

# NTD78N03

## Power MOSFET

25 V, 78 A, Single N-Channel, DPAK



ON Semiconductor®

<http://onsemi.com>

### Features

- Low  $R_{DS(on)}$
- Optimized Gate Charge
- Pb-Free Packages are Available

### Applications

- Desktop VCORE
- DC-DC Converters
- Low Side Switch

### 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 (Note 1)	$I_D$	$T_C = 25^\circ\text{C}$	14.8
		$T_C = 85^\circ\text{C}$	11.5
Power Dissipation (Note 1)	$P_D$	2.3	W
Continuous Drain Current (Note 2)	$I_D$	$T_C = 25^\circ\text{C}$	11.4
		$T_C = 85^\circ\text{C}$	8.8
Power Dissipation (Note 2)	$P_D$	1.4	W
Continuous Drain Current ( $R_{\theta JC}$ )	$I_D$	$T_C = 25^\circ\text{C}$	78
		$T_C = 85^\circ\text{C}$	56
Power Dissipation ( $R_{\theta JC}$ )	$P_D$	64	W
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	$I_{DM}$	210
Current Limited by Package	$T_A = 25^\circ\text{C}$	$I_{DmaxPkg}$	45
Drain to Source dV/dt	dV/dt	8.0	V/ns
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to 175	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	78	A
Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 24 \text{ V}, V_{GS} = 10 \text{ V}, L = 5.0 \text{ mH}, I_L(\text{pk}) = 17 \text{ A}, R_G = 25 \Omega$ )	$E_{AS}$	722.5	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 seconds)	$T_L$	260	$^\circ\text{C}$

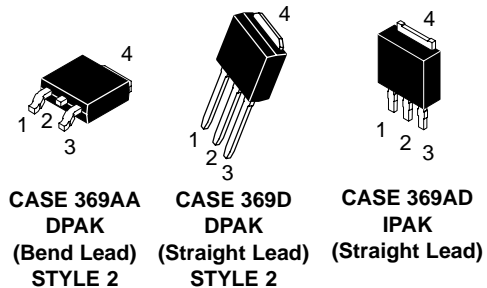
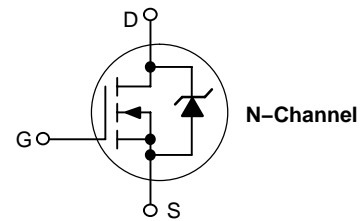
### THERMAL RESISTANCE

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	1.95	$^\circ\text{C/W}$
Junction-to-Ambient - Steady State (Note 1)	$R_{\theta JA}$	65	
Junction-to-Ambient - Steady State (Note 2)	$R_{\theta JA}$	110	

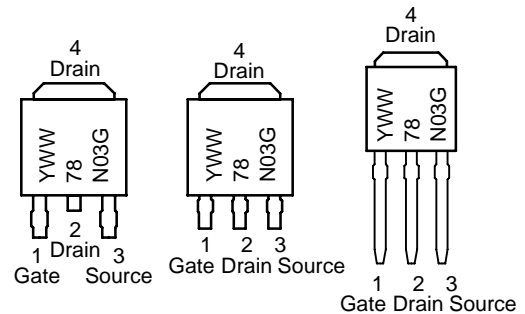
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
2. Surface-mounted on FR4 board using the minimum recommended pad size.

$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
25 V	4.6 @ 10 V	78 A
	6.5 @ 4.5 V	



### MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year  
 WW = Work Week  
 78N03 = 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.

# NTD78N03

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

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

Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	25			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>			24		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 20 V	T <sub>J</sub> = 25°C		1.5	μA
			T <sub>J</sub> = 125°C		10	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V			± 100	nA

### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA	1.0	1.6	3.0	V
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>			-5.0		mV/°C
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 78 A		4.6	6.0	mΩ
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 36 A		6.5	7.8	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 15 A		22		S

### CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = 12 V		1920	2250	pF
Output Capacitance	C <sub>oss</sub>			960		
Reverse Transfer Capacitance	C <sub>rss</sub>			420		
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 20 V, I <sub>D</sub> = 20 A		25.5	35	nC
Threshold Gate Charge	Q <sub>G(TH)</sub>			2.4		
Gate-to-Source Charge	Q <sub>GS</sub>			5.3		
Gate-to-Drain Charge	Q <sub>GD</sub>			18.2		

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 20 V, I <sub>D</sub> = 20 A, R <sub>G</sub> = 3.0 Ω		11		ns
Rise Time	t <sub>r</sub>			68		
Turn-Off Delay Time	t <sub>d(off)</sub>			23		
Fall Time	t <sub>f</sub>			42		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 20 A	T <sub>J</sub> = 25°C		0.83	1.0	V
			T <sub>J</sub> = 125°C		0.7		
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		39		ns	
Charge Time	t <sub>a</sub>			17.8			
Discharge Time	t <sub>b</sub>			21			
Reverse Recovery Time	Q <sub>RR</sub>			33		nC	

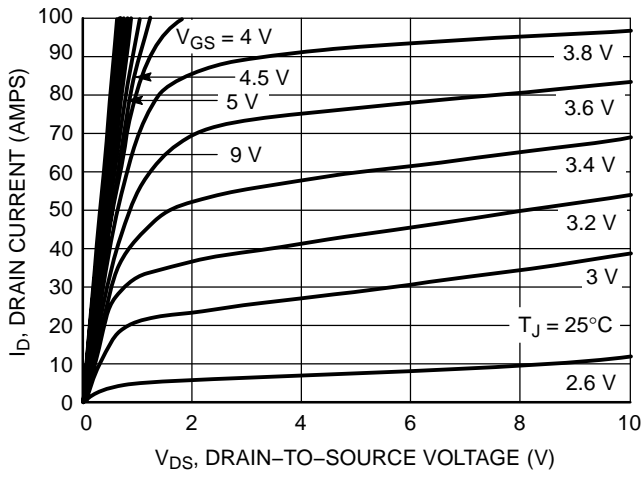
### PACKAGE PARASITIC VALUES

Source Inductance	L <sub>S</sub>	T <sub>a</sub> = 25C		2.49		nH
Drain Inductance	L <sub>D</sub>			0.02		
Gate Inductance	L <sub>G</sub>			3.46		
Gate Resistance	R <sub>G</sub>			1.0		

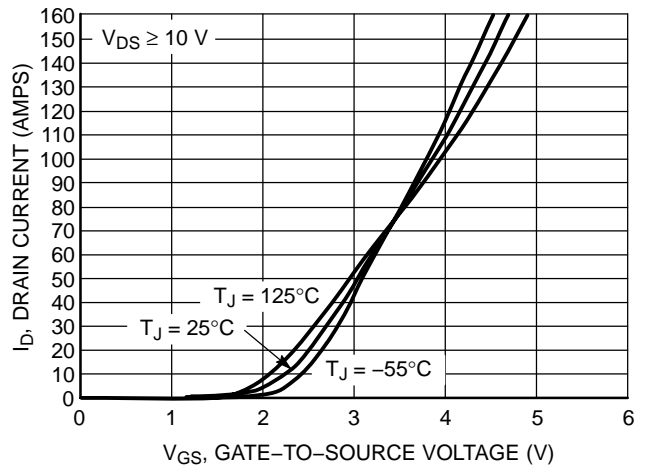
3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

4. Switching characteristics are independent of operating junction temperatures.

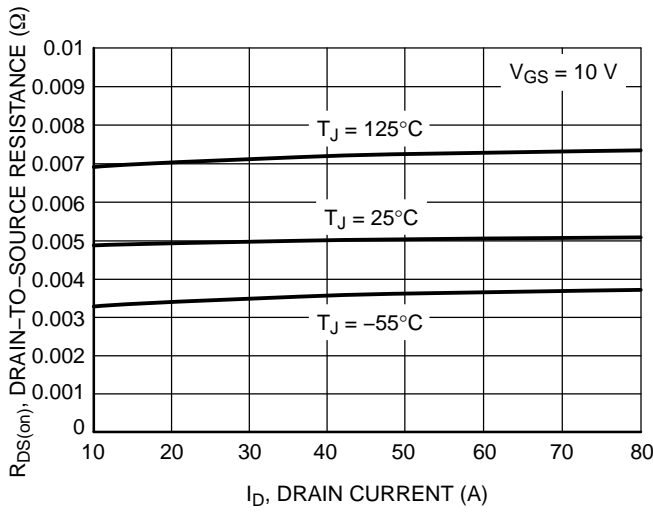
# NTD78N03



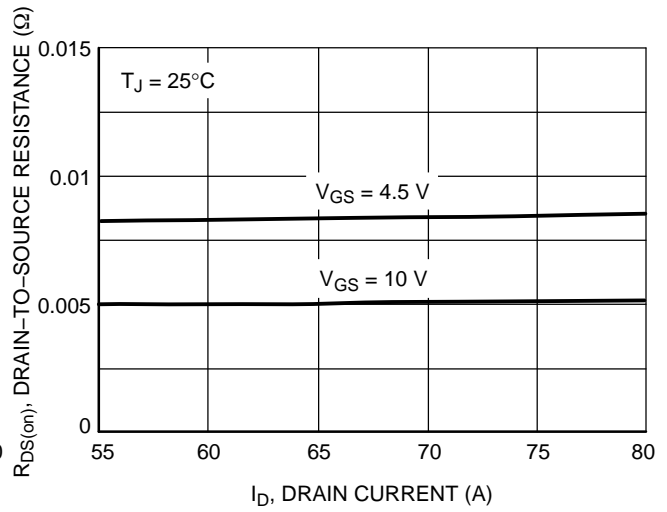
**Figure 1. On-Region Characteristics**



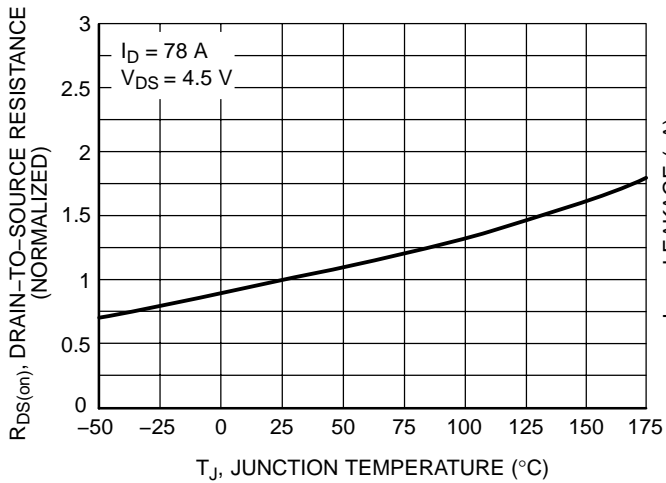
**Figure 2. Transfer Characteristics**



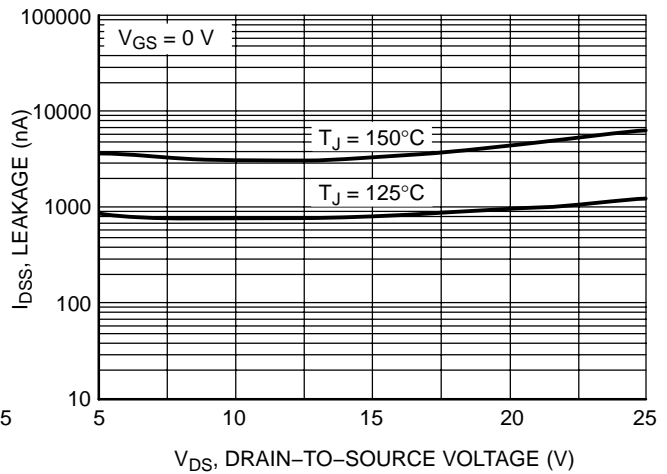
**Figure 3. On-Resistance versus Drain Current and Temperature**



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

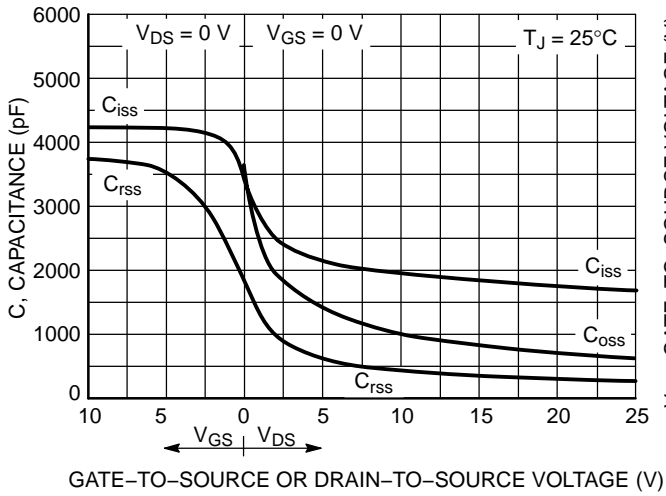


**Figure 5. On-Resistance Variation with Temperature**

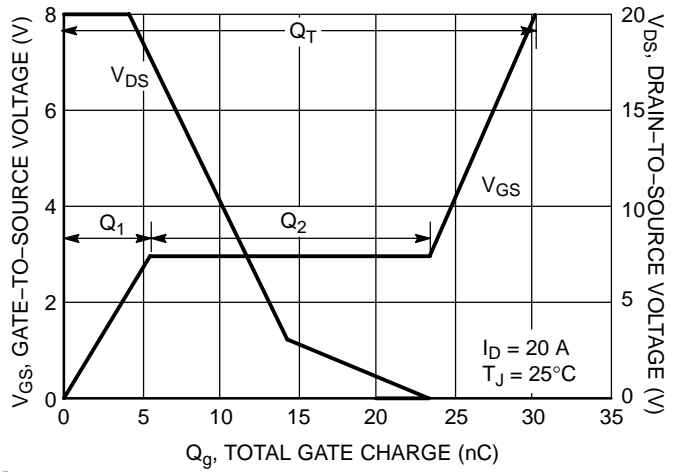


**Figure 6. Drain-to-Source Leakage Current versus Voltage**

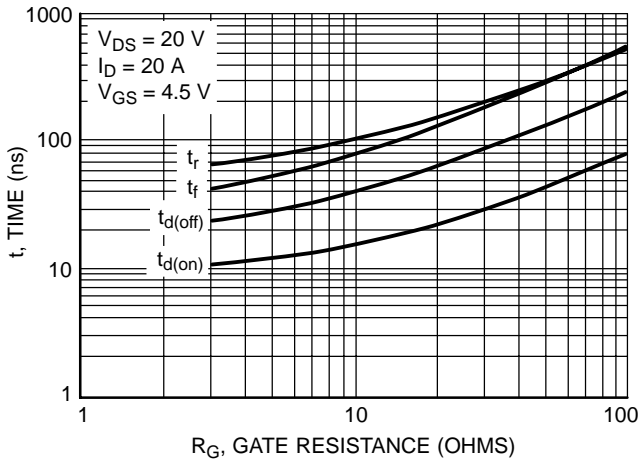
# NTD78N03



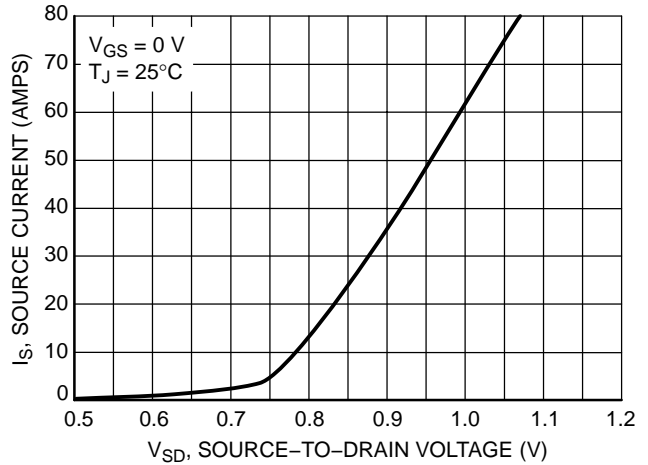
**Figure 7. Capacitance Variation**



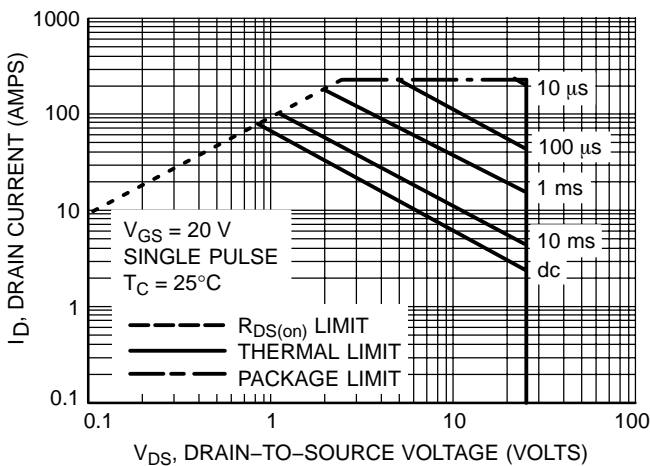
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



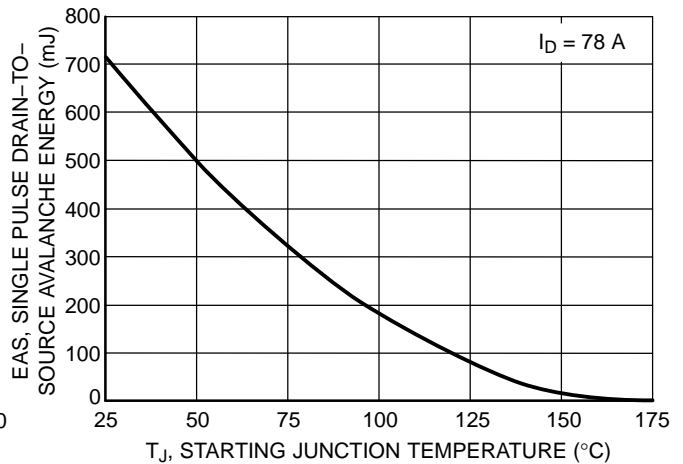
**Figure 9. Resistive Switching Time Variation versus Gate Resistance**



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



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



**Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature**

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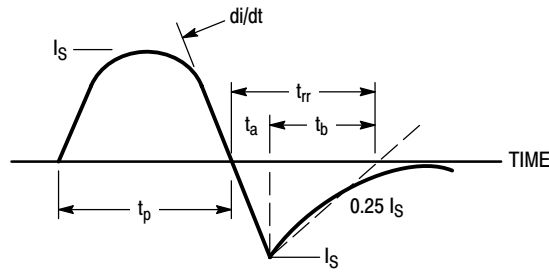


Figure 13. Diode Reverse Recovery Waveform

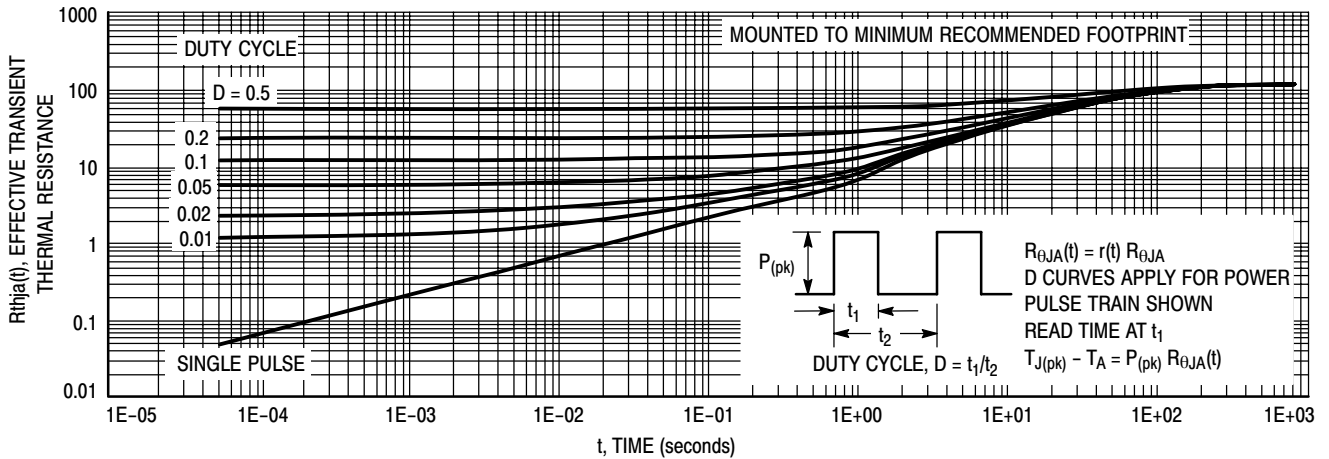


Figure 14. Thermal Response – Various Duty Cycles

## ORDERING INFORMATION

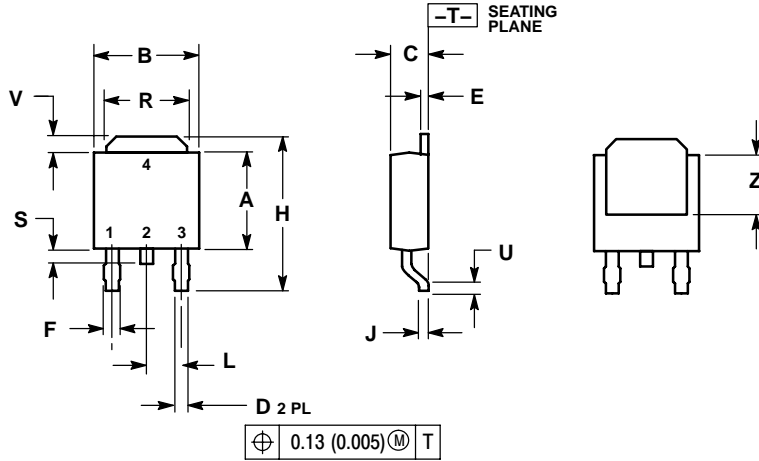
Order Number	Package	Shipping†
NTD78N03	DPAK	75 Units/Rail
NTD78N03G	DPAK (Pb-Free)	75 Units/Rail
NTD78N03T4	DPAK	2500 Tape & Reel
NTD78N03T4G	DPAK (Pb-Free)	
NTD78N03-1	DPAK Straight Lead	75 Units/Rail
NTD78N03-1G	DPAK Straight Lead (Pb-Free)	
NTD78N03-35	DPAK-3 Straight Lead (3.5 ± 0.15 mm)	75 Units/Rail
NTD78N03-35G	DPAK-3 Straight Lead (3.5 ± 0.15 mm) (Pb-Free)	

†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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## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369AA-01 ISSUE A

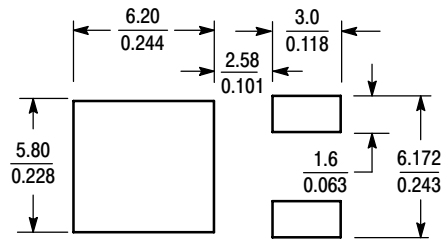


- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

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	0.025	0.035	0.63	0.89
E	0.018	0.024	0.46	0.61
F	0.030	0.045	0.77	1.14
H	0.386	0.410	9.80	10.40
J	0.018	0.023	0.46	0.58
L	0.090 BSC		2.29 BSC	
R	0.180	0.215	4.57	5.45
S	0.024	0.040	0.60	1.01
U	0.020	---	0.51	---
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

### SOLDERING FOOTPRINT\*



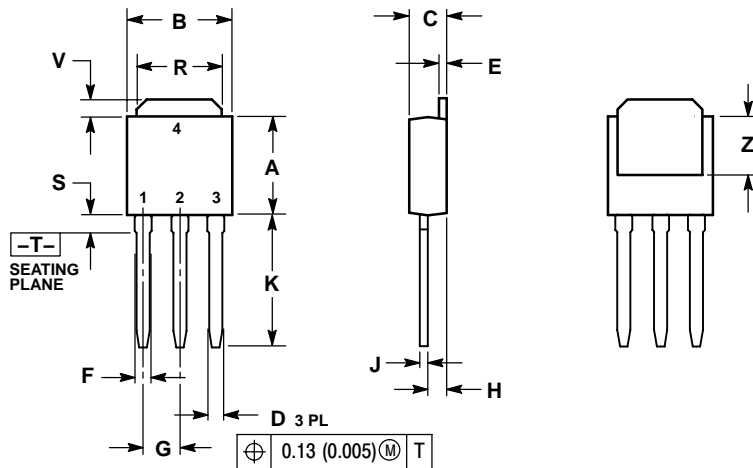
SCALE 3:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

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## PACKAGE DIMENSIONS

### DPAK CASE 369D-01 ISSUE B



NOTES:

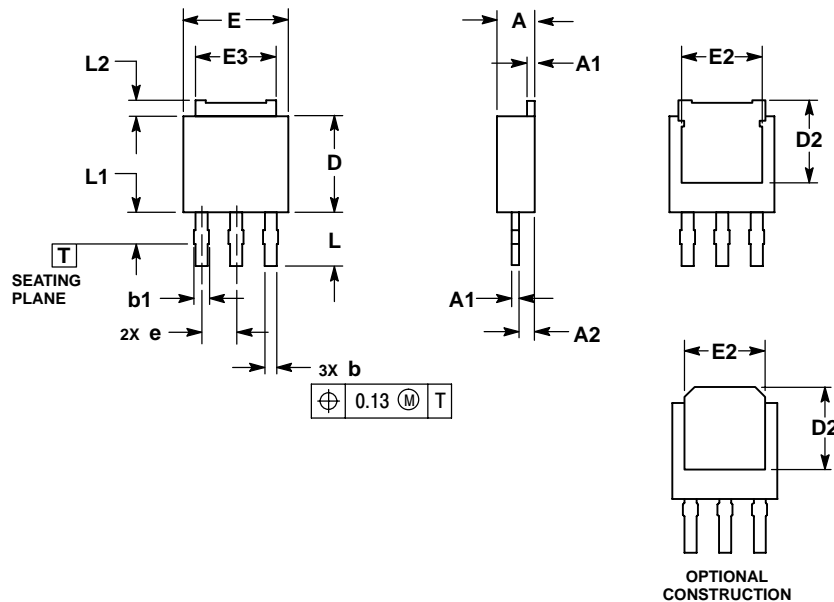
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

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

### 3.5 MM IPAK, STRAIGHT LEAD CASE 369AD-01 ISSUE O



NOTES:

- 1.. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- 2.. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD GATE OR MOLD FLASH.

DIM	MILLIMETERS	
	MIN	MAX
A	2.19	2.38
A1	0.46	0.60
A2	0.87	1.10
b	0.69	0.89
b1	0.77	1.10
D	5.97	6.22
D2	4.80	---
E	6.35	6.73
E2	4.70	---
E3	4.45	5.46
e	2.28 BSC	
L	3.40	3.60
L1	---	2.10
L2	0.89	1.27

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