NTMSD3P303R2

Product Preview

FETKY™

P–Channel Enhancement–Mode Power MOSFET and Schottky Diode Dual SO–8 Package

Features

- High Efficiency Components in a Single SO–8 Package
- High Density Power MOSFET with Low $R_{DS(on)}$, Schottky Diode with Low V_F
- Independent Pin–Outs for MOSFET and Schottky Die Allowing for Flexibility in Application Use
- Less Component Placement for Board Space Savings
- SO–8 Surface Mount Package, Mounting Information for SO–8 Package Provided

Applications

- DC–DC Converters
- Low Voltage Motor Control
- Power Management in Portable and Battery–Powered Products, i.e.: Computers, Printers, PCMCIA Cards, Cellular and Cordless Telephones

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

Rating	Symbol	Value	Unit
Drain–to–Source Voltage	V_{DSS}	–30	V
Gate–to–Source Voltage – Continuous	V_{GS}	±20	V
Thermal Resistance – Junction–to–Ambient (Note 1.) Total Power Dissipation @ T_A = 25°C Continuous Drain Current @ T_A = 25°C Continuous Drain Current @ T_A = 70°C Pulsed Drain Current (Note 4.)	 $R_{\theta JA}$ P_D I_D I_D I_{DM}	 171 0.73 –2.34 –1.87 –8.0	 °C/W W A A A
Thermal Resistance – Junction–to–Ambient (Note 2.) Total Power Dissipation @ T_A = 25°C Continuous Drain Current @ T_A = 25°C Continuous Drain Current @ T_A = 70°C Pulsed Drain Current (Note 4.)	 $R_{\theta JA}$ P_D I_D I_D I_{DM}	 100 1.25 –3.05 –2.44 –12	 °C/W W A A A
Thermal Resistance – Junction–to–Ambient (Note 3.) Total Power Dissipation @ T_A = 25°C Continuous Drain Current @ T_A = 25°C Continuous Drain Current @ T_A = 70°C Pulsed Drain Current (Note 4.)	 $R_{\theta JA}$ P_D I_D I_D I_{DM}	 62.5 2.0 –3.86 –3.10 –15	 °C/W W 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} = –30 Vdc, V_{GS} = –4.5 Vdc, Peak I_L = –7.5 Apk, L = 5 mH, R_G = 25 Ω)	E_{AS}	140	mJ
Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 10 seconds	T_L	260	°C

1. Minimum FR–4 or G–10 PCB, Steady State.
2. Mounted onto a 2″ square FR–4 Board (1″ sq. 2 oz Cu 0.06″ thick single sided), Steady State.
3. Mounted onto a 2″ square FR–4 Board (1″ sq. 2 oz Cu 0.06″ thick single sided), t ≤ 10 seconds.
4. Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

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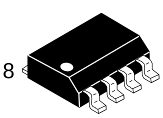
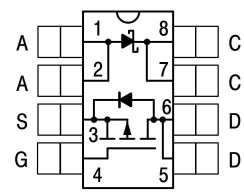
MOSFET
–3.05 AMPERES
–30 VOLTS
0.085 Ω @ V_{GS} = –10 V

SCHOTTKY DIODE
3.0 AMPERES
30 VOLTS
420 mV @ I_F = 3.0 A

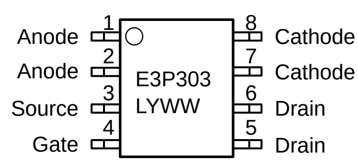


SO–8
CASE 751
STYLE 18



(TOP VIEW)

MARKING DIAGRAM & PIN ASSIGNMENTS



(Top View)

E3P303 = Device Code
L = Assembly Location
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
NTMSD3P303R2	SO–8	2500/Tape & Reel

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

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage DC Blocking Voltage	V_{RRM} V_R	30	V
Thermal Resistance – Junction–to–Ambient (Note 5.)	$R_{\theta JA}$	197	°C/W
Thermal Resistance – Junction–to–Ambient (Note 6.)	$R_{\theta JA}$	97	°C/W
Thermal Resistance – Junction–to–Ambient (Note 7.)	$R_{\theta JA}$	62.5	°C/W
Average Forward Current (Note 7.) (Rated V_R, T_A = 100°C)	I_O	3.0	A
Peak Repetitive Forward Current (Note 7.) (Rated V_R, Square Wave, 20 kHz, T_A = 105°C)	I_{FRM}	6.0	A
Non–Repetitive Peak Surge Current (Note 7.) (Surge Applied at Rated Load Conditions, Half–Wave, Single Phase, 60 Hz)	I_{FSM}	30	A

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) *

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain–to–Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = –250 μAdc) Temperature Coefficient (Positive)	$V_{(BR)DSS}$	 –30 –	 – –30	 – –	Vdc mV/°C
Zero Gate Voltage Drain Current (V_{DS} = –30 Vdc, V_{GS} = 0 Vdc, T_J = 25°C) (V_{DS} = –30 Vdc, V_{GS} = 0 Vdc, T_J = 125°C)	I_{DSS}	 – –	 – –	 –1.0 –25	μAdc
Gate–Body Leakage Current (V_{GS} = –20 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	–	–	–100	nAdc
Gate–Body Leakage Current (V_{GS} = +20 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	–	–	100	nAdc
ON CHARACTERISTICS					
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = –250 μAdc) Temperature Coefficient (Negative)	$V_{GS(th)}$	 –1.0 –	 –1.7 3.6	 –2.5 –	Vdc
Static Drain–to–Source On–State Resistance (V_{GS} = –10 Vdc, I_D = –3.05 Adc) (V_{GS} = –4.5 Vdc, I_D = –1.5 Adc)	$R_{DS(on)}$	 – –	 0.063 0.090	 0.085 0.125	Ω
Forward Transconductance (V_{DS} = –15 Vdc, I_D = –3.05 Adc)	g_{FS}	–	5.0	–	Mhos

DYNAMIC CHARACTERISTICS

Characteristic	Conditions	Symbol	Min	Typ	Max	Unit
Input Capacitance	(V_{DS} = –24 Vdc, V_{GS} = 0 Vdc, f = 1.0 MHz)	C_{iss}	–	520	750	pF
Output Capacitance		C_{oss}	–	170	325	
Reverse Transfer Capacitance		C_{rss}	–	70	135	

5. Minimum FR–4 or G–10 PCB, Steady State.
6. Mounted onto a 2″ square FR–4 Board (1″ sq. 2 oz Cu 0.06″ thick single sided), Steady State.
7. Mounted onto a 2″ square FR–4 Board (1″ sq. 2 oz Cu 0.06″ thick single sided), t ≤ 10 seconds.

* Handling precautions to protect against electrostatic discharge is mandatory.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) *

Characteristic		Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS (Notes 8. and 9.)						
Turn–On Delay Time	(V_{DD} = –24 Vdc, I_D = –3.05 Adc, V_{GS} = –10 Vdc, R_G = 6.0 Ω)	$t_{d(on)}$	–	12	22	ns
Rise Time		t_r	–	16	30	
Turn–Off Delay Time		$t_{d(off)}$	–	45	80	
Fall Time		t_f	–	45	80	
Turn–On Delay Time	(V_{DD} = –24 Vdc, I_D = –1.5 Adc, V_{GS} = –4.5 Vdc, R_G = 6.0 Ω)	$t_{d(on)}$	–	16	–	ns
Rise Time		t_r	–	42	–	
Turn–Off Delay Time		$t_{d(off)}$	–	32	–	
Fall Time		t_f	–	35	–	
Total Gate Charge	(V_{DS} = –24 Vdc, V_{GS} = –10 Vdc, I_D = –3.05 Adc)	Q_{tot}	–	16	25	nC
Gate–Source Charge		Q_{gs}	–	2.0	–	
Gate–Drain Charge		Q_{gd}	–	4.5	–	
BODY–DRAIN DIODE RATINGS (Note 8.)						
Diode Forward On–Voltage	(I_S = –3.05 Adc, V_{GS} = 0 Vdc) (I_S = –3.05 Adc, V_{GS} = 0 Vdc, T_J = 125°C)	V_{SD}	– –	–0.96 –0.78	–1.25 –	Vdc
Reverse Recovery Time	(I_S = –3.05 Adc, V_{GS} = 0 Vdc, dI_S/dt = 100 A/μs)	t_{rr}	–	34	–	ns
		t_a	–	18	–	
		t_b	–	16	–	
Reverse Recovery Stored Charge		Q_{RR}	–	0.03	–	μC

SCHOTTKY RECTIFIER ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) (Note 8.)

Characteristic	Condition	Symbol	T_J = 25°C	T_J = 125°C	Unit
Maximum Instantaneous Forward Voltage	I_F = 100 mAdc I_F = 3.0 Adc I_F = 6.0 Adc	V_F	0.28 0.42 0.50	0.13 0.33 0.45	Volts
Maximum Instantaneous Reverse Current	V_R = 30 Vdc	I_R	250	25	μA mA
Maximum Voltage Rate of Change	V_R = 30 Vdc	dV/dt	10,000		V/μs

8. Indicates Pulse Test: Pulse Width = 300 μs max, Duty Cycle = 2%.
9. Switching characteristics are independent of operating junction temperature.

* Handling precautions to protect against electrostatic discharge is mandatory.

TYPICAL MOSFET ELECTRICAL CHARACTERISTICS

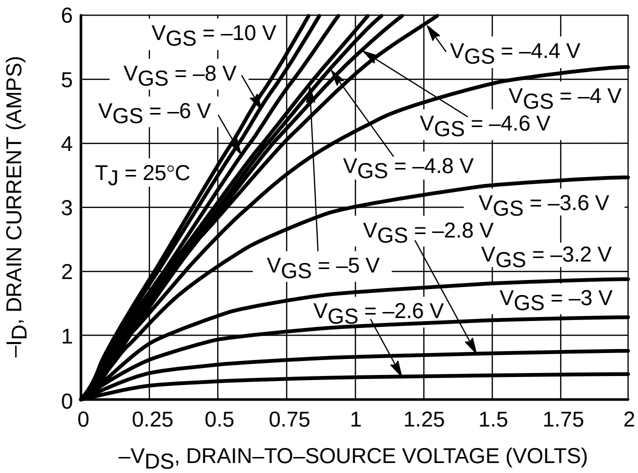


Figure 1. On–Region Characteristics

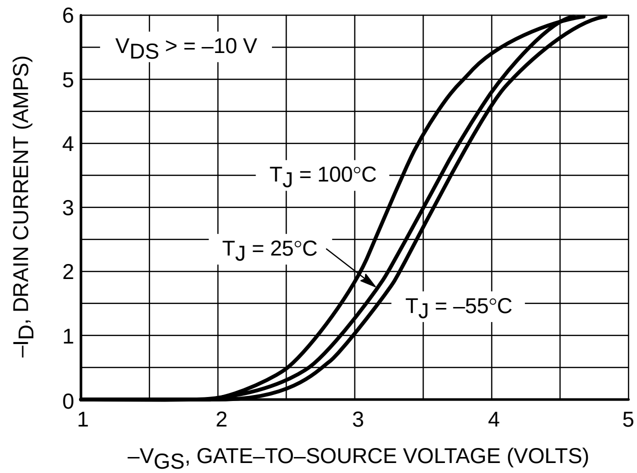


Figure 2. Transfer Characteristics

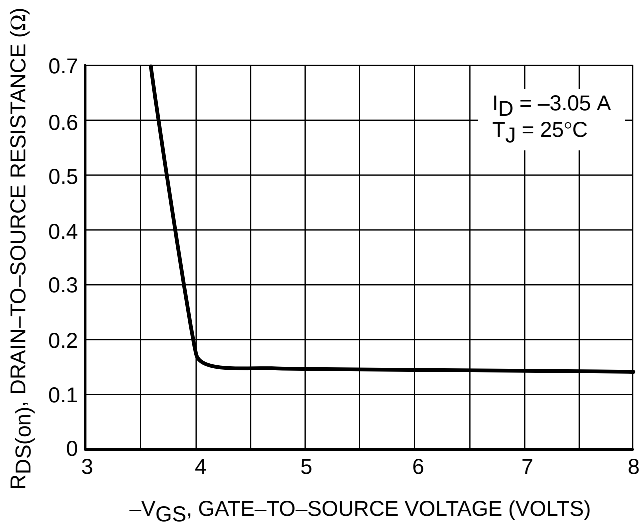


Figure 3. On–Resistance vs. Gate–to–Source Voltage

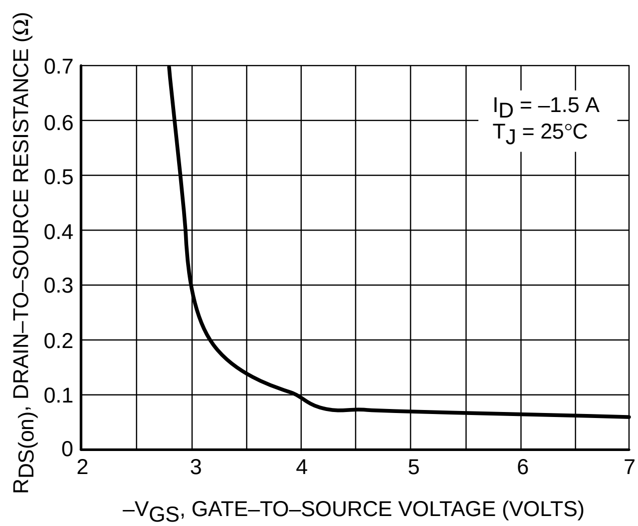


Figure 4. On–Resistance vs. Gate–to–Source Voltage

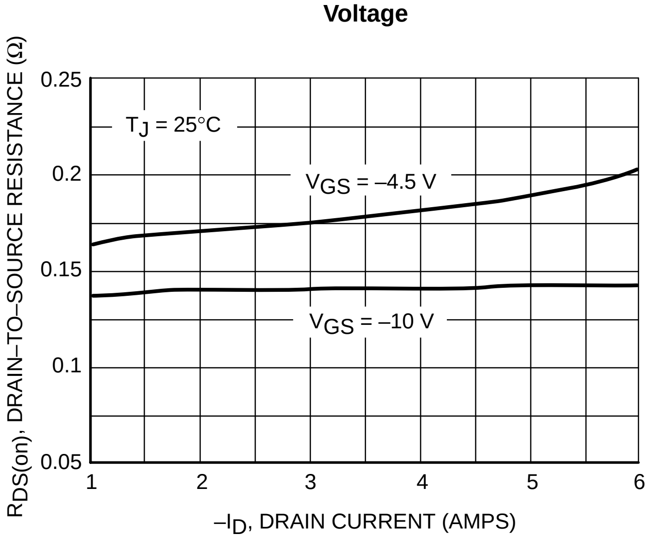


Figure 5. On–Resistance vs. Drain Current and Gate Voltage

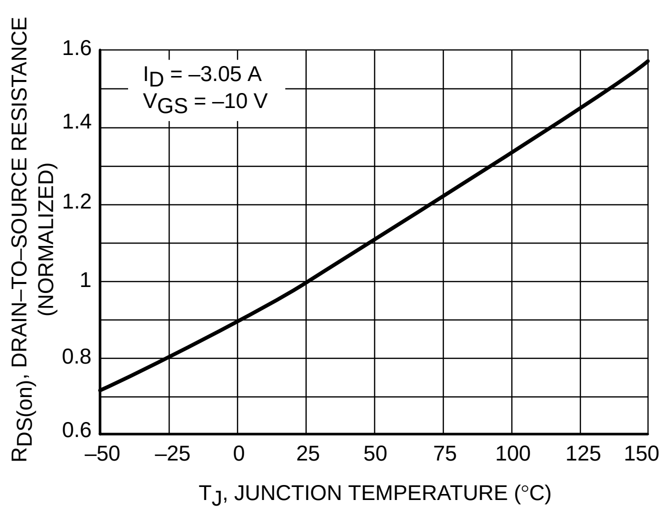


Figure 6. On Resistance Variation with Temperature

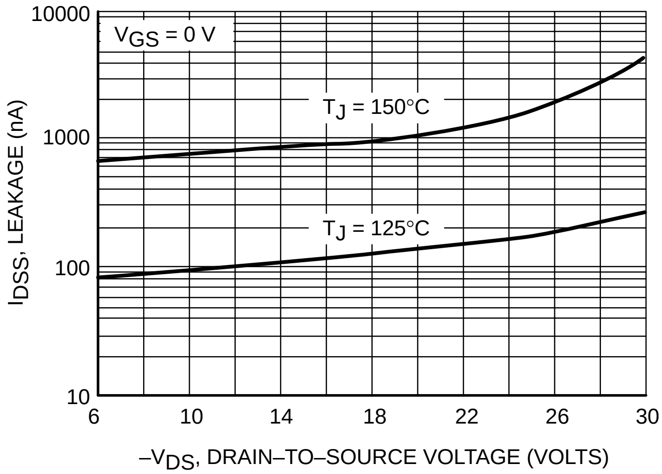


Figure 7. Drain–to–Source Leakage Current vs. Voltage

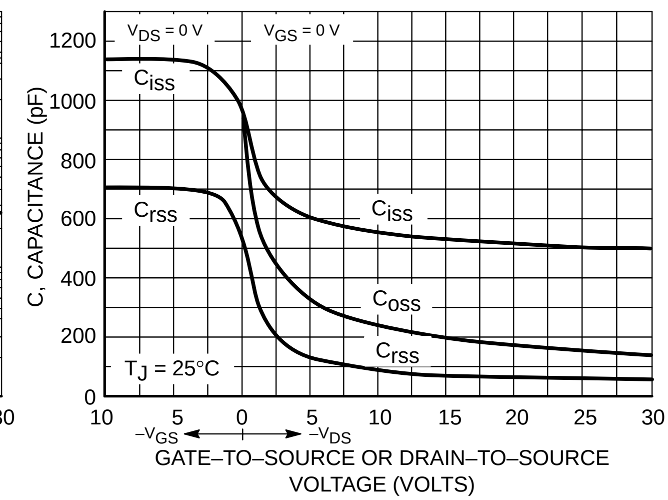


Figure 8. Capacitance Variation

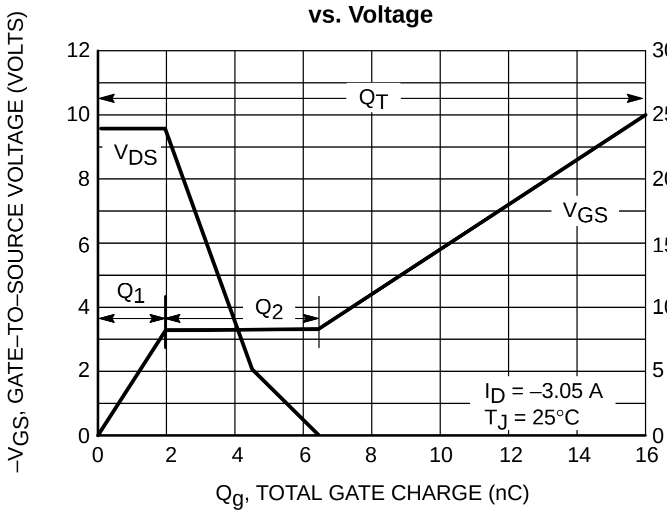


Figure 9. Gate–to–Source and Drain–to–Source Voltage vs. Total Charge

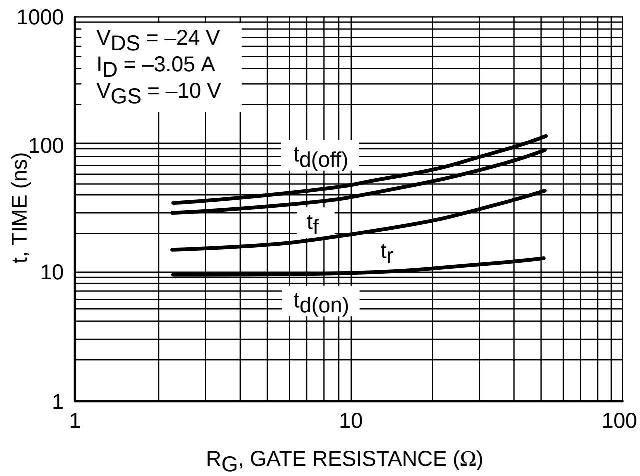


Figure 10. Resistive Switching Time Variation vs. Gate Resistance

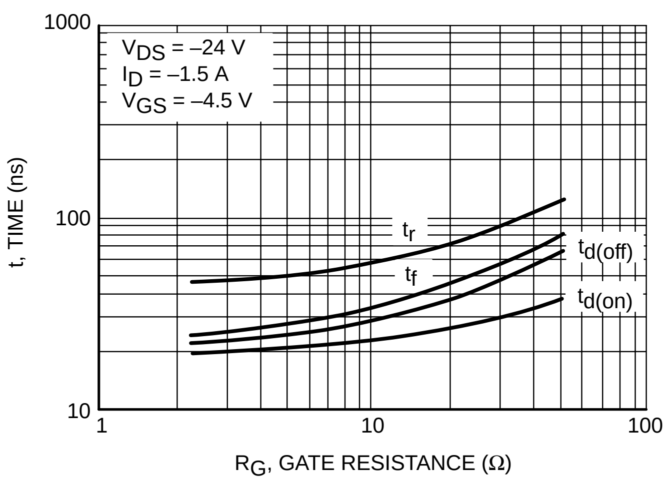


Figure 11. Resistive Switching Time Variation vs. Gate Resistance

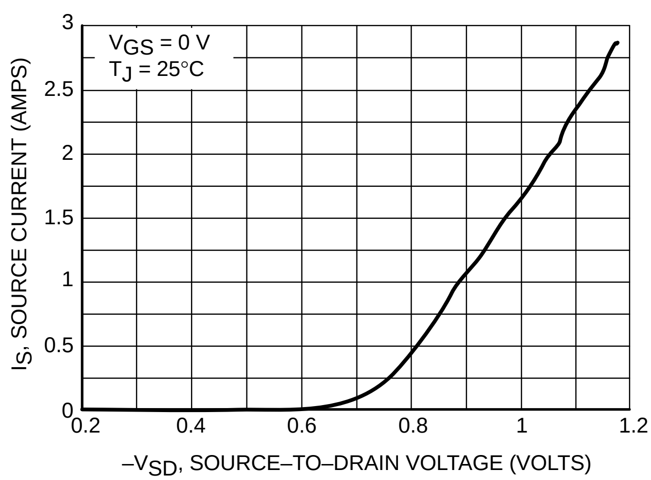


Figure 12. Diode Forward Voltage vs. Current

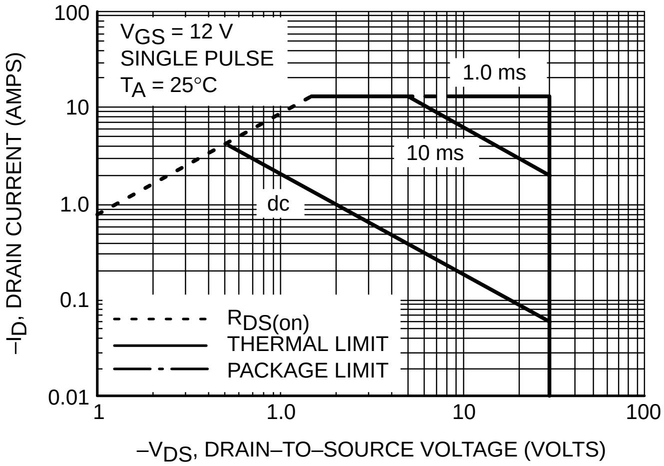


Figure 13. Maximum Rated Forward Biased Safe Operating Area

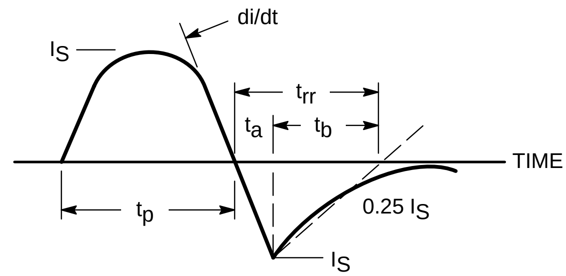


Figure 14. Diode Reverse Recovery Waveform

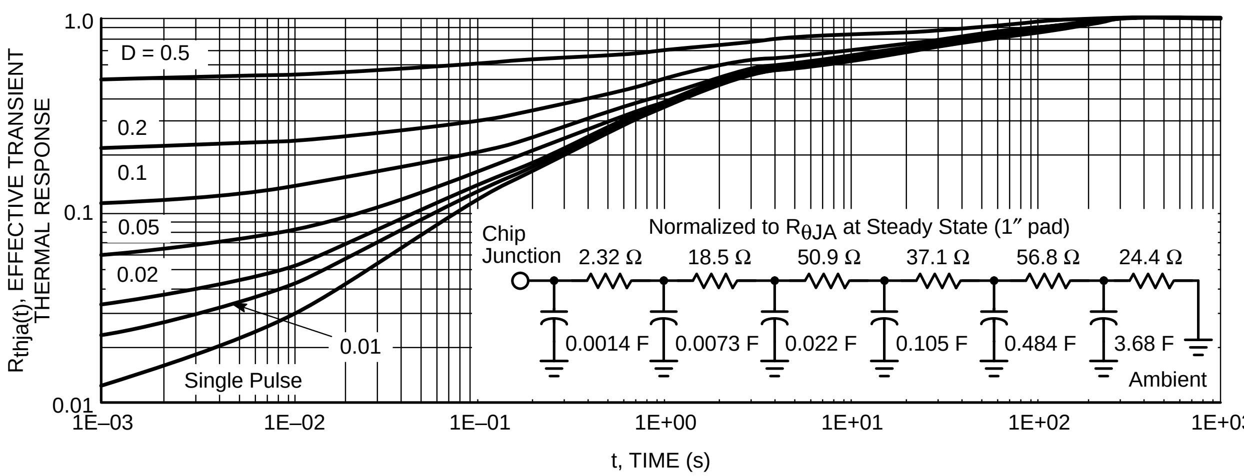


Figure 15. FET Thermal Response

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

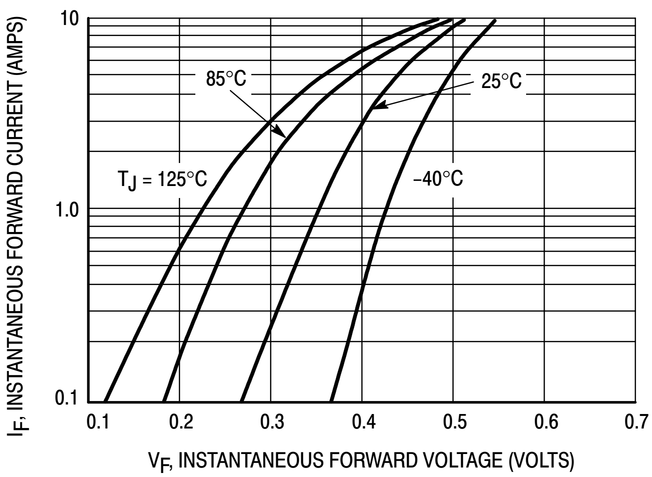


Figure 16. Typical Forward Voltage

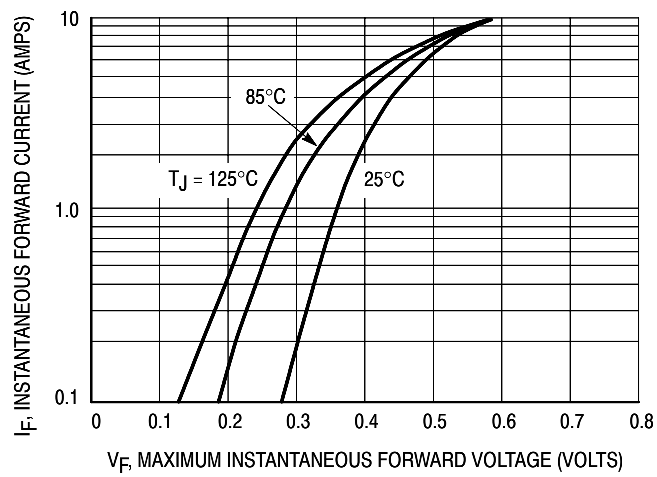


Figure 17. Maximum Forward Voltage

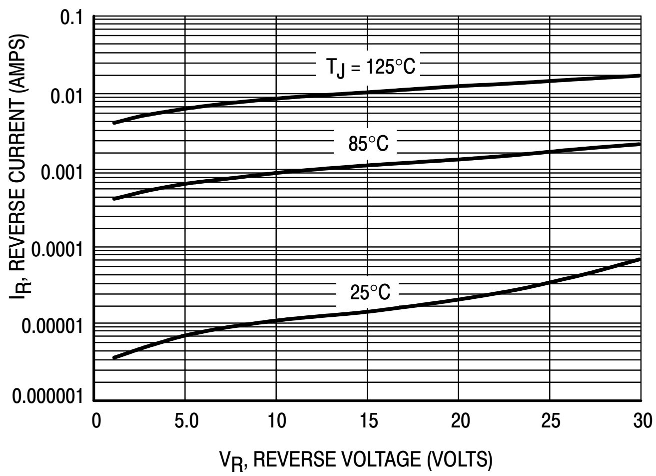


Figure 18. Typical Reverse Current

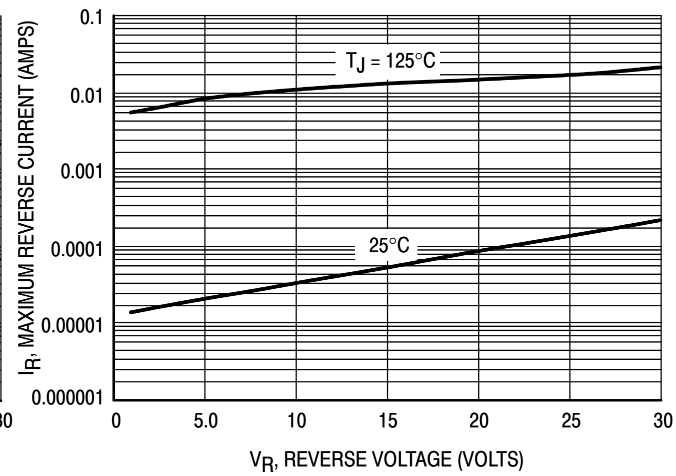


Figure 19. Maximum Reverse Current

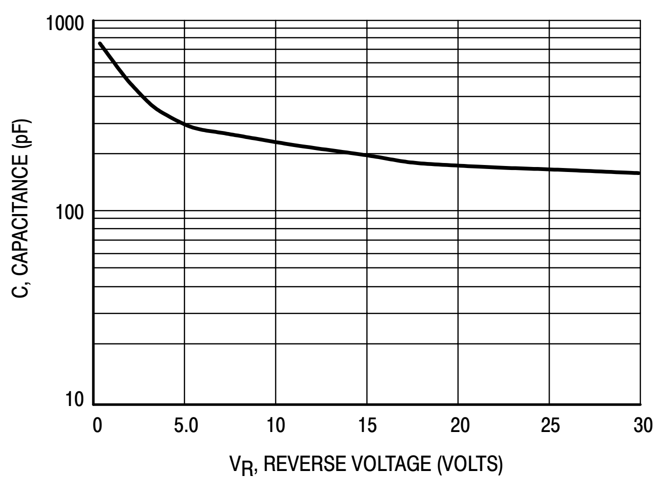


Figure 20. Typical Capacitance

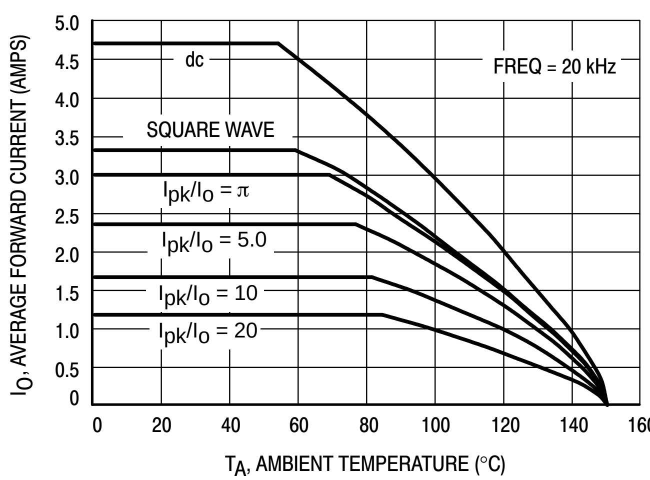


Figure 21. Current Derating

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

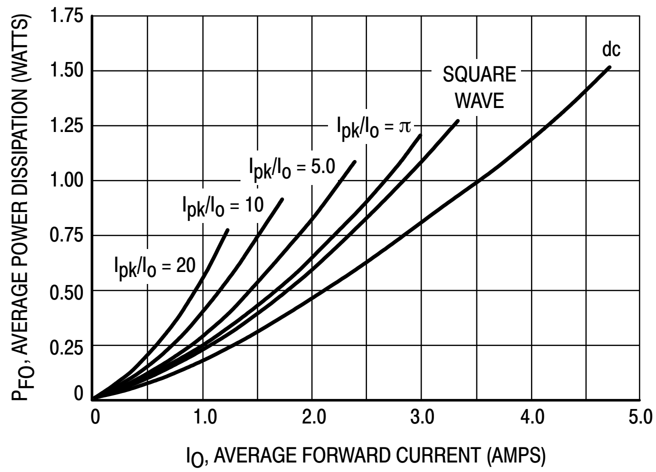


Figure 22. Forward Power Dissipation

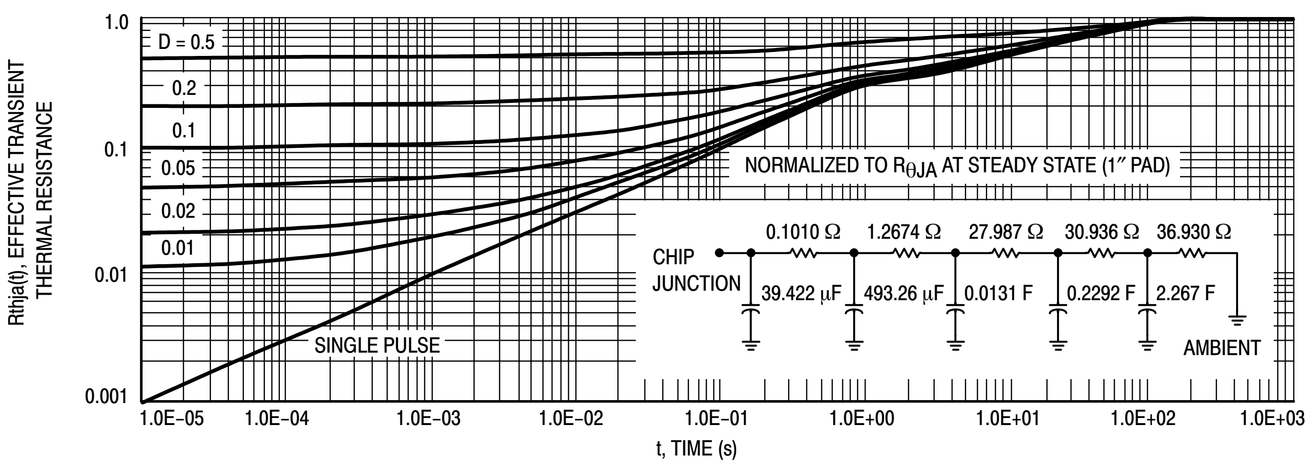
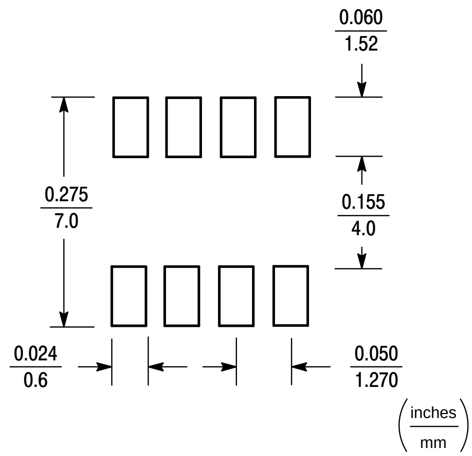


Figure 23. Schottky Thermal Response

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 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.



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 24 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.

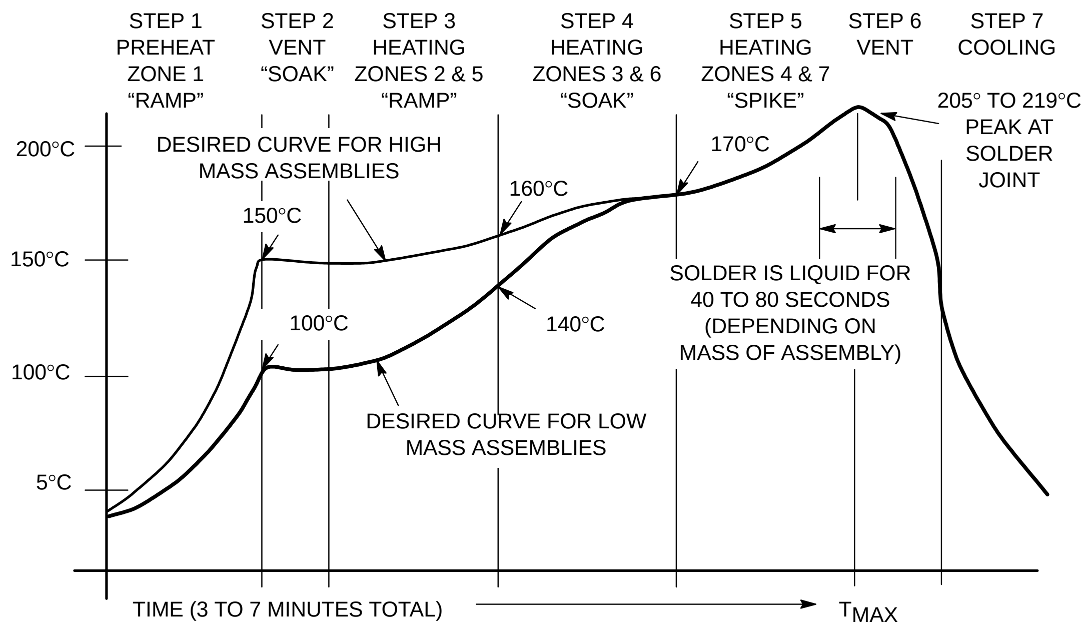
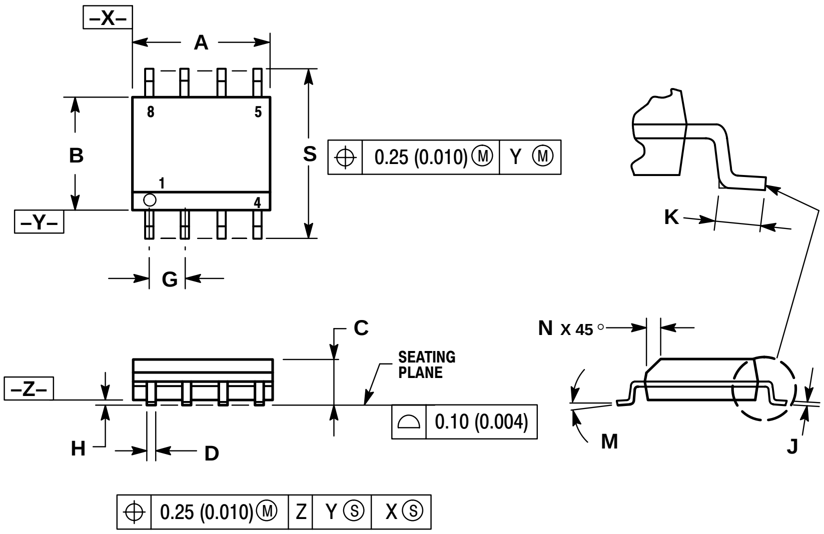


Figure 24. Typical Solder Heating Profile

PACKAGE DIMENSIONS

SO–8
CASE 751–07
ISSUE W



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

STYLE 18:
PIN 1. ANODE
2. ANODE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. CATHODE
8. CATHODE

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