

# NTD78N03R

## Power MOSFET

25 V, 85 A, Single N-Channel, DPAK

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Optimized Gate Charge to Minimize Switching Losses
- Pb-Free Packages are Available

### Applications

- VCORE Applications
- DC-DC Converters
- Optimized for Low Side Switching

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

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			$V_{DSS}$	25	V
Gate-to-Source Voltage			$V_{GS}$	$\pm 20$	V
Continuous Drain Current ( $R_{\theta JA}$ ) (Note 1)	Steady State	$T_A = 25^{\circ}\text{C}$	$I_D$	14.7	A
		$T_A = 85^{\circ}\text{C}$		11.4	
$T_A = 25^{\circ}\text{C}$		$P_D$	2.3	W	
$T_A = 25^{\circ}\text{C}$		$I_D$	11.3	A	
			8.8		
Power Dissipation ( $R_{\theta JA}$ ) (Note 2)		$T_A = 25^{\circ}\text{C}$	$P_D$	1.4	W
		$T_C = 25^{\circ}\text{C}$	$I_D$	85	A
$T_C = 85^{\circ}\text{C}$				66	
Power Dissipation ( $R_{\theta JC}$ )		$T_C = 25^{\circ}\text{C}$	$P_D$	76.9	W
Pulsed Drain Current	$t_p = 10\ \mu\text{s}$	$I_{DM}$	98	A	
Current Limited by Package		$T_A = 25^{\circ}\text{C}$	$I_{DmaxPkg}$	32	A
Operating Junction and Storage Temperature			$T_J, T_{stg}$	-55 to 175	$^{\circ}\text{C}$
Source Current (Body Diode)			$I_S$	77	A
Drain to Source dV/dt			dV/dt	8.0	V/ns
Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 24\text{ V}$ , $V_{GS} = 10\text{ V}$ , $L = 5.0\text{ mH}$ , $I_L(\text{pk}) = 5.5\text{ A}$ , $R_G = 25\ \Omega$ )			$E_{AS}$	75	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)			$T_L$	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.

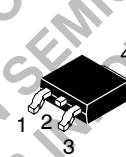
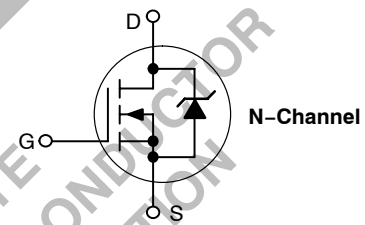
1. Surface-mounted on FR4 board using 1 in sq pad size, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.



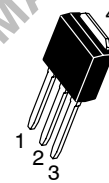
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<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
25 V	5.0 @ 11.5 V	85 A
	7.5 @ 4.5 V	



CASE 369C  
DPAK  
(Bend Lead)  
STYLE 2

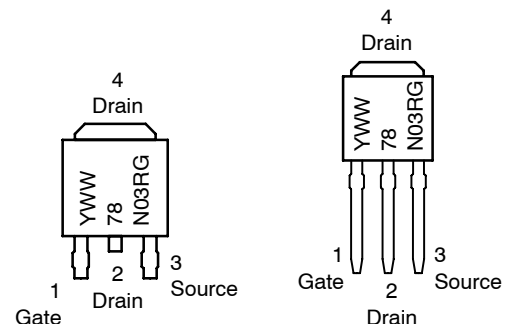


CASE 369D  
DPAK  
(Straight Lead)  
STYLE 2



CASE 369AC  
3 IPAK  
(Straight Lead)

### MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year  
WW = Work Week  
78N03R = Device Code  
G = Pb-Free Package

### ORDERING INFORMATION

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

# NTD78N03R

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	1.95	°C/W
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	65	
Junction-to-Ambient – Steady State (Note 4)	$R_{\theta JA}$	110	

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	25			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			10		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$	$T_J = 25^\circ\text{C}$		1.5	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		10	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	1.0	1.7	3.0	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-5.3		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V to } 11.5\text{ V}$	$I_D = 30\text{ A}$	5.0	5.8	m $\Omega$
			$I_D = 15\text{ A}$	4.9	5.7	
		$V_{GS} = 4.5\text{ V}$	$I_D = 30\text{ A}$	7.5	9.0	
			$I_D = 15\text{ A}$	7.2	8.5	
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 10\text{ A}$		23		S

### CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 12\text{ V}$		1794		pF
Output Capacitance	$C_{oss}$			882		
Reverse Transfer Capacitance	$C_{rss}$			373		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}, I_D = 20\text{ A}$		19.4	24	nC
Threshold Gate Charge	$Q_{G(TH)}$			0.8		
Gate-to-Source Charge	$Q_{GS}$			2.9		
Gate-to-Drain Charge	$Q_{GD}$			12.4		

### SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}, I_D = 20\text{ A}, R_G = 2.5\text{ }\Omega$		11		ns
Rise Time	$t_r$			75		
Turn-Off Delay Time	$t_{d(off)}$			18		
Fall Time	$t_f$			17		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 30 A	T <sub>J</sub> = 25°C		0.8	1.0	V
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, dI <sub>S</sub> /d <sub>t</sub> = 100 A/μs, I <sub>S</sub> = 20 A			38		ns
Charge Time	t <sub>a</sub>				16.5		
Discharge Time	t <sub>b</sub>				22		
Reverse Recovery Time	Q <sub>RR</sub>				31		nC

- Surface-mounted on FR4 board using 1 in sq pad size, 1 oz Cu.
- Surface-mounted on FR4 board using the minimum recommended pad size.
- Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

# NTD78N03R

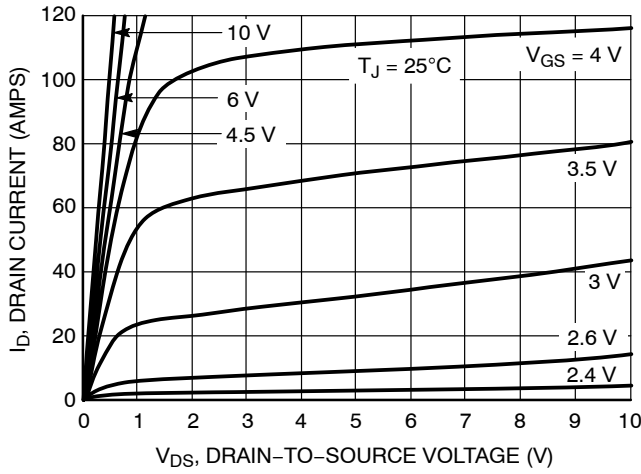


Figure 1. On-Region Characteristics

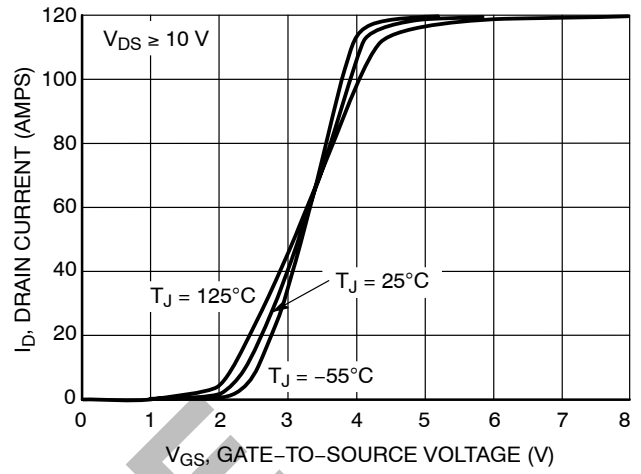


Figure 2. Transfer Characteristics

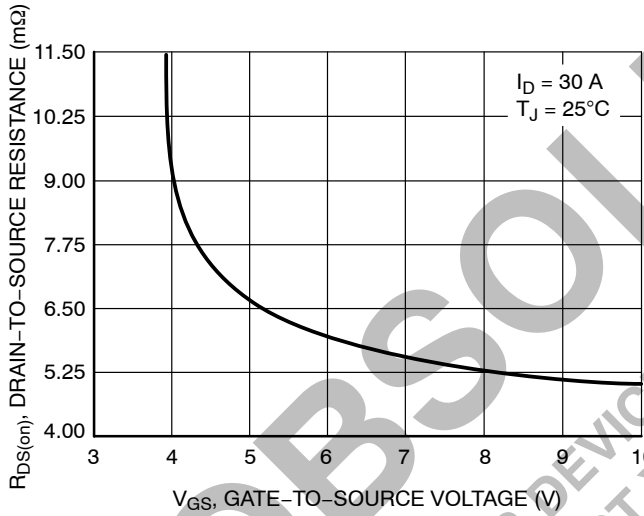


Figure 3. On-Resistance versus Gate-to-Source Voltage

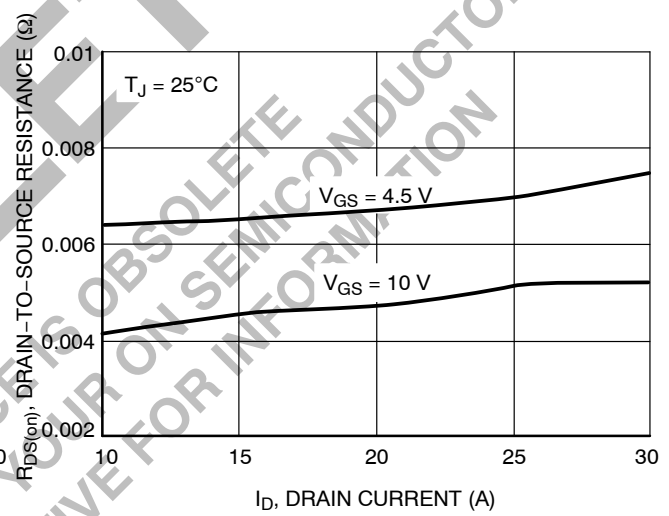


Figure 4. On-Resistance versus Drain Current and Gate Voltage

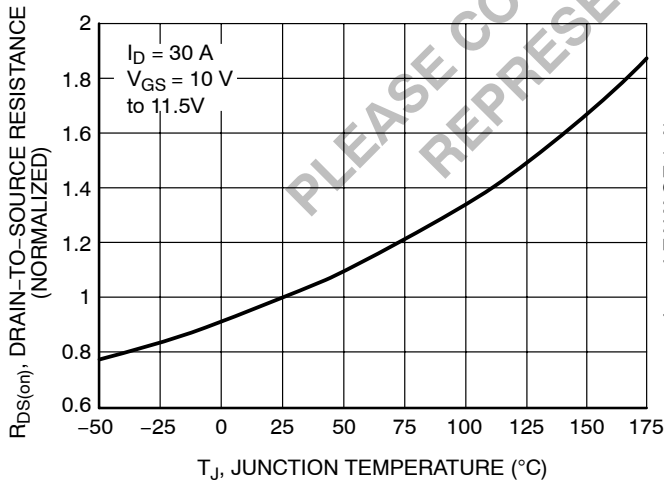


Figure 5. On-Resistance Variation with Temperature

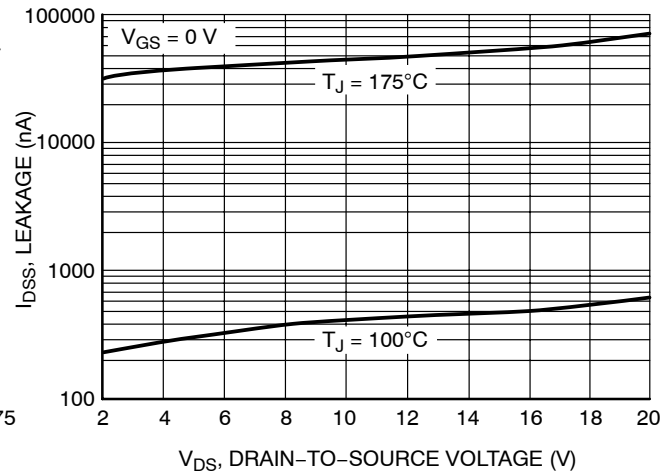
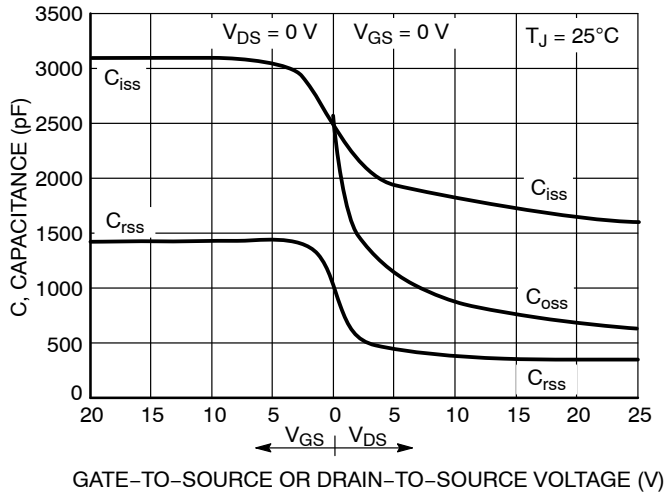
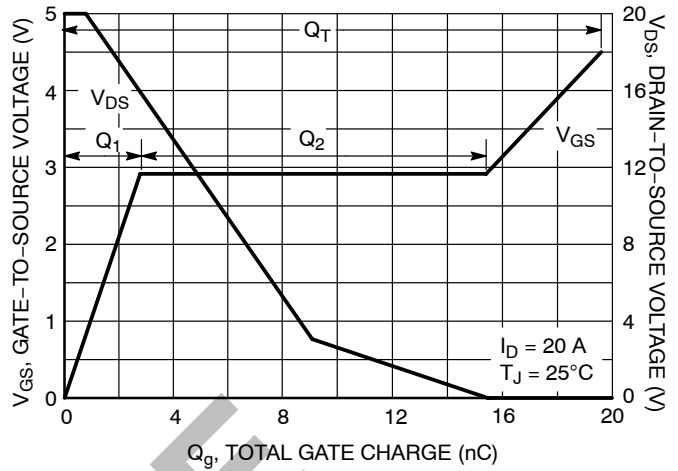


Figure 6. Drain-to-Source Leakage Current versus Voltage

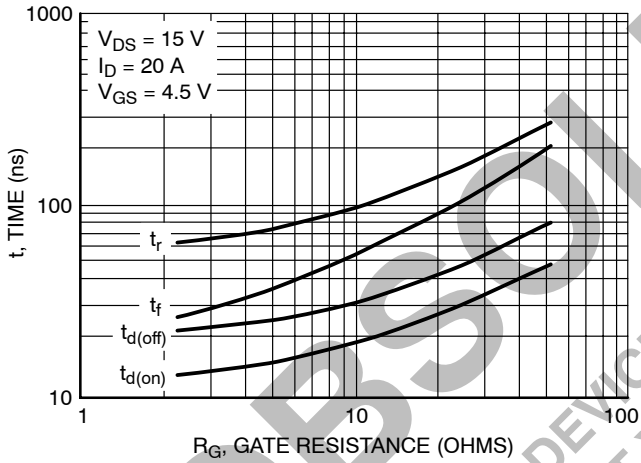
# NTD78N03R



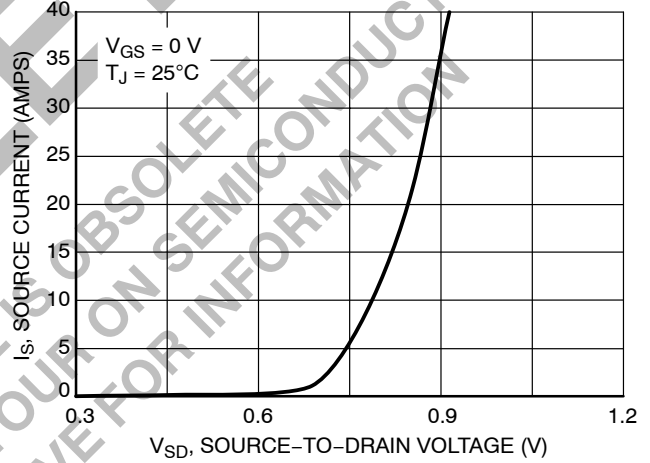
**Figure 7. Capacitance Variation**



**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**

## NTD78N03R

### ORDERING INFORMATION

Order Number	Package	Shipping <sup>†</sup>
NTD78N03R	DPAK	75 Units/Rail
NTD78N03RG	DPAK (Pb-Free)	
NTD78N03RT4	DPAK	2500 Tape & Reel
NTD78N03RT4G	DPAK (Pb-Free)	
NTD78N03R-1	DPAK Straight Lead	75 Units/Rail
NTD78N03R-1G	DPAK Straight Lead (Pb-Free)	
NTD78N03R-35	DPAK Straight Lead (3.5 ± 0.15 mm)	
NTD78N03R-35G	DPAK Straight Lead (3.5 ± 0.15 mm) (Pb-Free)	

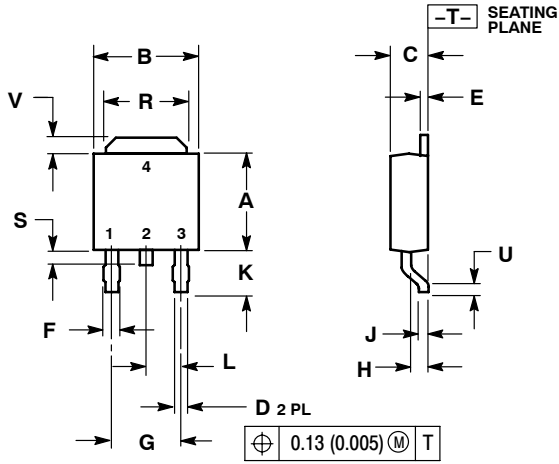
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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THIS DEVICE IS OBSOLETE  
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# NTD78N03R

## PACKAGE DIMENSIONS

DPAK  
CASE 369C-01  
ISSUE O

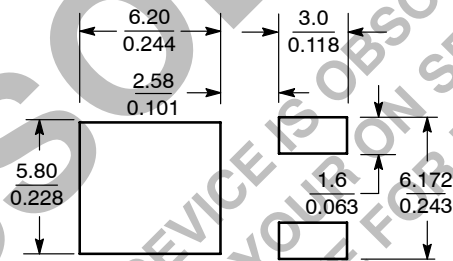


### NOTES:

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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
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	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.180 BSC		4.58 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090 BSC		2.29 BSC	
R	0.180	0.215	4.57	5.45
S	0.025	0.040	0.63	1.01
U	0.020	---	0.51	---
V	0.035	0.050	0.89	1.27
Z	0.155	---	3.93	---

### SOLDERING FOOTPRINT\*



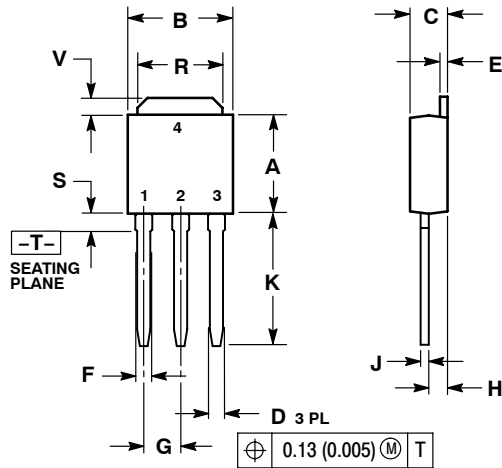
SCALE 3:1  $\left( \frac{\text{mm}}{\text{inches}} \right)$

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

# NTD78N03R

## PACKAGE DIMENSIONS

DPAK  
CASE 369D-01  
ISSUE B



### NOTES:

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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	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	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
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	0.180	0.215	4.45	5.45
S	0.025	0.040	0.63	1.01
V	0.035	0.050	0.89	1.27
Z	0.155	---	3.93	---

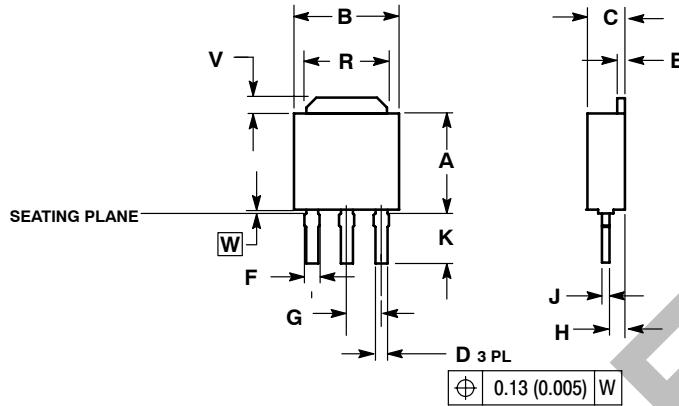
### STYLE 2:

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

# NTD78N03R

## PACKAGE DIMENSIONS

### 3 IPAK, STRAIGHT LEAD CASE 369AC-01 ISSUE O



#### NOTES:

- 1.. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2.. CONTROLLING DIMENSION: INCH.
3. SEATING PLANE IS ON TOP OF DAMBAR POSITION.
4. DIMENSION A DOES NOT INCLUDE DAMBAR POSITION OR MOLD GATE.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
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	0.018	0.023	0.46	0.58
F	0.037	0.043	0.94	1.09
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	0.134	0.142	3.40	3.60
R	0.180	0.215	4.57	5.46
V	0.035	0.050	0.89	1.27
W	0.000	0.010	0.000	0.25

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NTD78N03R/D



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