

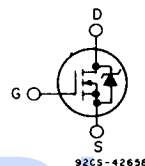
Avalanche Energy Rated N-Channel Power MOSFETs

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

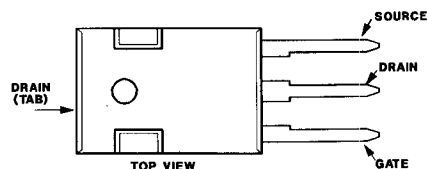


TERMINAL DIAGRAM

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

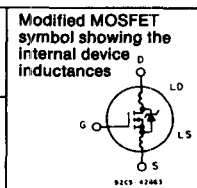
Absolute Maximum Ratings

Parameter	IRFP450R	IRFP451R	IRFP452R	IRFP453R	Units
V_{DS}	500	450	500	450	V
V_{DGR}	500	450	500	450	V
$I_D @ T_C = 25^\circ\text{C}$	13	13	12	12	A
$I_D @ T_C = 100^\circ\text{C}$	8.0	8.0	7.0	7.0	A
I_{DM}	52	52	48	48	A
V_{GS}	± 20				V
$P_D @ T_C = 25^\circ\text{C}$	150 (See Fig. 14)				W
	Linear Derating Factor				W/ $^\circ\text{C}$
E_{AS}	860				mj
T_J T_{stg}	-55 to 150				$^\circ\text{C}$
	Lead Temperature				$^\circ\text{C}$
	300 (0.063 in. (1.6mm) from case for 10s)				

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 IRFP452R	500	—	—	V	V _{GS} = 0V I _D = 250μA
	IRFP451R IRFP453R	450	—	—	V	
	ALL	—	—	—	—	
V _{GS(th)} Gate Threshold Voltage	ALL	2.0	—	4.0	V	V _{DS} = V _{GS} , I _D = 250μA
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	μA	V _{DS} = Max. Rating, V _{GS} = 0V V _{DS} = Max. Rating x 0.8, V _{GS} = 0V, T _C = 125°C
	ALL	—	—	1000	μA	
I _{D(on)} On-State Drain Current ②	IRFP450R IRFP451R	13	—	—	A	V _{DS} > I _{D(on)} x R _{DS(on)max} , V _{GS} = 10V
	IRFP452R IRFP453R	12	—	—	A	
	ALL	—	—	—	—	
R _{DS(on)} Static Drain-Source On-State Resistance ②	IRFP450R IRFP451R	—	0.3	0.4	Ω	V _{GS} = 10V, I _D = 7.0A
	IRFP452R IRFP453R	—	0.4	0.5	Ω	
	ALL	—	—	—	—	
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 See Fig. 10
C _{oss} Output Capacitance	ALL	—	400	—	pF	
C _{res} 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 = 4.7Ω See Fig. 17 (MOSFET switching times are essentially independent of operating temperature.)
t _r Rise Time	ALL	—	—	50	ns	
t _{d(off)} Turn-Off Delay Time	ALL	—	—	150	ns	
t _f Fall Time	ALL	—	—	70	ns	
Q _g Total Gate Charge (Gate-Source Plus Gate-Drain)	ALL	—	82	140	nC	
Q _{gs} Gate-Source Charge	ALL	—	40	—	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 _{gd} Gate-Drain ("Miller") Charge	ALL	—	42	—	nC	
L _D Internal Drain Inductance	ALL	—	5.0	—	nH	
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	°C/W
R _{thCS} Case-to-Sink	ALL	—	0.1	—	°C/W
R _{thJA} Junction-to-Ambient	ALL	—	—	30	°C/W

Source-Drain Diode Ratings and Characteristics

I _S Continuous Source Current (Body Diode)	IRFP450R IRFP451R	—	—	13	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.
	IRFP452R IRFP453R	—	—	12	A	
	ALL	—	—	—	—	
I _{SM} Pulse Source Current (Body Diode) ③	IRFP450R IRFP451R	—	—	52	A	
	IRFP452R IRFP453R	—	—	48	A	
	ALL	—	—	—	—	
V _{SD} Diode Forward Voltage ②	IRFP450R IRFP451R	—	—	1.4	V	T _C = 25°C, I _S = 13A, V _{GS} = 0V
	IRFP452R IRFP453R	—	—	1.3	V	T _C = 25°C, I _S = 12A, V _{GS} = 0V
t _{rr} Reverse Recovery Time	ALL	—	1300	—	ns	T _J = 150°C, I _F = 13A, di/dt = 100A/μs
Q _{RR} Reverse Recovered Charge	ALL	—	7.4	—	μC	T _J = 150°C, I _F = 13A, di/dt = 100A/μs
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°C to 150°C. ② Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 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°C, L = 9.2mH, R_{gs} = 25Ω, I_{peak} = 13A. See figures 15, 16.

IRFP450R, IRFP451R, IRFP452R, IRFP453R

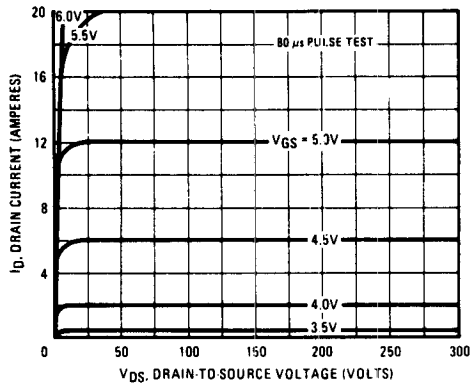


Fig. 1 - Typical Output Characteristics

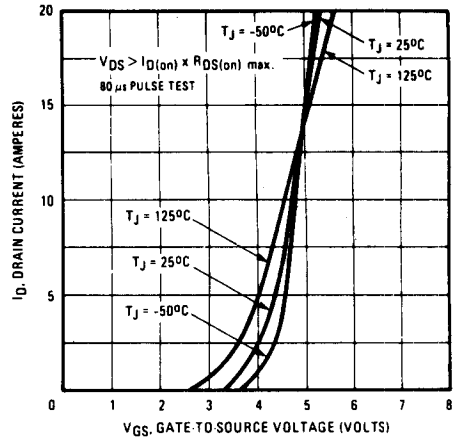


Fig. 2 - Typical Transfer Characteristics

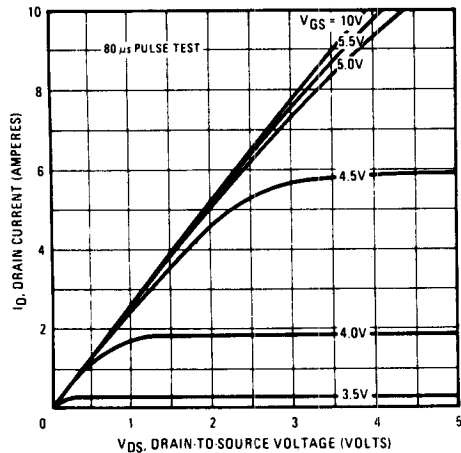


Fig. 3 - Typical Saturation Characteristics

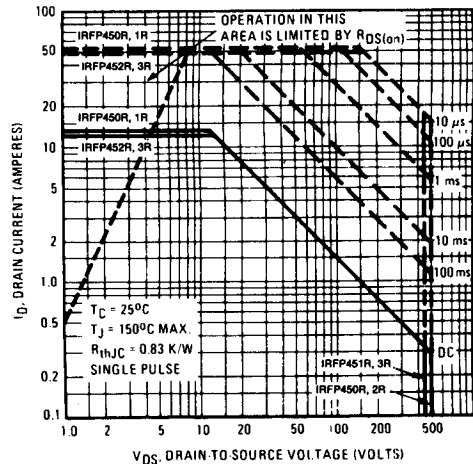


Fig. 4 - Maximum Safe Operating Area

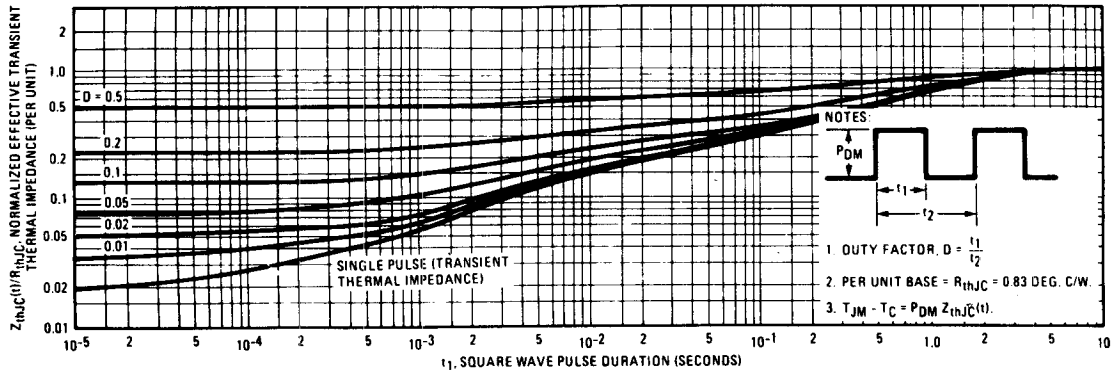


Fig. 5 - Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

IRFP450R, IRFP451R, IRFP452R, IRFP453R

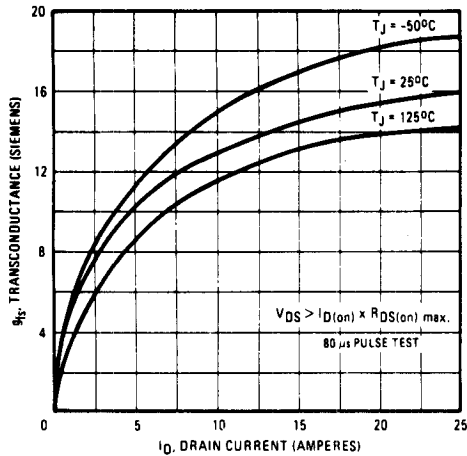


Fig. 6 – Typical Transconductance Vs. Drain Current

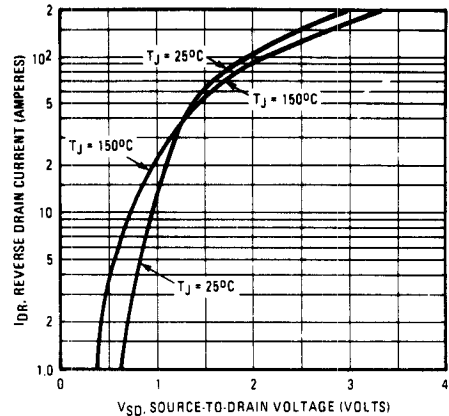


Fig. 7 – Typical Source-Drain Diode Forward Voltage

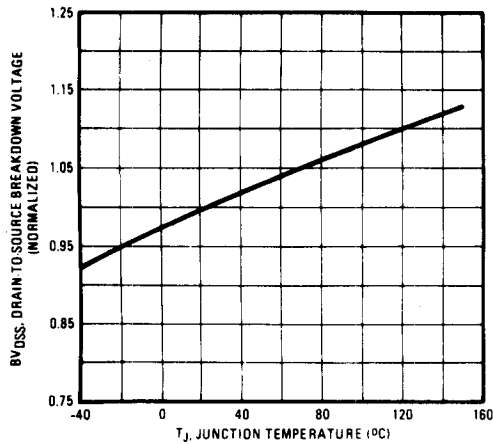


Fig. 8 – Breakdown Voltage Vs. Temperature

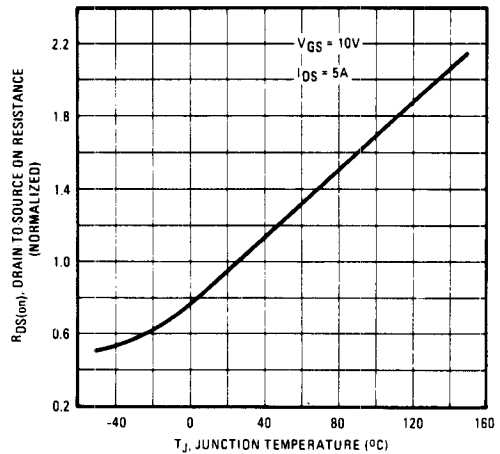


Fig. 9 – Normalized On-Resistance Vs. Temperature

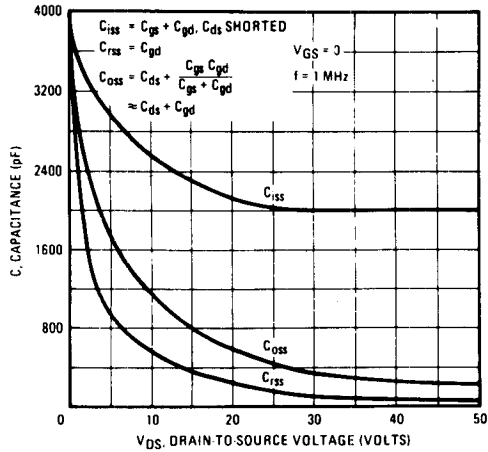


Fig. 10 – Typical Capacitance Vs. Drain-to-Source Voltage

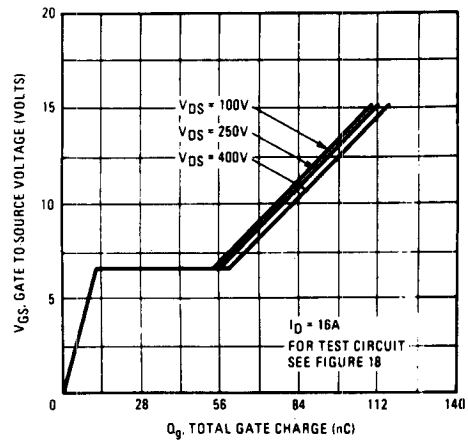


Fig. 11 – Typical Gate Charge Vs. Gate-to-Source Voltage

IRFP450R, IRFP451R, IRFP452R, IRFP453R

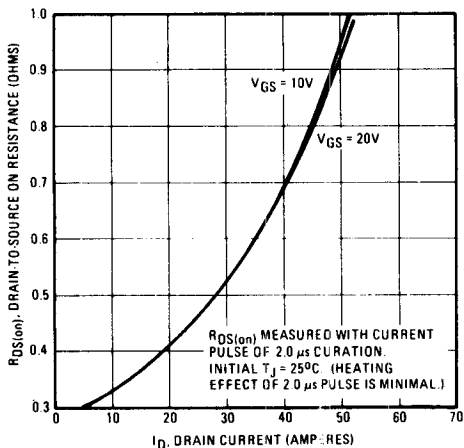


Fig. 12 – Typical On-Resistance Vs. Drain Current

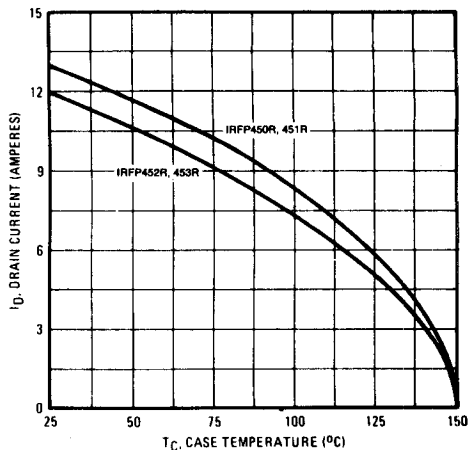


Fig. 13 – Maximum Drain Current Vs. Case Temperature

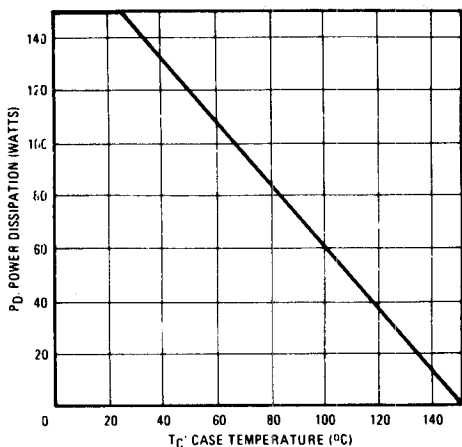


Fig. 14 – Power Vs. Temperature Derating Curve

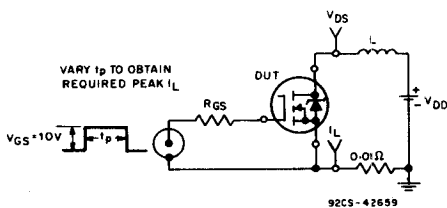


Fig. 15 – Unclamped Energy Test Circuit

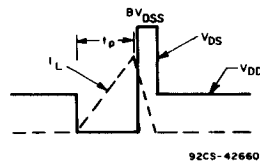


Fig. 16 – Unclamped Energy Waveforms

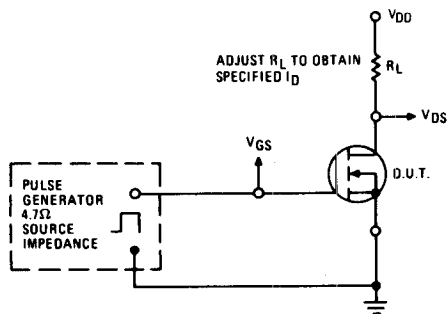


Fig. 17 – Switching Time Test Circuit

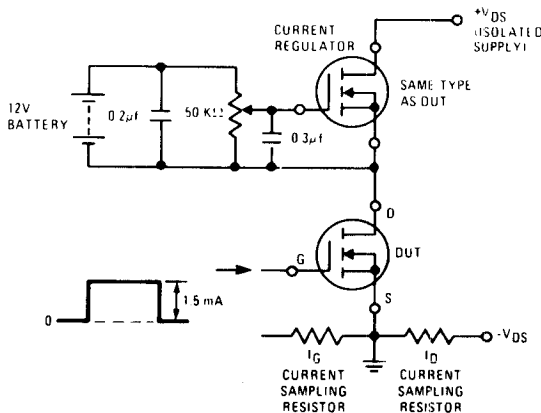


Fig. 18 – Gate Charge Test Circuit