IRF540

Product Preview

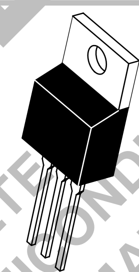
TMOS E-FET ™ Power Field Effect Transistor

N−Channel Enhancement−Mode Silicon Gate

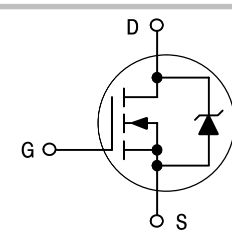
ON Semiconductor®

http://onsemi.com

TMOS POWER FET
27 AMPERES, 100 VOLTS
$R_{DS(on)}$ = 0.070 OHMS



CASE 221A−09
TO-220AB



TMOS®

This advanced TMOS power FET is designed to withstand high energy in the avalanche and commutation modes. This new energy efficient design also offers a drain−to−source diode with a fast recovery time. Designed for low voltage, high speed switching applications in power supplies, converters, and PWM motor controls. These devices are particularly well suited for bridge circuits where diode speed and commutating safe operating area are critical and offer additional safety margin against unexpected voltage transients.

- Avalanche Energy Specified
- Source−to−Drain Diode Recovery Time Comparable to a Discrete Fast Recovery Diode
- Diode is Characterized for Use in Bridge Circuits
- I_{DSS} and $V_{DS(on)}$ Specified at Elevated Temperature

MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Drain−to−Source Voltage	V_{DSS}	100	Vdc
Drain−to−Gate Voltage (R_{GS} = 1.0 MΩ)	V_{DGR}	100	Vdc
Gate−to−Source Voltage — Continuous — Non−repetitive ($t_p \le$ 10 ms)	V_{GS} V_{GSM}	±20 ±40	Vdc Vpk
Drain Current — Continuous — Continuous @ 100°C — Single Pulse ($t_p \le$ 10 μs)	I_D I_D I_{DM}	27 19 95	Adc Apk
Total Power Dissipation Derate above 25°C	P_D	145 1.16	Watts W/°C
Operating and Storage Temperature Range	T_J, T_{stg}	−55 to 150	°C
Single Pulse Drain−to−Source Avalanche Energy — STARTING T_J = 25°C (V_{DD} = 50 Vdc, V_{GS} = 10 Vdc, PEAK I_L = 27 Apk, L = 1.0 mH, R_G = 25 Ω)	E_{AS}	365	mJ
Thermal Resistance — Junction−to−Case — Junction−to−Ambient	$R_{\theta JC}$ $R_{\theta JA}$	0.86 62.5	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 10 seconds	T_L	260	°C

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August, 2006 − Rev. 4
Publication Order Number:
IRF540/D

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain−to−Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 0.25 mAdc)	$V_{(BR)DSS}$	100	—	—	Vdc
Temperature Coefficient (Positive)		—	116	—	mV/°C
Zero Gate Voltage Drain Current (V_{DS} = 100 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
(V_{DS} = 100 Vdc, V_{GS} = 0 Vdc, T_J = 125°C)		—	—	100	
Gate−Body Leakage Current (V_{GS} = ±20 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	100	nAdc
ON CHARACTERISTICS(1)					
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 250 μAdc) Cpk ≥ 2.0(3)	$V_{GS(th)}$	2.0	2.9	4.0	Vdc
Threshold Temperature Coefficient (Negative)		—	6.8	—	mV/°C
Static Drain−to−Source On−Resistance (V_{GS} = 10 Vdc, I_D = 15 Adc) Cpk ≥ 2.0(3)	$R_{DS(on)}$	—	0.047	0.070	Ohms
Drain−to−Source On−Voltage (V_{GS} = 10 Vdc, I_D = 27 Adc)	$V_{DS(on)}$	—	—	1.9	Vdc
(V_{GS} = 10 Vdc, I_D = 15 Adc, T_J = 125°C)		—	—	1.8	
Forward Transconductance (V_{DS} = 15 Vdc, I_D = 15 Adc)	g_{FS}	6.0	15	—	Mhos
DYNAMIC CHARACTERISTICS					
Input Capacitance (V_{DS} = 25 Vdc, V_{GS} = 0 Vdc, f = 1.0 MHz)	C_{iss}	—	1460	1600	pF
Output Capacitance	C_{oss}	—	390	800	
Transfer Capacitance	C_{rss}	—	120	300	
SWITCHING CHARACTERISTICS(2)					
Turn−On Delay Time (V_{DD} = 30 Vdc, I_D = 15 Adc, V_{GS} = 10 Vdc, R_G = 4.7 Ω)	$t_{d(on)}$	—	11.6	30	ns
Rise Time	t_r	—	50	60	
Turn−Off Delay Time	$t_{d(off)}$	—	26	80	
Fall Time	t_f	—	19	30	
Gate Charge (See Figure 8) (V_{DS} = 80 Vdc, I_D = 27 Adc, V_{GS} = 10 Vdc)	Q_T	—	50	60	nC
	Q_1	—	9.0	—	
	Q_2	—	26	—	
	Q_3	—	20	—	
SOURCE−DRAIN DIODE CHARACTERISTICS					
Forward On−Voltage (I_S = 27 Adc, V_{GS} = 0 Vdc)	V_{SD}	—	0.93	2.4	Vdc
(I_S = 27 Adc, V_{GS} = 0 Vdc, T_J = 125°C)		—	0.84	—	
Reverse Recovery Time (I_S = 27 Adc, V_{GS} = 0 Vdc, dI_S/dt = 100 A/μs)	t_{rr}	—	110	—	ns
	t_a	—	100	—	
	t_b	—	10	—	
Reverse Recovery Stored Charge	Q_{RR}	—	0.67	—	μC
INTERNAL PACKAGE INDUCTANCE					
Internal Drain Inductance (Measured from the contact screw on tab to center of die)	L_d	—	3.5	—	nH
(Measured from the drain lead 0.25″ from package to center of die)		—	4.5	—	
Internal Source Inductance (Measured from the source lead 0.25″ from package to source bond pad)	L_s	—	7.5	—	

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
(2) Switching characteristics are independent of operating junction temperature.
(3) Reflects typical values. $Cpk = \left|\frac{\text{Max limit} - \text{Typ}}{3 \times \text{sigma}}\right|$

TYPICAL ELECTRICAL CHARACTERISTICS

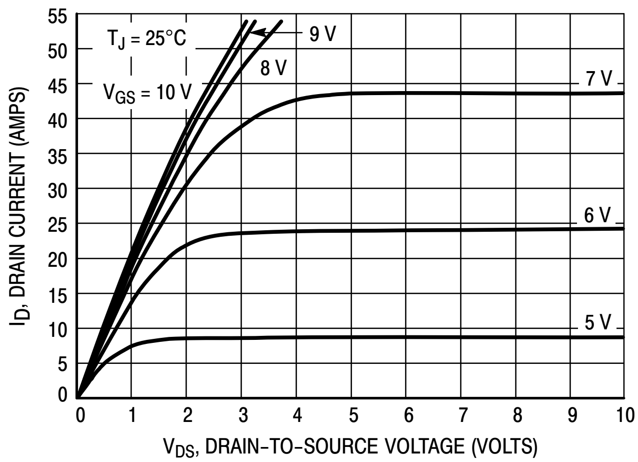


Figure 1. On−Region Characteristics

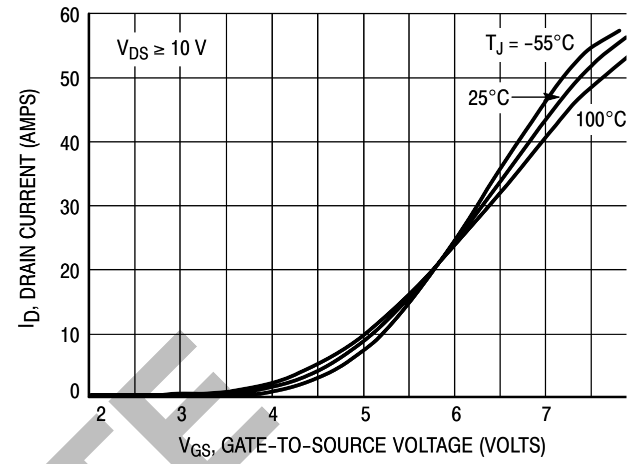


Figure 2. Transfer Characteristics

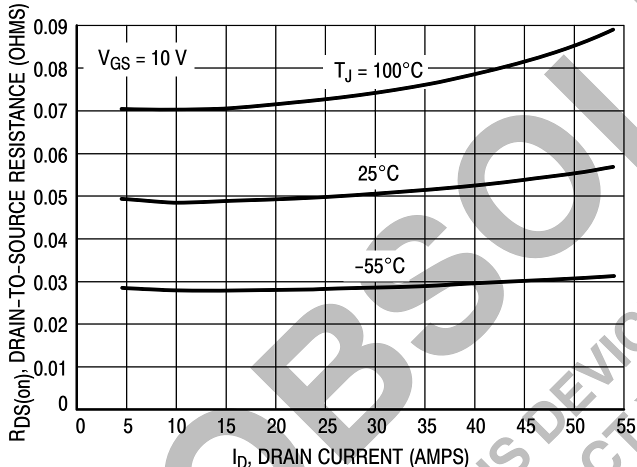


Figure 3. On−Resistance versus Drain Current and Temperature

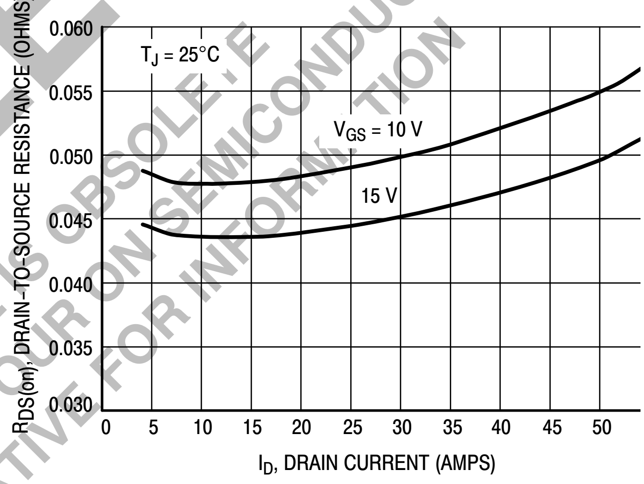


Figure 4. On−Resistance versus Drain Current and Gate Voltage

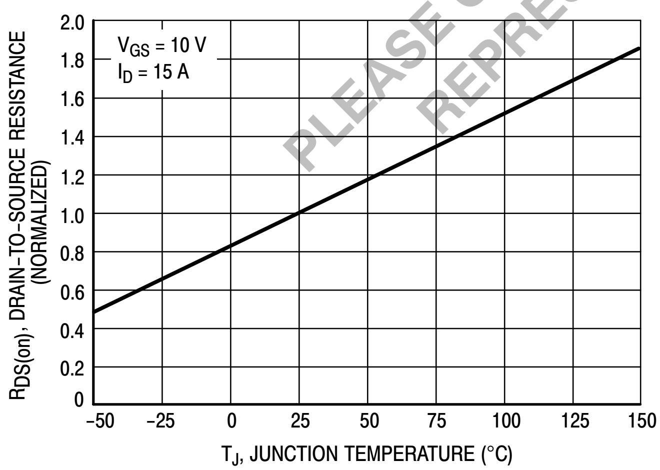


Figure 5. On−Resistance Variation with Temperature

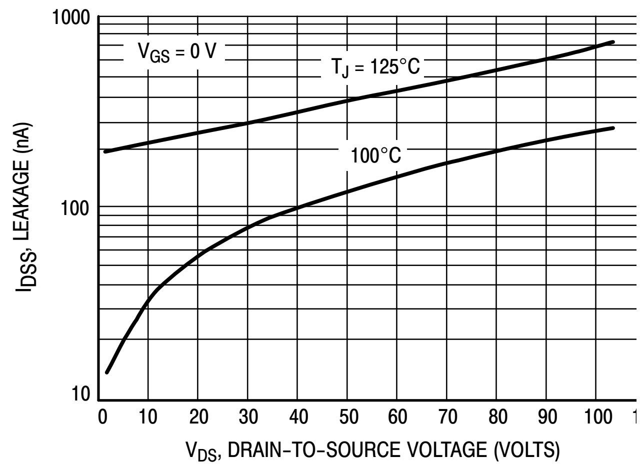


Figure 6. Drain−to−Source Leakage Current versus Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

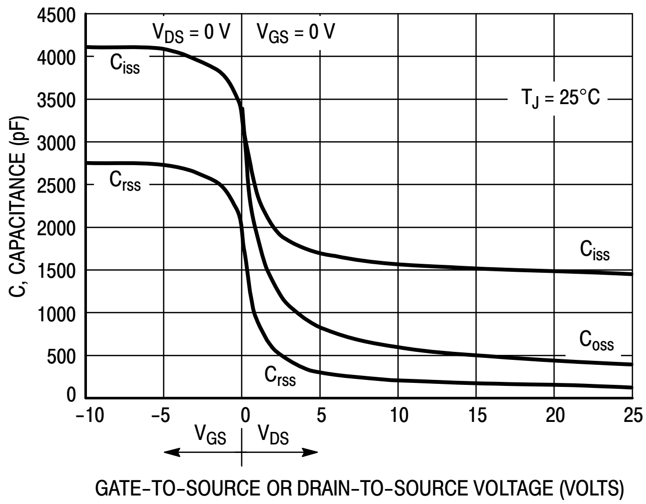


Figure 7. Capacitance Variation

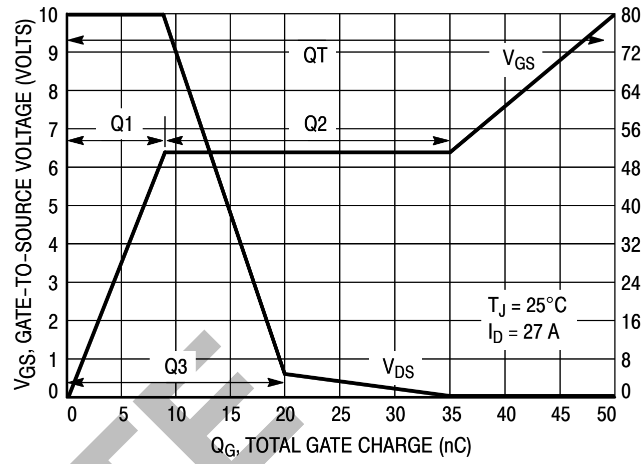


Figure 8. Gate−to−Source and Drain−to−Source Voltage versus Total Charge

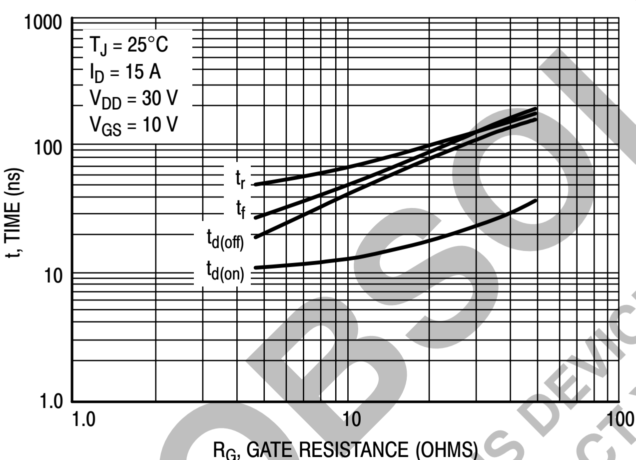


Figure 9. Resistive Switching Time Variation versus Gate Resistance

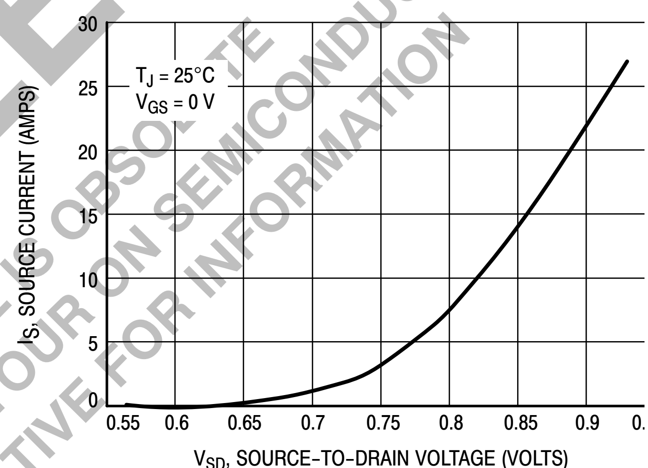


Figure 10. Diode Forward Voltage versus Current

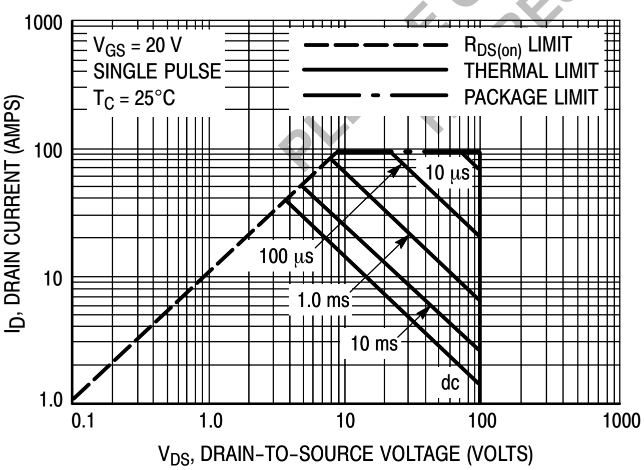


Figure 11. Maximum Rated Forward Biased Safe Operating Area

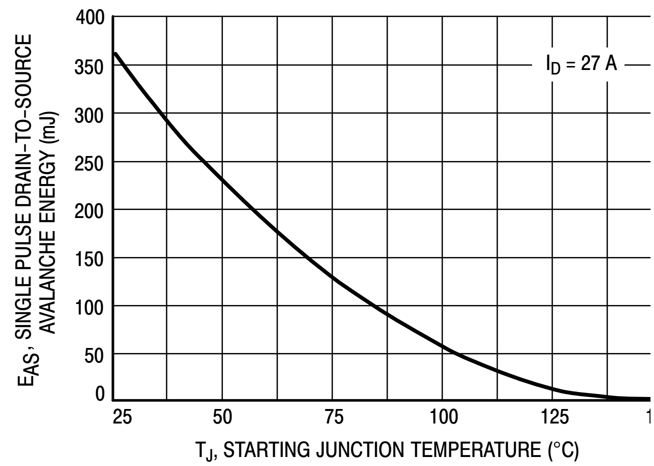


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

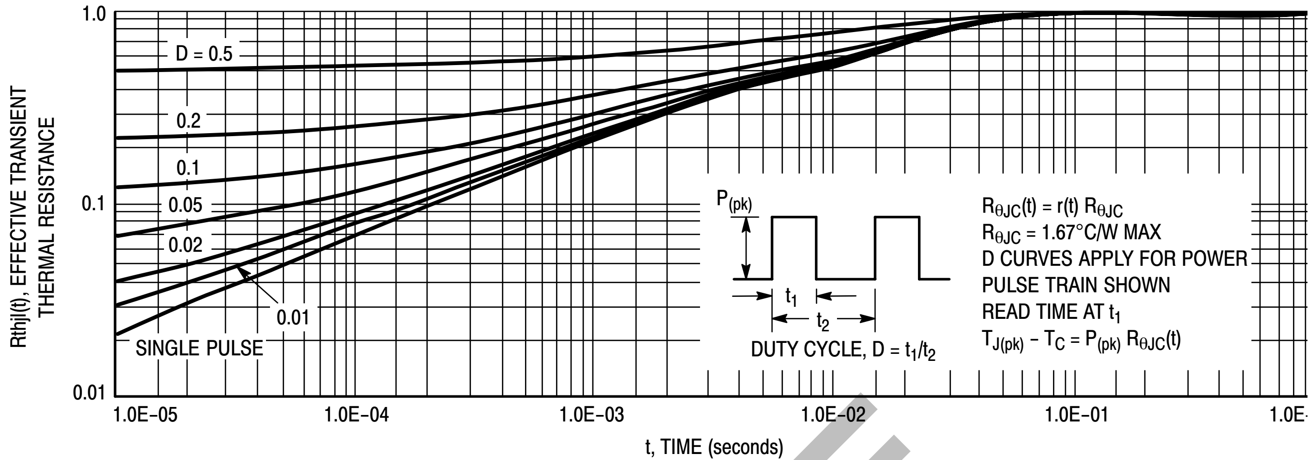
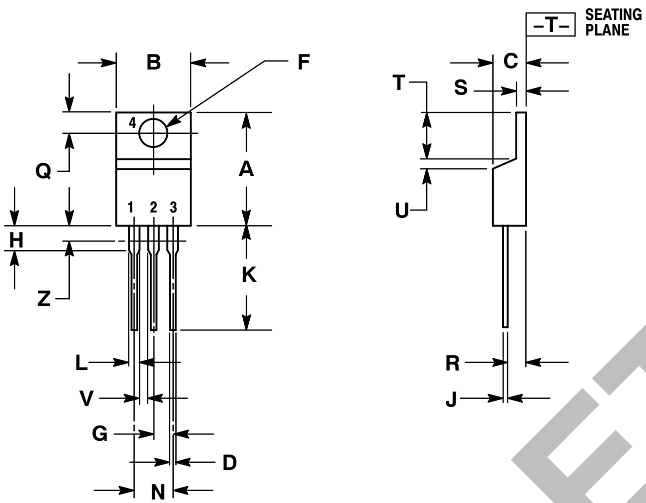


Figure 13. Thermal Response

PACKAGE DIMENSIONS

CASE 221A−09
(TO−220AB)
ISSUE Z



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

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