NTQD6866R2

Power MOSFET 6.9 Amps, 20 Volts

N–Channel TSSOP–8

Features

- New Low Profile TSSOP–8 Package
- Ultra Low $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- I_{DSS} and $V_{DS(on)}$ Specified at Elevated Temperatures

Applications

- Power Management in Portable and Battery–Powered Products, i.e.: Computers, Printers, PCMCIA Cards, Cellular and Cordless Telephones
- Battery Applications
- NoteBook PC

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

Rating	Symbol	Value	Unit
Drain–to–Source Voltage	V_{DSS}	20	Vdc
Drain–to–Gate Voltage (R_{GS} = 1.0 MΩ)	V_{DGR}	20	Vdc
Gate–to–Source Voltage – Continuous	V_{GS}	±12	Vdc
Thermal Resistance – Single Die			
Junction–to–Ambient (Note 1)	$R_{\theta JA}$	62.5	°C/W
Total Power Dissipation @ T_A = 25°C	P_D	2.0	W
Continuous Drain Current @ T_A = 25°C	I_D	6.9	Adc
Pulsed Drain Current (Note 4)	I_{DM}	24	Adc
Thermal Resistance – Single Die			
Junction–to–Ambient (Note 2)	$R_{\theta JA}$	88	°C/W
Total Power Dissipation @ T_A = 25°C	P_D	1.42	W
Continuous Drain Current @ T_A = 25°C	I_D	5.8	Adc
Continuous Drain Current @ T_A = 70°C	I_D	4.6	Adc
Pulsed Drain Current (Note 4)	I_{DM}	20	Adc
Thermal Resistance – Single Die			
Junction–to–Ambient (Note 3)	$R_{\theta JA}$	132	°C/W
Total Power Dissipation @ T_A = 25°C	P_D	0.94	W
Continuous Drain Current @ T_A = 25°C	I_D	4.7	Adc
Continuous Drain Current @ T_A = 70°C	I_D	3.8	Adc
Pulsed Drain Current (Note 4)	I_{DM}	14	Adc

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

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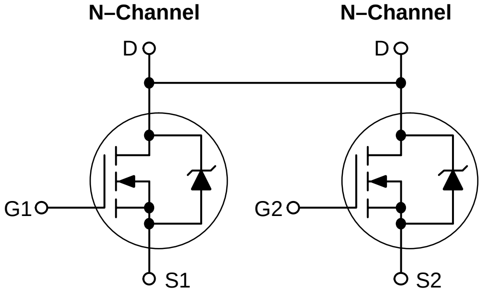
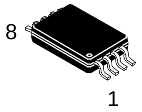
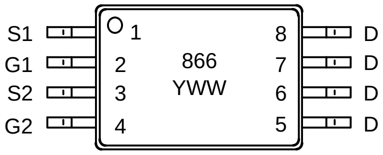
6.9 AMPERES
20 VOLTS
30 mΩ @ V_{GS} = 4.5 V





TSSOP–8
CASE 948S
PLASTIC

MARKING DIAGRAM & PIN ASSIGNMENT



Top View

866 = Device Code
YWW = Date Code

ORDERING INFORMATION

Device	Package	Shipping
NTQD6866R2	TSSOP–8	4000/Tape & Reel

MAXIMUM RATINGS (continued)

Rating	Symbol	Value	Unit
Thermal Resistance – Both Die Junction–to–Ambient (Note 5)	$R_{\theta JA}$	160	°C/W
Total Power Dissipation @ T_A = 25°C	P_D	0.78	W
Continuous Drain Current @ T_A = 25°C	I_D	4.3	Adc
Pulsed Drain Current (Note 5)	I_{DM}	14	Adc
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} = 5.0 Vdc, Peak I_L = 5.5 Apk, L = 10 mH, R_G = 25 Ω)	E_{AS}	150	mJ
Maximum Lead Temperature for Soldering Purposes for 10 seconds	T_L	260	°C

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 = 250 µAdc)	$V_{(BR)DSS}$	20	–	–	Vdc
Temperature Coefficient (Positive)		–	18.5	–	mV/°C
Zero Gate Voltage Drain Current (V_{GS} = 0 Vdc, V_{DS} = 20 Vdc, T_J = 25°C)	I_{DSS}	–	–	1.0	µAdc
(V_{GS} = 0 Vdc, V_{DS} = 20 Vdc, T_J = 100°C)		–	–	10	
Gate–Body Leakage Current (V_{GS} = ±12 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	–	–	±100	nAdc
ON CHARACTERISTICS					
Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 250 µAdc)	$V_{GS(th)}$	0.6	0.9	1.2	Vdc
Temperature Coefficient (Negative)		–	–2.7	–	mV/°C
Static Drain–to–Source On–State Resistance (V_{GS} = 4.5 Vdc, I_D = 6.9 Adc)	$R_{DS(on)}$	–	0.026	0.032	Ω
(V_{GS} = 4.5 Vdc, I_D = 5.8 Adc)		–	0.025	0.030	
(V_{GS} = 2.5 Vdc, I_D = 3.5 Adc)		–	0.030	0.038	
(V_{GS} = 2.5 Vdc, I_D = 2.9 Adc)		–	0.030	0.038	
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 5.8 Adc)	g_{FS}	–	14	–	Mhos
DYNAMIC CHARACTERISTICS					
Input Capacitance (V_{DS} = 16 Vdc, V_{GS} = 0 Vdc, f = 1.0 MHz)	C_{iss}	–	875	1400	pF
Output Capacitance	C_{oss}	–	325	550	
Reverse Transfer Capacitance	C_{rss}	–	100	175	

5. Pulse Test: Pulse Width = 300 µs, Duty Cycle = 2%.

ELECTRICAL CHARACTERISTICS (continued)

Characteristic		Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS (Notes 6 & 7)						
Turn–On Delay Time	(V_{DD} = 16 Vdc, I_D = 5.8 Adc, V_{GS} = 4.5 Vdc, R_G = 6.0 Ω)	$t_{d(on)}$	–	10	18	ns
Rise Time		t_r	–	45	80	
Turn–Off Delay Time		$t_{d(off)}$	–	40	75	
Fall Time		t_f	–	90	150	
Turn–On Delay Time	(V_{DD} = 16 Vdc, I_D = 5.8 Adc, V_{GS} = 4.5 Vdc, R_G = 3.0 Ω)	$t_{d(on)}$	–	8.0	–	ns
Rise Time		t_r	–	45	–	
Turn–Off Delay Time		$t_{d(off)}$	–	35	–	
Fall Time		t_f	–	75	–	
Gate Charge	(V_{DS} = 16 Vdc, V_{GS} = 4.5 Vdc, I_D = 5.8 Adc)	Q_{tot}	–	13	22	nC
		Q_{gs}	–	1.8	–	
		Q_{gd}	–	4.5	–	
BODY–DRAIN DIODE RATINGS (Note 6)						
Forward On–Voltage	(I_S = 5.8 Adc, V_{GS} = 0 Vdc) (I_S = 5.8 Adc, V_{GS} = 0 Vdc, T_J = 100°C)	V_{SD}	– –	0.85 0.75	1.0 –	Vdc
Reverse Recovery Time	(I_S = 5.8 Adc, V_{GS} = 0 Vdc, V_{DS} = 20 Vdc dI_S/dt = 100 A/μs)	t_{rr}	–	23	–	ns
		t_a	–	12	–	
		t_b	–	11	–	
Reverse Recovery Stored Charge		Q_{RR}	–	0.013	–	μC

6. Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.
7. Switching characteristics are independent of operating junction temperature.

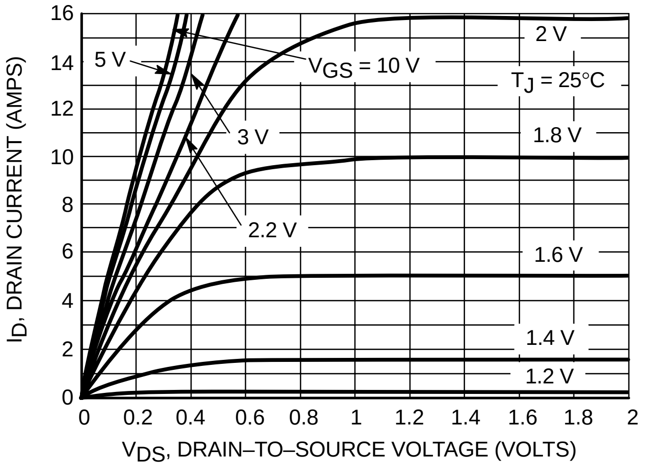


Figure 1. On–Region Characteristics

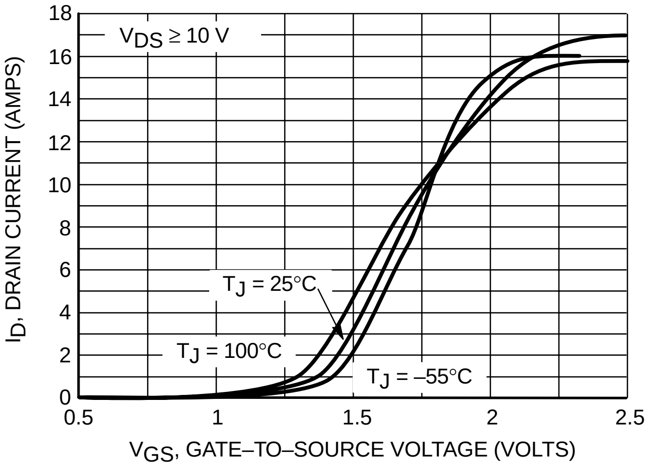


Figure 2. Transfer Characteristics

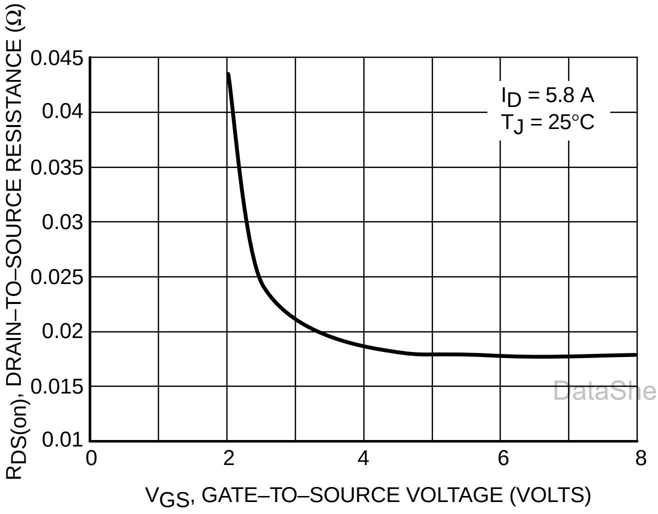


Figure 3. On–Resistance versus Gate–to–Source Voltage

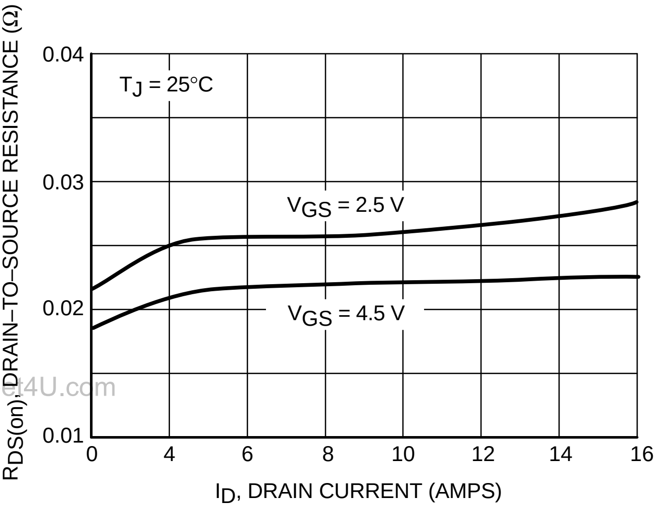


Figure 4. On–Resistance versus Drain Current and Gate Voltage

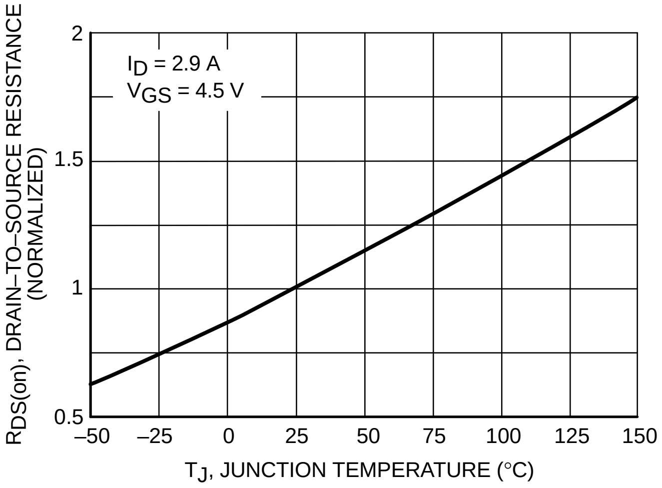


Figure 5. On–Resistance Variation with Temperature

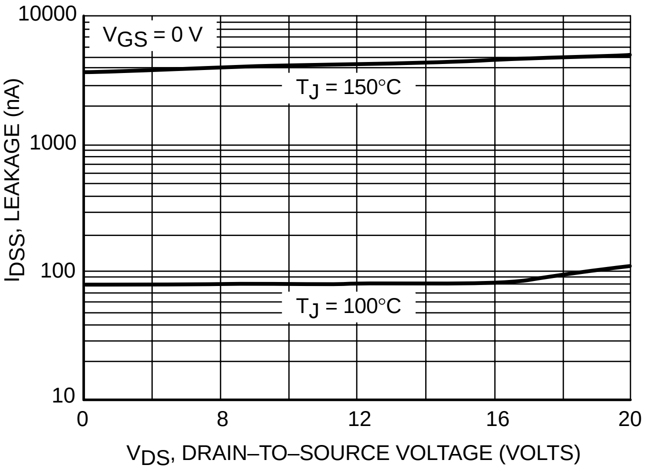


Figure 6. Drain–to–Source Leakage Current versus Voltage

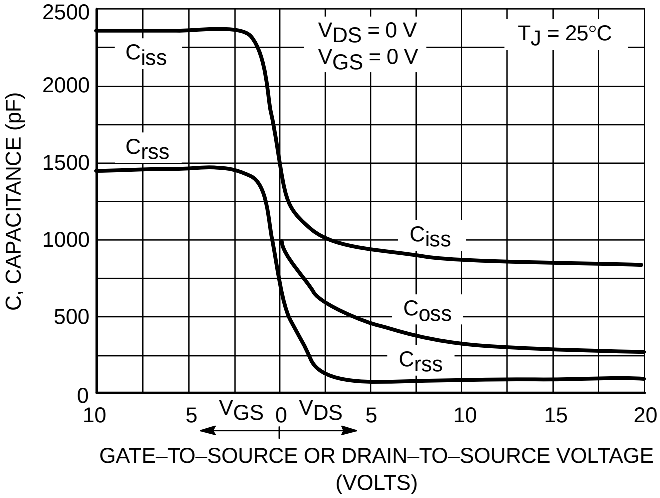


Figure 7. Capacitance Variation

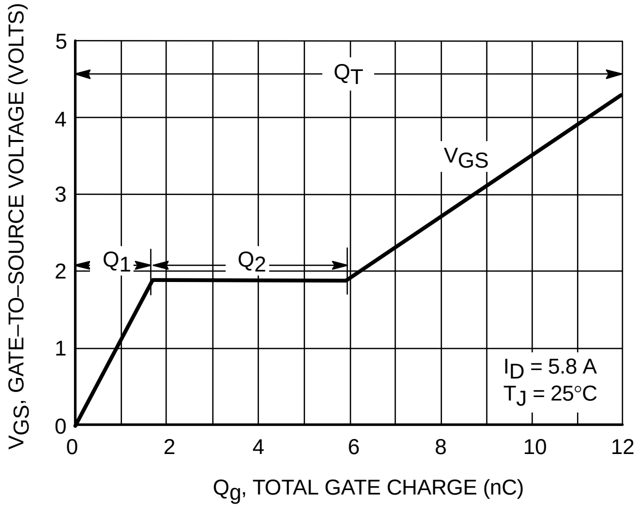
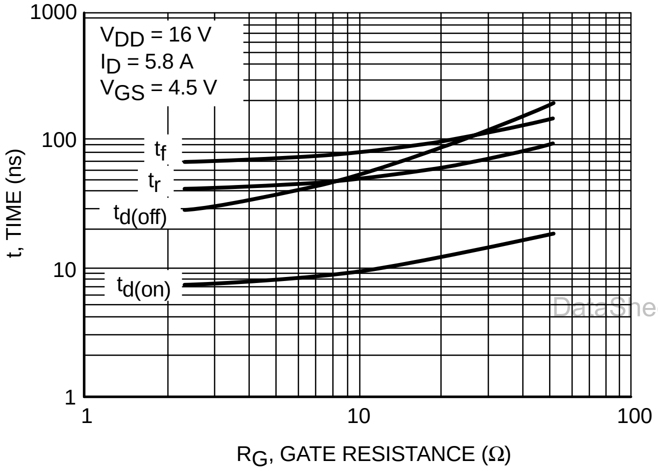


Figure 8. Gate–to–Source Voltage versus Total Charge



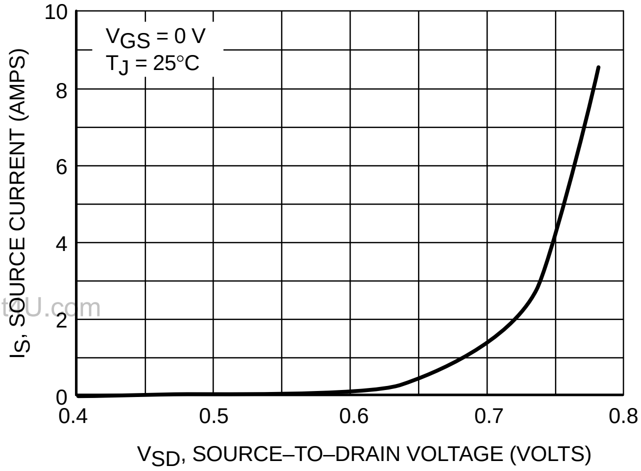


Figure 9. Resistive Switching Time Variation versus Gate Resistance

Figure 10. Diode Forward Voltage versus Current

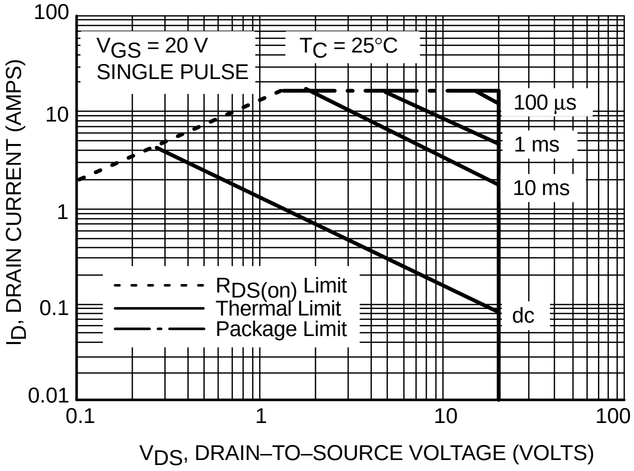


Figure 11. Maximum Rated Forward Biased Safe Operating Area

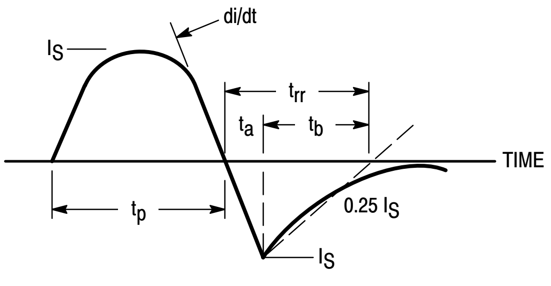


Figure 12. Diode Reverse Recovery Waveform

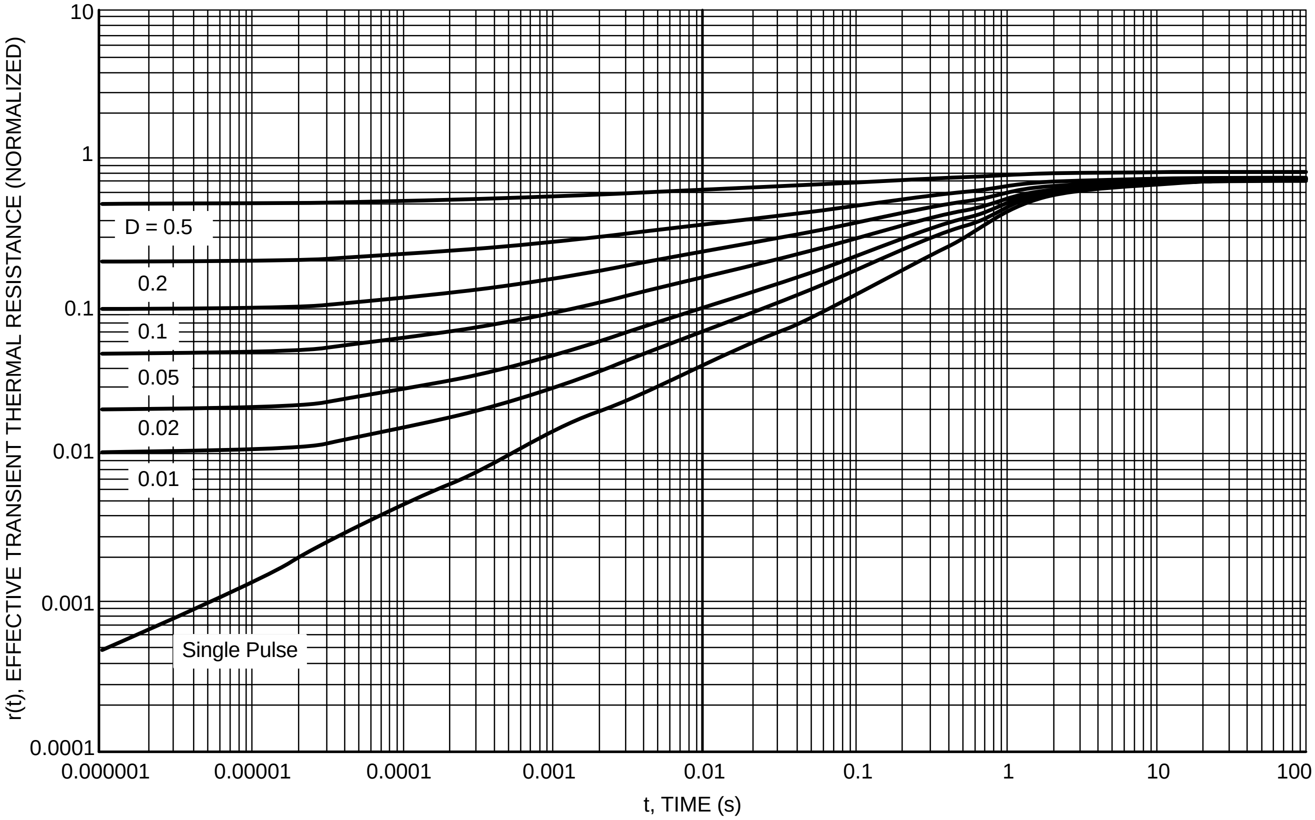
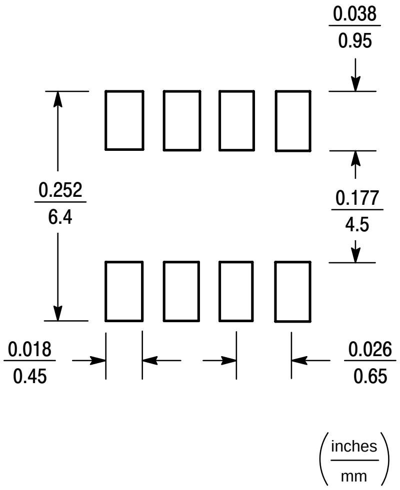


Figure 13. Thermal Response

INFORMATION FOR USING THE TSSOP–8 SURFACE MOUNT PACKAGE

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.

* * Due to shadowing and the inability to set the wave height to incorporate other surface mount components, the D^{2}PAK is not recommended for wave soldering.

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 14 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 joint.

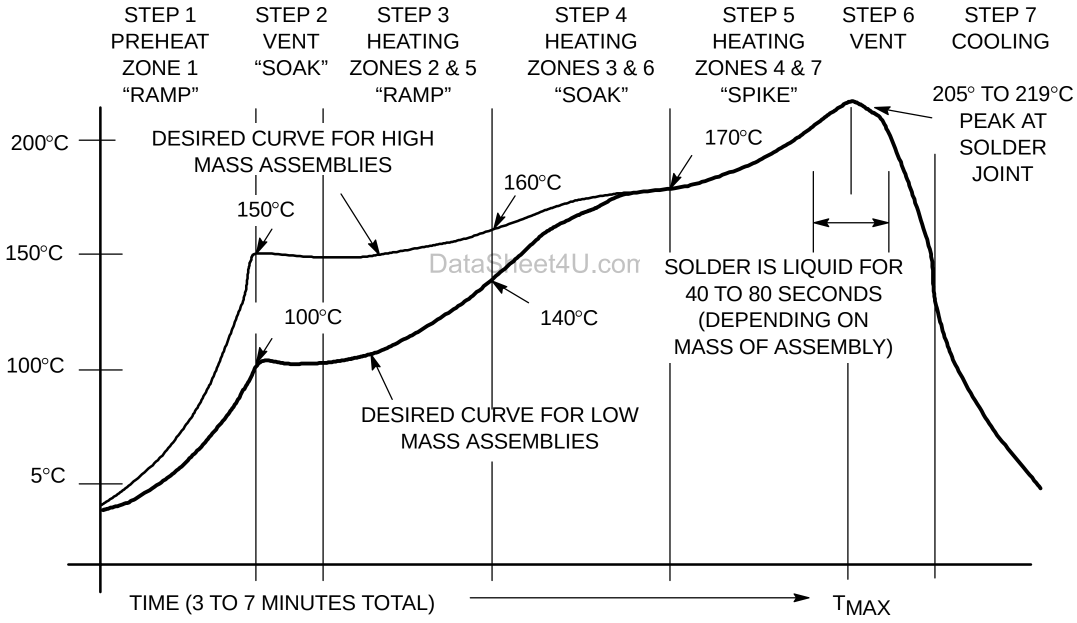
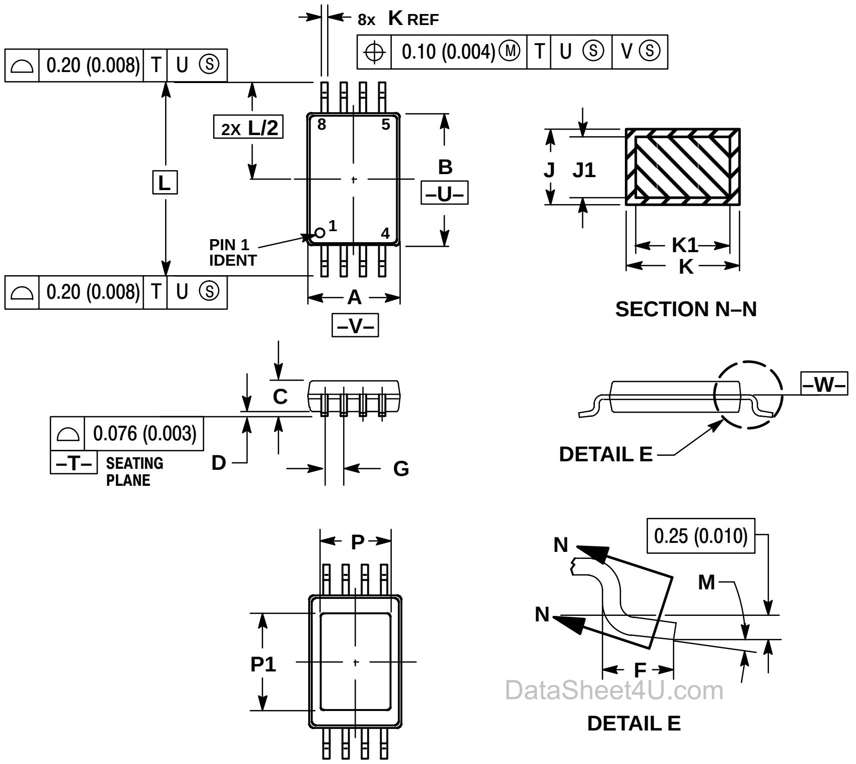


Figure 14. Typical Solder Heating Profile

PACKAGE DIMENSIONS

TSSOP–8

CASE 948S–01
PLASTIC
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	4.30	4.50	0.169	0.177
C	---	1.10	---	0.043
D	0.05	0.15	0.002	0.006
F	0.50	0.70	0.020	0.028
G	0.65 BSC		0.026 BSC	
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°
P	---	2.20	---	0.087
P1	---	3.20	---	0.126

Notes

Notes

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