

NTF6P02T3

Power MOSFET -6.0 Amps, -20 Volts P-Channel SOT-223

Features

- Low $R_{DS(on)}$
- Logic Level Gate Drive
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified

Typical Applications

- Power Management in Portables and Battery-Powered Products, i.e.: Cellular and Cordless Telephones and PCMCIA Cards

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	V_{DS}	-20	Vdc
Gate-to-Source Voltage	V_{GS}	± 8.0	Vdc
Drain Current (Note 1)			
– Continuous @ $T_A = 25^\circ\text{C}$	I_D	-10	A dc
– Continuous @ $T_A = 70^\circ\text{C}$	I_D	-8.4	
– Single Pulse ($t_p = 10 \mu\text{s}$)	I_{DM}	-35	A pk
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	P_D	8.3	W
Operating and Storage Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ($V_{DD} = -20 \text{ Vdc}$, $V_{GS} = -5.0 \text{ Vdc}$, $I_{L(pk)} = -10 \text{ A}$, $L = 3.0 \text{ mH}$, $R_G = 25\Omega$)	E_{AS}	150	mJ
Thermal Resistance			$^\circ\text{C/W}$
– Junction to Lead (Note 1)	$R_{\theta JL}$	15	
– Junction to Ambient (Note 2)	$R_{\theta JA}$	71.4	
– Junction to Ambient (Note 3)	$R_{\theta JA}$	160	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	T_L	260	$^\circ\text{C}$

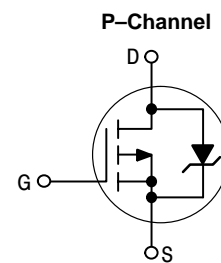
1. Steady State.
2. When surface mounted to an FR4 board using 1" pad size, (Cu. Area 1.127 in²), Steady State.
3. When surface mounted to an FR4 board using minimum recommended pad size, (Cu. Area 0.412 in²), Steady State.



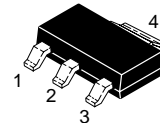
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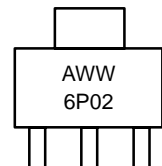
-6.0 AMPERES
-20 VOLTS
 $R_{DS(on)} = 44 \text{ m}\Omega$ (Typ.)



MARKING DIAGRAM

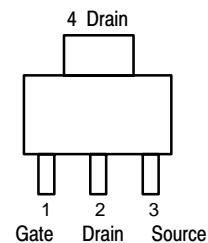


SOT-223
CASE 318E
STYLE 3



A = Assembly Location
WW = Work Week
6P02 = Device Code

PIN ASSIGNMENT



ORDERING INFORMATION

Device	Package	Shipping
NTF6P02T3	SOT-223	4000/Tape & Reel

NTF6P02T3

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 4) (V _{GS} = 0 Vdc, I _D = -250 μAdc) Temperature Coefficient (Positive)	V _{(BR)DSS}	-20 -	-25 -11	- -	Vdc mV/°C
Zero Gate Voltage Drain Current (V _{DS} = -20 Vdc, V _{GS} = 0 Vdc) (V _{DS} = -20 Vdc, V _{GS} = 0 Vdc, T _J = 125°C)	I _{DSS}	- -	- -	-1.0 -10	μAdc
Gate-Body Leakage Current (V _{GS} = ± 8.0 Vdc, V _{DS} = 0 Vdc)	I _{GSS}	-	-	± 100	nAdc

ON CHARACTERISTICS (Note 4)

Gate Threshold Voltage (Note 4) (V _{DS} = V _{GS} , I _D = -250 μAdc) Threshold Temperature Coefficient (Negative)	V _{GS(th)}	-0.4 -	-0.7 2.6	-1.0 -	Vdc mV/°C
Static Drain-to-Source On-Resistance (Note 4) (V _{GS} = -4.5 Vdc, I _D = -6.0 Adc) (V _{GS} = -2.5 Vdc, I _D = -4.0 Adc) (V _{GS} = -2.5 Vdc, I _D = -3.0 Adc)	R _{DS(on)}	- - -	44 57 57	50 70 -	mΩ
Forward Transconductance (Note 4) (V _{DS} = -10 Vdc, I _D = -6.0 Adc)	g _{fs}	-	12	-	Mhos

DYNAMIC CHARACTERISTICS

Input Capacitance	(V _{DS} = -16 Vdc, V _{GS} = 0 V, f = 1.0 MHz)	C _{iss}	-	900	1200	pF
Output Capacitance		C _{oss}	-	350	500	
Transfer Capacitance		C _{rss}	-	90	150	
Input Capacitance	(V _{DS} = -10 Vdc, V _{GS} = 0 V, f = 1.0 MHz)	C _{iss}	-	940	-	pF
Output Capacitance		C _{oss}	-	410	-	
Transfer Capacitance		C _{rss}	-	110	-	

SWITCHING CHARACTERISTICS (Note 5)

Turn-On Delay Time	(V _{DD} = -5.0 Vdc, I _D = -1.0 Adc, V _{GS} = -4.5 Vdc, R _G = 6.0 Ω)	t _{d(on)}	-	7.0	12	ns
Rise Time		t _r	-	25	45	
Turn-Off Delay Time		t _{d(off)}	-	75	125	
Fall Time		t _f	-	50	85	
Turn-On Delay Time	(V _{DD} = -16 Vdc, I _D = -6.0 Adc, V _{GS} = -4.5 Vdc, R _G = 2.5 Ω)	t _{d(on)}	-	8.0	-	ns
Rise Time		t _r	-	30	-	
Turn-Off Delay Time		t _{d(off)}	-	60	-	
Fall Time		t _f	-	60	-	
Gate Charge	(V _{DS} = -16 Vdc, I _D = -6.0 Adc, V _{GS} = -4.5 Vdc) (Note 4)	Q _T	-	15	20	nC
		Q _{gs}	-	1.7	-	
		Q _{gd}	-	6.0	-	

SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	(I _S = -3.0 Adc, V _{GS} = 0 Vdc) (Note 4) (I _S = -2.1 Adc, V _{GS} = 0 Vdc) (I _S = -3.0 Adc, V _{GS} = 0 Vdc, T _J = 125°C)	V _{SD}	- - -	-0.82 -0.74 -0.68	-1.2 - -	Vdc
Reverse Recovery Time	(I _S = -3.0 Adc, V _{GS} = 0 Vdc, dI _S /dt = 100 A/μs) (Note 4)	t _{rr}	-	42	-	ns
		t _a	-	17	-	
		t _b	-	25	-	
Reverse Recovery Stored Charge		Q _{RR}	-	0.036	-	μC

4. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
5. Switching characteristics are independent of operating junction temperatures.

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TYPICAL ELECTRICAL CHARACTERISTICS

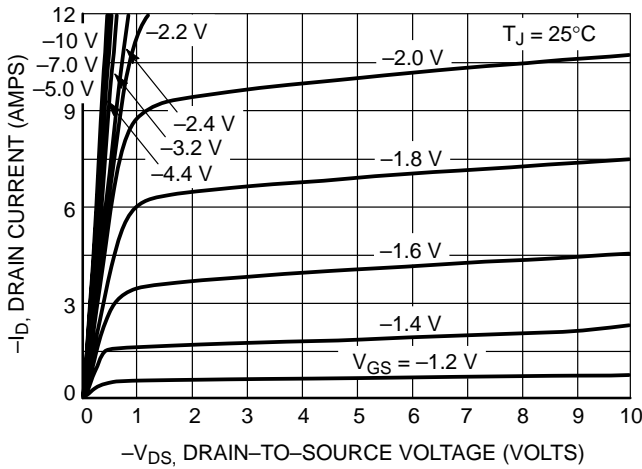


Figure 1. On-Region Characteristics

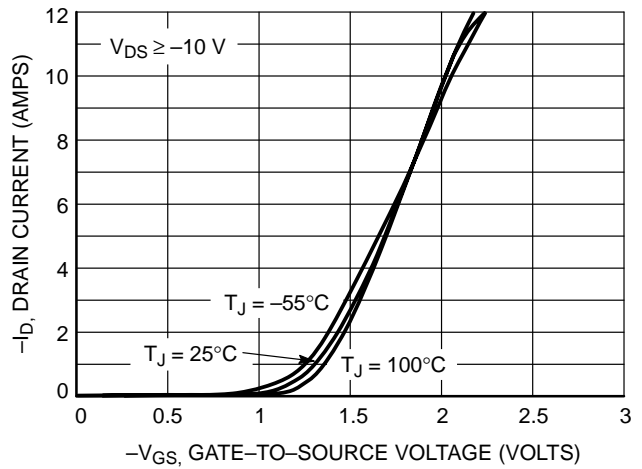


Figure 2. Transfer Characteristics

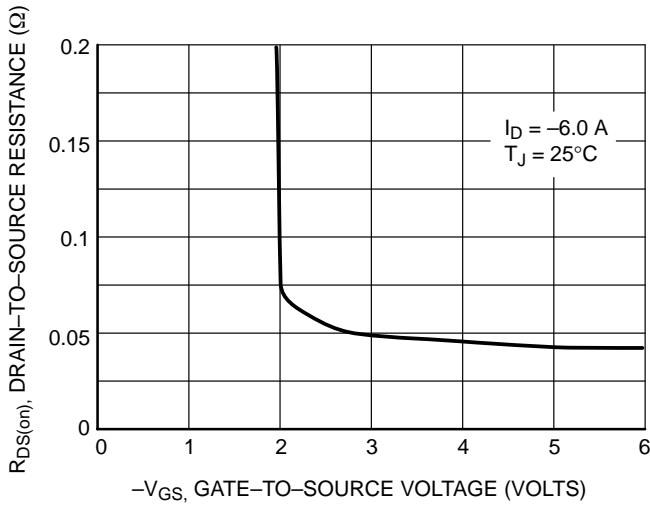


Figure 3. On-Resistance versus Gate-to-Source Voltage

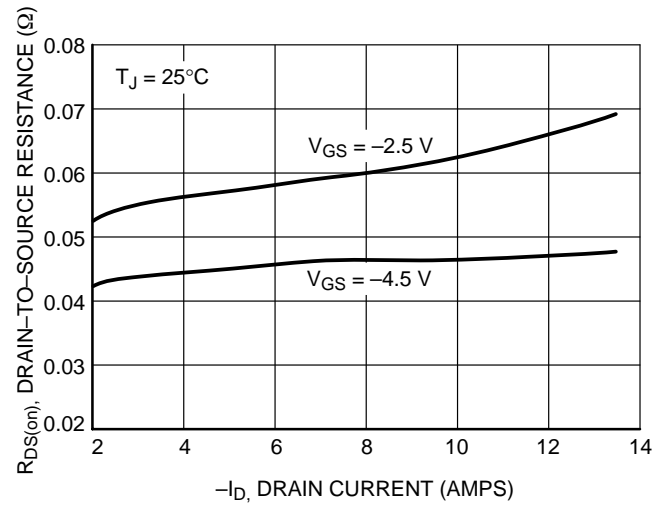


Figure 4. On-Resistance versus Drain Current and Gate Voltage

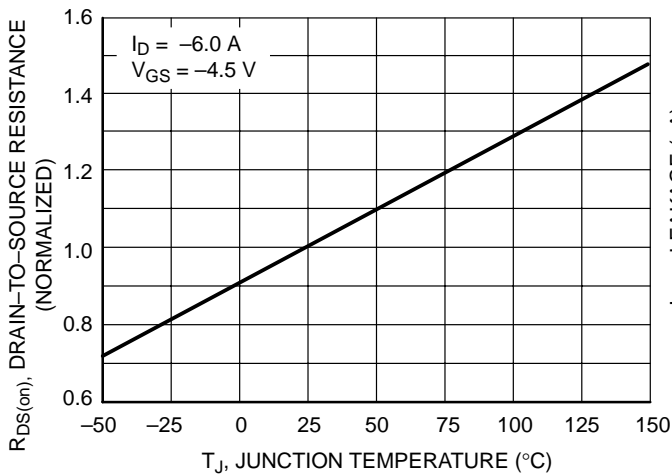


Figure 5. On-Resistance Variation with Temperature

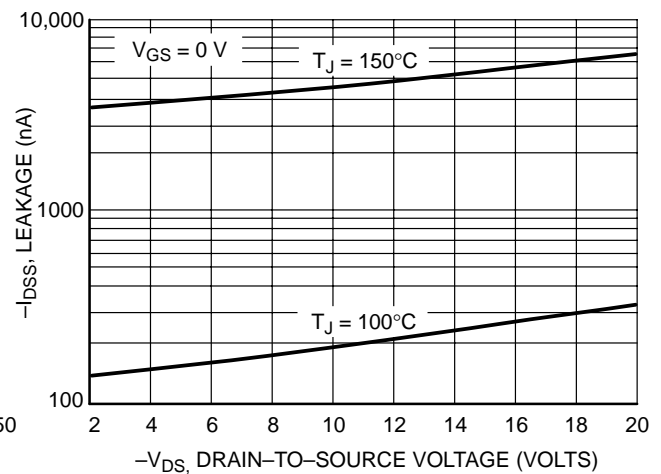


Figure 6. Drain-to-Source Leakage Current versus Voltage

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TYPICAL ELECTRICAL CHARACTERISTICS

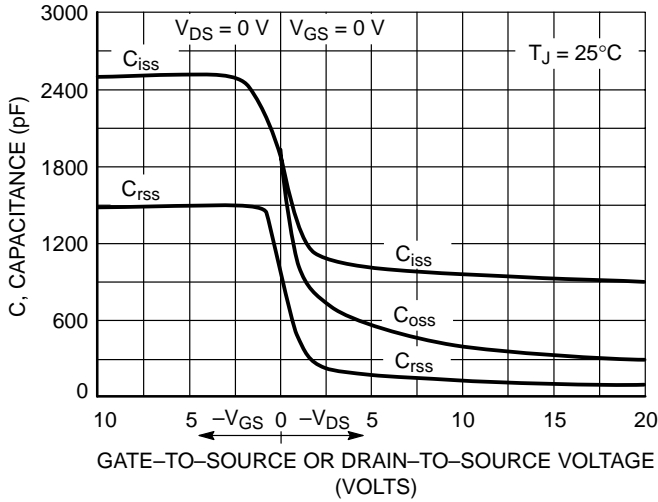


Figure 7. Capacitance Variation

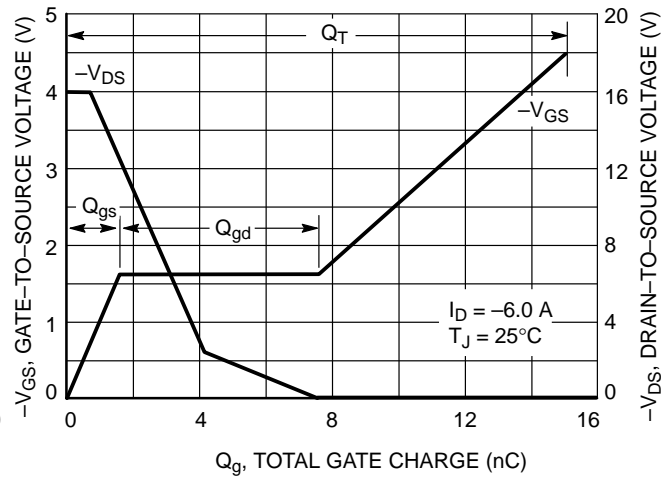


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

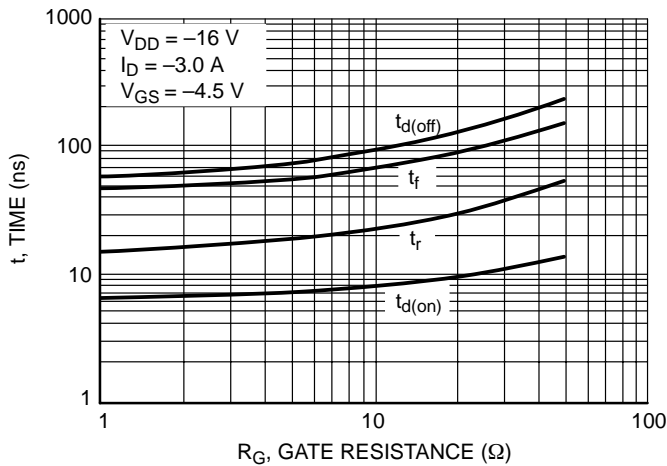


Figure 9. Resistive Switching Time Variation versus Gate Resistance

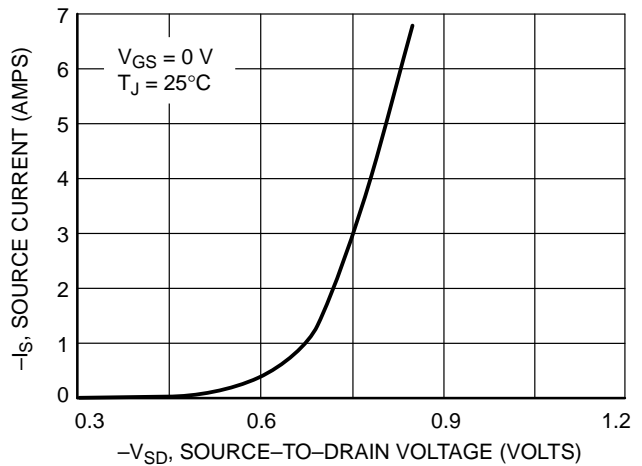


Figure 10. Diode Forward Voltage versus Current

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TYPICAL ELECTRICAL CHARACTERISTICS

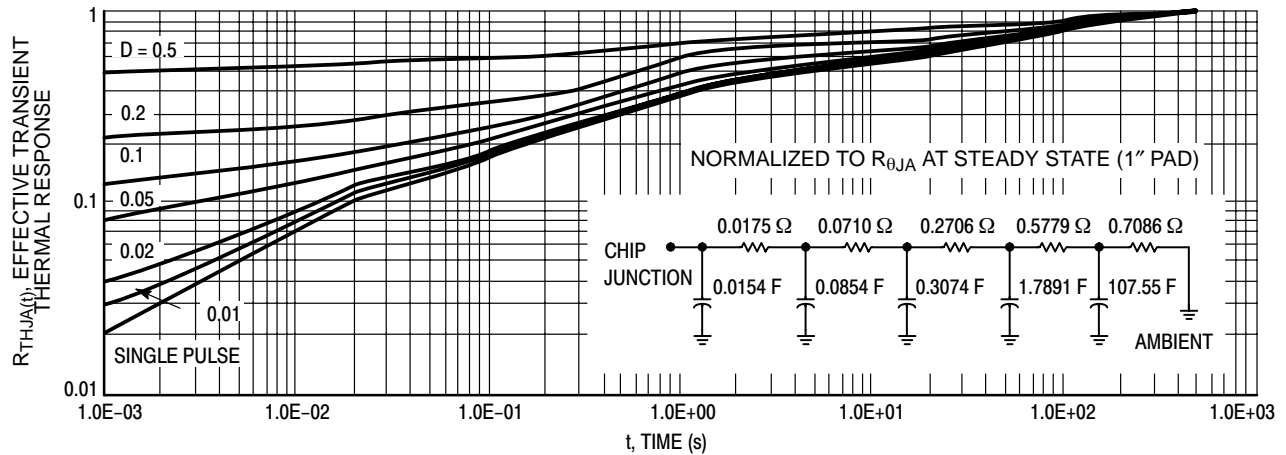


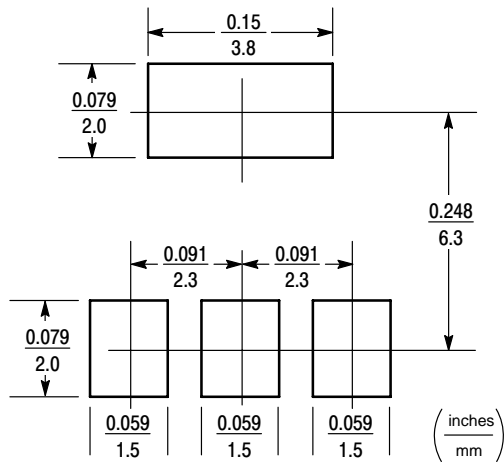
Figure 11. FET Thermal Response

INFORMATION FOR USING THE SOT-223 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.



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 12 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.

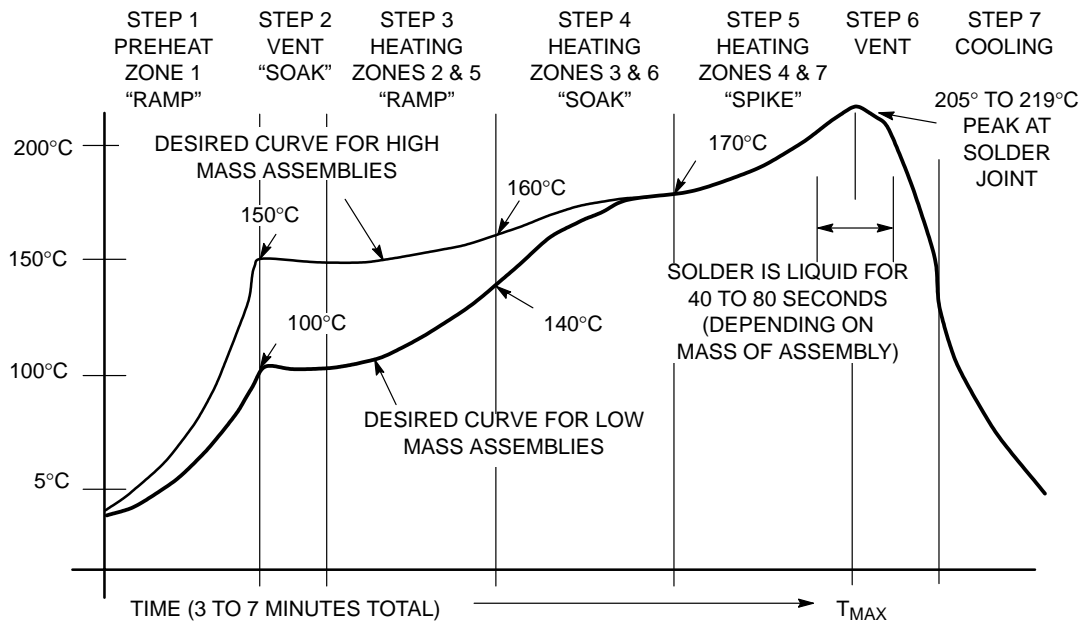
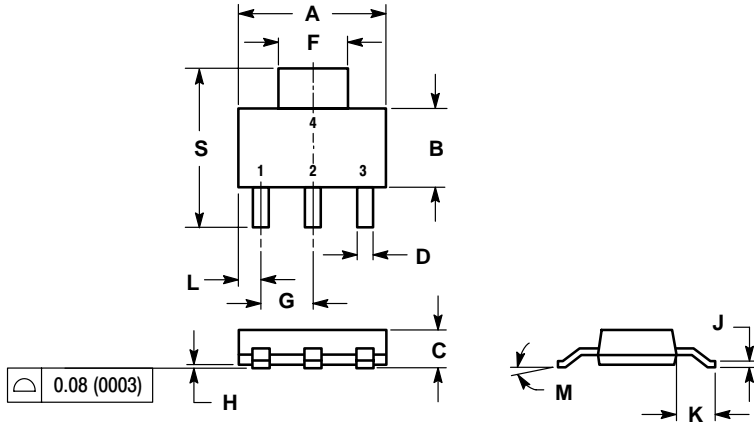


Figure 12. Typical Solder Heating Profile

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PACKAGE DIMENSIONS


SOT-223 (TO-261)
CASE 318E-04
ISSUE K



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.249	0.263	6.30	6.70
B	0.130	0.145	3.30	3.70
C	0.060	0.068	1.50	1.75
D	0.024	0.035	0.60	0.89
F	0.115	0.126	2.90	3.20
G	0.087	0.094	2.20	2.40
H	0.0008	0.0040	0.020	0.100
J	0.009	0.014	0.24	0.35
K	0.060	0.078	1.50	2.00
L	0.033	0.041	0.85	1.05
M	0°	10°	0°	10°
S	0.264	0.287	6.70	7.30

- STYLE 3:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

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