

File Number 1827

IRF450, IRF451, IRF452, IRF453

Power MOS Field-Effect Transistors

N-Channel Enhancement-Mode Power Field-Effect Transistors

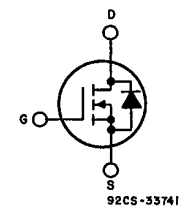
12 A and 13 A, 450 V - 500 V
 $r_{DS(on)} = 0.4 \Omega$ and 0.5Ω

- Features:**
- SOA is power-dissipation limited
 - Nanosecond switching speeds
 - Linear transfer characteristics
 - High Input Impedance
 - Majority carrier device

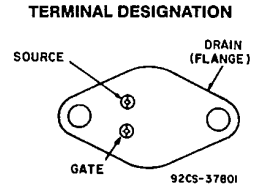
The IRF450, IRF451, IRF452 and IRF453 are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

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

N-CHANNEL ENHANCEMENT MODE



TERMINAL DIAGRAM



JEDEC TO-204AA

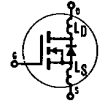
Absolute Maximum Ratings

Parameter	IRF450	IRF451	IRF452	IRF453	Units
V_{DS} Drain - Source Voltage ①	500	450	500	450	V
V_{DGR} Drain - Gate Voltage ($I_{RGS} = 20 \text{ k}\Omega$) 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 ②	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/K
I_{LM} Inductive Current, Clamped	(See Fig. 14 and 15) $L = 100\mu\text{H}$				A
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)				$^\circ\text{C}$

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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	IRF450 IRF452	500	-	-	V	V _{GS} = 0V I _D = 250μA	
	IRF451 IRF453	450	-	-	V		
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	
I _{D(on)} On-State Drain Current ②	IRF450 IRF451	13	-	-	A	V _{DS} > I _{D(on)} × R _{DS(on)} max.; V _{GS} = 10V	
	IRF452 IRF453	12	-	-	A		
R _{DS(on)} Static Drain-Source On-State Resistance ②	IRF450 IRF451	-	0.3	0.4	Ω	V _{GS} = 10V, I _D = 7.0A	
	IRF452 IRF453	-	0.4	0.5	Ω		
g _{fs} Forward Transconductance ②	ALL	6.0	11	-	S(V)	V _{DS} > I _{D(on)} × R _{DS(on)} max.; I _D = 7.0A	
C _{iss} Input Capacitance	ALL	-	2000	3000	pF	V _{GS} = 0V, V _{DS} = 25V, f = 1.0 MHz See Fig. 10	
C _{oss} Output Capacitance	ALL	-	400	600	pF		
C _{rss} Reverse Transfer Capacitance	ALL	-	100	200	pF		
t _{d(on)} Turn-On Delay Time	ALL	-	-	35	ns	V _{DD} = 210V, I _D = 7.0A, Z ₀ = 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	120	nC		
Q _{gs} Gate-Source Charge	ALL	-	40	-	nC	V _{GS} = 10V, I _D = 16A, V _{DS} = 0.8 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		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.	Modified MOSFET symbol showing the internal device inductances 

Thermal Resistance

R _{thJC} Junction-to-Case	ALL	-	-	83	K/W	
R _{thCS} Case-to-Sink	ALL	-	0.1	-	K/W	Mounting surface flat, smooth, and greased.
R _{thJA} Junction-to-Ambient	ALL	-	-	30	K/W	Free Air Operation

Source-Drain Diode Ratings and Characteristics

I _S Continuous Source Current (Body Diode)	IRF450 IRF451	-	-	13	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier. 
	IRF452 IRF453	-	-	12	A	
I _{SM} Pulse Source Current (Body Diode) ③	IRF450 IRF451	-	-	52	A	
V _{SD} Diode Forward Voltage ②	IRF450 IRF451	-	-	1.4	V	T _C = 25°C, I _S = 13A, V _{GS} = 0V
	IRF452 IRF453	-	-	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 _F /dt = 100A/μs
C _{RR} Reverse Recovered Charge	ALL	-	7.4	-	μC	T _J = 150°C, I _F = 13A, di _F /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).

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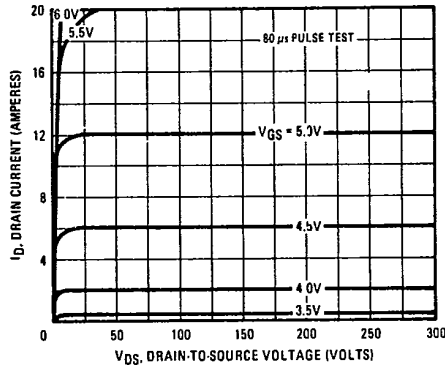


Fig. 1 - Typical Output Characteristics

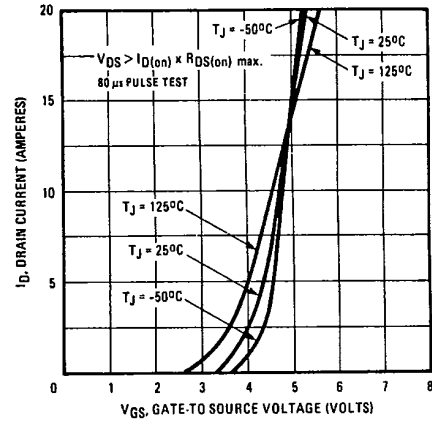


Fig. 2 - Typical Transfer Characteristics

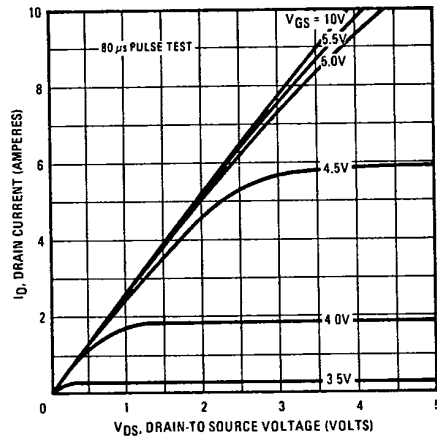


Fig. 3 - Typical Saturation Characteristics

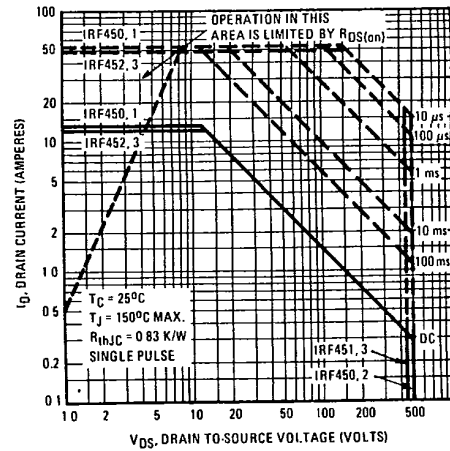


Fig. 4 - Maximum Safe Operating Area

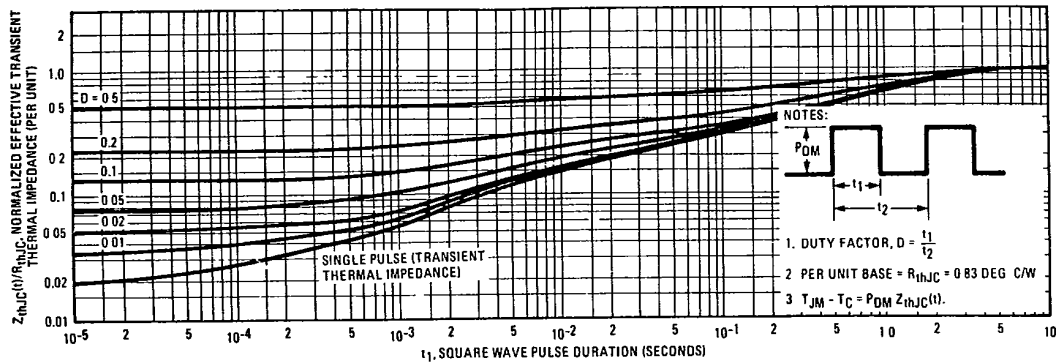


Fig. 5 - Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

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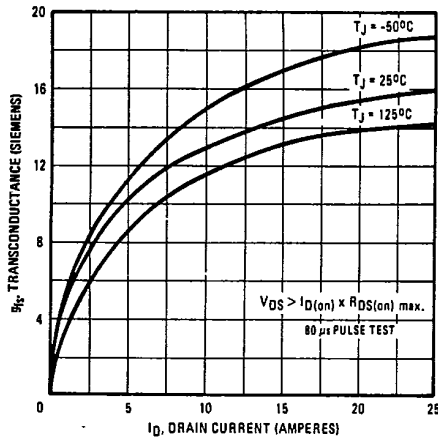


Fig. 6 - Typical Transconductance Vs. Drain Current

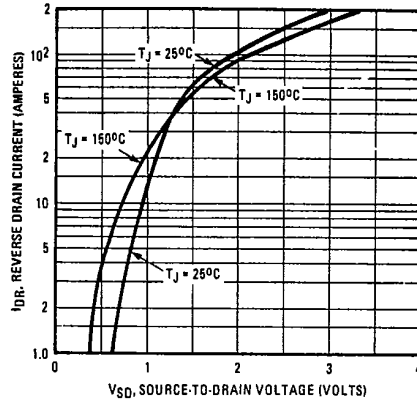


Fig. 7 - Typical Source-Drain Diode Forward Voltage

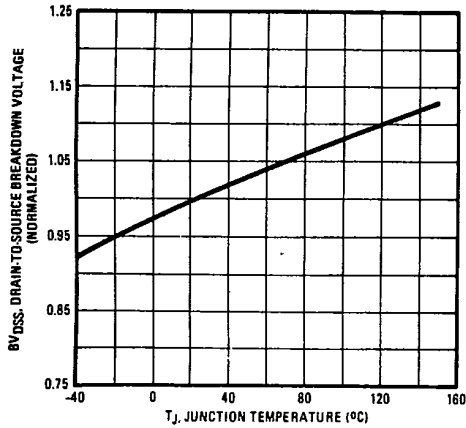


Fig. 8 - Breakdown Voltage Vs. Temperature

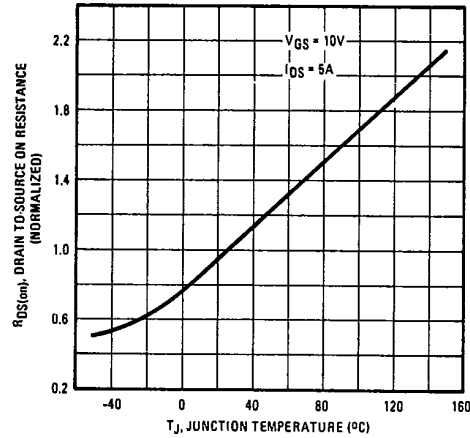


Fig. 9 - Normalized On-Resistance Vs. Temperature

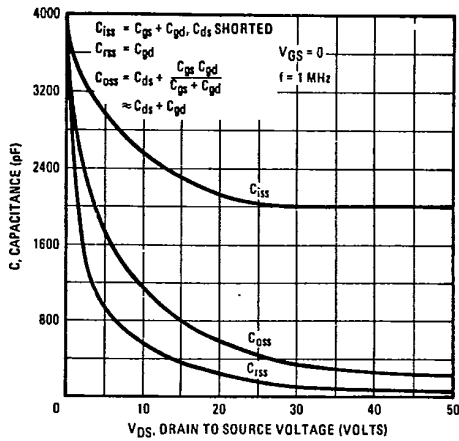


Fig. 10 - Typical Capacitance Vs. Drain-to-Source Voltage

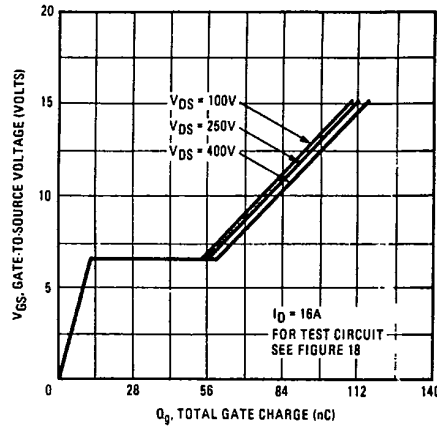


Fig. 11 - Typical Gate Charge Vs. Gate-to-Source Voltage

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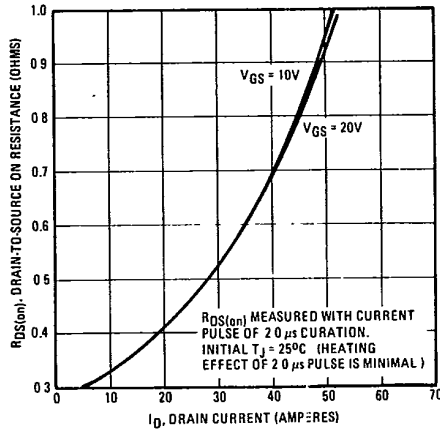


Fig. 12 - Typical On-Resistance Vs. Drain Current

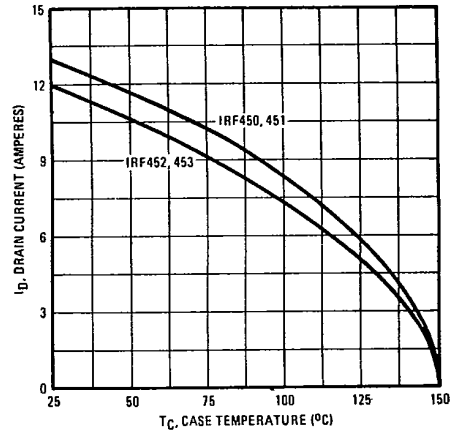


Fig. 13 - Maximum Drain Current Vs. Case Temperature

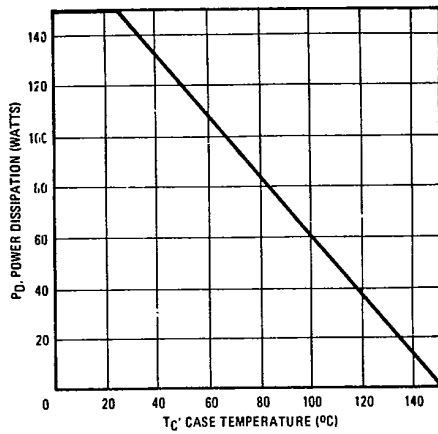


Fig. 14 - Power Vs. Temperature Derating Curve

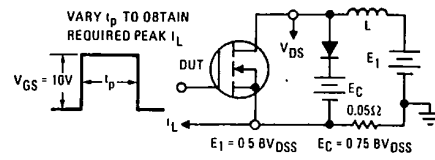


Fig. 15 - Clamped Inductive Test Circuit

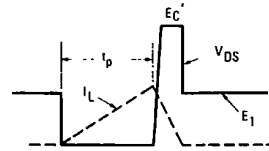


Fig. 16 - Clamped Inductive Waveforms

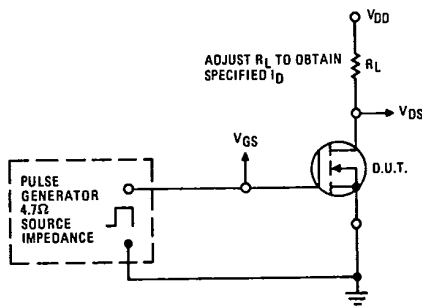


Fig. 17 - Switching Time Test Circuit

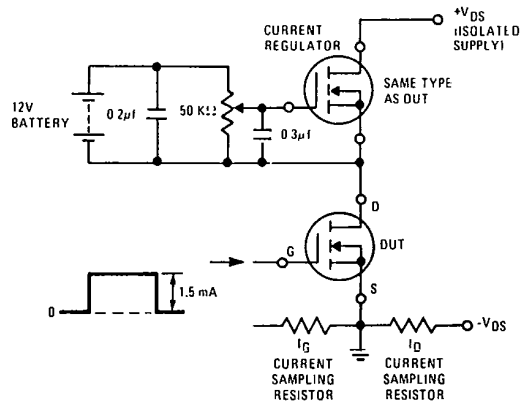


Fig. 18 - Gate Charge Test Circuit