NTMD6P02, NVMD6P02

[MOSFET](#) – Power, Dual, P-Channel, SOIC-8

6 A, 20 V

ON Semiconductor®

Features

- Ultra Low $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Miniature Dual SOIC−8 Surface Mount Package
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- These Devices are Pb−Free and are RoHS Compliant
- NVMD Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q101 Qualified and PPAP Capable

Applications

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

6 AMPERES, 20 VOLTS

P−Channel

MARKING DIAGRAM & PIN ASSIGNMENT

SOIC−8
CASE 751
STYLE 11

E6P02
AYWW ▪

E6P02 = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain−to−Source Voltage	V_{DSS}	−20	V
Gate−to−Source Voltage – Continuous	V_{GS}	± 12	V
Thermal Resistance – 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	−7.8	A
Continuous Drain Current @ T_A = 70°C	I_D	−5.7	A
Maximum Operating Power Dissipation	P_D	0.5	W
Maximum Operating Drain Current	I_D	−3.89	A
Pulsed Drain Current (Note 4)	I_{DM}	−40	A
Thermal Resistance – Junction−to−Ambient (Note 2)	$R_{\theta JA}$	98	°C/W
Total Power Dissipation @ T_A = 25°C	P_D	1.28	W
Continuous Drain Current @ T_A = 25°C	I_D	−6.2	A
Continuous Drain Current @ T_A = 70°C	I_D	−4.6	A
Maximum Operating Power Dissipation	P_D	0.3	W
Maximum Operating Drain Current	I_D	−3.01	A
Pulsed Drain Current (Note 4)	I_{DM}	−35	A
Thermal Resistance – Junction−to−Ambient (Note 3)	$R_{\theta JA}$	166	°C/W
Total Power Dissipation @ T_A = 25°C	P_D	0.75	W
Continuous Drain Current @ T_A = 25°C	I_D	−4.8	A
Continuous Drain Current @ T_A = 70°C	I_D	−3.5	A
Maximum Operating Power Dissipation	P_D	0.2	W
Maximum Operating Drain Current	I_D	−2.48	A
Pulsed Drain Current (Note 4)	I_{DM}	−30	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} = −5.0 Vdc, Peak I_L = −5.0 Apk, L = 40 mH, R_G = 25 Ω)	E_{AS}	500	mJ
Maximum Lead Temperature for Soldering Purposes for 10 seconds	T_L	260	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
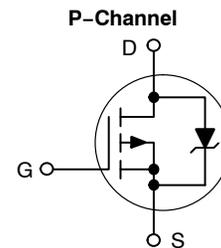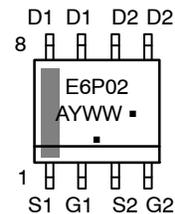
1. Mounted onto a 2″ square FR−4 Board (1 in sq, 2 oz. Cu 0.06″ thick single sided), t = 10 seconds.

ORDERING INFORMATION

Device	Package	Shipping†
NTMD6P02R2G	SOIC−8 (Pb−Free)	2500 / Tape & Reel
NVMD6P02R2G	SOIC−8 (Pb−Free)	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D

May, 2019 − Rev. 5

1

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

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)		–	–11.6	–	mV/°C
Zero Gate Voltage Drain Current (V_{DS} = –20 Vdc, V_{GS} = 0 Vdc, T_J = 25°C) (V_{DS} = –20 Vdc, V_{GS} = 0 Vdc, T_J = 70°C)	I_{DSS}	– –	– –	–1.0 –5.0	μAdc
Gate–Body Leakage Current (V_{GS} = –12 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	–	–	–100	nAdc
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	–0.88	–1.20	Vdc
Temperature Coefficient (Negative)		–	2.6	–	mV/°C
Static Drain–to–Source On–State Resistance (V_{GS} = –4.5 Vdc, I_D = –6.2 Adc) (V_{GS} = –2.5 Vdc, I_D = –5.0 Adc) (V_{GS} = –2.5 Vdc, I_D = –3.1 Adc)	$R_{DS(on)}$	– – –	0.027 0.038 0.038	0.033 0.050 –	Ω
Forward Transconductance (V_{DS} = –10 Vdc, I_D = –6.2 Adc)	g_{FS}	–	15	–	Mhos
DYNAMIC CHARACTERISTICS					
Input Capacitance	C_{iss}	–	1380	1700	pF
Output Capacitance	C_{oss}	–	515	775	
Reverse Transfer Capacitance	C_{rss}	–	250	450	

(For capacitances: V_{DS} = –16 Vdc, V_{GS} = 0 Vdc, f = 1.0 MHz)

SWITCHING CHARACTERISTICS (Notes 5 and 6)

Characteristic	Symbol	Min	Typ	Max	Unit
Turn–On Delay Time	$t_{d(on)}$	–	15	25	ns
Rise Time	t_r	–	20	50	
Turn–Off Delay Time	$t_{d(off)}$	–	85	125	
Fall Time	t_f	–	50	110	

(V_{DD} = –10 Vdc, I_D = –1.0 Adc, V_{GS} = –10 Vdc, R_G = 6.0 Ω)

Characteristic	Symbol	Min	Typ	Max	Unit
Turn–On Delay Time	$t_{d(on)}$	–	17	–	ns
Rise Time	t_r	–	65	–	
Turn–Off Delay Time	$t_{d(off)}$	–	50	–	
Fall Time	t_f	–	80	–	

(V_{DD} = –16 Vdc, I_D = –6.2 Adc, V_{GS} = –4.5 Vdc, R_G = 6.0 Ω)

Characteristic	Symbol	Min	Typ	Max	Unit
Total Gate Charge	Q_{tot}	–	20	35	nC
Gate–Source Charge	Q_{gs}	–	4.0	–	
Gate–Drain Charge	Q_{gd}	–	8.0	–	

(V_{DS} = –16 Vdc, V_{GS} = –4.5 Vdc, I_D = –6.2 Adc)

BODY–DRAIN DIODE RATINGS (Note 5)

Characteristic	Symbol	Min	Typ	Max	Unit
Diode Forward On–Voltage (I_S = –1.7 Adc, V_{GS} = 0 Vdc) (I_S = –1.7 Adc, V_{GS} = 0 Vdc, T_J = 125°C)	V_{SD}	– –	–0.80 –0.65	–1.2 –	Vdc
Diode Forward On–Voltage (I_S = –6.2 Adc, V_{GS} = 0 Vdc) (I_S = –6.2 Adc, V_{GS} = 0 Vdc, T_J = 125°C)	V_{SD}	– –	–0.95 –0.80	– –	Vdc
Reverse Recovery Time	t_{rr}	–	50	80	ns
	t_a	–	20	–	
	t_r	–	30	–	
Reverse Recovery Stored Charge	Q_{RR}	–	0.04	–	μC

(Reverse recovery: I_S = –1.7 Adc, V_{GS} = 0 Vdc, dI_S/dt = 100 A/μs)

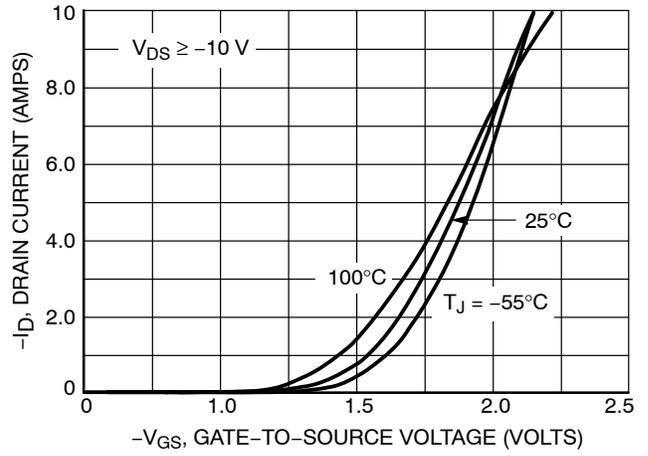5. Indicates Pulse Test: Pulse Width = 300 μs max, Duty Cycle = 2%.
6. Switching characteristics are independent of operating junction temperature.

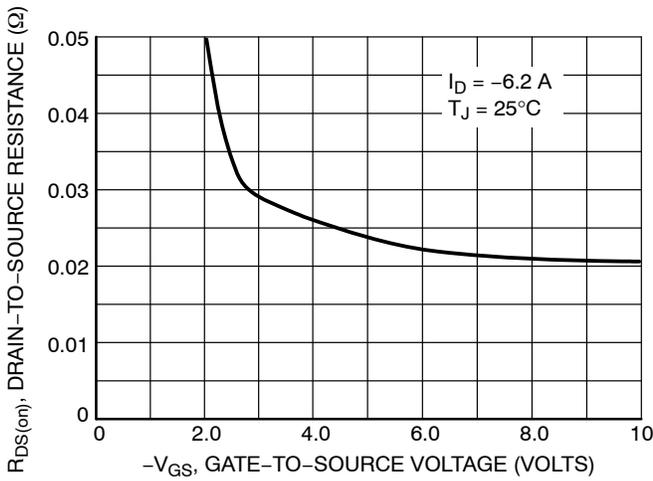*Handling precautions to protect against electrostatic discharge are mandatory.
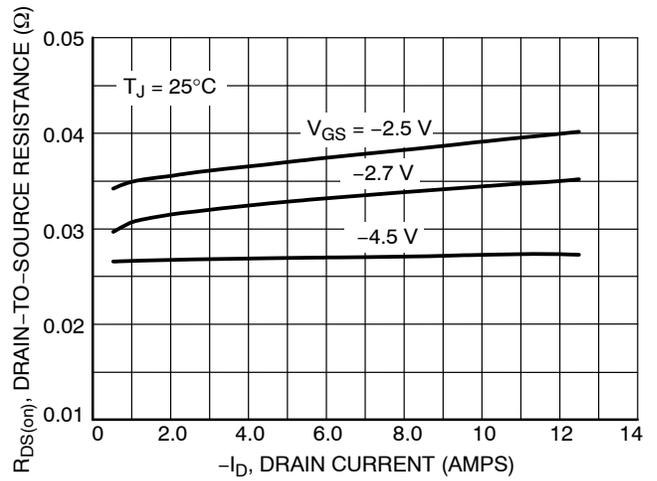
NTMD6P02, NVMD6P02
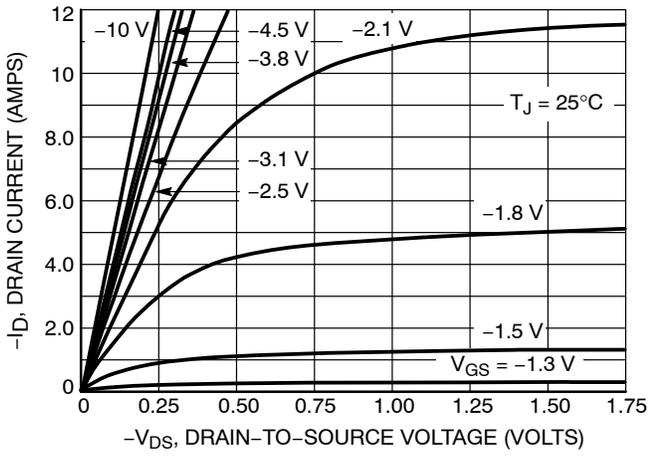
Figure 1. On−Region Characteristics
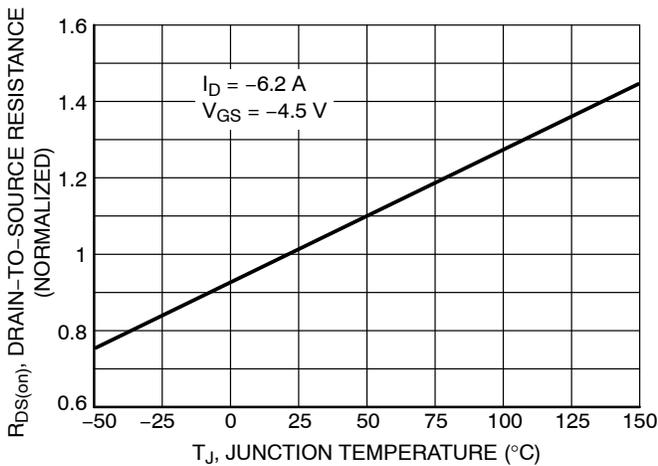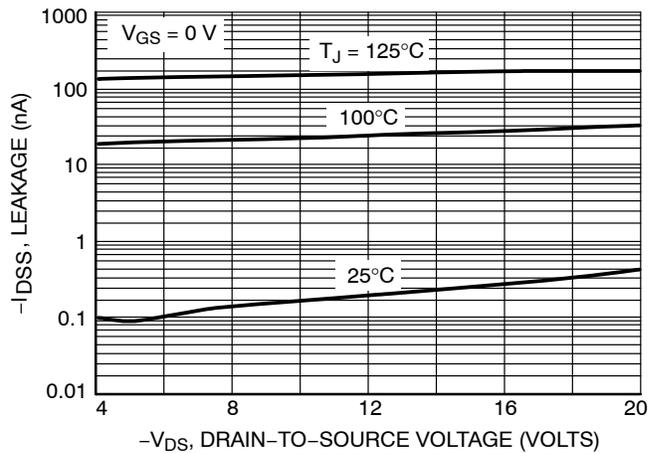

Figure 2. Transfer Characteristics

Figure 3. On−Resistance versus
Gate−To−Source Voltage

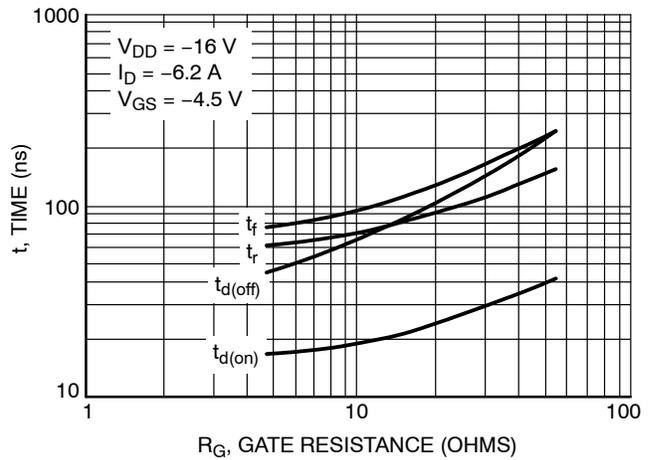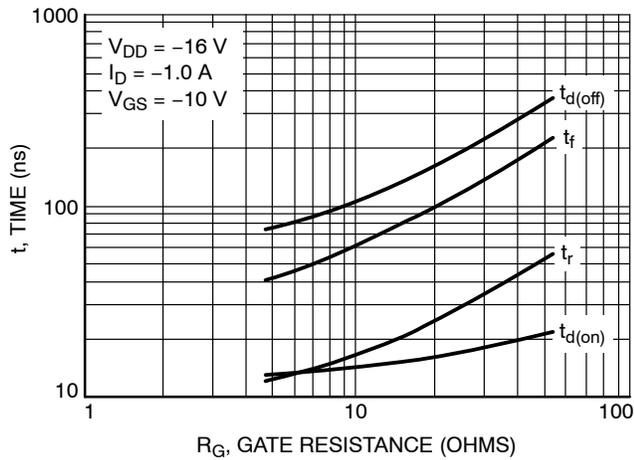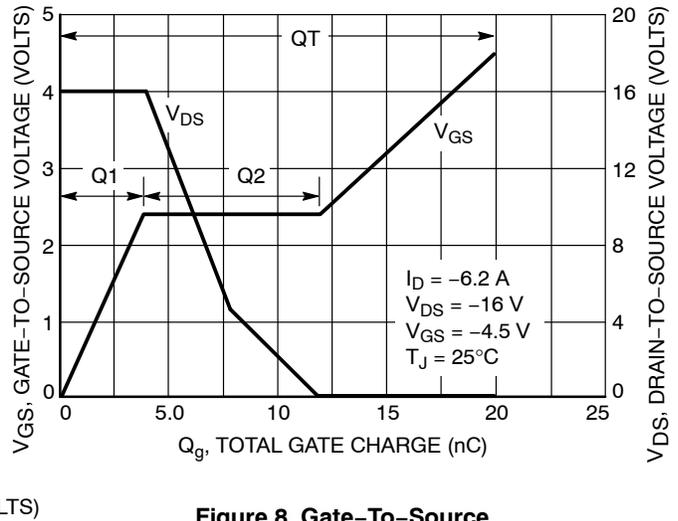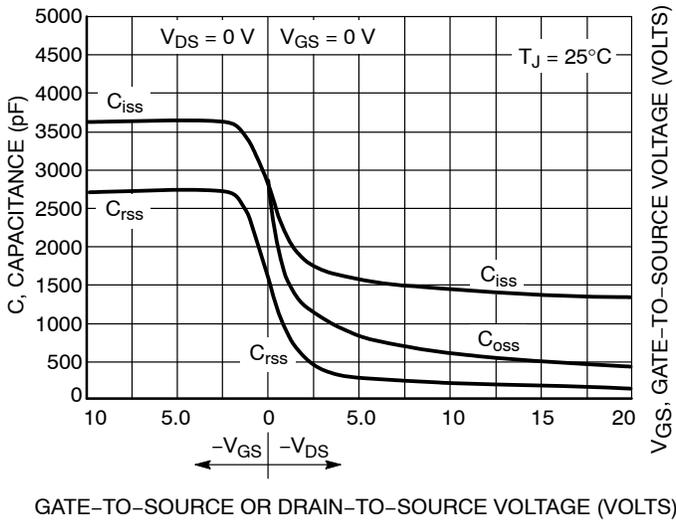Figure 4. On-Resistance versus Drain Current
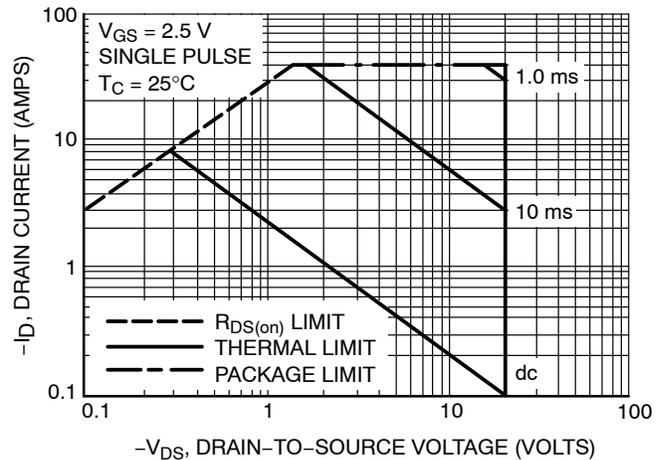and Gate Voltage

Figure 5. On−Resistance Variation with
Temperature

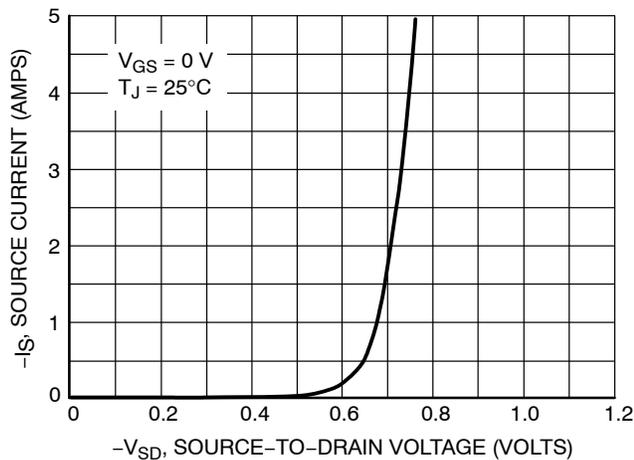Figure 6. Drain−To−Source Leakage Current
versus Voltage

Figure 7. Capacitance Variation

**Figure 8. Gate−To−Source
and Drain−To−Source Voltage versus Total Charge**

**Figure 9. Resistive Switching Time Variation
versus Gate Resistance**

**Figure 10. Resistive Switching Time Variation
versus Gate Resistance**

DRAIN−TO−SOURCE DIODE CHARACTERISTICS

Figure 11. Diode Forward Voltage versus Current

**Figure 12. Maximum Rated Forward Biased
Safe Operating Area**
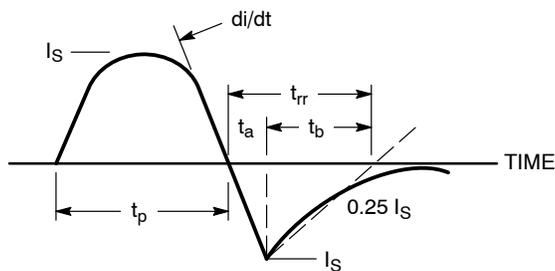
Figure 13. Diode Reverse Recovery Waveform

TYPICAL ELECTRICAL CHARACTERISTICS
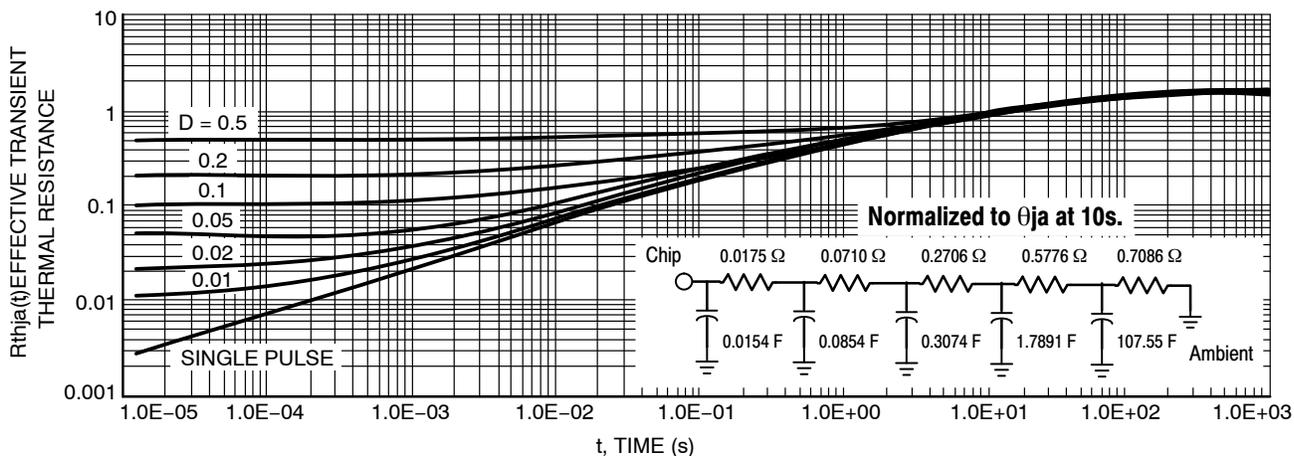
Figure 14. Thermal Response

SOIC−8 NB
CASE 751−07
ISSUE AK

DATE 16 FEB 2011

8
1
SCALE 1:1
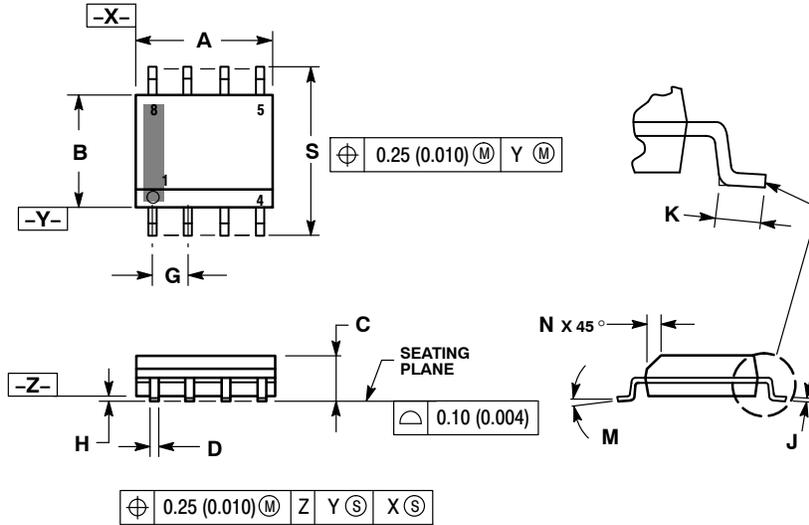
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

⊕ | 0.25 (0.010) Ⓜ | Y Ⓜ

SEATING PLANE

⌓ | 0.10 (0.004)

N X 45°

⊕ | 0.25 (0.010) Ⓜ | Z Y Ⓢ X Ⓢ

DIM	MILLIMETERS		INCHES	
	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

SOLDERING FOOTPRINT*

1.52 / 0.060

7.0 / 0.275

4.0 / 0.155

0.6 / 0.024

1.270 / 0.050

SCALE 6:1 (mm / inches)

GENERIC MARKING DIAGRAM*

8 XXXXX ALYWX 1
IC

8 XXXXX ALYWX 1
IC (Pb−Free)

8 XXXXXX AYWW 1
Discrete

8 XXXXXX AYWW 1
Discrete (Pb−Free)
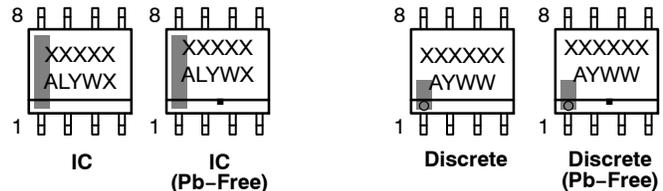
XXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

XXXXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42564B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	SOIC−8 NB		PAGE 1 OF 2

SOIC−8 NB
CASE 751−07
ISSUE AK

STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. COLLECTOR
4. EMITTER
5. EMITTER
6. BASE
7. BASE
8. EMITTER

STYLE 2:
PIN 1. COLLECTOR, DIE, #1
2. COLLECTOR, #1
3. COLLECTOR, #2
4. COLLECTOR, #2
5. BASE, #2
6. EMITTER, #2
7. BASE, #1
8. EMITTER, #1

STYLE 3:
PIN 1. DRAIN, DIE #1
2. DRAIN, #1
3. DRAIN, #2
4. DRAIN, #2
5. GATE, #2
6. SOURCE, #2
7. GATE, #1
8. SOURCE, #1

STYLE 4:
PIN 1. ANODE
2. ANODE
3. ANODE
4. ANODE
5. ANODE
6. ANODE
7. ANODE
8. COMMON CATHODE

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

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

STYLE 7:
PIN 1. INPUT
2. EXTERNAL BYPASS
3. THIRD STAGE SOURCE
4. GROUND
5. DRAIN
6. GATE 3
7. SECOND STAGE Vd
8. FIRST STAGE Vd

STYLE 8:
PIN 1. COLLECTOR, DIE #1
2. BASE, #1
3. BASE, #2
4. COLLECTOR, #2
5. COLLECTOR, #2
6. EMITTER, #2
7. EMITTER, #1
8. COLLECTOR, #1

STYLE 9:
PIN 1. EMITTER, COMMON
2. COLLECTOR, DIE #1
3. COLLECTOR, DIE #2
4. EMITTER, COMMON
5. EMITTER, COMMON
6. BASE, DIE #2
7. BASE, DIE #1
8. EMITTER, COMMON

STYLE 10:
PIN 1. GROUND
2. BIAS 1
3. OUTPUT
4. GROUND
5. GROUND
6. BIAS 2
7. INPUT
8. GROUND

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

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

STYLE 13:
PIN 1. N.C.
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

STYLE 14:
PIN 1. N−SOURCE
2. N−GATE
3. P−SOURCE
4. P−GATE
5. P−DRAIN
6. P−DRAIN
7. N−DRAIN
8. N−DRAIN

STYLE 15:
PIN 1. ANODE 1
2. ANODE 1
3. ANODE 1
4. ANODE 1
5. CATHODE, COMMON
6. CATHODE, COMMON
7. CATHODE, COMMON
8. CATHODE, COMMON

STYLE 16:
PIN 1. EMITTER, DIE #1
2. BASE, DIE #1
3. EMITTER, DIE #2
4. BASE, DIE #2
5. COLLECTOR, DIE #2
6. COLLECTOR, DIE #2
7. COLLECTOR, DIE #1
8. COLLECTOR, DIE #1

STYLE 17:
PIN 1. VCC
2. V2OUT
3. V1OUT
4. TXE
5. RXE
6. VEE
7. GND
8. ACC

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

STYLE 19:
PIN 1. SOURCE 1
2. GATE 1
3. SOURCE 2
4. GATE 2
5. DRAIN 2
6. MIRROR 2
7. DRAIN 1
8. MIRROR 1

STYLE 20:
PIN 1. SOURCE (N)
2. GATE (N)
3. SOURCE (P)
4. GATE (P)
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

STYLE 21:
PIN 1. CATHODE 1
2. CATHODE 2
3. CATHODE 3
4. CATHODE 4
5. CATHODE 5
6. COMMON ANODE
7. COMMON ANODE
8. CATHODE 6

STYLE 22:
PIN 1. I/O LINE 1
2. COMMON CATHODE/VCC
3. COMMON CATHODE/VCC
4. I/O LINE 3
5. COMMON ANODE/GND
6. I/O LINE 4
7. I/O LINE 5
8. COMMON ANODE/GND

STYLE 23:
PIN 1. LINE 1 IN
2. COMMON ANODE/GND
3. COMMON ANODE/GND
4. LINE 2 IN
5. LINE 2 OUT
6. COMMON ANODE/GND
7. COMMON ANODE/GND
8. LINE 1 OUT

STYLE 24:
PIN 1. BASE
2. EMITTER
3. COLLECTOR/ANODE
4. COLLECTOR/ANODE
5. CATHODE
6. CATHODE
7. COLLECTOR/ANODE
8. COLLECTOR/ANODE

STYLE 25:
PIN 1. VIN
2. N/C
3. REXT
4. GND
5. IOUT
6. IOUT
7. IOUT
8. IOUT

STYLE 26:
PIN 1. GND
2. dv/dt
3. ENABLE
4. ILIMIT
5. SOURCE
6. SOURCE
7. SOURCE
8. VCC

STYLE 27:
PIN 1. ILIMIT
2. OVLO
3. UVLO
4. INPUT+
5. SOURCE
6. SOURCE
7. SOURCE
8. DRAIN

STYLE 28:
PIN 1. SW_TO_GND
2. DASIC_OFF
3. DASIC_SW_DET
4. GND
5. V_MON
6. VBULK
7. VBULK
8. VIN

STYLE 29:
PIN 1. BASE, DIE #1
2. EMITTER, #1
3. BASE, #2
4. EMITTER, #2
5. COLLECTOR, #2
6. COLLECTOR, #2
7. COLLECTOR, #1
8. COLLECTOR, #1

STYLE 30:
PIN 1. DRAIN 1
2. DRAIN 1
3. GATE 2
4. SOURCE 2
5. SOURCE 1/DRAIN 2
6. SOURCE 1/DRAIN 2
7. SOURCE 1/DRAIN 2
8. GATE 1

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DESCRIPTION:	SOIC−8 NB		PAGE 2 OF 2

PUBLICATION ORDERING INFORMATION

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