Product Preview

Medium Power Surface Mount Products

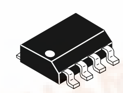
TMOS Single P-Channel Field Effect Transistors

MMSF3205

Motorola Preferred Device

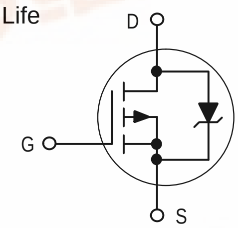
SINGLE TMOS POWER MOSFET
11 AMPERES
20 VOLTS
$R_{DS(on)}$ = 0.015 OHM

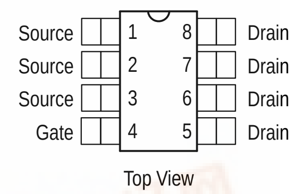
MiniMOS™ devices are an advanced series of power MOSFETs which utilize Motorola's High Cell Density HDTMOS process. These miniature surface mount MOSFETs feature ultra low $R_{DS(on)}$ and true logic level performance. They are capable of withstanding high energy in the avalanche and commutation modes and the drain–to–source diode has a very 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.



CASE 751–06, Style 12
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, With Soft Recovery
- I_{DSS} Specified at Elevated Temperature
- Avalanche Energy Specified
- Mounting Information for SO–8 Package Provided





DEVICE MARKING	ORDERING INFORMATION			
	Device	Reel Size	Tape Width	Quantity
S3205	MMSF3205R2	13″	12 mm embossed tape	4000 units

Preferred devices are Motorola recommended choices for future use and best overall value.
This document contains information on a product under development. Motorola reserves the right to change or discontinue this product without notice.

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)
Negative sign for P–Channel devices omitted for clarity

Rating		Symbol	Max	Unit
Drain–to–Source Voltage		V_{DSS}	20	V
Drain–to–Gate Voltage (R_{GS} = 1.0 MΩ)		V_{DGR}	20	V
Gate–to–Source Voltage — Continuous		V_{GS}	± 12	V
1 inch SQ. FR–4 or G–10 PCB 10 seconds	Thermal Resistance — Junction to Ambient Total Power Dissipation @ T_A = 25°C Linear Derating Factor Drain Current — Continuous @ T_A = 25°C Continuous @ T_A = 70°C Pulsed Drain Current (1)	R_{THJA} P_D I_D I_D I_{DM}	50 2.5 20 11 8.0 55	°C/W Watts mW/°C A A A
Minimum FR–4 or G–10 PCB 10 seconds	Thermal Resistance — Junction to Ambient Total Power Dissipation @ T_A = 25°C Linear Derating Factor Drain Current — Continuous @ T_A = 25°C Continuous @ T_A = 70°C Pulsed Drain Current (1)	R_{THJA} P_D I_D I_D I_{DM}	80 1.56 12.5 8.6 6.4 43	°C/W Watts mW/°C A A A
Operating and Storage Temperature Range		T_J, T_{stg}	– 55 to 150	°C
Single Pulse Drain–to–Source Avalanche Energy — Starting T_J = 25°C (V_{DD} = 20 Vdc, V_{GS} = 4.5 Vdc, Peak I_L = 11 Apk, L = TBD mH, R_G = 25 Ω)		E_{AS}	TBD	mJ

(1) Repetitive rating; pulse width limited by maximum junction temperature.

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

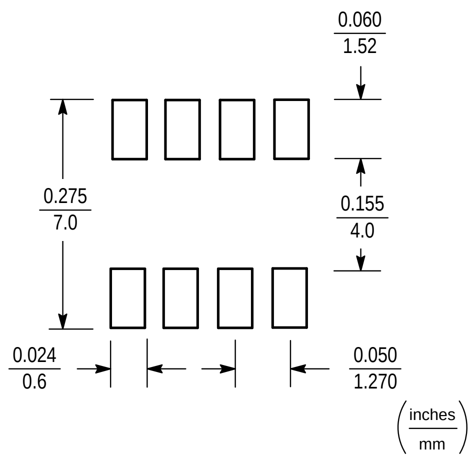
Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain–to–Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 0.25 mAdc)		$V_{(BR)DSS}$	20	—	—	Vdc
Temperature Coefficient (Positive)			—	TBD	—	mV/°C
Zero Gate Voltage Drain Current (V_{DS} = 20 Vdc, V_{GS} = 0 Vdc)		I_{DSS}	—	—	1.0	μAdc
(V_{DS} = 20 Vdc, V_{GS} = 0 Vdc, T_J = 70°C)			—	—	5.0	
Gate–Body Leakage Current (V_{GS} = ± 12 Vdc, V_{DS} = 0)		I_{GSS}	—	—	100	nAdc
ON CHARACTERISTICS(1)						
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 0.25 mAdc)		$V_{GS(th)}$	0.6	—	—	Vdc
Threshold Temperature Coefficient (Negative)			—	—	—	mV/°C
Static Drain–to–Source On–Resistance (V_{GS} = 4.5 Vdc, I_D = 11 Adc)		$R_{DS(on)}$	—	TBD	15	mΩ
(V_{GS} = 2.5 Vdc, I_D = 8.6 Adc)			—	TBD	25	
On–State Drain Current (V_{DS} ≤ 5.0 V, V_{GS} = 4.5 V)		$I_{D(on)}$	20	—	—	A
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 11 Adc)		g_{FS}	40	TBD	—	Mhos
DYNAMIC CHARACTERISTICS						
Input Capacitance	(V_{DS} = 16 Vdc, V_{GS} = 0 Vdc, f = 1.0 MHz)	C_{iss}	—	TBD	TBD	pF
Output Capacitance		C_{oss}	—	TBD	TBD	
Transfer Capacitance		C_{rss}	—	TBD	TBD	
SWITCHING CHARACTERISTICS(2)						
Turn–On Delay Time	(V_{DD} = 10 Vdc, I_D = 1.0 Adc, V_{GS} = 4.5 Vdc, R_G = 6.0 Ω) (1)	$t_{d(on)}$	—	TBD	TBD	ns
Rise Time		t_r	—	TBD	TBD	
Turn–Off Delay Time		$t_{d(off)}$	—	TBD	TBD	
Fall Time		t_f	—	TBD	TBD	
Gate Charge See Figure 8	(V_{DS} = 10 Vdc, I_D = 11 Adc, V_{GS} = 4.5 Vdc) (1)	Q_T	—	TBD	TBD	nC
		Q_1	—	TBD	—	
		Q_2	—	TBD	—	
		Q_3	—	TBD	—	
SOURCE–DRAIN DIODE CHARACTERISTICS						
Forward On–Voltage(1)	(I_S = 2.1 Adc, V_{GS} = 0 Vdc) (1)	V_{SD}	—	TBD	1.2	Vdc
	(I_S = 2.1 Adc, V_{GS} = 0 Vdc, T_J = 125°C)		—	TBD	—	
Reverse Recovery Time See Figure 15	(I_S = 2.1 Adc, V_{GS} = 0 Vdc, dI_S/dt = 100 A/μs) (1)	t_{rr}	—	TBD	TBD	ns
		t_a	—	TBD	—	
		t_b	—	TBD	—	
Reverse Recovery Stored Charge		Q_{RR}	—	TBD	—	μC

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
(2) Switching characteristics are independent of operating junction temperature.
(3) Reflects typical values. $C_{pk} = \left| \frac{\text{Max limit – Typ}}{3 \times \text{SIGMA}} \right|$
(4) Repetitive rating; pulse width limited by maximum junction temperature.

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 ensure 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. This 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 1.6 Watts.

$$P_D = \frac{150°C - 25°C}{80°C/W} = 1.6 \text{ Watts}$$

The 80°C/W for the SO–8 package assumes the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 1.6 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.

TYPICAL SOLDER HEATING PROFILE

For any given circuit board, there will be a group of control settings that will give the desired heat pattern. The operator must set temperatures for several heating zones and a figure for belt speed. Taken together, these control settings make up a heating “profile” for that particular circuit board. On machines controlled by a computer, the computer remembers these profiles from one operating session to the next. Figure 1 shows a typical heating profile for use when soldering a surface mount device to a printed circuit board. This profile will vary among soldering systems, but it is a good starting point. Factors that can affect the profile include the type of soldering system in use, density and types of components on the board, type of solder used, and the type of board or substrate material being used. This profile shows temperature versus time. The line on the graph shows the actual temperature that might be experienced on the surface of a test board at or near a central solder joint. The two profiles are based on a high density and a low density board. The Vitronics SMD310 convection/infrared reflow soldering system was used to generate this profile. The type of solder used was 62/36/2 Tin Lead Silver with a melting point between 177–189°C. When this type of furnace is used for solder reflow work, the circuit boards and solder joints tend to heat first. The components on the board are then heated by conduction. The circuit board, because it has a large surface area, absorbs the thermal energy more efficiently, then distributes this energy to the components. Because of this effect, the main body of a component may be up to 30 degrees cooler than the adjacent solder joints.

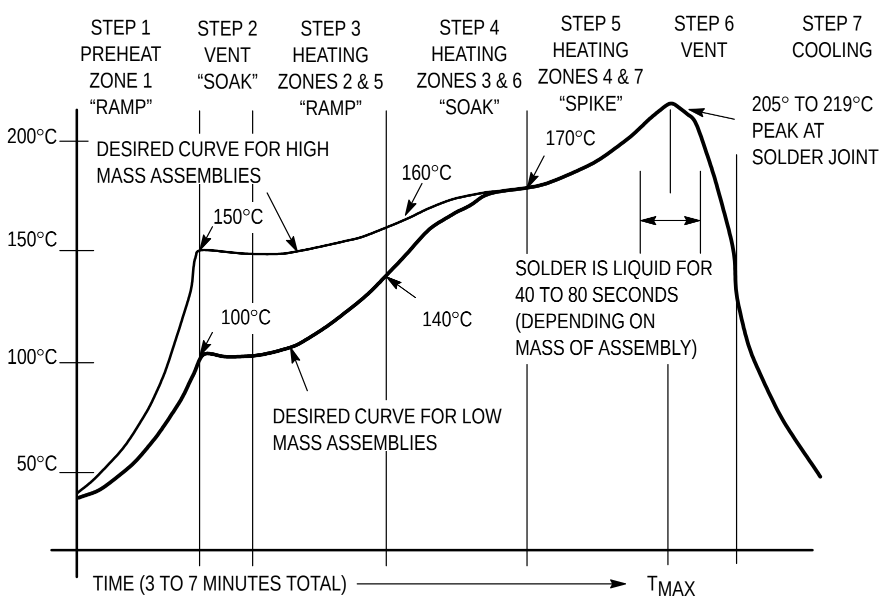
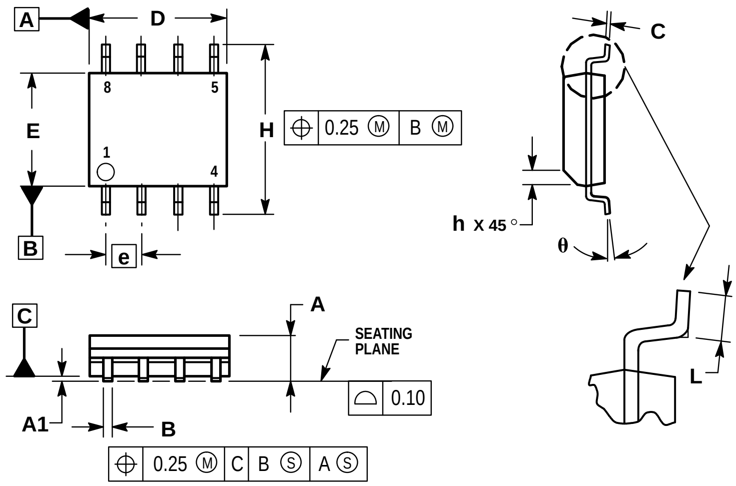


Figure 1. Typical Solder Heating Profile

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0°	7°

STYLE 12:
PIN 1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

CASE 751–06
SO–8
ISSUE T

How to reach us:
USA / EUROPE / Locations Not Listed: Motorola Literature Distribution;
P.O. Box 5405, Denver, Colorado 80217. 1–303–675–2140 or 1–800–441–2447

JAPAN: Nippon Motorola Ltd.: SPD, Strategic Planning Office, 141,
4–32–1 Nishi–Gotanda, Shagawa–ku, Tokyo, Japan. 03–5487–8488

Customer Focus Center: 1–800–521–6274

Mfax™: RMFAX0@email.sps.mot.com – TOUCHTONE 1–602–244–6609
Motorola Fax Back System – US & Canada ONLY 1–800–774–1848
– http://sps.motorola.com/mfax/

ASIA / PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298

HOME PAGE: http://motorola.com/sps/