MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MTP2955

Designer's Data Sheet

Power Field Effect Transistor

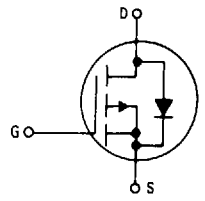
P-Channel Enhancement-Mode Silicon Gate

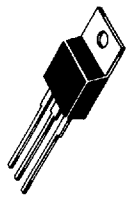
TMOS POWER FET
12 AMPERES
$R_{DS(on)}$ = 0.3 OHM
60 VOLTS

This TMOS Power FET is designed for low voltage, high speed power switching applications such as switching regulators, converters, solenoid and relay drivers.

- Silicon Gate for Fast Switching Speeds — Switching Times Specified at 100°C
- Designer's Data — I_{DSS}, $V_{DS(on)}$, $V_{GS(th)}$ and SOA Specified at Elevated Temperature
- SOA is Power Dissipation Limited
- Source-to-Drain Diode Characterized for Use With Inductive Loads
- P-Channel — Can Be Used as Complement to MTP3055E

TMOS®





CASE 221A-06
TO-220AB

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	60	Vdc
Drain-Gate Voltage (R_{GS} = 1.0 MΩ)	V_{DGR}	60	Vdc
Gate-Source Voltage — Continuous — Non-repetitive ($t_p \leq 50\ \mu s$)	V_{GS} V_{GSM}	±15 ±20	Vdc
Drain Current — Continuous — Pulsed	I_D I_{DM}	12 26	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	$R_{\theta JA}$	62.5	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	T_L	260	°C

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design

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 = 250 μA)	$V_{(BR)DSS}$	60	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 60 Volts, V_{GS} = 0) (V_{DS} = 60 Volts, V_{GS} = 0, T_J = 125°C)	I_{DSS}	— —	10 80	μAdc
Gate-Body Leakage Current, Forward (V_{GSF} = 15 Vdc, V_{DS} = 0)	I_{GSSF}	—	100	nAdc
Gate-Body Leakage Current, Reverse (V_{GSR} = −15 Vdc, V_{DS} = 0)	I_{GSSR}	—	100	nAdc
ON CHARACTERISTICS*				
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 1.0 mA) T_J = 100°C	$V_{GS(th)}$	2.0 1.5	4.5 4.0	Vdc
Static Drain-Source On-Resistance (V_{GS} = 10 Vdc, I_D = 6.0 Adc)	$R_{DS(on)}$	—	0.3	Ohm
Drain-Source On-Voltage (V_{GS} = 10 V) (I_D = 12 Adc) (I_D = 6.0 Adc, T_J = 100°C)	$V_{DS(on)}$	— —	3.9 3.2	Vdc
Forward Transconductance (V_{DS} = 10 V, I_D = 6.0 A)	g_{FS}	3.0	—	mhos
DYNAMIC CHARACTERISTICS				
Input Capacitance	(V_{DS} = 25 V, V_{GS} = 0, f = 1.0 MHz) See Figure 12	C_{iss}	600 (Typ)	—	pF
Output Capacitance		C_{oss}	300 (Typ)	—	
Reverse Transfer Capacitance		C_{rss}	135 (Typ)	—	
SWITCHING CHARACTERISTICS* (T_J = 100°C)					
Turn-On Delay Time	(V_{GS} = 10 V, V_{DD} = 25 V, I_D = 6.0 Amps, R_g = 50 ohms) See Figures 9, 13 and 14	$t_{d(on)}$	10 (Typ)	—	ns
Rise Time		t_r	75 (Typ)	—	
Turn-Off Delay Time		$t_{d(off)}$	75 (Typ)	—	
Fall Time		t_f	50 (Typ)	—	
Total Gate Charge	(V_{DD} = 48 V, I_D = 12 A, V_{GS} = 10 V) See Figure 11	Q_g	26 (Typ)	45	nC
Gate-Source Charge		Q_{gs}	3.5 (Typ)	—	
Gate-Drain Charge		Q_{gd}	15 (Typ)	—	
SOURCE DRAIN DIODE CHARACTERISTICS*					
Forward On-Voltage	I_S = 12 A, V_{GS} = 0	V_{SD}	3.0 (Typ)	3.8	Vdc
Forward Turn-On Time	I_S = 12 A, dI_S/dt = 100 A/μs, V_R = 30 V	t_{on}	Limited by stray inductance		
Reverse Recovery Time		t_{rr}	110 (Typ)	—	ns
INTERNAL PACKAGE INDUCTANCE					
Internal Drain Inductance (Measured from contact screw on tab to center of die) (Measured from the drain lead 0.25" from package to center of die)		L_d	3.5 (Typ) 4.5 (Typ)	— —	nH
Internal Source Inductance (Measured from the source lead 0.25" from package to center of pad)		L_s	7.5 (Typ)	—	

*Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%

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TYPICAL ELECTRICAL CHARACTERISTICS

Figure 1. On-Region Characteristics

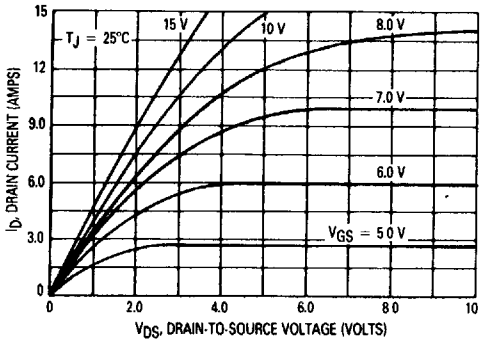


Figure 2. Gate Threshold Variation With Temperature

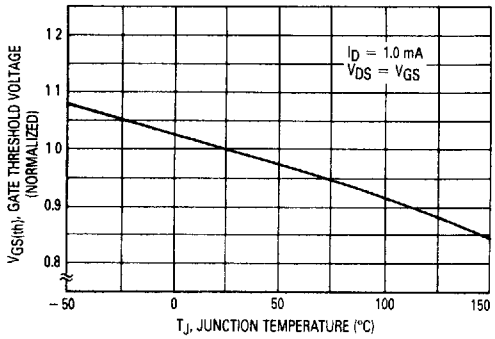


Figure 3. Transfer Characteristics

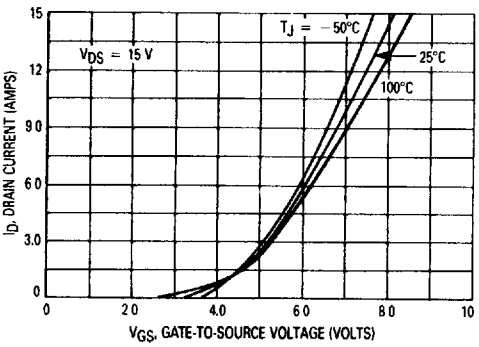


Figure 4. Breakdown Voltage Variation With Temperature

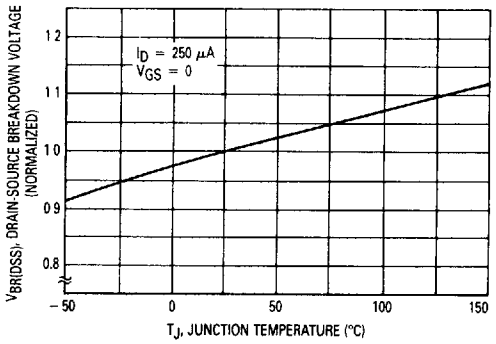


Figure 5. On-Resistance Variation With Drain Current

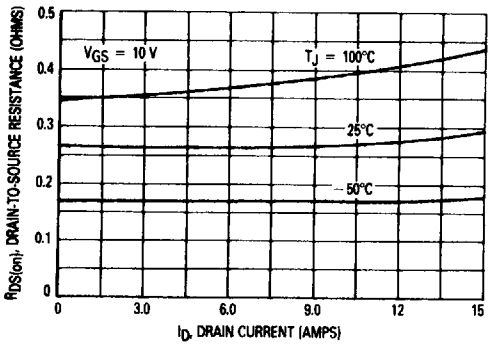
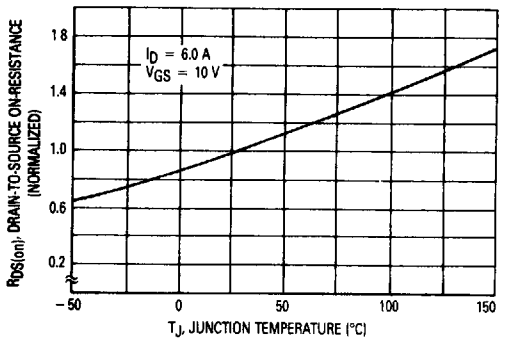


Figure 6. On-Resistance Variation With Temperature



SAFE OPERATING AREA INFORMATION

Figure 7. Maximum Rated Forward Biased Safe Operating Area

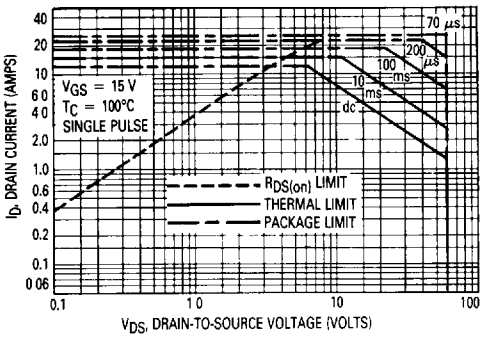
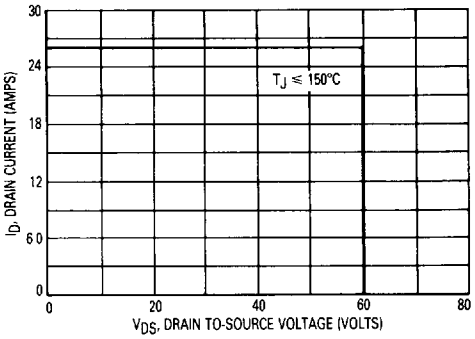


Figure 8. Maximum Rated Switching Safe Operating Area



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. Resistive Switching Time versus Gate Resistance

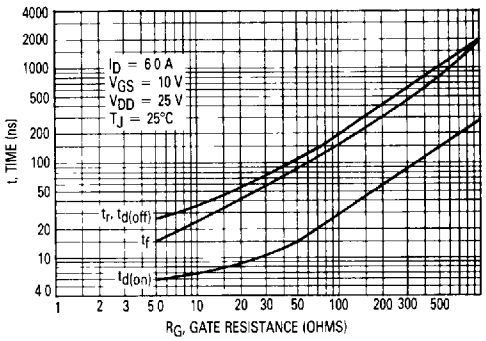
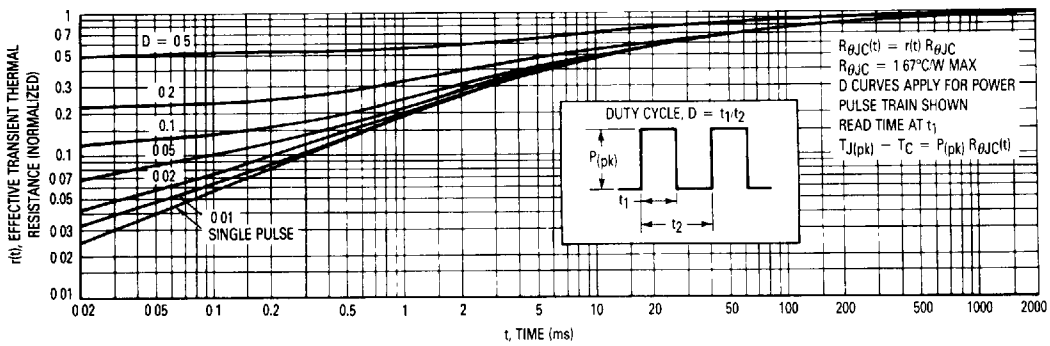


Figure 10. Thermal Response



TYPICAL CHARACTERISTICS

Figure 11. Gate Charge versus Gate-To-Source Voltage

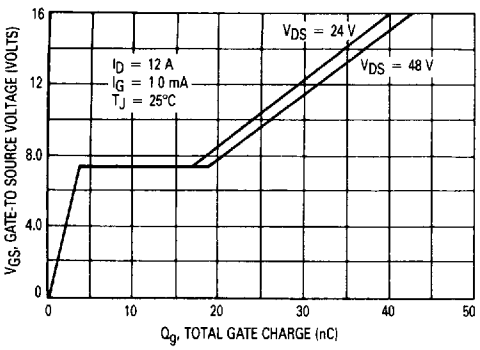
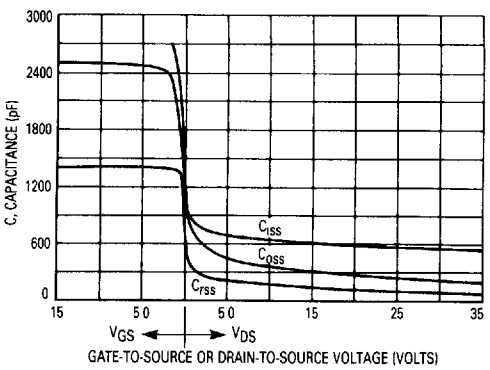


Figure 12. Capacitance Variation With Voltage



RESISTIVE SWITCHING

Figure 13. Switching Test Circuit

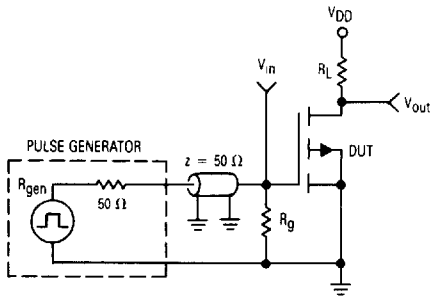
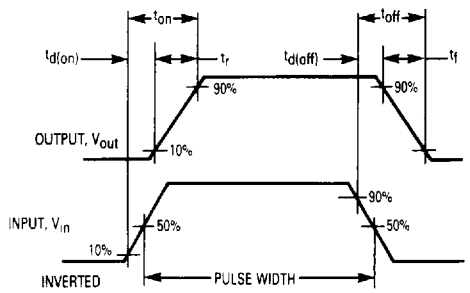
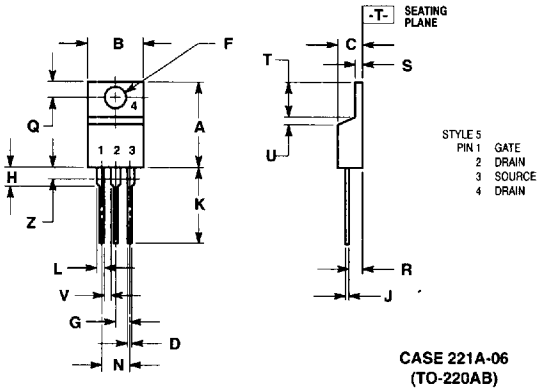


Figure 14. Switching Waveforms



PACKAGE OUTLINE DIMENSIONS AND FOOTPRINTS (continued)

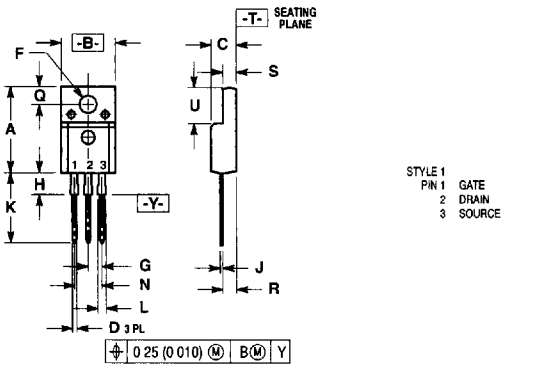


STYLE 5
PIN 1 GATE
2 DRAIN
3 SOURCE
4 DRAIN

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

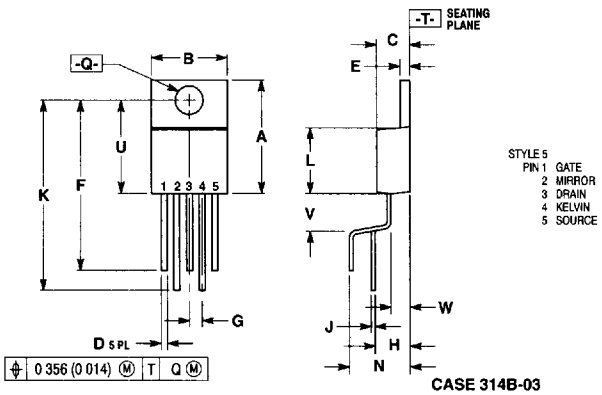


STYLE 1
PIN 1 GATE
2 DRAIN
3 SOURCE

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

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