MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MTP5P25

Advance Information

Power Field Effect Transistor

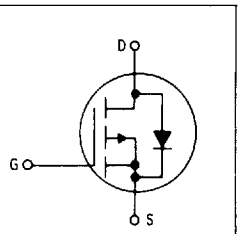
P-Channel Enhancement-Mode Silicon Gate

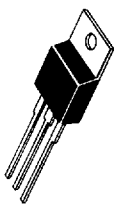
TMOS POWER FET
5 AMPERES
$R_{DS(on)}$ = 3 OHMS
250 VOLTS

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

TMOS®





CASE 221A-06
TO-220AB

MAXIMUM RATINGS

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

THERMAL CHARACTERISTICS

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

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Drain-Source Breakdown Voltage (V_{GS} = 0, I_D = 0.25 mA)	$V_{(BR)DSS}$	250	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = Rated V_{DSS}, V_{GS} = 0) (V_{DS} = 0.8 Rated V_{DSS}, V_{GS} = 0, T_J = 125°C)	I_{DSS}	— —	0.2 1	mAdc

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

(continued)

ELECTRICAL CHARACTERISTICS — continued (T_C = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
Gate-Body Leakage Current, Forward (V_{GSF} = 20 Vdc, V_{DS} = 0)		I_{GSSF}	—	100	nAdc
Gate-Body Leakage Current, Reverse (V_{GSR} = 20 Vdc, V_{DS} = 0)		I_{GSSR}	—	100	nAdc
ON CHARACTERISTICS*					
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 1 mA) T_J = 100°C		$V_{GS(th)}$	2 1.5	4.5 4	Vdc
Static Drain-Source On-Resistance (V_{GS} = 10 Vdc, I_D = 2.5 Adc)		$R_{DS(on)}$	—	3	Ohms
Drain-Source On-Voltage (V_{GS} = 10 V) (I_D = 5 Adc) (I_D = 2.5 Adc, T_J = 100°C)		$V_{DS(on)}$	— —	16 15	Vdc
Forward Transconductance (V_{DS} = 10 V, I_D = 2.5 A)		g_{FS}	1	—	mhos
DYNAMIC CHARACTERISTICS					
Input Capacitance	(V_{DS} = 25 V, V_{GS} = 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°C)					
Turn-On Delay Time	(V_{DD} = 25 V, I_D = 0.5 Rated I_D, R_{gen} = 50 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	(V_{DS} = 0.8 Rated V_{DSS}, I_D = Rated I_D, V_{GS} = 10 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	(I_S = Rated I_D, V_{GS} = 0)	V_{SD}	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 ≤ 300 μs, Duty Cycle ≤ 2%.

TYPICAL ELECTRICAL CHARACTERISTICS

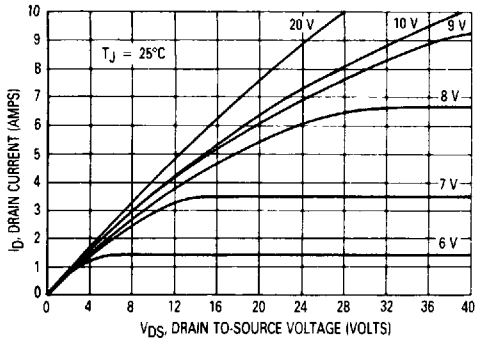


Figure 1. On-Region Characteristics

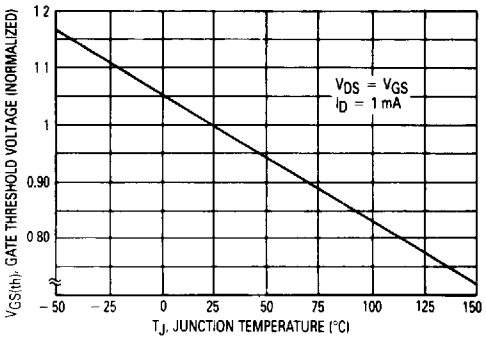


Figure 2. Gate-Threshold Voltage Variation With Temperature

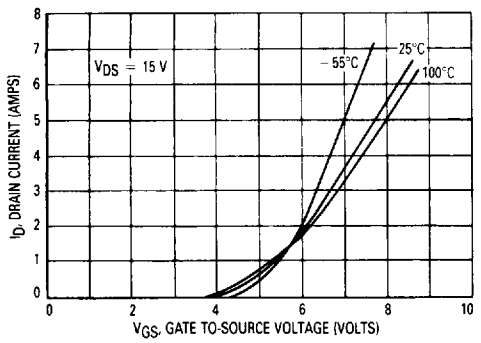


Figure 3. Transfer Characteristics

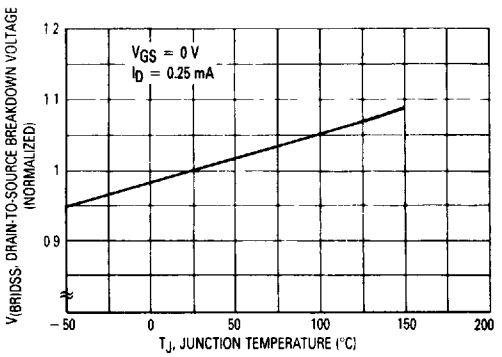


Figure 4. Drain-To-Source Breakdown Voltage Variation With Temperature

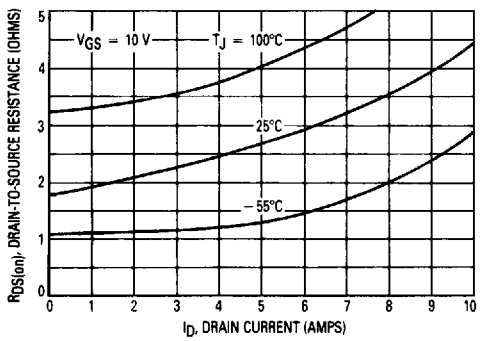


Figure 5. On-Resistance versus Drain Current

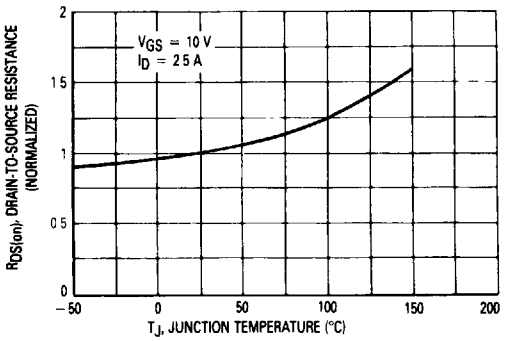


Figure 6. On-Resistance Variation With Temperature

SAFE OPERATING AREA INFORMATION

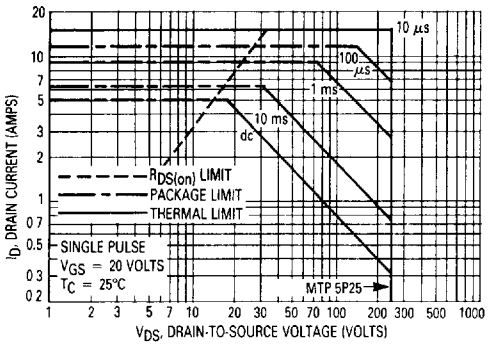


Figure 7. Maximum Rated Forward Bias Safe Operating Area

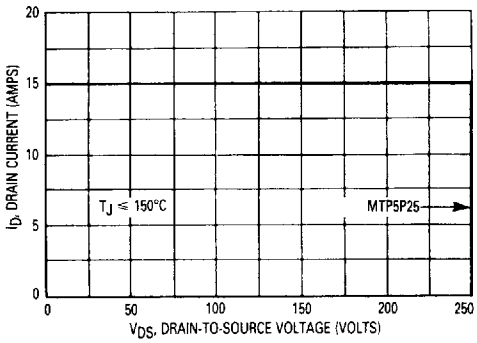


Figure 8. Maximum Rated Switching Safe Operating Area

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:

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

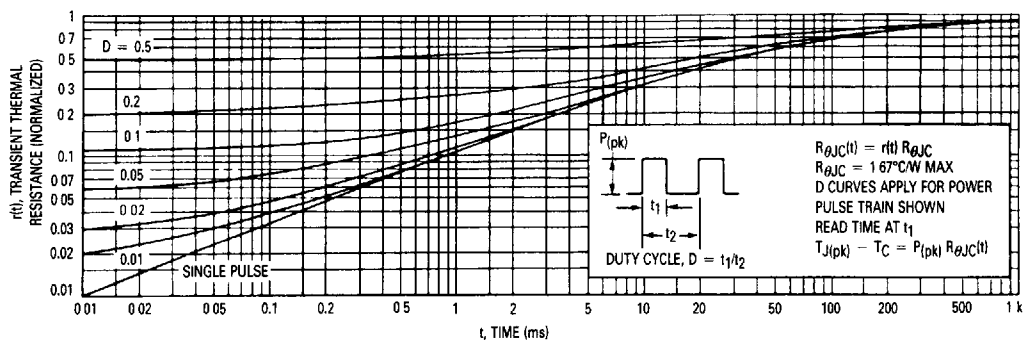


Figure 9. Thermal Response

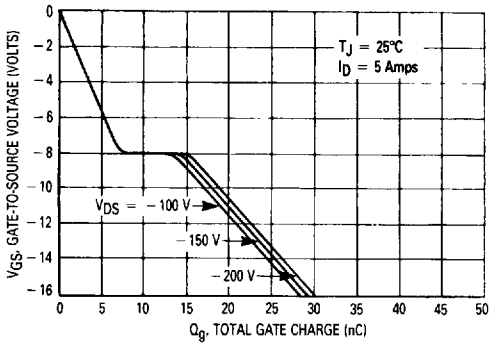


Figure 10. Gate Charge versus Gate-To-Source Voltage

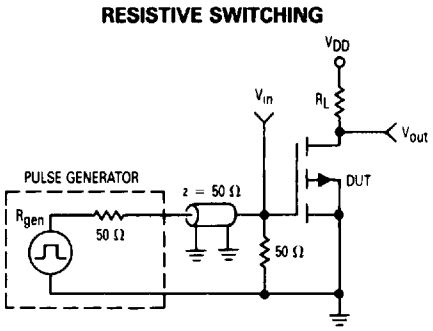


Figure 11. Switching Test Circuit

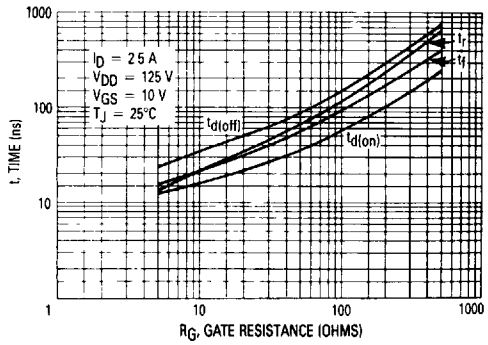


Figure 12. Resistive Switching versus Gate Resistance

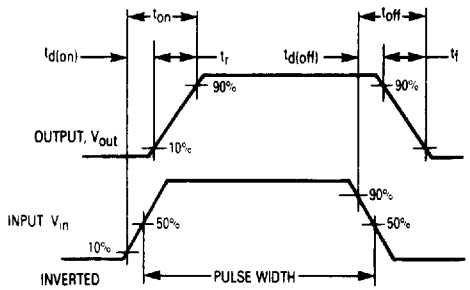


Figure 13. Switching Waveforms

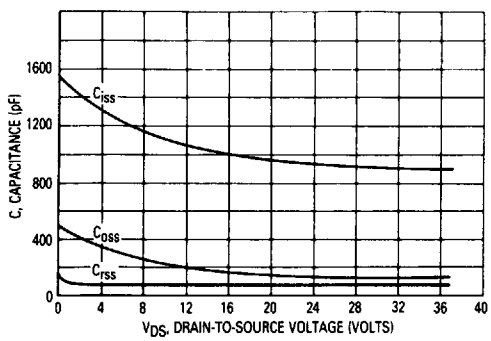
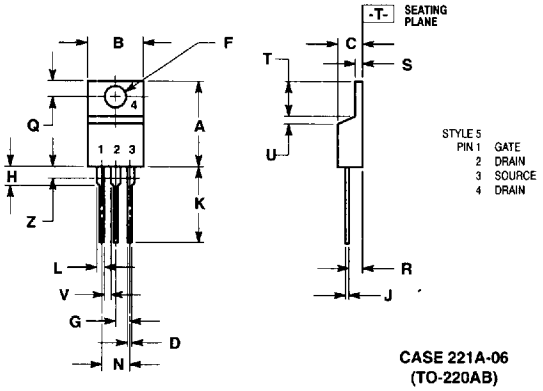


Figure 14. Capacitance Variation

PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)

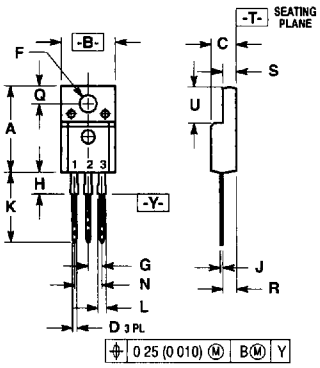


STYLE 5
PIN 1 GATE
2 DRAIN
3 SOURCE
4 DRAIN

CASE 221A-06
(TO-220AB)

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

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	14 48	15 75	0 570	0 620
B	9 66	10 28	0 380	0 405
C	4 07	4 82	0 160	0 190
D	0 64	0 88	0 025	0 035
F	3 61	3 73	0 142	0 147
G	2 42	2 66	0 095	0 105
H	2 80	3 93	0 110	0 155
J	0 46	0 64	0 018	0 025
K	12 70	14 27	0 500	0 562
L	1 15	1 52	0 045	0 060
N	4 83	5 33	0 190	0 210
Q	2 54	3 04	0 100	0 120
R	2 04	2 79	0 080	0 110
S	1 15	1 39	0 045	0 055
T	5 97	6 47	0 235	0 255
U	0 00	1 27	0 000	0 050
V	1 15	—	0 045	—
Z		2 04	—	0 080

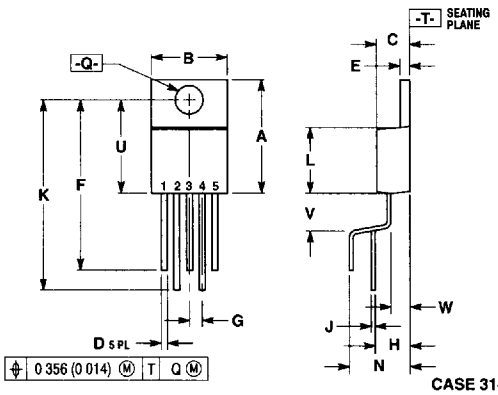


STYLE 1
PIN 1 GATE
2 DRAIN
3 SOURCE

CASE 221D-02
(ISOLATED TO-220 TYPE)

NOTES
1 DIMENSIONING AND TOLERANCING PER ANSI Y14 5M 1982
2 CONTROLLING DIMENSION INCH
3 221D 01 OBSOLETE NEW STANDARD 221D 02

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	15 78	15 97	0 621	0 629
B	10 01	10 21	0.394	0 402
C	4 60	4 80	0 181	0 189
D	0 67	0 86	0 026	0 034
F	3 08	3 27	0 121	0 129
G	2 54 BSC		0 100 BSC	
H	3 13	3 27	0 123	0 129
J	0 46	0 64	0 018	0 025
K	12 70	14 27	0 500	0 562
L	1 14	1 52	0 045	0 060
N	5 08 BSC		0 200 BSC	
Q	3 21	3 40	0 126	0 134
R	2 72	2 81	0 107	0 111
S	2 44	2 64	0 096	0 104
U	6 58	6 78	0 259	0 267



STYLE 5
PIN 1 GATE
2 MIRROR
3 DRAIN
4 KELVIN
5 SOURCE

CASE 314B-03
(5-PIN TO-220)

NOTES
1 DIMENSIONING AND TOLERANCING PER ANSI Y14 5M, 1982
2 CONTROLLING DIMENSION INCH
3 314B 01 AND -02 OBSOLETE, NEW STANDARD 314B 03
STYLE 1 THRU 4 OBSOLETE

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	14 529	15 570	0 572	0 613
B	9 906	10 541	0 390	0 415
C	4 318	4 572	0 170	0 180
D	0 635	0 965	0 025	0 038
E	1 169	1 397	0 046	0 055
F	21 590	23 749	0 850	0 935
G	1 702 BSC		0 067 BSC	
H	3 800	5 080	0 149	0 200
J	0 381	0 635	0 015	0 025
K	22 860	27 940	0 900	1 100
L	8 052	9 398	0 317	0 370
N	7 874	8 800	0 310	0 346
Q	3 556	3 937	0 140	0 155
U	11 888	12 827	0 468	0 505
V	4 699	5 842	0 185	0 230
W	2 286	2 794	0 090	0 110

5