

# NTMSD3P102R2

## 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
- Pb-Free Packages are Available

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DS}$	-20	V
Gate-to-Source Voltage - Continuous	$V_{GS}$	$\pm 20$	V
Thermal Resistance - Junction-to-Ambient (Note 1) Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Continuous Drain Current @ $T_A = 25^\circ\text{C}$ Continuous Drain Current @ $T_A = 70^\circ\text{C}$ 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	$^\circ\text{C/W}$ W A A A
Thermal Resistance - Junction-to-Ambient (Note 2) Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Continuous Drain Current @ $T_A = 25^\circ\text{C}$ Continuous Drain Current @ $T_A = 70^\circ\text{C}$ Pulsed Drain Current (Note 4)	$R_{\theta JA}$ $P_D$ $I_D$ $I_D$ $I_{DM}$	100 1.25 -3.05 -2.44 -12	$^\circ\text{C/W}$ W A A A
Thermal Resistance - Junction-to-Ambient (Note 3) Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Continuous Drain Current @ $T_A = 25^\circ\text{C}$ Continuous Drain Current @ $T_A = 70^\circ\text{C}$ 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	$^\circ\text{C/W}$ W A A A
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$ ( $V_{DD} = -20\text{ Vdc}$ , $V_{GS} = -4.5\text{ Vdc}$ , Peak $I_L = -7.5\text{ Apk}$ , $L = 5\text{ mH}$ , $R_G = 25\ \Omega$ )	$E_{AS}$	140	mJ
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	$T_L$	260	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Minimum FR-4 or G-10 PCB, Steady State.
2. Mounted onto a 2" square FR-4 Board (1 in sq, 2 oz Cu 0.06" thick single-sided), Steady State.
3. Mounted onto a 2" square FR-4 Board (1 in sq, 2 oz Cu 0.06" thick single sided),  $t \leq 10$  seconds.
4. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.

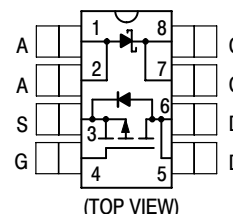


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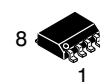
<http://onsemi.com>

**MOSFET**  
**-3.05 AMPERES**  
**-20 VOLTS**  
**0.085  $\Omega$  @  $V_{GS} = -10\text{ V}$**

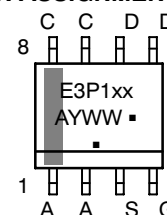
**SCHOTTKY DIODE**  
**1.0 AMPERE**  
**20 VOLTS**  
**470 mV @  $I_F = 1.0\text{ A}$**



#### MARKING DIAGRAM & PIN ASSIGNMENT



**SO-8**  
**CASE 751**  
**STYLE 18**



E3P1 = Device Code  
xx = 02 or S  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

Device	Package	Shipping†
NTMSD3P102R2	SO-8	2500/Tape & Reel
NTMSD3P102R2G	SO-8 (Pb-Free)	2500/Tape & Reel
NTMSD3P102R2SG	SO-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 Specification Brochure, BRD8011/D.

# NTMSD3P102R2

## SCHOTTKY MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage DC Blocking Voltage	V <sub>RRM</sub> V <sub>R</sub>	20	V
Thermal Resistance - Junction-to-Ambient (Note 5)	R <sub>θJA</sub>	204	°C/W
Thermal Resistance - Junction-to-Ambient (Note 6)	R <sub>θJA</sub>	122	°C/W
Thermal Resistance - Junction-to-Ambient (Note 7)	R <sub>θJA</sub>	83	°C/W
Average Forward Current (Note 7) (Rated V <sub>R</sub> , T <sub>A</sub> = 100°C)	I <sub>O</sub>	1.0	A
Peak Repetitive Forward Current (Note 7) (Rated V <sub>R</sub> , Square Wave, 20 kHz, T <sub>A</sub> = 105°C)	I <sub>FRM</sub>	2.0	A
Non-Repetitive Peak Surge Current (Note 7) (Surge Applied at Rated Load Conditions, Half-Wave, Single Phase, 60 Hz)	I <sub>FSM</sub>	20	A

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

5. Minimum FR-4 or G-10 PCB, Steady State.

6. Mounted onto a 2" square FR-4 Board (1 in sq, 2 oz Cu 0.06" thick single-sided), Steady State.

7. Mounted onto a 2" square FR-4 Board (1 in sq, 2 oz Cu 0.06" thick single sided), t ≤ 10 seconds.

## SCHOTTKY ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted) (Note 8)

Characteristic	Symbol	Value		Unit
Maximum Instantaneous Forward Voltage I <sub>F</sub> = 1.0 Adc I <sub>F</sub> = 2.0 Adc	V <sub>F</sub>	T <sub>J</sub> = 25°C	T <sub>J</sub> = 125°C	Volts
Maximum Instantaneous Forward Voltage I <sub>F</sub> = 1.0 Adc I <sub>F</sub> = 2.0 Adc	V <sub>F</sub>	0.47 0.58	0.39 0.53	Volts
Maximum Instantaneous Reverse Current V <sub>R</sub> = 20 Vdc	I <sub>R</sub>	T <sub>J</sub> = 25°C 0.05	T <sub>J</sub> = 125°C 10	mA
Maximum Voltage Rate of Change V <sub>R</sub> = 20 Vdc	dV/dt	10,000		V/μs

8. Indicates Pulse Test: Pulse Width = 300 μs max, Duty Cycle = 2%.

# NTMSD3P102R2

## MOSFET ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (Note 9)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage ( $V_{GS} = 0\text{ Vdc}$ , $I_D = -250\text{ }\mu\text{Adc}$ ) Temperature Coefficient (Positive)	$V_{(BR)DSS}$	-20 -	- -30	- -	Vdc mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current ( $V_{DS} = -20\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 25^\circ\text{C}$ ) ( $V_{DS} = -20\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 125^\circ\text{C}$ )	$I_{DSS}$	- -	- -	-1.0 -25	$\mu\text{Adc}$
Gate-Body Leakage Current ( $V_{GS} = -20\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	-	-	-100	nAdc
Gate-Body Leakage Current ( $V_{GS} = +20\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	-	-	100	nAdc

### ON CHARACTERISTICS

Gate Threshold Voltage ( $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{Adc}$ ) Temperature Coefficient (Negative)	$V_{GS(th)}$	-1.0 -	-1.7 3.6	-2.5 -	Vdc
Static Drain-to-Source On-State Resistance ( $V_{GS} = -10\text{ Vdc}$ , $I_D = -3.05\text{ Adc}$ ) ( $V_{GS} = -4.5\text{ Vdc}$ , $I_D = -1.5\text{ Adc}$ )	$R_{DS(on)}$	- -	0.063 0.090	0.085 0.125	$\Omega$
Forward Transconductance ( $V_{DS} = -15\text{ Vdc}$ , $I_D = -3.05\text{ Adc}$ )	$g_{FS}$	-	5.0	-	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	$(V_{DS} = -16\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$C_{iss}$	-	518	750	pF
Output Capacitance		$C_{oss}$	-	190	350	
Reverse Transfer Capacitance		$C_{rss}$	-	70	135	

### SWITCHING CHARACTERISTICS (Notes 10 & 11)

Turn-On Delay Time	$(V_{DD} = -20\text{ Vdc}$ , $I_D = -3.05\text{ Adc}$ , $V_{GS} = -10\text{ Vdc}$ , $R_G = 6.0\text{ }\Omega$ )	$t_{d(on)}$	-	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	$(V_{DD} = -20\text{ Vdc}$ , $I_D = -1.5\text{ Adc}$ , $V_{GS} = -4.5\text{ Vdc}$ , $R_G = 6.0\text{ }\Omega$ )	$t_{d(on)}$	-	16	-	ns
Rise Time		$t_r$	-	42	-	
Turn-Off Delay Time		$t_{d(off)}$	-	32	-	
Fall Time		$t_f$	-	35	-	
Total Gate Charge	$(V_{DS} = -20\text{ Vdc}$ , $V_{GS} = -10\text{ Vdc}$ , $I_D = -3.05\text{ Adc}$ )	$Q_{tot}$	-	16	25	nC
Gate-Source Charge		$Q_{gs}$	-	2.0	-	
Gate-Drain Charge		$Q_{gd}$	-	4.5	-	

### BODY-DRAIN DIODE RATINGS (Note 10)

Diode Forward On-Voltage	$(I_S = -3.05\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ ) $(I_S = -3.05\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 125^\circ\text{C}$ )	$V_{SD}$	- -	-0.96 -0.78	-1.25 -	Vdc
Reverse Recovery Time	$(I_S = -3.05\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ , $di_S/dt = 100\text{ A}/\mu\text{s}$ )	$t_{rr}$	-	34	-	ns
		$t_a$	-	18	-	
		$t_b$	-	16	-	
Reverse Recovery Stored Charge		$Q_{RR}$	-	0.03	-	$\mu\text{C}$

9. Handling precautions to protect against electrostatic discharge are mandatory.

10. Indicates Pulse Test: Pulse Width = 300  $\mu\text{s}$  max, Duty Cycle = 2%.

11. Switching characteristics are independent of operating junction temperature.

TYPICAL MOSFET ELECTRICAL CHARACTERISTICS

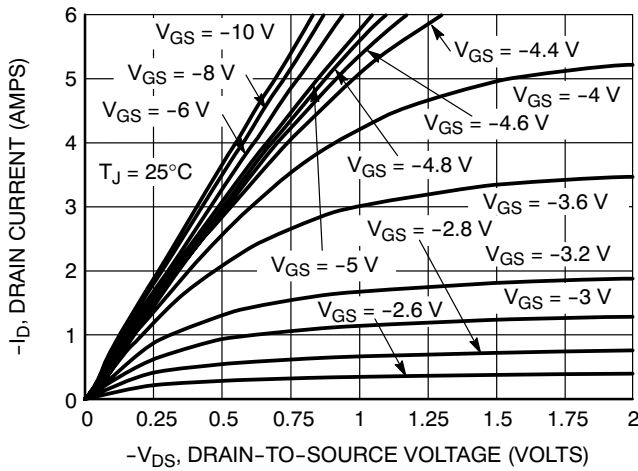


Figure 1. On-Region Characteristics

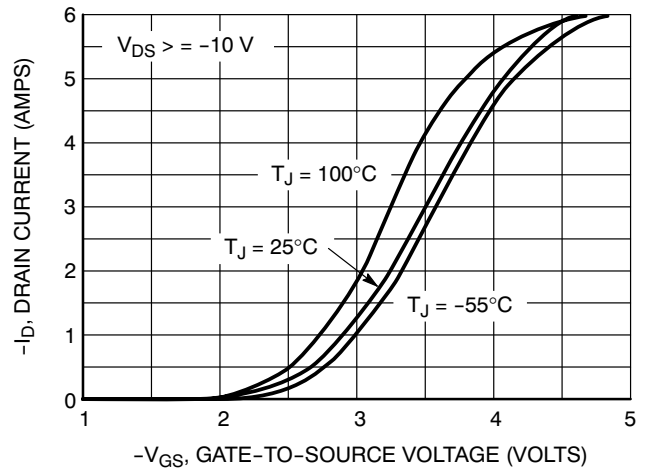


Figure 2. Transfer Characteristics

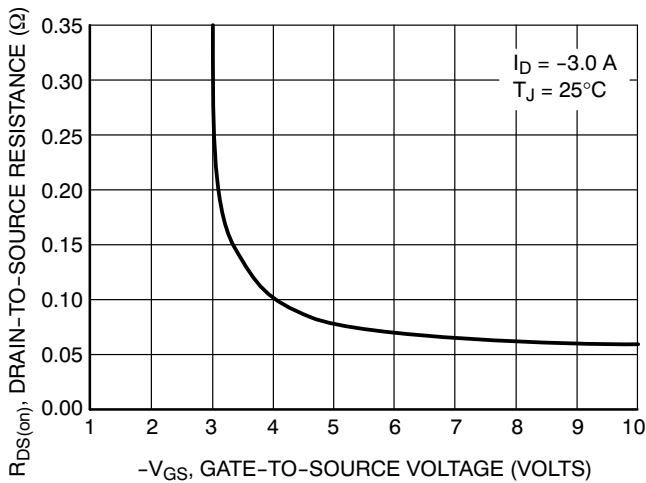


Figure 3. On-Resistance vs. Gate-to-Source Voltage

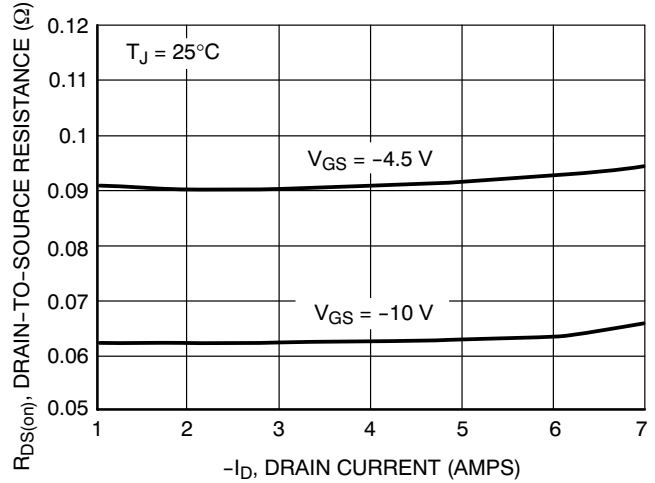


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

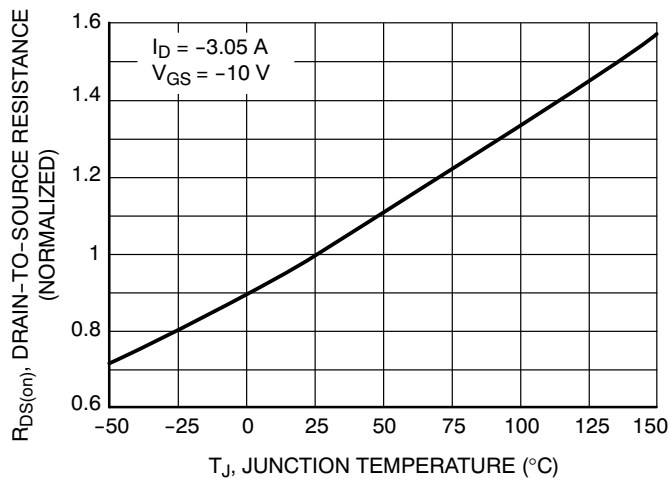
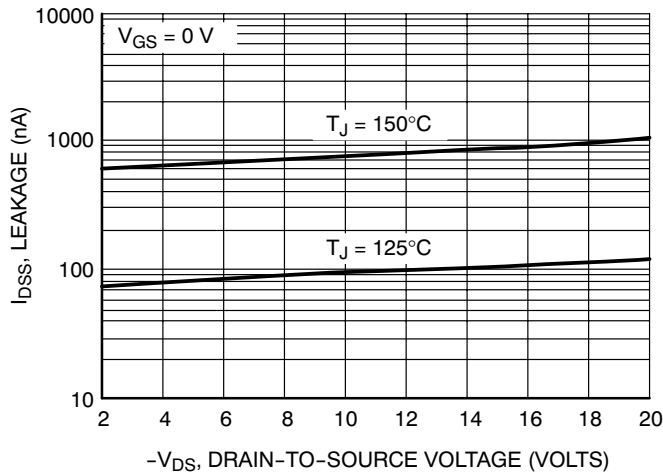
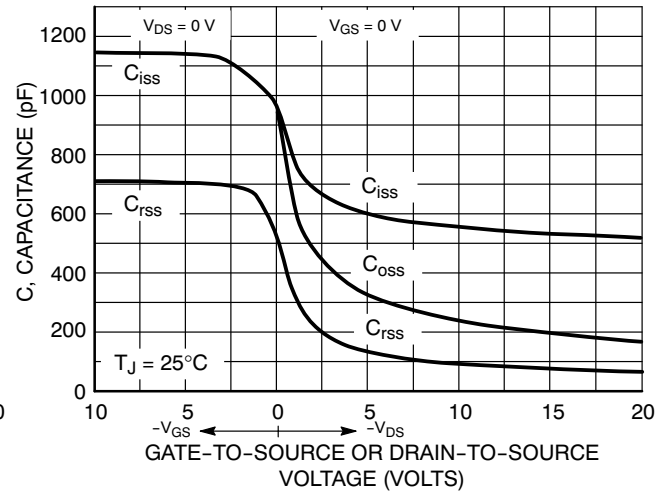


Figure 5. On Resistance Variation with Temperature

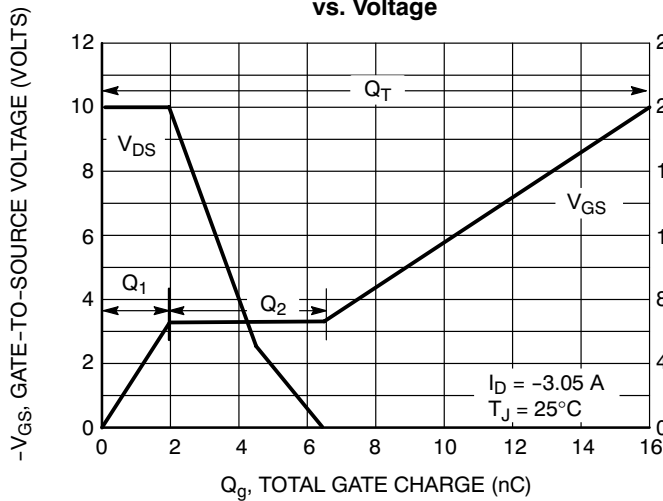
# NTMSD3P102R2



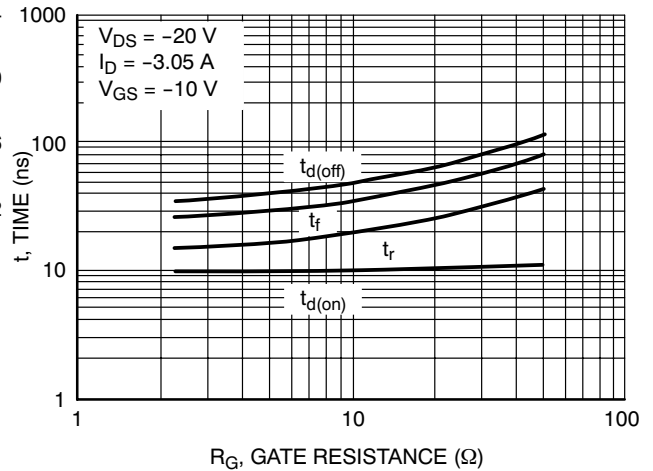
**Figure 6. Drain-to-Source Leakage Current vs. Voltage**



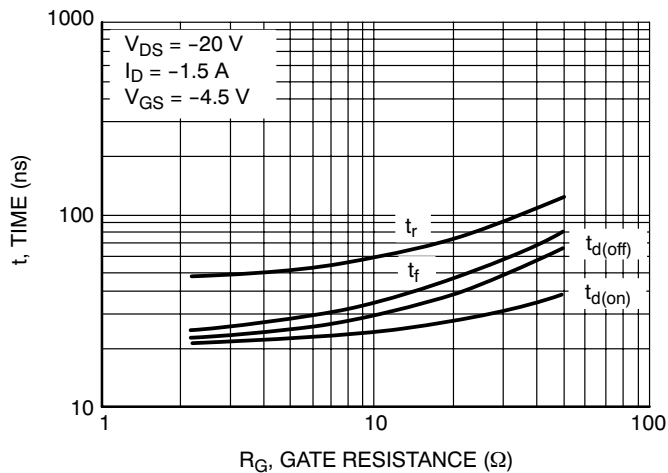
**Figure 7. Capacitance Variation**



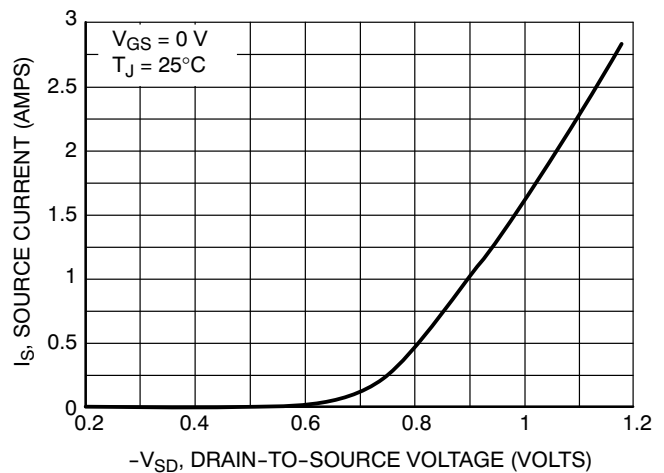
**Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



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



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



**Figure 11. Diode Forward Voltage vs. Current**

# NTMSD3P102R2

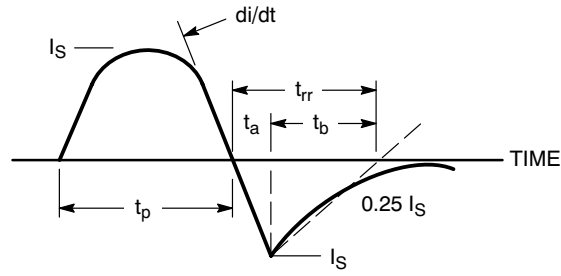


Figure 12. Diode Reverse Recovery Waveform

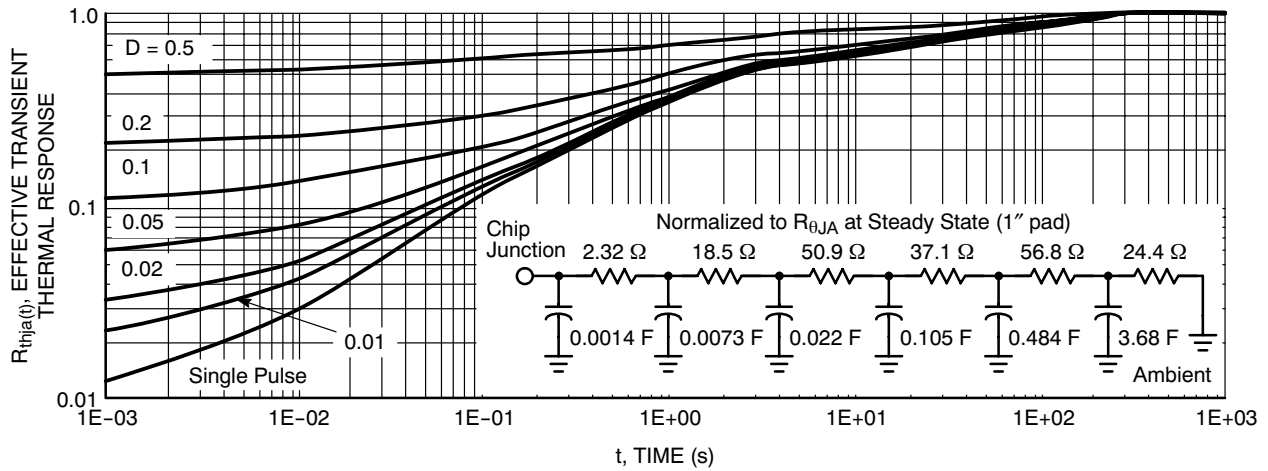


Figure 13. FET Thermal Response

## TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

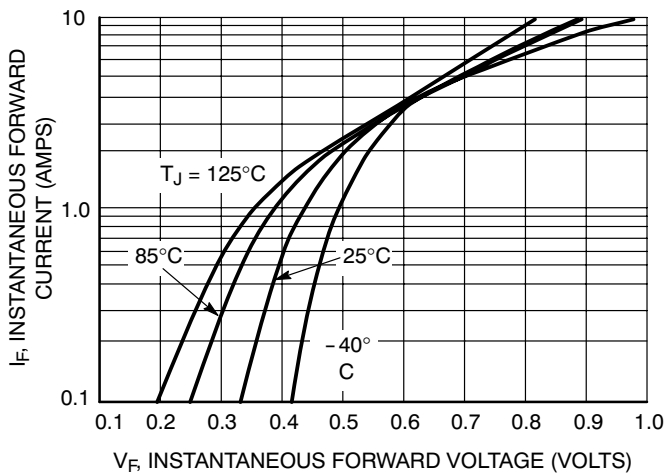


Figure 14. Typical Forward Voltage

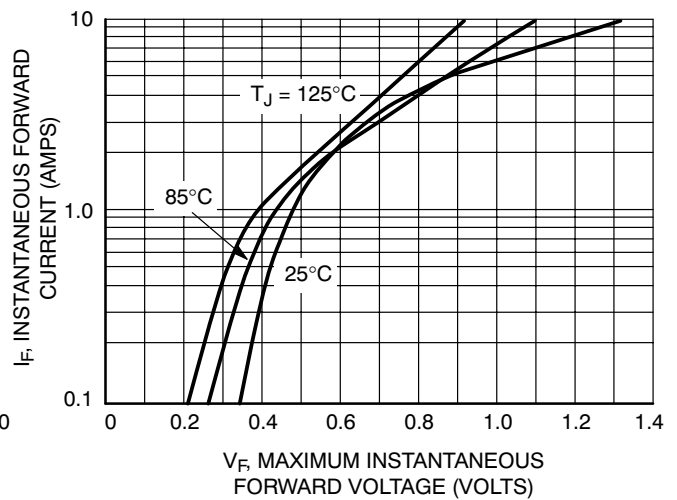


Figure 15. Maximum Forward Voltage

# NTMSD3P102R2

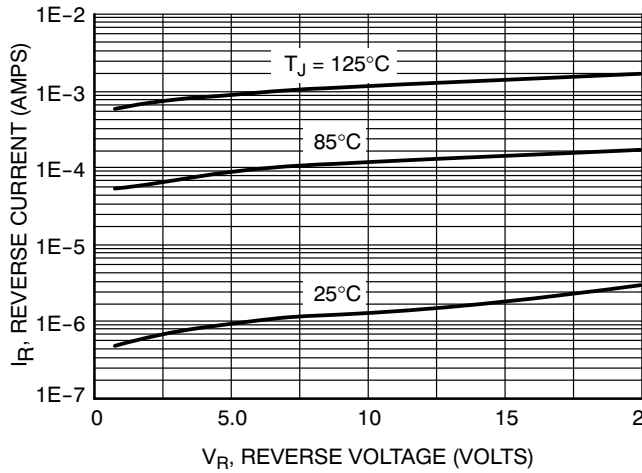


Figure 16. Typical Reverse Current

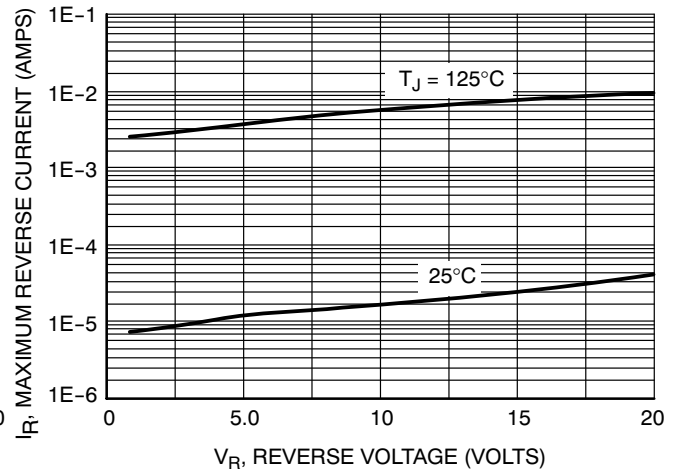


Figure 17. Maximum Reverse Current

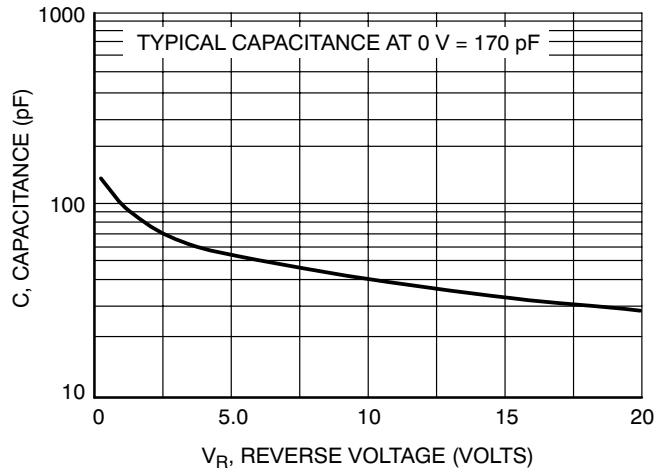


Figure 18. Typical Capacitance

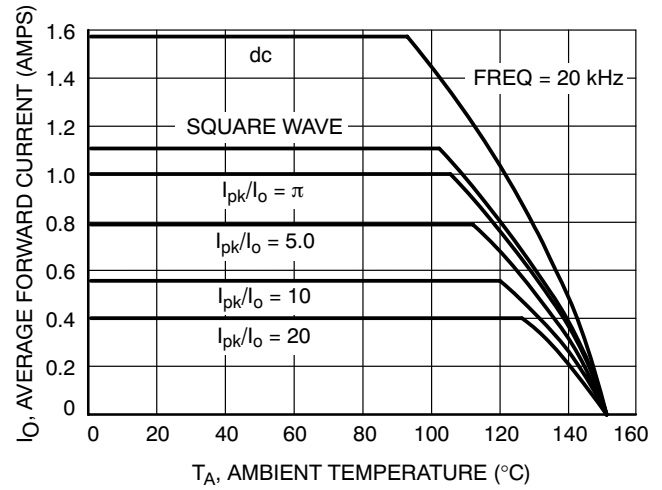


Figure 19. Current Derating

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

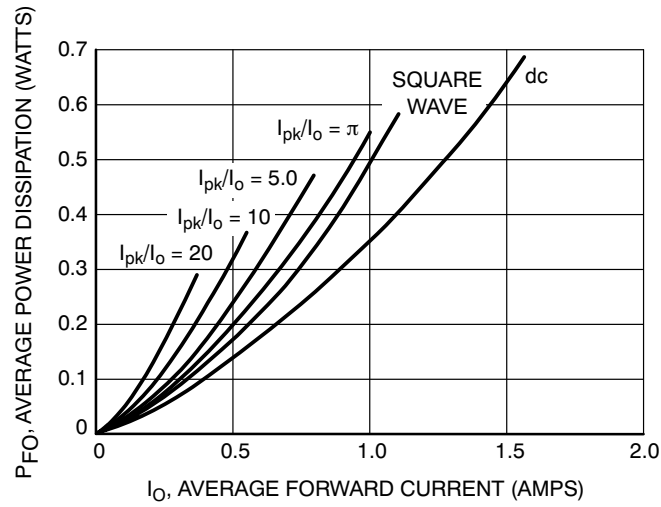


Figure 20. Forward Power Dissipation

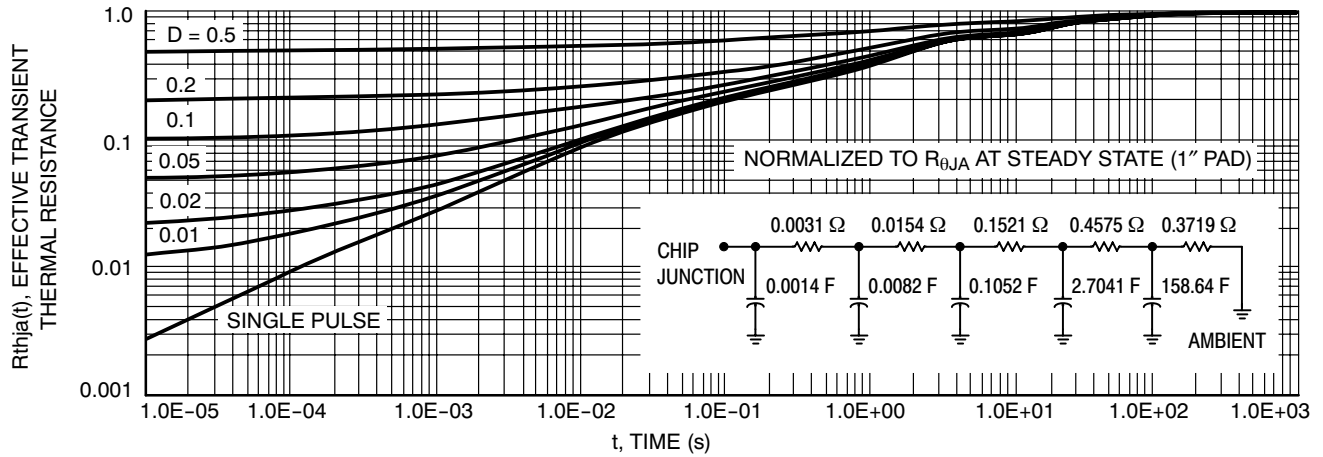
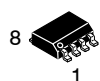


Figure 21. Schottky Thermal Response

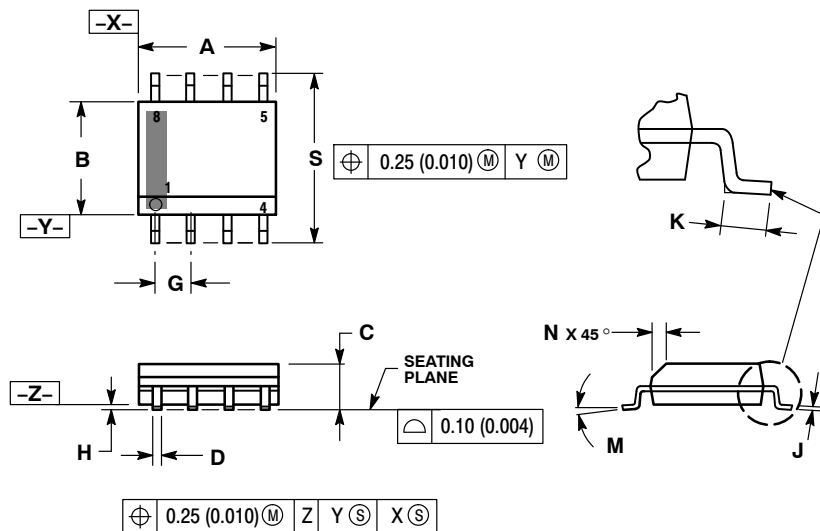




SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011

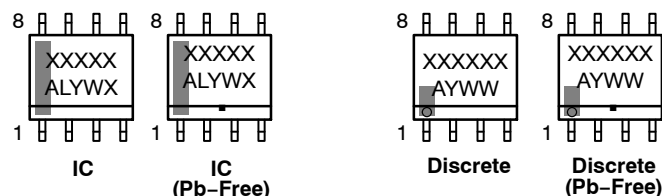
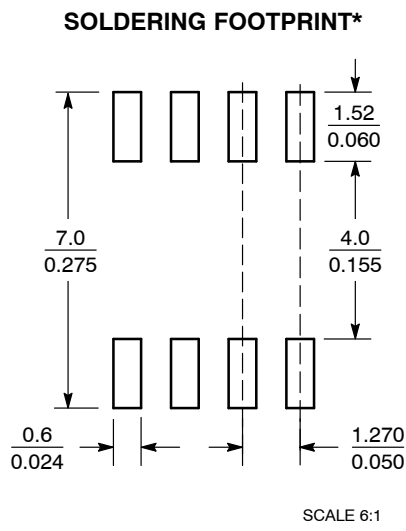


NOTES:

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.

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

GENERIC  
MARKING DIAGRAM\*



XXXXXX = 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 **onsemi** 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

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**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

DATE 16 FEB 2011

<b>STYLE 1:</b> PIN 1. EMITTER 2. COLLECTOR 3. COLLECTOR 4. EMITTER 5. EMITTER 6. BASE 7. BASE 8. EMITTER	<b>STYLE 2:</b> 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	<b>STYLE 3:</b> 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	<b>STYLE 4:</b> PIN 1. ANODE 2. ANODE 3. ANODE 4. ANODE 5. ANODE 6. ANODE 7. ANODE 8. COMMON CATHODE
<b>STYLE 5:</b> PIN 1. DRAIN 2. DRAIN 3. DRAIN 4. DRAIN 5. GATE 6. GATE 7. SOURCE 8. SOURCE	<b>STYLE 6:</b> PIN 1. SOURCE 2. DRAIN 3. DRAIN 4. SOURCE 5. SOURCE 6. GATE 7. GATE 8. SOURCE	<b>STYLE 7:</b> 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	<b>STYLE 8:</b> 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
<b>STYLE 9:</b> 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	<b>STYLE 10:</b> PIN 1. GROUND 2. BIAS 1 3. OUTPUT 4. GROUND 5. GROUND 6. BIAS 2 7. INPUT 8. GROUND	<b>STYLE 11:</b> 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	<b>STYLE 12:</b> PIN 1. SOURCE 2. SOURCE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN
<b>STYLE 13:</b> PIN 1. N.C. 2. SOURCE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN	<b>STYLE 14:</b> 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	<b>STYLE 15:</b> 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	<b>STYLE 16:</b> 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
<b>STYLE 17:</b> PIN 1. VCC 2. V2OUT 3. V1OUT 4. TXE 5. RXE 6. VEE 7. GND 8. ACC	<b>STYLE 18:</b> PIN 1. ANODE 2. ANODE 3. SOURCE 4. GATE 5. DRAIN 6. DRAIN 7. CATHODE 8. CATHODE	<b>STYLE 19:</b> 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	<b>STYLE 20:</b> PIN 1. SOURCE (N) 2. GATE (N) 3. SOURCE (P) 4. GATE (P) 5. DRAIN 6. DRAIN 7. DRAIN 8. DRAIN
<b>STYLE 21:</b> 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	<b>STYLE 22:</b> 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	<b>STYLE 23:</b> 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	<b>STYLE 24:</b> PIN 1. BASE 2. EMITTER 3. COLLECTOR/ANODE 4. COLLECTOR/ANODE 5. CATHODE 6. CATHODE 7. COLLECTOR/ANODE 8. COLLECTOR/ANODE
<b>STYLE 25:</b> PIN 1. VIN 2. N/C 3. REXT 4. GND 5. IOUT 6. IOUT 7. IOUT 8. IOUT	<b>STYLE 26:</b> PIN 1. GND 2. dv/dt 3. ENABLE 4. ILIMIT 5. SOURCE 6. SOURCE 7. SOURCE 8. VCC	<b>STYLE 27:</b> PIN 1. ILIMIT 2. OVLO 3. UVLO 4. INPUT+ 5. SOURCE 6. SOURCE 7. SOURCE 8. DRAIN	<b>STYLE 28:</b> PIN 1. SW_TO_GND 2. DASIC_OFF 3. DASIC_SW_DET 4. GND 5. V_MON 6. VBULK 7. VBULK 8. VIN
<b>STYLE 29:</b> 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	<b>STYLE 30:</b> 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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