

# MOTOROLA SEMICONDUCTOR TECHNICAL DATA

## Advance Information

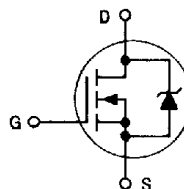
### TMOS E-FET™

### Power Field Effect Transistor

### N-Channel Enhancement-Mode Silicon Gate

This advanced TMOS E-FET is designed to withstand high energy in the avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time. Designed for high 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 areas are critical and offer additional safety margin against unexpected voltage transients.

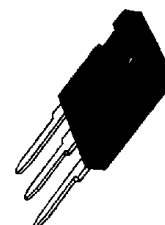
- Avalanche Energy Specified
- Source-to-Drain Recovery Time Comparable to a Discrete Fast Recovery Diode
- Diode is Characterized for Use in Bridge Circuits
- $I_{DSS}$  and  $V_{DS(on)}$  Specified at Elevated Temperature



## MTW10N40E

Motorola Preferred Device

**TMOS POWER FET**  
**10 AMPERES**  
 $R_{DS(on)} = 0.55 \text{ OHM}$   
**400 VOLTS**



CASE 340F-03  
TO-247AE

#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	400	Vdc
Drain-Gate Voltage ( $R_{GS} = 1.0 \text{ M}\Omega$ )	$V_{DGR}$	400	Vdc
Gate-Source Voltage — Continuous	$V_{GS}$	$\pm 20$	Vdc
Drain Current — Continuous @ $T_C = 25^\circ\text{C}$	$I_D$	10	Adc
— Continuous @ $T_C = 100^\circ\text{C}$	$I_D$	7.0	
— Single Pulse ( $t_p \leq 10 \mu\text{s}$ )	$I_{DM}$	40	Apk
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	150	Watts
Derate above $25^\circ\text{C}$		1.0	W/ $^\circ\text{C}$
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy — Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = 50 \text{ Vdc}$ , $V_{GS} = 10 \text{ Vpk}$ , $I_L = 10 \text{ Apk}$ , $L = 10.4 \text{ mH}$ , $R_G = 25 \Omega$ )	EAS	520	mJ
Thermal Resistance — Junction to Case	$R_{\theta JC}$	1.0	$^\circ\text{C/W}$
— Junction to Ambient	$R_{\theta JA}$	40	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	$T_L$	260	$^\circ\text{C}$

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

E-FET is a trademark of Motorola Inc.

TMOS is a registered trademark of Motorola Inc.

Preferred devices are Motorola recommended choices for future use and best overall value.

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

Characteristic	Symbol	Min	Typ	Max	Unit	
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{ V}$ , $I_D = 250\ \mu\text{Adc}$ ) Temperature Coefficient (Positive)	$BV_{DSS}$	400	— 360	—	Vdc mV/°C	
Zero Gate Voltage Drain Current ( $V_{DS} = 400\text{ Vdc}$ , $V_{GS} = 0$ ) ( $V_{DS} = 400\text{ Vdc}$ , $V_{GS} = 0$ , $T_J = 125^\circ\text{C}$ )	$I_{DSS}$	—	—	250 1000	$\mu\text{Adc}$	
Gate-Body Leakage Current ( $V_{GS} = \pm 20\text{ Vdc}$ , $V_{DS} = 0$ )	$I_{GSS}$	—	—	100	nAdc	
<b>ON CHARACTERISTICS*</b>						
Gate Threshold Voltage ( $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{Adc}$ ) Temperature Coefficient (Negative)	$V_{GS(th)}$	2.0	— 5.0	4.0	Vdc mV/°C	
Static Drain-Source On-Resistance ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 5.0\text{ Adc}$ )	$R_{DS(on)}$	—	—	0.55	Ohm	
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ ) ( $I_D = 10\text{ Adc}$ ) ( $I_D = 5.0\text{ Adc}$ , $T_J = 125^\circ\text{C}$ )	$V_{DS(on)}$	—	—	6.6 5.5	Vpk	
Forward Transconductance ( $V_{DS} = 50\text{ Vdc}$ , $I_D = 5.0\text{ Adc}$ )	$g_{FS}$	4.0	—	—	mhos	
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$(V_{DS} = 25\text{ Vdc}$ , $V_{GS} = 0$ , $f = 1.0\text{ MHz}$ )	$C_{iss}$	—	1570	2355	pF
Output Capacitance		$C_{oss}$	—	230	345	
Reverse Transfer Capacitance		$C_{rss}$	—	55	83	
<b>SWITCHING CHARACTERISTICS*†</b>						
Turn-On Delay Time	$(V_{DD} = 200\text{ Vdc}$ , $I_D = 10\text{ Adc}$ , $V_{GS} = 10\text{ Vdc}$ , $R_g = 9.1\ \Omega$ )	$t_{d(on)}$	—	25	50	ns
Rise Time		$t_r$	—	37	75	
Turn-Off Delay Time		$t_{d(off)}$	—	75	150	
Fall Time		$t_f$	—	31	65	
Gate Charge	$(V_{DS} = 320\text{ Vdc}$ , $I_D = 10\text{ Adc}$ , $V_{GS} = 10\text{ Vdc}$ )	$Q_T$	—	75	110	nC
		$Q_1$	—	14	—	
		$Q_2$	—	41	—	
		$Q_3$	—	30	—	
<b>SOURCE-DRAIN DIODE CHARACTERISTICS*</b>						
Forward On-Voltage	$(I_S = 10\text{ Adc}$ , $V_{GS} = 0$ ) $(I_S = 10\text{ Adc}$ , $V_{GS} = 0$ , $T_J = 125^\circ\text{C}$ )	$V_{SD}$	—	1.3 1.2	2.0	Vdc
Reverse Recovery Time	$(I_S = 10\text{ Adc}$ , $V_{GS} = 0$ , $di_S/dt = 100\text{ A}/\mu\text{s}$ )	$t_{rr}$	—	330	—	ns
		$t_a$	—	220	—	
		$t_b$	—	110	—	
Reverse Recovery Stored Charge		$Q_{RR}$	—	4.3	—	$\mu\text{C}$
<b>INTERNAL PACKAGE INDUCTANCE</b>						
Internal Drain Inductance (Measured from the contact screw on tab to center of die) (Measured from the drain lead 0.25" from package to center of die)	$L_D$	—	5.0	—	nH	
Internal Source Inductance (Measured from the source lead 0.25" from package to source bond pad)	$L_S$	—	13	—	nH	

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

†Switching characteristics are independent of operating junction temperature.