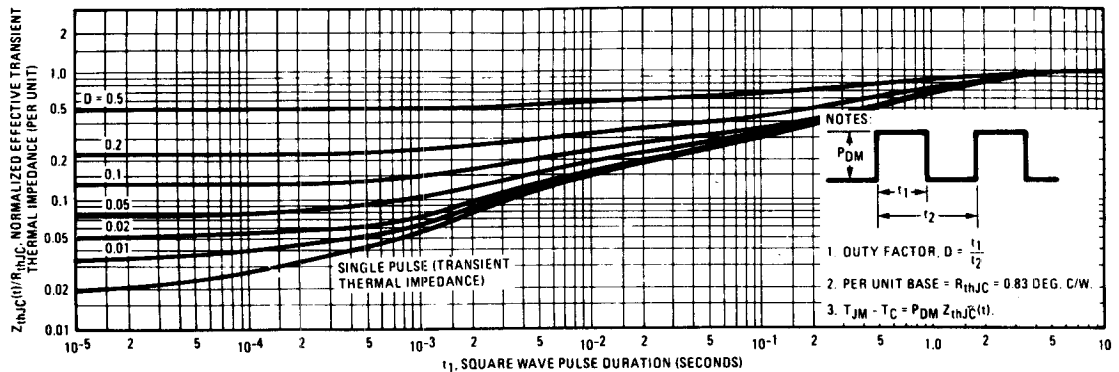


Fig. 5 – Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

IRFP450R, IRFP451R, IRFP452R, IRFP453R

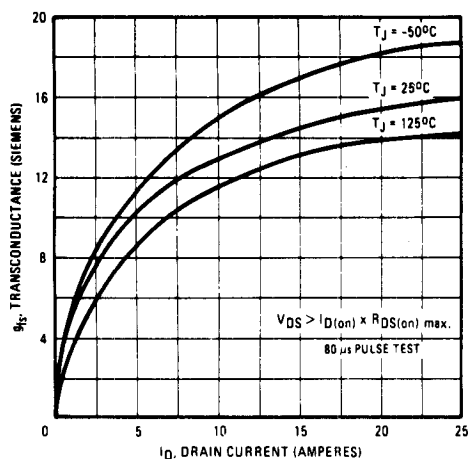


Fig. 6 – Typical Transconductance Vs. Drain Current

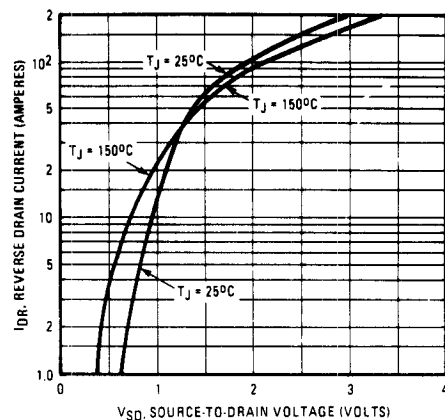


Fig. 7 – Typical Source-Drain Diode Forward Voltage

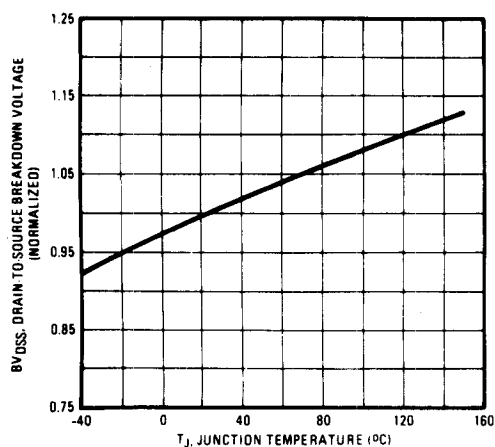


Fig. 8 – Breakdown Voltage Vs. Temperature

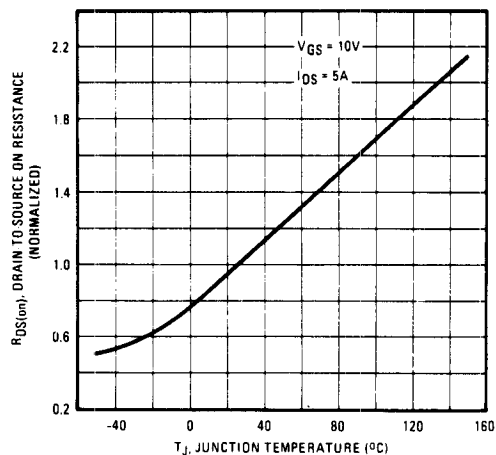


Fig. 9 – Normalized On-Resistance Vs. Temperature

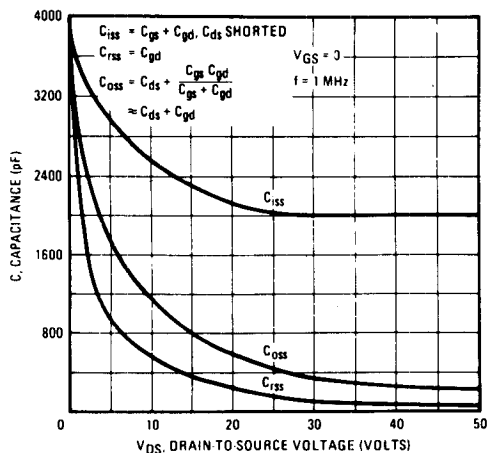


Fig. 10 – Typical Capacitance Vs. Drain-to-Source Voltage

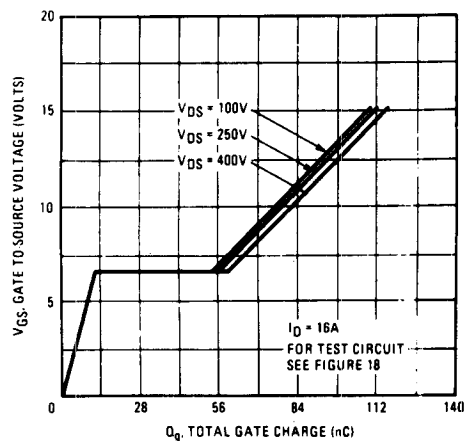


Fig. 11 – Typical Gate Charge Vs. Gate-to-Source Voltage

IRFP450R, IRFP451R, IRFP452R, IRFP453R

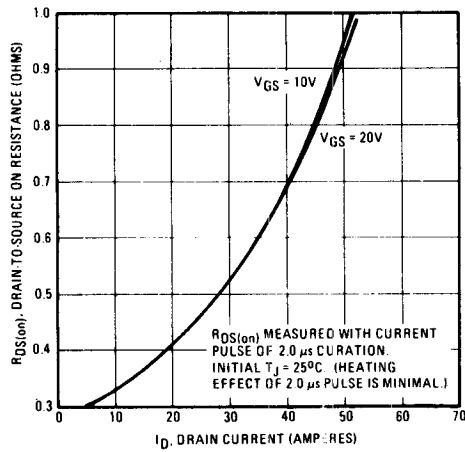


Fig. 12 – Typical On-Resistance Vs. Drain Current

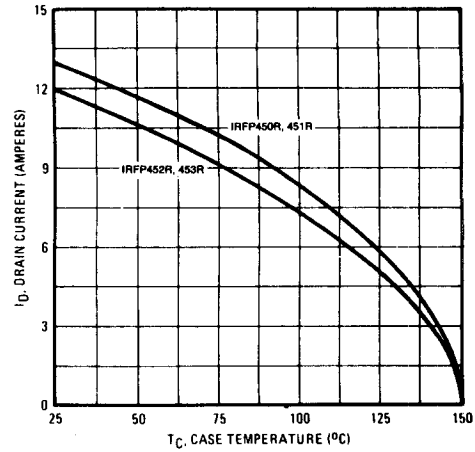


Fig. 13 – Maximum Drain Current Vs. Case Temperature

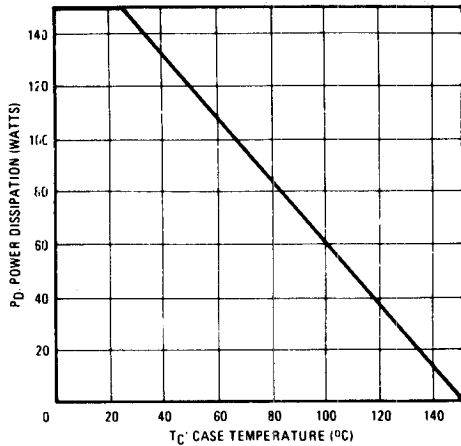


Fig. 14 – Power Vs. Temperature Derating Curve

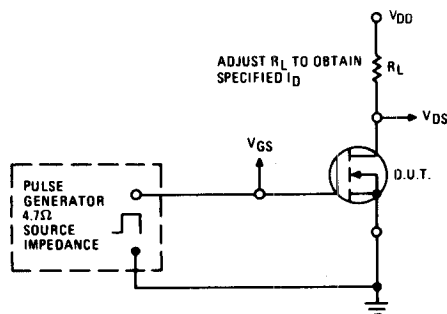


Fig. 17 – Switching Time Test Circuit

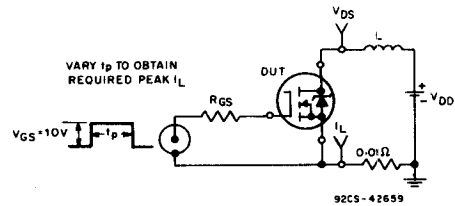


Fig. 15 – Unclamped Energy Test Circuit

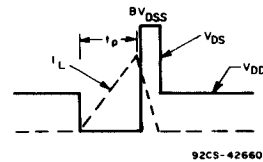


Fig. 16 – Unclamped Energy Waveforms

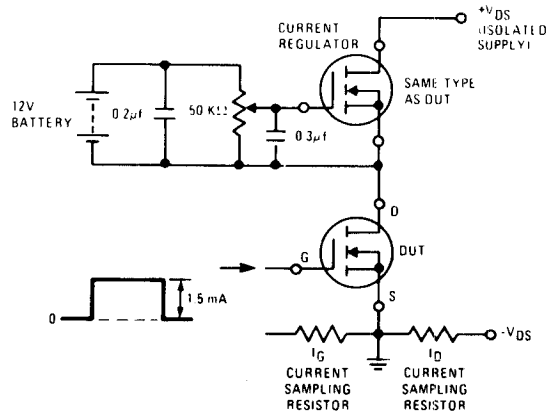


Fig. 18 – Gate Charge Test Circuit