

MOTOROLA

SEMICONDUCTOR

TECHNICAL DATA

Advance Information

Power Field Effect Transistor

P-Channel Enhancement-Mode

Silicon Gate

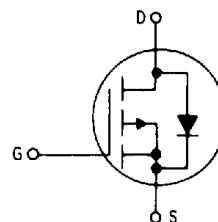
This TMOS Power FET is designed for medium voltage, high speed power switching applications such as switching regulators, converters, solenoid and motor drives.

- Silicon Gate for Fast Switching Speeds — Switching Times Specified at 100°C
- Designers Data — I_{DSS} , $V_{DS(on)}$, $V_{GS(th)}$, and SOA Specified at Elevated Temperature
- Rugged — SOA is Power Dissipation Limited
- Source-to-Drain Diode Characterized for Use With Inductive Loads



MTP5P25

TMOS POWER FET
5 AMPERES
 $R_{DS(on)} = 3 \text{ OHMS}$
250 VOLTS



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	250	Vdc
Drain-Gate Voltage ($R_{GS} = 1 \text{ M}\Omega$)	V_{DGR}	250	Vdc
Gate-Source Voltage — Continuous	V_{GS}	± 20	Vdc
— Non-repetitive ($t_p \leq 50 \mu\text{s}$)	V_{GSM}	± 40	Vpk
Drain Current — Continuous	I_D	5	Adc
— Pulsed	I_{DM}	15	
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	P_D	75	Watts
Derate above 25°C		0.6	W/ $^\circ\text{C}$
Operating and Storage Temperature Range	T_J, T_{stg}	-65 to 150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Thermal Resistance	$R_{\theta JC}$	1.67		$^\circ\text{C/W}$
Junction to Case				
Junction to Ambient	$R_{\theta JA}$	30	62.5	
Maximum Lead Temperature for Soldering	T_L	260		$^\circ\text{C}$
Purposes, 1/8" from case for 5 seconds				

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

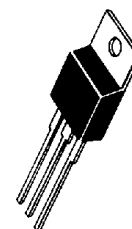
Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Drain-Source Breakdown Voltage ($V_{GS} = 0, I_D = 0.25 \text{ mA}$)	$V_{(BR)DSS}$	250	—	Vdc
Zero Gate Voltage Drain Current ($V_{DS} = \text{Rated } V_{DSS}, V_{GS} = 0$)	I_{DSS}	—	0.2	mAdc
($V_{DS} = 0.8 \text{ Rated } V_{DSS}, V_{GS} = 0, T_J = 125^\circ\text{C}$)		—	1	

This document contains information on a new product. Specifications and information herein are subject to change without notice.

(continued)



CASE 221A-06
TO-220AB

MTP5P25

ELECTRICAL CHARACTERISTICS — continued ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
Gate-Body Leakage Current, Forward ($V_{GS} = 20\text{ Vdc}$, $V_{DS} = 0$)	I_{GSSF}	—	100	nAdc
Gate-Body Leakage Current, Reverse ($V_{GSR} = 20\text{ Vdc}$, $V_{DS} = 0$)	I_{GSSR}	—	100	nAdc

ON CHARACTERISTICS*

Gate Threshold Voltage ($V_{DS} = V_{GS}$, $I_D = 1\text{ mA}$) $T_J = 100^\circ\text{C}$	$V_{GS(th)}$	2 1.5	4.5 4	Vdc
Static Drain-Source On-Resistance ($V_{GS} = 10\text{ Vdc}$, $I_D = 2.5\text{ Adc}$)	$R_{DS(on)}$	—	3	Ohms
Drain-Source On-Voltage ($V_{GS} = 10\text{ V}$) ($I_D = 5\text{ Adc}$) ($I_D = 2.5\text{ Adc}$, $T_J = 100^\circ\text{C}$)	$V_{DS(on)}$	— —	16 15	Vdc
Forward Transconductance ($V_{DS} = 10\text{ V}$, $I_D = 2.5\text{ A}$)	g_{FS}	1	—	mhos

DYNAMIC CHARACTERISTICS

Input Capacitance	(VDS = 25 V, VGS = 0, f = 1 MHz) See Figure 14	C_{iss}	—	1600	pF
Output Capacitance		C_{oss}	—	400	
Reverse Transfer Capacitance		C_{rss}	—	250	

SWITCHING CHARACTERISTICS* ($T_J = 100^\circ\text{C}$)

Turn-On Delay Time	(VDD = 25 V, $I_D = 0.5\text{ Rated } I_D$ $R_{gen} = 50\text{ ohms}$) See Figures 11, 12 and 13	$t_{d(on)}$	—	40	ns
Rise Time		t_r	—	70	
Turn-Off Delay Time		$t_{d(off)}$	—	90	
Fall Time		t_f	—	60	
Total Gate Charge	(VDS = 0.8 Rated VDS, $I_D = \text{Rated } I_D$, $V_{GS} = 10\text{ V}$) See Figure 10	Q_g	15 (Typ)	30	nC
Gate-Source Charge		Q_{gs}	5 (Typ)	—	
Gate-Drain Charge		Q_{gd}	10 (Typ)	—	

SOURCE DRAIN DIODE CHARACTERISTICS*

Forward On-Voltage	(IS = Rated ID VGS = 0)	VSD	3 (Typ)	5	Vdc
Forward Turn-On Time		t_{on}	180 (Typ)	—	ns
Reverse Recovery Time		t_{rr}	200 (Typ)	—	ns

*Pulse Test: Pulse Width $\leq 300\text{ }\mu\text{s}$, Duty Cycle $\leq 2\%$.

TYPICAL ELECTRICAL CHARACTERISTICS

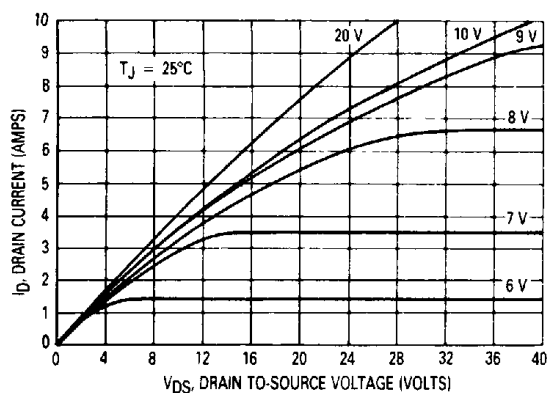


Figure 1. On-Region Characteristics

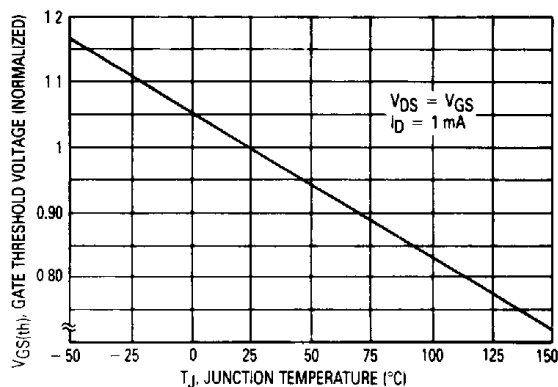


Figure 2. Gate-Threshold Voltage Variation With Temperature

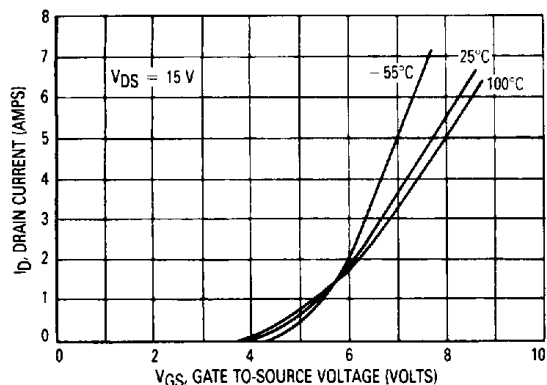


Figure 3. Transfer Characteristics

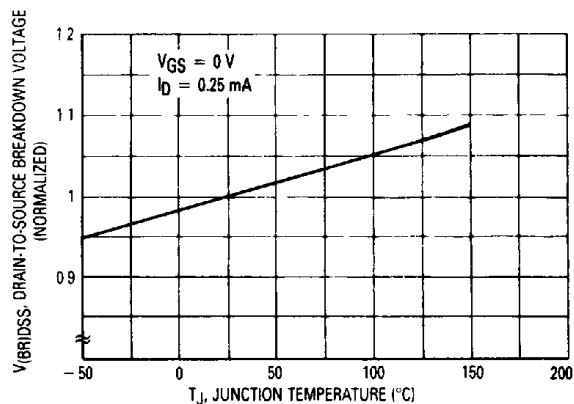


Figure 4. Drain-To-Source Breakdown Voltage Variation With Temperature

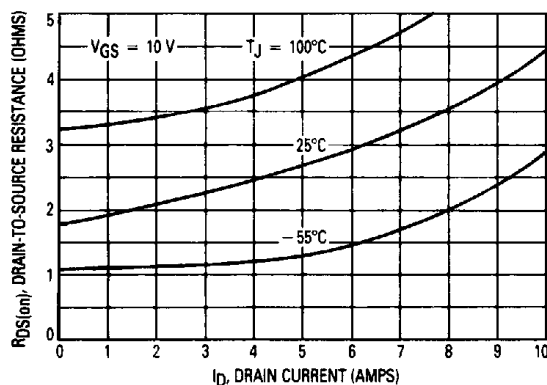


Figure 5. On-Resistance versus Drain Current

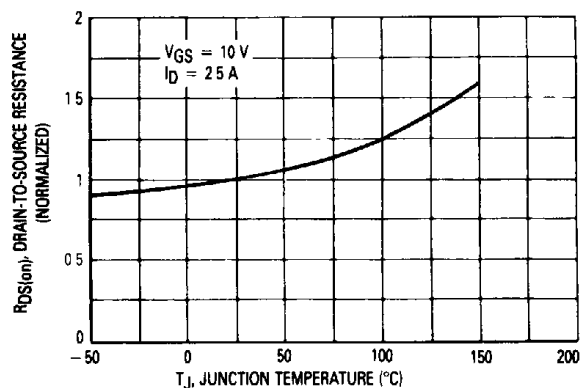


Figure 6. On-Resistance Variation With Temperature

SAFE OPERATING AREA INFORMATION

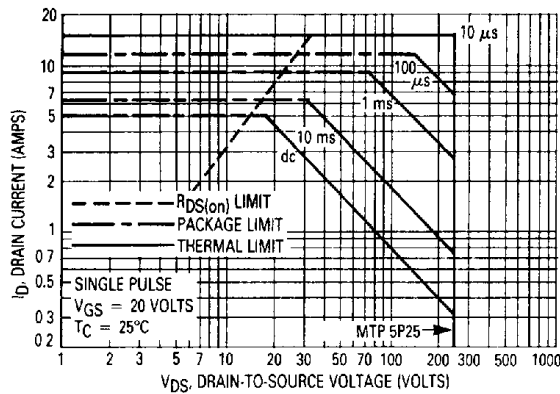


Figure 7. Maximum Rated Forward Bias Safe Operating Area

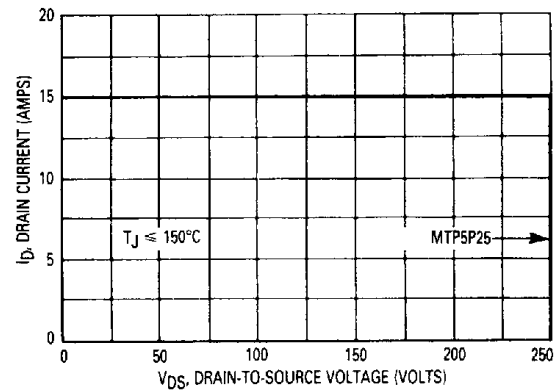


Figure 8. Maximum Rated Switching Safe Operating Area

FORWARD BIASED SAFE OPERATING AREA

The FBSOA curves define the maximum drain-to-source voltage and drain current that a device can safely handle when it is forward biased, or when it is on, or being turned on. Because these curves include the limitations of simultaneous high voltage and high current, up to the rating of the device, they are especially useful to designers of linear systems. The curves are based on a case temperature of 25°C and a maximum junction temperature of 150°C. Limitations for repetitive pulses at various case temperatures can be determined by using the thermal response curves. Motorola Application Note, AN569, "Transient Thermal Resistance-General Data and its Use" provides detailed instructions.

SWITCHING SAFE OPERATING AREA

The switching safe operating area (SOA) of Figure 8 is the boundary that the load line may traverse without incurring damage to the MOSFET. The fundamental limits are the peak current, I_{DM} and the breakdown voltage, $V_{(BR)DSS}$. The switching SOA shown in Figure 8 is applicable for both turn-on and turn-off of the devices for switching times less than one microsecond.

The power averaged over a complete switching cycle must be less than:

$$\frac{T_{J(max)} - T_C}{R_{\theta JC}}$$

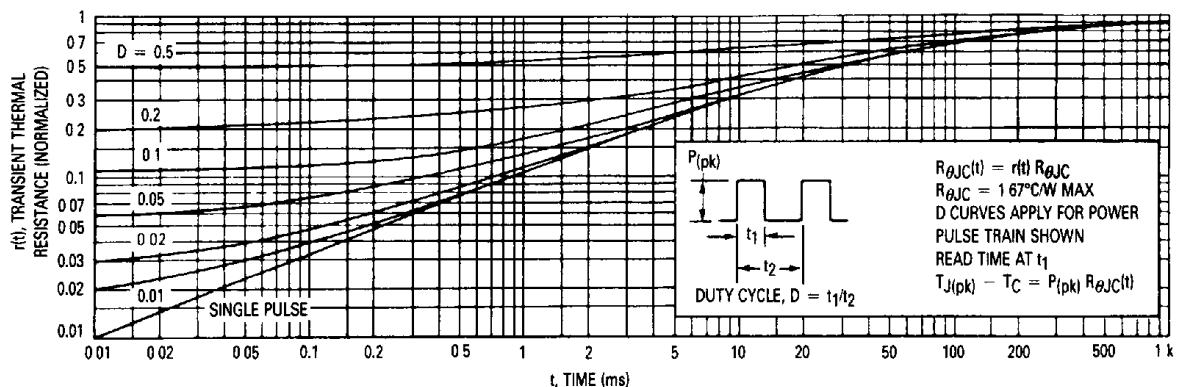


Figure 9. Thermal Response

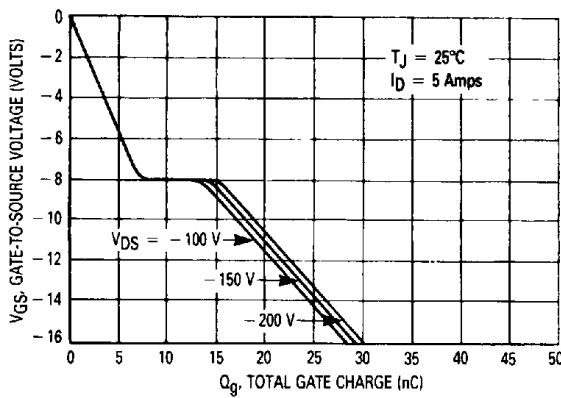


Figure 10. Gate Charge versus Gate-To-Source Voltage

RESISTIVE SWITCHING

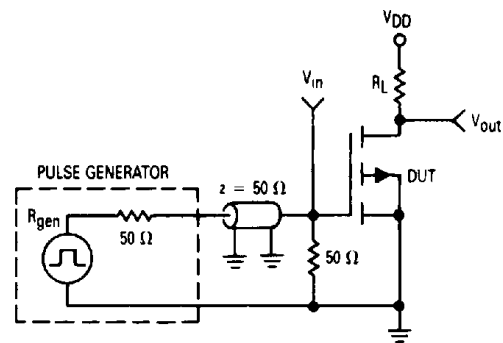


Figure 11. Switching Test Circuit

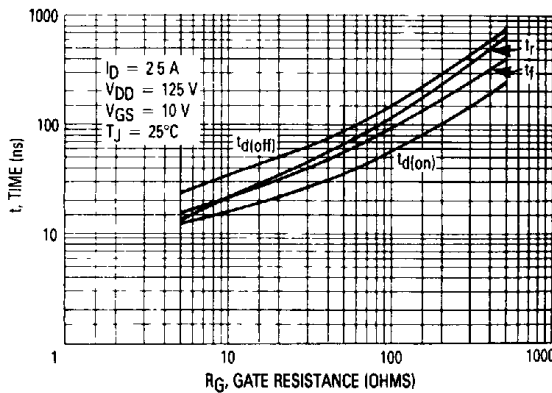


Figure 12. Resistive Switching versus Gate Resistance

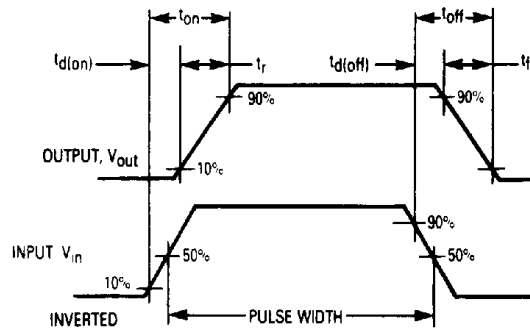


Figure 13. Switching Waveforms

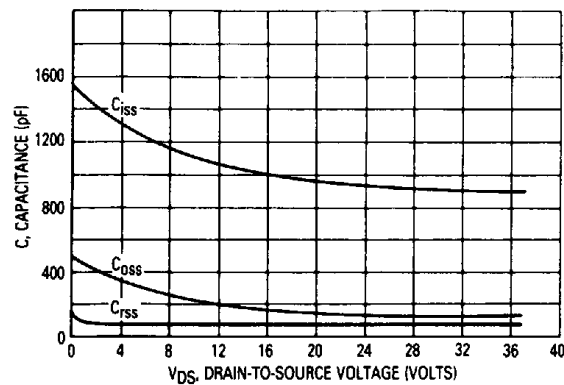


Figure 14. Capacitance Variation