Medium Power Surface Mount Products

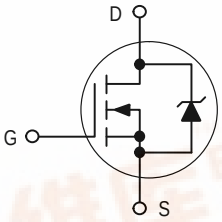
TMOS Dual N-Channel Field Effect Transistors

MMDF1N05E

MiniMOS™ devices are an advanced series of power MOSFETs which utilize Motorola's TMOS process. These miniature surface mount MOSFETs feature ultra low $R_{DS(on)}$ and true logic level performance. They are capable of withstanding high energy in the avalanche and commutation modes and the drain–to–source diode has a low reverse recovery time. MiniMOS devices are designed for use in low voltage, high speed switching applications where power efficiency is important. Typical applications are dc–dc converters, and power management in portable and battery powered products such as computers, printers, cellular and cordless phones. They can also be used for low voltage motor controls in mass storage products such as disk drives and tape drives. The avalanche energy is specified to eliminate the guesswork in designs where inductive loads are switched and offer additional safety margin against unexpected voltage transients.

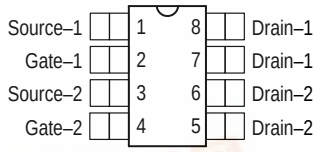
TMOS®

DUAL TMOS MOSFET
50 VOLTS
1.5 AMPERE
$R_{DS(on)}$ = 0.30 OHM



CASE 751–05, Style 11
SO–8

- Ultra Low $R_{DS(on)}$ Provides Higher Efficiency and Extends Battery Life
- Logic Level Gate Drive — Can Be Driven by Logic ICs
- Miniature SO–8 Surface Mount Package — Saves Board Space
- Diode Is Characterized for Use In Bridge Circuits
- Diode Exhibits High Speed
- Avalanche Energy Specified
- Mounting Information for SO–8 Package Provided
- I_{DSS} Specified at Elevated Temperature



Top View

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

Rating	Symbol	Value	Unit
Drain–to–Source Voltage	V_{DS}	50	Volts
Gate–to–Source Voltage — Continuous	V_{GS}	±20	Volts
Drain Current — Continuous — Pulsed	I_D I_{DM}	2.0 10	Amps
Single Pulse Drain–to–Source Avalanche Energy — Starting T_J = 25°C (V_{DD} = 25 V, V_{GS} = 10 V, I_L = 2 Apk)	E_{AS}	300	mJ
Operating and Storage Temperature Range	T_J, T_{stg}	–55 to 150	°C
Total Power Dissipation @ T_A = 25°C	P_D	2.0	Watts
Thermal Resistance – Junction to Ambient (1)	$R_{\theta JA}$	62.5	°C/W
Maximum Temperature for Soldering, Time in Solder Bath	T_L	260 10	°C Sec

DEVICE MARKING

F1N05

(1) Mounted on 2" square FR4 board (1" sq. 2 oz. Cu 0.06" thick single sided) with one die operating, 10 sec. max.

ORDERING INFORMATION

Device	Reel Size	Tape Width	Quantity
MMDF1N05ER2	13″	12 mm embossed tape	2500

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Thermal Clad is a trademark of the Bergquist Company

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain–to–Source Breakdown Voltage (V_{GS} = 0, I_D = 250 μA)		$V_{(BR)DSS}$	50	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 50 V, V_{GS} = 0)		I_{DSS}	—	—	250	μAdc
Gate–Body Leakage Current (V_{GS} = 20 Vdc, V_{DS} = 0)		I_{GSS}	—	—	100	nAdc
ON CHARACTERISTICS(1)						
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 250 μAdc)		$V_{GS(th)}$	1.0	—	3.0	Vdc
Drain–to–Source On–Resistance (V_{GS} = 10 Vdc, I_D = 1.5 Adc) (V_{GS} = 4.5 Vdc, I_D = 0.6 Adc)		$R_{DS(on)}$ $R_{DS(on)}$	— —	— —	0.30 0.50	Ohms
Forward Transconductance (V_{DS} = 15 V, I_D = 1.5 A)		g_{FS}	—	1.5	—	mhos
DYNAMIC CHARACTERISTICS						
Input Capacitance	(V_{DS} = 25 V, V_{GS} = 0, f = 1.0 MHz)	C_{iss}	—	330	—	pF
Output Capacitance		C_{oss}	—	160	—	
Reverse Transfer Capacitance		C_{rss}	—	50	—	
SWITCHING CHARACTERISTICS(2)						
Turn–On Delay Time	(V_{DD} = 10 V, I_D = 1.5 A, R_L = 10 Ω, V_G = 10 V, R_G = 50 Ω)	$t_{d(on)}$	—	—	20	ns
Rise Time		t_r	—	—	30	
Turn–Off Delay Time		$t_{d(off)}$	—	—	40	
Fall Time		t_f	—	—	25	
Total Gate Charge	(V_{DS} = 10 V, I_D = 1.5 A, V_{GS} = 10 V)	Q_g	—	12.5	—	nC
Gate–Source Charge		Q_{gs}	—	1.9	—	
Gate–Drain Charge		Q_{gd}	—	3.0	—	
SOURCE–DRAIN DIODE CHARACTERISTICS (T_C = 25°C)						
Forward Voltage(1)	(I_S = 1.5 A, V_{GS} = 0 V) (dI_S/dt = 100 A/μs)	V_{SD}	—	—	1.6	V
Reverse Recovery Time		t_{rr}	—	45	—	ns

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

(2) Switching characteristics are independent of operating junction temperature.

TYPICAL ELECTRICAL CHARACTERISTICS

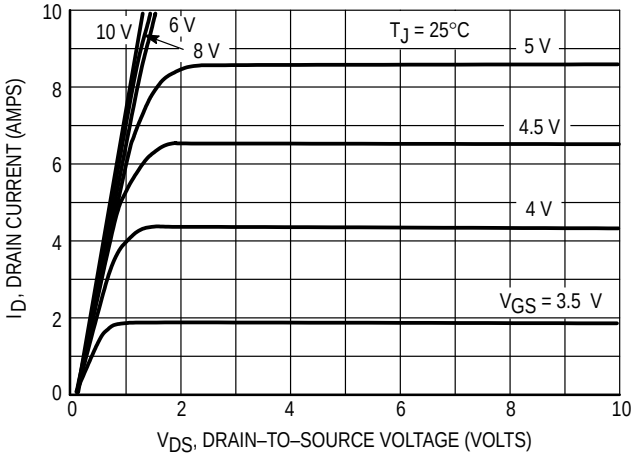


Figure 1. On–Region Characteristics

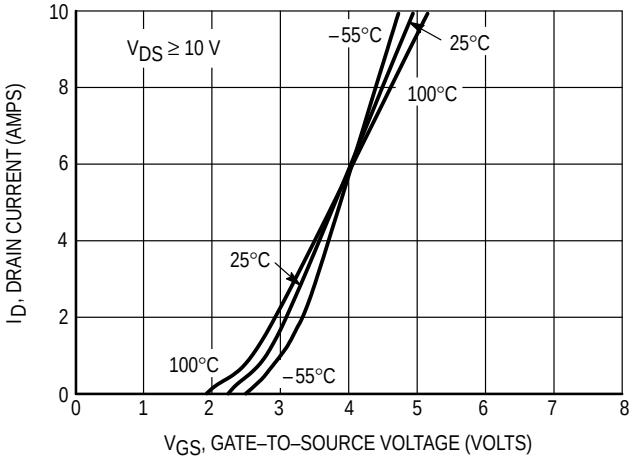


Figure 2. Transfer Characteristics

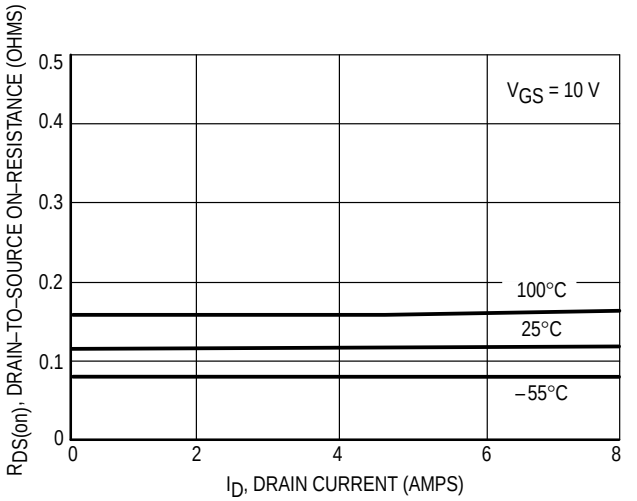


Figure 3. On–Resistance versus Drain Current

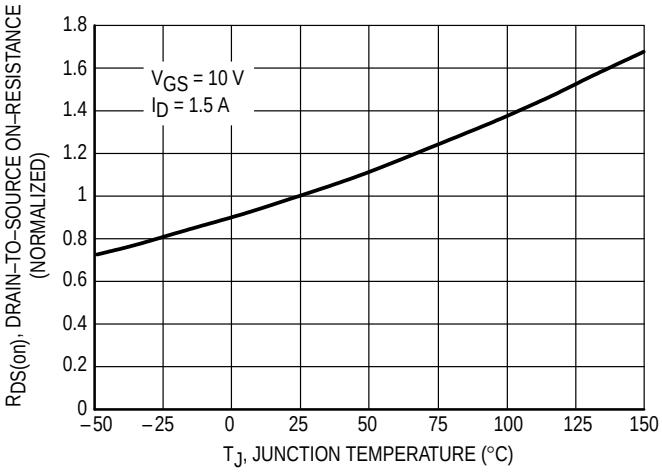


Figure 4. On–Resistance Variation with Temperature

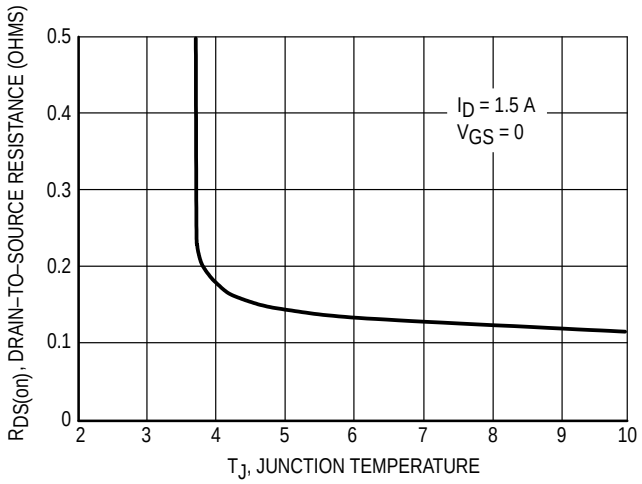


Figure 5. On Resistance versus Gate–To–Source Voltage

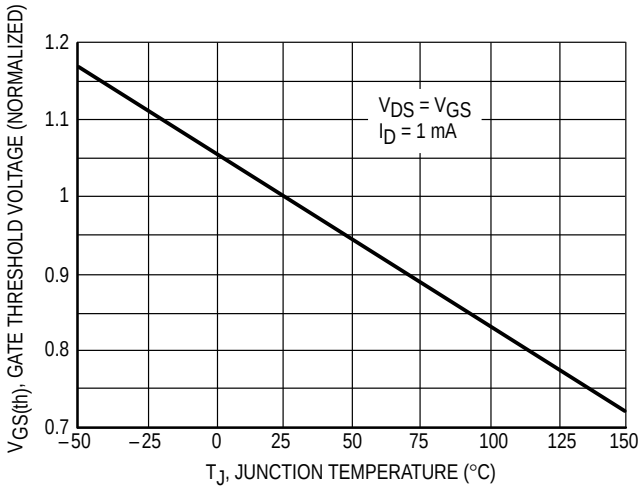


Figure 6. Gate Threshold Voltage Variation with Temperature

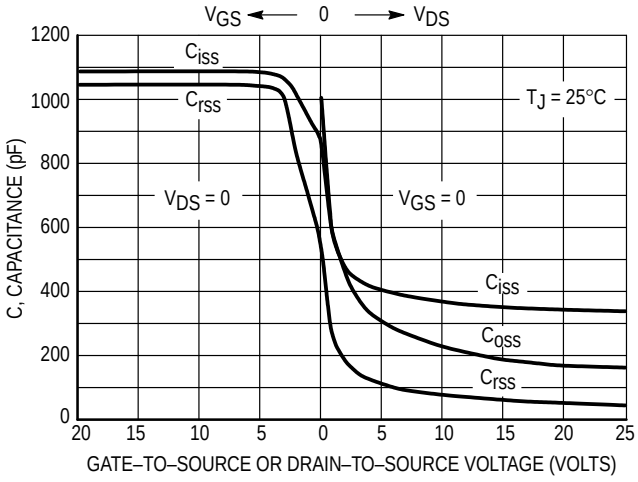


Figure 7. Capacitance Variation

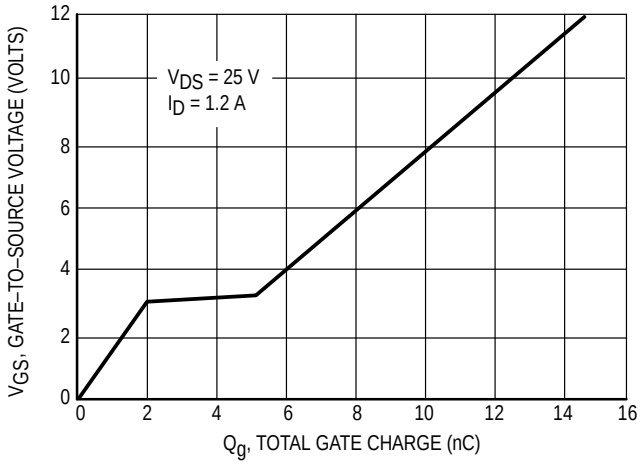


Figure 8. Gate Charge versus Gate–To–Source Voltage

SAFE OPERATING AREA INFORMATION

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.

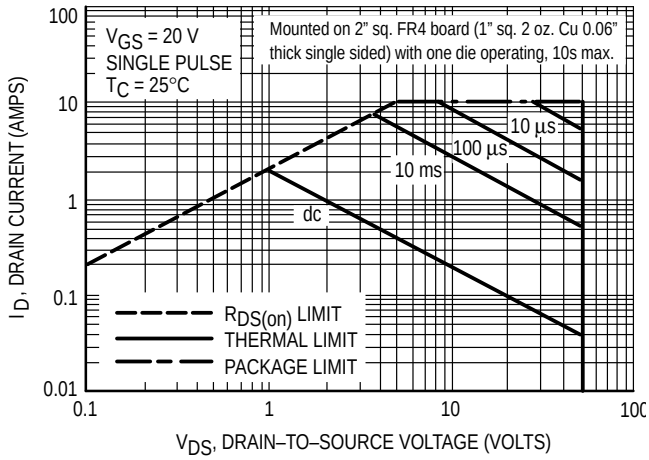


Figure 9. Maximum Rated Forward Biased Safe Operating Area

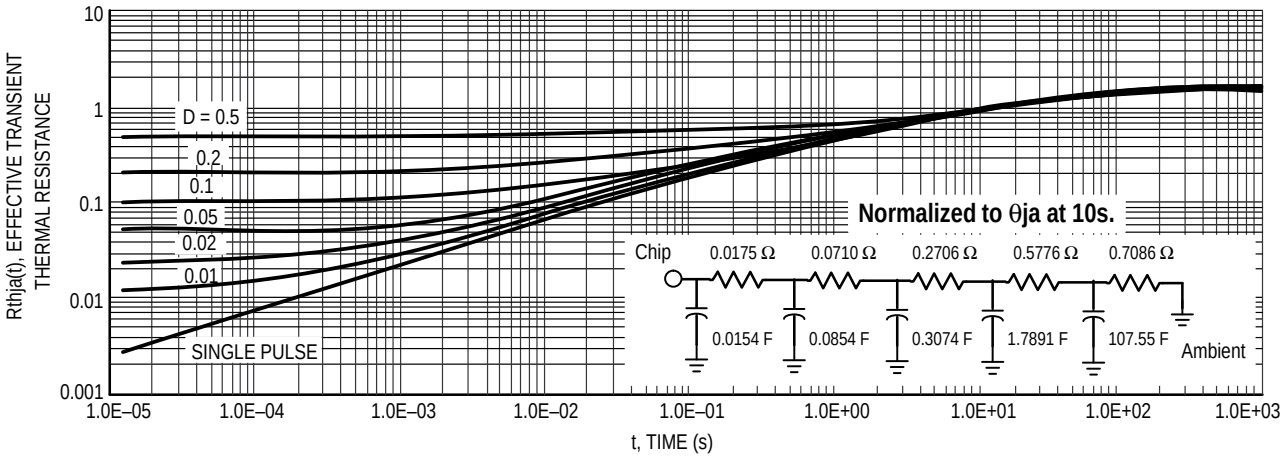
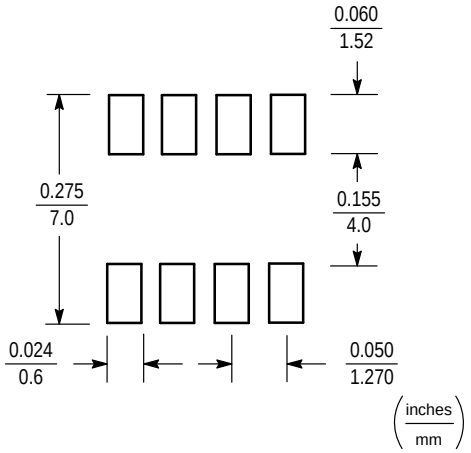


Figure 10. Thermal Response

INFORMATION FOR USING THE SO–8 SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self–align when subjected to a solder reflow process.



SO–8 POWER DISSIPATION

The power dissipation of the SO–8 is a function of the input pad size. These can vary from the minimum pad size for soldering to the pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient; and the operating temperature, T_A. Using the values provided on the data sheet for the SO–8 package, P_D can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device which in this case is 2.0 Watts.

$$P_D = \frac{150°C - 25°C}{62.5°C/W} = 2.0 \text{ Watts}$$

The 62.5°C/W for the SO–8 package assumes the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 2.0 Watts using the footprint shown. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using board material such as Thermal Clad, the power dissipation can be doubled using the same footprint.

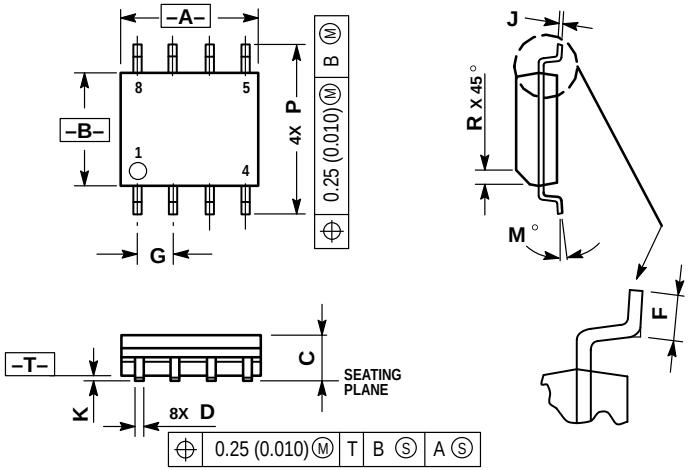
SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference shall be a maximum of 10°C.
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. DIMENSIONS ARE IN MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
6. DIMENSION D DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	4.80	5.00
B	3.80	4.00
C	1.35	1.75
D	0.35	0.49
F	0.40	1.25
G	1.27 BSC	
J	0.18	0.25
K	0.10	0.25
M	0 °	7 °
P	5.80	6.20
R	0.25	0.50

STYLE 11:
PIN 1. SOURCE 1
2. GATE 1
3. SOURCE 2
4. GATE 2
5. DRAIN 2
6. DRAIN 2
7. DRAIN 1
8. DRAIN 1

CASE 751–05
SO–8
ISSUE P

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