

# NTD23N03R

## Power MOSFET

23 A, 25 V, N-Channel DPAK



ON Semiconductor®

<http://onsemi.com>

### Features

- Planar HD3e Process for Fast Switching Performance
- Low  $R_{DS(on)}$  to Minimize Conduction Loss
- Low  $C_{iss}$  to Minimize Driver Loss
- Low Gate Charge
- Optimized for High Side Switching Requirements in High-Efficiency DC-DC Converters
- Pb-Free Packages are Available

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

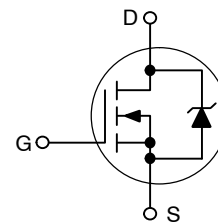
Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	25	Vdc
Gate-to-Source Voltage – Continuous	$V_{GS}$	$\pm 20$	Vdc
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	5.6	$^\circ\text{C/W}$
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	22.3	W
Drain Current	$I_D$	23	A
– Continuous @ $T_C = 25^\circ\text{C}$ , Chip	$I_D$	17.1	A
– Continuous @ $T_C = 25^\circ\text{C}$ , Limited by Package	$I_{DM}$	40	A
– Single Pulse			
Thermal Resistance, Junction-to-Ambient (Note 1)	$R_{\theta JA}$	76	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	1.64	W
Drain Current – Continuous @ $T_A = 25^\circ\text{C}$	$I_D$	4.5	A
Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	110	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	1.14	W
Drain Current – Continuous @ $T_A = 25^\circ\text{C}$	$I_D$	3.8	A
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$
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.

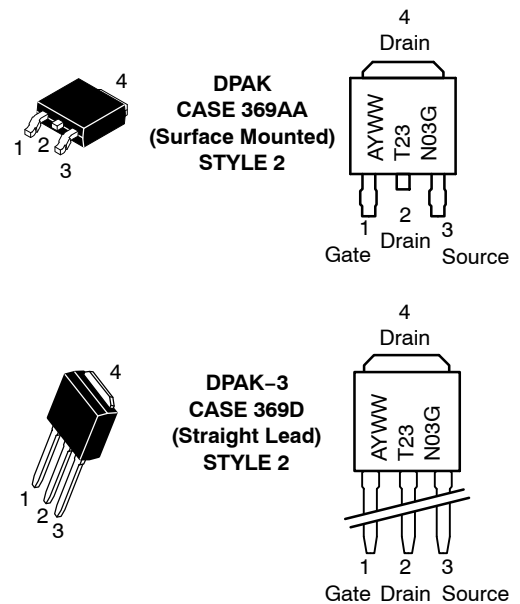
1. When surface mounted to an FR4 board using 0.5 sq in pad size.
2. When surface mounted to an FR4 board using minimum recommended pad size.

$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
25 V	32 m $\Omega$	23 A

### N-CHANNEL



### MARKING DIAGRAMS



T23N03 = Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# NTD23N03R

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

Characteristics	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 3) (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 250 μAdc) Temperature Coefficient (Positive)	V <sub>(br)DSS</sub>	25 –	28 –	– –	Vdc mV/°C
Zero Gate Voltage Drain Current (V <sub>DS</sub> = 20 Vdc, V <sub>GS</sub> = 0 Vdc) (V <sub>DS</sub> = 20 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 150°C)	I <sub>DSS</sub>	– –	– –	1.0 10	μAdc
Gate-Body Leakage Current (V <sub>GS</sub> = ±20 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	–	–	±100	nAdc

### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage (Note 3) (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μAdc) Threshold Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	1.0 –	1.8 –	2.0 –	Vdc mV/°C
Static Drain-to-Source On-Resistance (Note 3) (V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 6 Adc) (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 6 Adc)	R <sub>DS(on)</sub>	– –	50.3 32.3	60 45	mΩ
Forward Transconductance (Note 3) (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 6 Adc)	g <sub>FS</sub>	–	13	–	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 20 Vdc, V <sub>GS</sub> = 0 V, f = 1 MHz)	C <sub>ISS</sub>	–	225	–	pF
Output Capacitance		C <sub>OSS</sub>	–	108	–	
Transfer Capacitance		C <sub>RSS</sub>	–	48	–	

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	(V <sub>GS</sub> = 10 Vdc, V <sub>DD</sub> = 10 Vdc, I <sub>D</sub> = 6 Adc, R <sub>G</sub> = 3 Ω)	t <sub>d(on)</sub>	–	2.0	–	ns
Rise Time		t <sub>r</sub>	–	14.9	–	
Turn-Off Delay Time		t <sub>d(off)</sub>	–	9.9	–	
Fall Time		t <sub>f</sub>	–	2.0	–	
Gate Charge	(V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 6 Adc, V <sub>DS</sub> = 10 Vdc) (Note 3)	Q <sub>T</sub>	–	3.76	–	nC
		Q <sub>1</sub>	–	1.7	–	
		Q <sub>2</sub>	–	1.6	–	

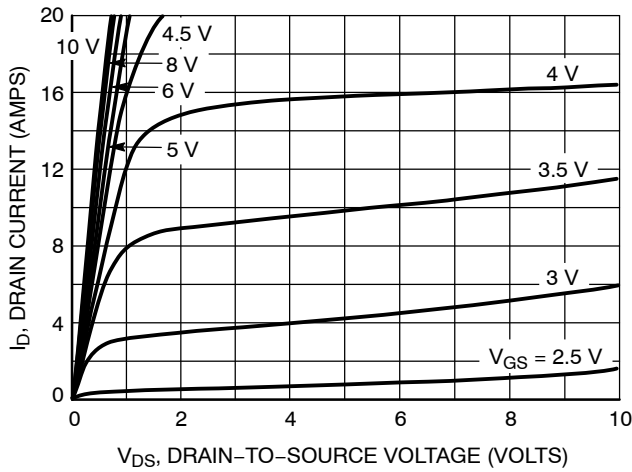
### SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	(I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc) (Note 3) (I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	V <sub>SD</sub>	– –	0.87 0.74	1.2 –	Vdc
Reverse Recovery Time	(I <sub>S</sub> = 6 Adc, V <sub>GS</sub> = 0 Vdc, di <sub>S</sub> /dt = 100 A/μs) (Note 3)	t <sub>rr</sub>	–	8.7	–	ns
		t <sub>a</sub>	–	5.2	–	
		t <sub>b</sub>	–	3.5	–	
Reverse Recovery Stored Charge		Q <sub>RR</sub>	–	0.003	–	μC

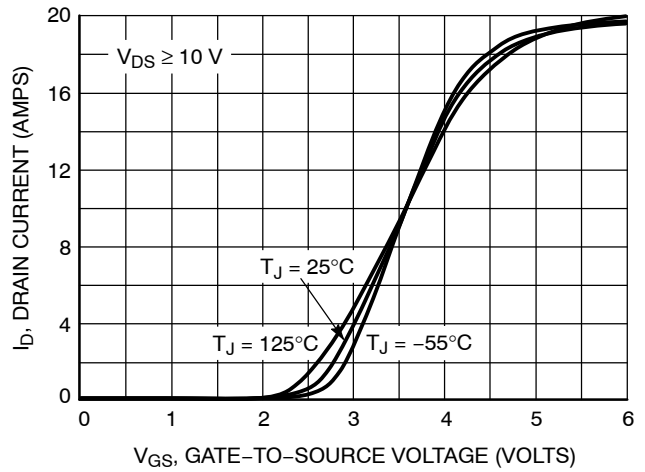
3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperatures.

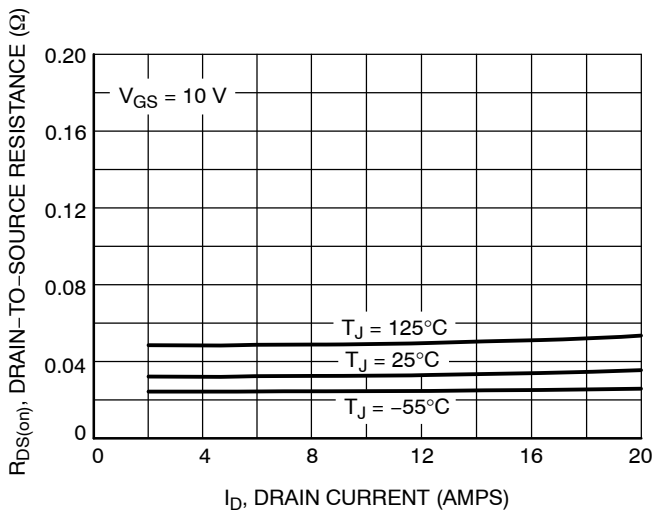
# NTD23N03R



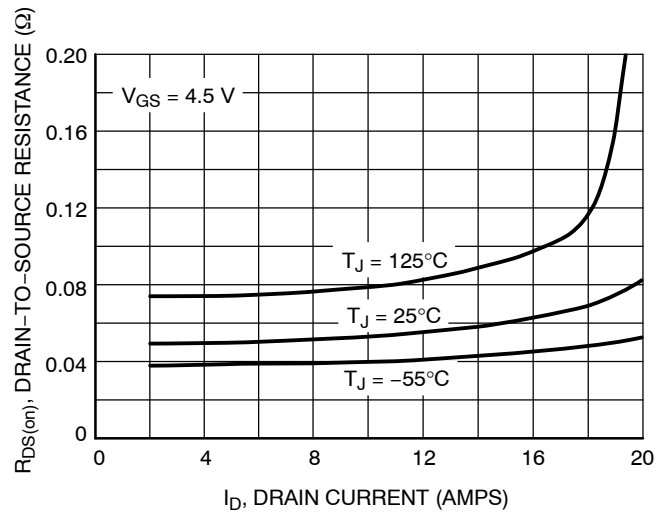
**Figure 1. On-Region Characteristics**



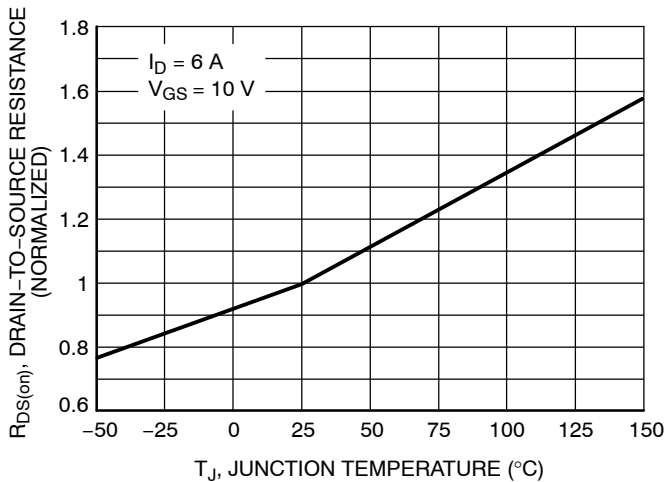
**Figure 2. Transfer Characteristics**



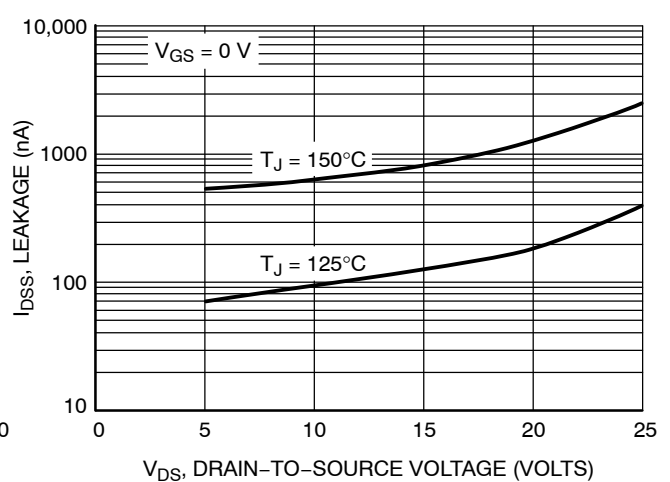
**Figure 3. On-Resistance versus Drain Current and Temperature**



**Figure 4. On-Resistance versus Drain Current and Temperature**

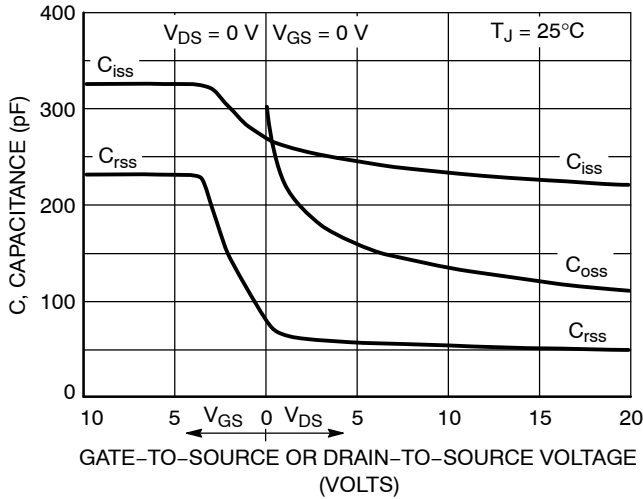


**Figure 5. On-Resistance Variation with Temperature**

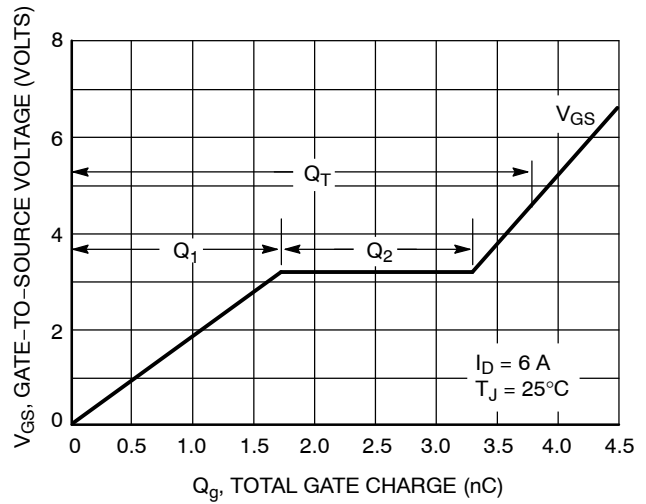


**Figure 6. Drain-to-Source Leakage Current versus Voltage**

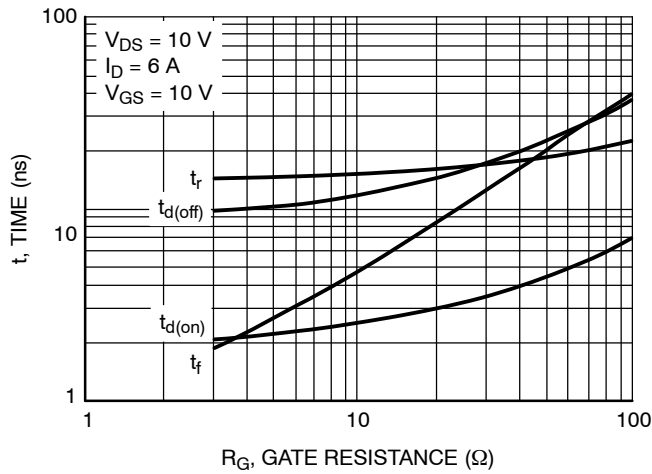
# NTD23N03R



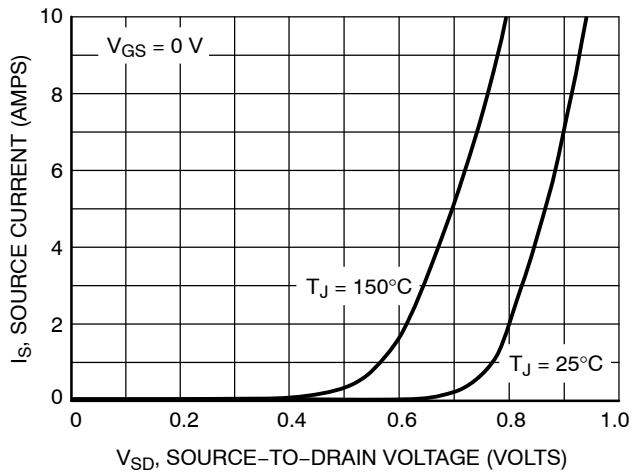
**Figure 7. Capacitance Variation**



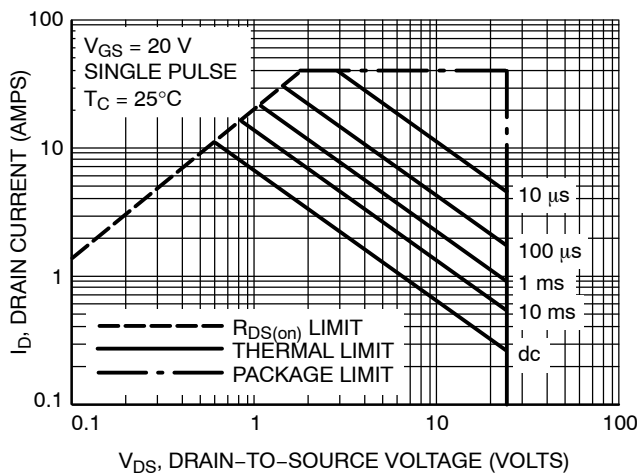
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



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



**Figure 10. Diode Forward Voltage versus Current**



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

# NTD23N03R

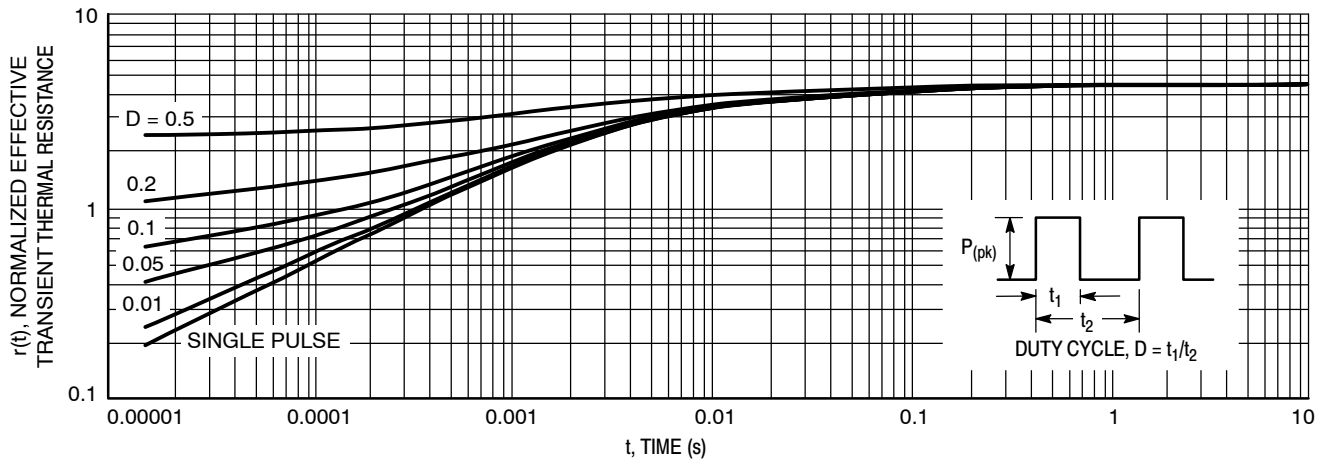
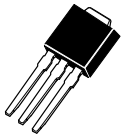


Figure 12. Thermal Response

## ORDERING INFORMATION

Device	Package	Shipping†
NTD23N03RG	DPAK (Pb-Free)	75 Units/Rail
NTD23N03R-1G	DPAK-3 (Pb-Free)	75 Units/Rail
NTD23N03RT4	DPAK	2500 Tape & Reel
NTD23N03RT4G	DPAK (Pb-Free)	2500 Tape & Reel

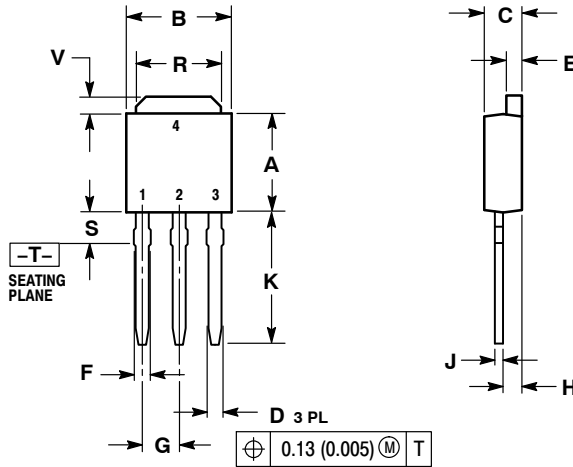
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



DPAK INSERTION MOUNT  
CASE 369  
ISSUE O

DATE 02 JAN 2000

SCALE 1:1



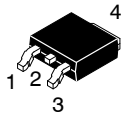
- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.250	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.033	0.040	0.84	1.01
F	0.037	0.047	0.94	1.19
G	0.090 BSC		2.29 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.350	0.380	8.89	9.65
R	0.175	0.215	4.45	5.46
S	0.050	0.090	1.27	2.28
V	0.030	0.050	0.77	1.27

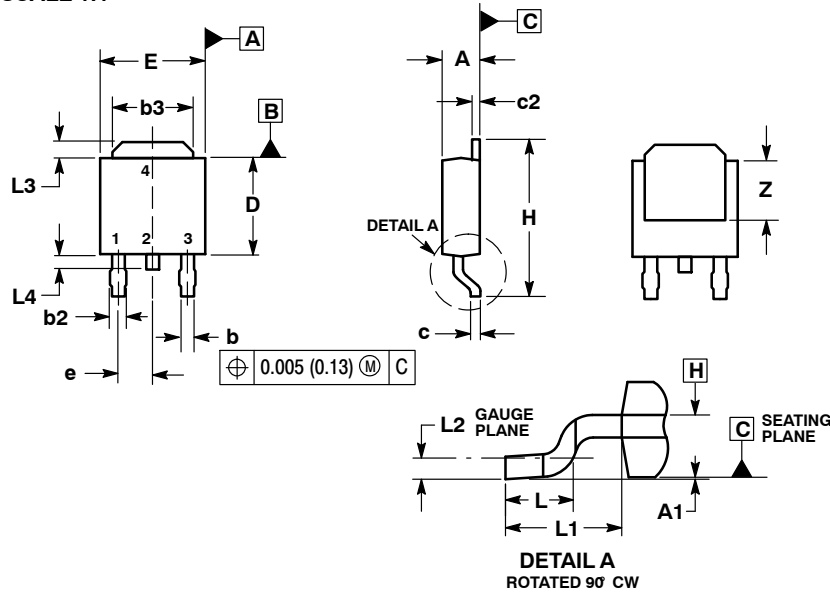
- |   |  |  |   |   |   |
|---|--|--|---|---|---|
| STYLE 1:<br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | STYLE 2:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE<br>4. DRAIN | STYLE 3:<br>PIN 1. ANODE<br>2. CATHODE<br>3. ANODE<br>4. CATHODE | STYLE 4:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE<br>4. ANODE | STYLE 5:<br>PIN 1. GATE<br>2. ANODE<br>3. CATHODE<br>4. ANODE | STYLE 6:<br>PIN 1. MT1<br>2. MT2<br>3. GATE<br>4. MT2 |
|---|--|--|---|---|---|

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SCALE 1:1



DPAK (SINGLE GAUGE)  
CASE 369AA  
ISSUE B

DATE 03 JUN 2010

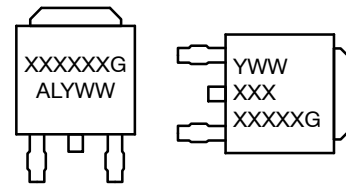
NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: INCHES.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b<sub>3</sub>, L<sub>3</sub> and Z.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
- DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.030	0.045	0.76	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090 BSC		2.29 BSC	
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.108 REF		2.74 REF	
L2	0.020 BSC		0.51 BSC	
L3	0.035	0.050	0.89	1.27
L4	---	0.040	---	1.01
Z	0.155	---	3.93	---

- STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR
- STYLE 2:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN
- STYLE 3:  
PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE
- STYLE 4:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE
- STYLE 5:  
PIN 1. GATE  
2. ANODE  
3. CATHODE  
4. ANODE
- STYLE 6:  
PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2
- STYLE 7:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

GENERIC MARKING DIAGRAM\*

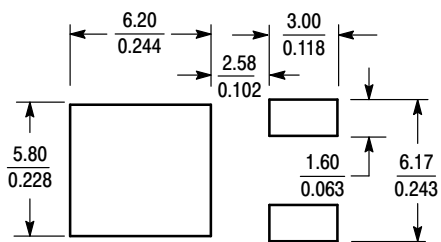


IC Discrete

- XXXXXX = Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking.

SOLDERING FOOTPRINT\*



SCALE 3:1 (mm/inches)

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

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