



**THE DATASHEET OF  
NTD50N03R-035**



# NTD50N03R

## Power MOSFET 25 V, 45 A, Single N-Channel, DPAK

### Features

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

### Applications

- VCORE DC-DC Buck Converter Applications
- Optimized for High 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)	$I_D$	$T_A = 25^\circ\text{C}$	9.2	A
		$T_A = 85^\circ\text{C}$	7.2	
Power Dissipation ( $R_{\theta JA}$ ) (Note 1)	$P_D$	$T_A = 25^\circ\text{C}$	2.1	W
Continuous Drain Current ( $R_{\theta JA}$ ) (Note 2)	$I_D$	$T_A = 25^\circ\text{C}$	7.8	A
		$T_A = 85^\circ\text{C}$	6.0	
Power Dissipation ( $R_{\theta JA}$ ) (Note 2)	$P_D$	$T_A = 25^\circ\text{C}$	1.5	W
Continuous Drain Current ( $R_{\theta JC}$ ) (Note 1)	$I_D$	$T_C = 25^\circ\text{C}$	45	A
		$T_C = 85^\circ\text{C}$	35	
Power Dissipation ( $R_{\theta JC}$ ) (Note 1)	$P_D$	$T_C = 25^\circ\text{C}$	50	W
Pulsed Drain Current	$I_{DM}$	$T_A = 25^\circ\text{C}$ , $t_p = 10 \mu\text{s}$	180	A
Current Limited by Package	$I_{DmaxPkg}$	$T_A = 25^\circ\text{C}$	45	A
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to 175	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	45	A	
Drain-to-Source (dv/dt)	dv/dt	8.0	V/ns	
Single Pulse Drain-to-Source Avalanche Energy ( $T_J = 25^\circ\text{C}$ , $V_{DD} = 50 \text{ V}$ , $V_{GS} = 10 \text{ V}$ , $I_L = 6.32 \text{ A}_{pk}$ , $L = 1.0 \text{ mH}$ , $R_G = 25 \Omega$ )	$E_{AS}$	20	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 sq in pad, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.

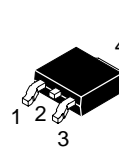
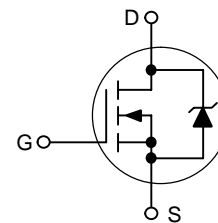


ON Semiconductor®

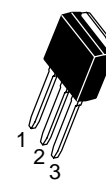
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$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
25 V	12.5 m $\Omega$ @ 10 V	45 A
	19 m $\Omega$ @ 4.5 V	

### N-Channel



CASE 369AA  
DPAK  
(Surface Mount)  
STYLE 2

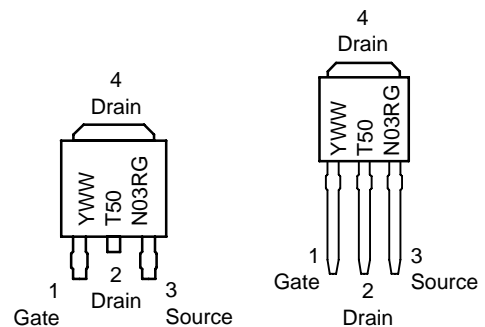


CASE 369D  
DPAK  
(Straight Lead)  
STYLE 2



CASE 369AC  
3 IPAK  
(Straight Lead)

### MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year  
WW = Work Week  
T50N03R = Device Code  
G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

# NTD50N03R

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	3.0	°C/W
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	71.4	
Junction-to-Ambient – Steady State (Note 4)	$R_{\theta JA}$	100	

## 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	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	25			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			-16		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	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.0	1.7	2.0	V	
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-5.0		mV/°C	
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 11.5\text{ V}$	$I_D = 30\text{ A}$		12	$\text{m}\Omega$	
			$I_D = 15\text{ A}$		11.7		
		$V_{GS} = 10\text{ V}$	$I_D = 30\text{ A}$		12.5		14
			$I_D = 15\text{ A}$		19		23
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 15\text{ A}$		15		S	

### CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 12\text{ V}$		610	750	$\text{pF}$
Output Capacitance	$C_{oss}$			300		
Reverse Transfer Capacitance	$C_{rss}$			125		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		6.0	10	$\text{nC}$
Threshold Gate Charge	$Q_{G(TH)}$			0.9		
Gate-to-Source Charge	$Q_{GS}$			1.9		
Gate-to-Drain Charge	$Q_{GD}$			3.7		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 11.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		15		$\text{nC}$
Threshold Gate Charge	$Q_{G(TH)}$			1.0		
Gate-to-Source Charge	$Q_{GS}$			1.9		
Gate-to-Drain Charge	$Q_{GD}$			3.9		

3. Surface-mounted on FR4 board using 1 sq in pad, 1 oz Cu.
4. Surface-mounted on FR4 board using the minimum recommended pad size.
5. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

# NTD50N03R

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V},$ $I_D = 30\text{ A}, R_G = 3.0\ \Omega$		8.2		ns
Rise Time	$t_r$			9.6		
Turn-Off Delay Time	$t_{d(off)}$			11.2		
Fall Time	$t_f$			6.8		
Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 11.5\text{ V}, V_{DS} = 15\text{ V},$ $I_D = 30\text{ A}, R_G = 3.0\ \Omega$		5.0		ns
Rise Time	$t_r$			84		
Turn-Off Delay Time	$t_{d(off)}$			15		
Fall Time	$t_f$			4.0		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V},$ $I_S = 30\text{ A}$	$T_J = 25^\circ\text{C}$		0.85	1.1	V
			$T_J = 125^\circ\text{C}$		0.71		
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dt_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = 30\text{ A}$		24		ns	
Charge Time	$t_a$			14			
Discharge Time	$t_b$			10.5			
Reverse Recovery Charge	$Q_{RR}$			14		nC	

### PACKAGE PARASITIC VALUES

Source Inductance	$L_S$	$T_a = 25\text{C}$		2.49		nH
Drain Inductance	$L_D$			0.02		
Gate Inductance	$L_G$			3.46		
Gate Resistance	$R_G$			3.75		

6. Switching characteristics are independent of operating junction temperatures.

# NTD50N03R

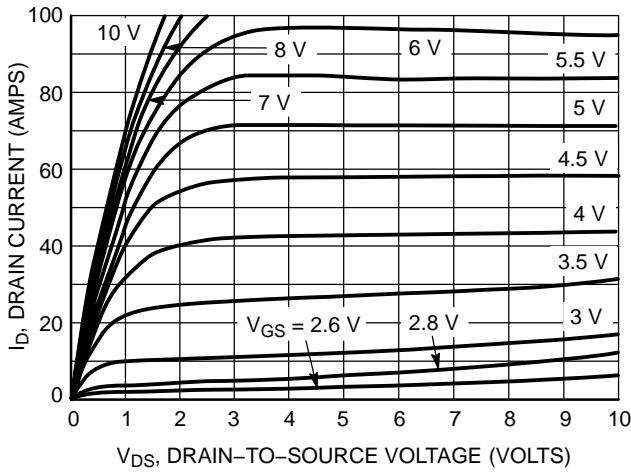


Figure 1. On-Region Characteristics

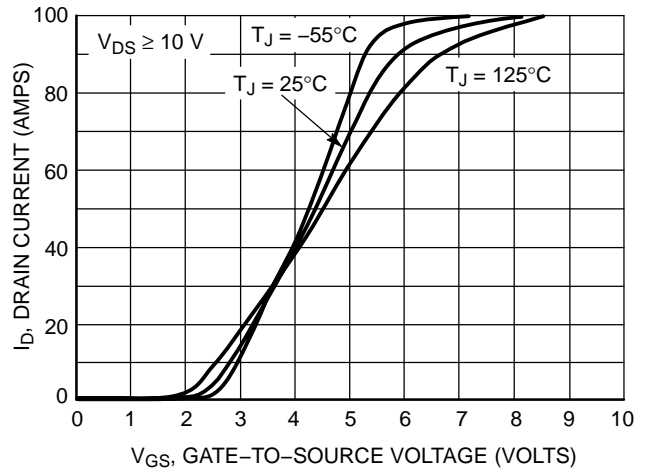


Figure 2. Transfer Characteristics

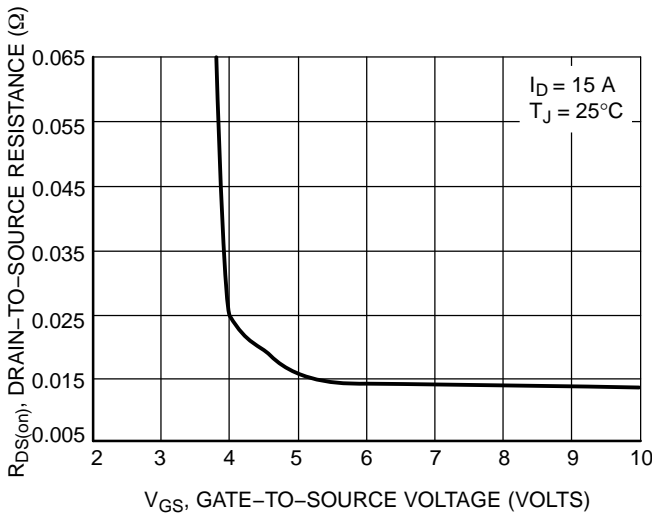


Figure 3. On-Resistance versus Gate-to-Source Voltage

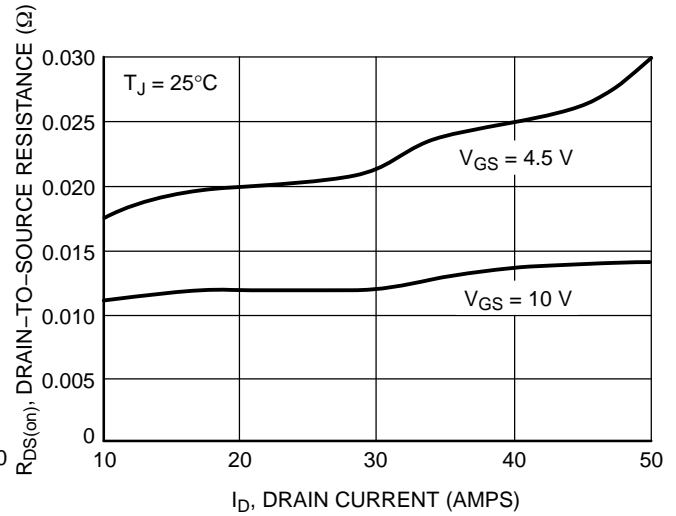


Figure 4. On-Resistance versus Drain Current and Gate Voltage

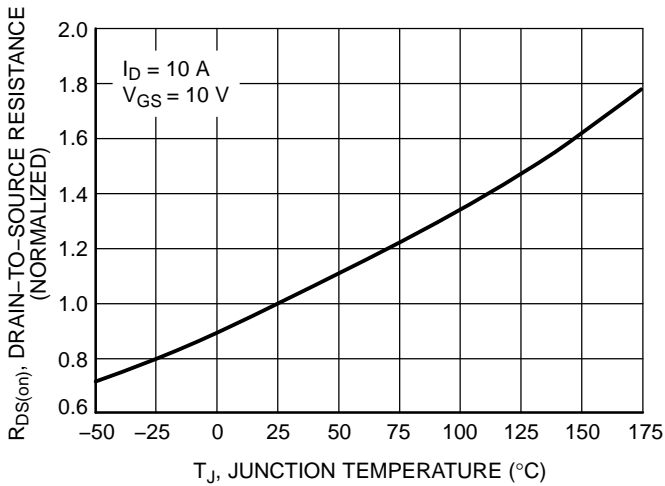


Figure 5. On-Resistance Variation with Temperature

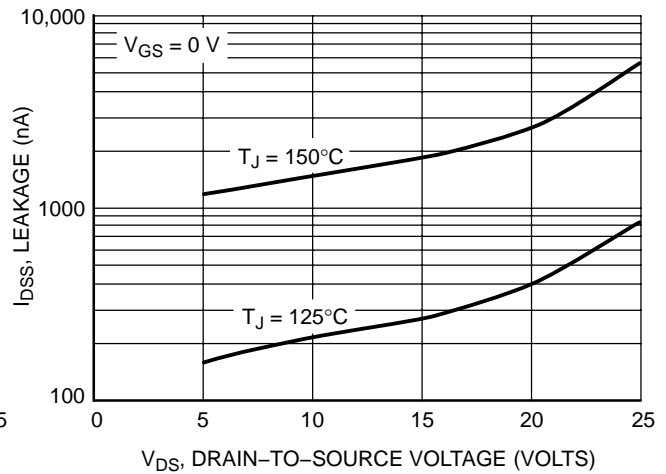
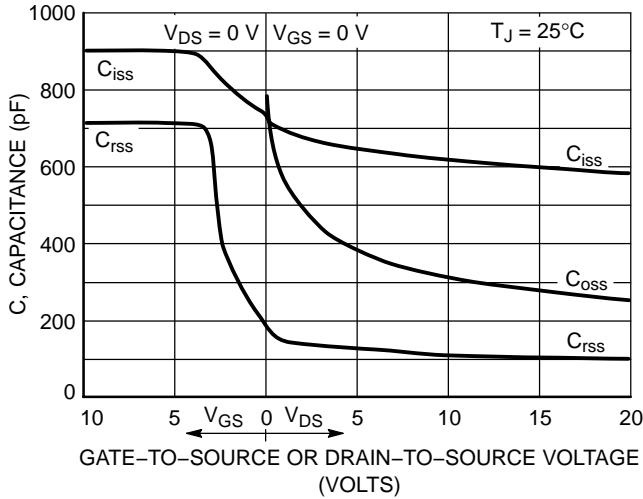
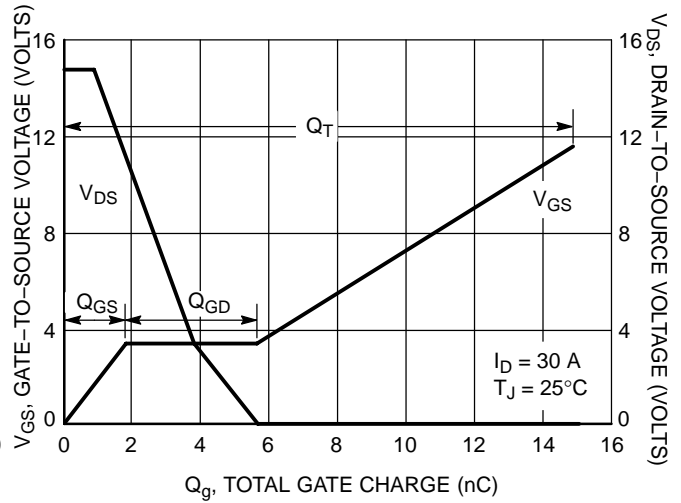


Figure 6. Drain-to-Source Leakage Current versus Voltage

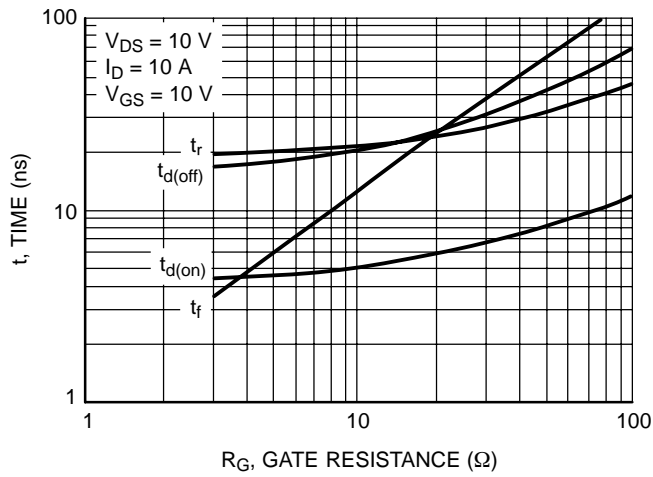
# NTD50N03R



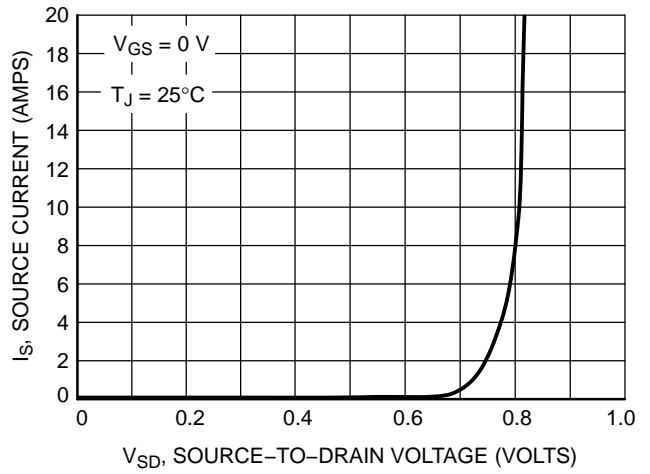
**Figure 7. Capacitance Variation**



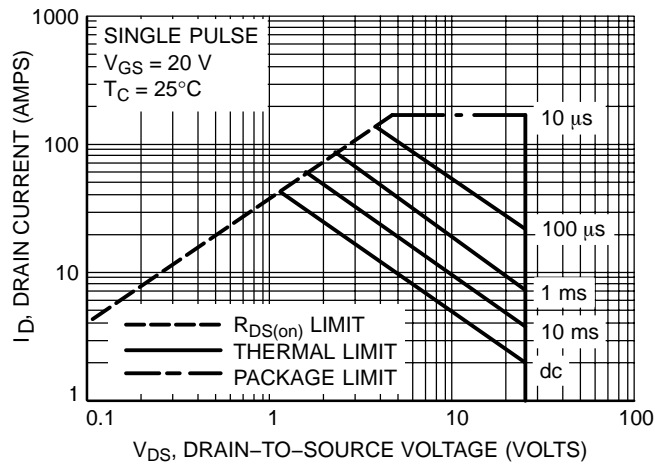
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



**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**

# NTD50N03R

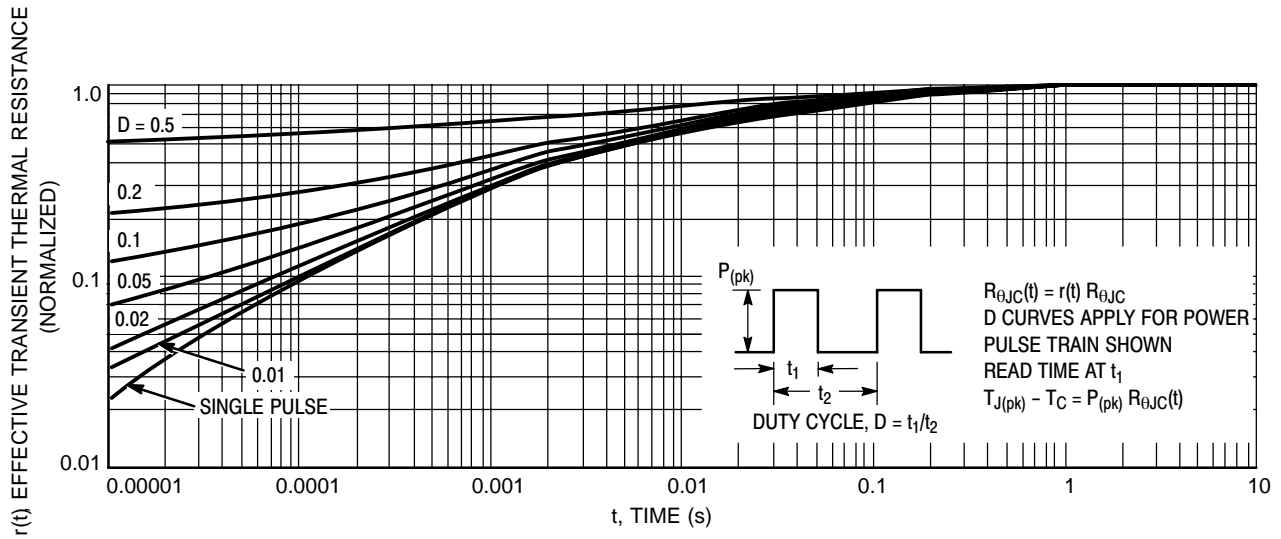


Figure 12. Thermal Response

## ORDERING INFORMATION

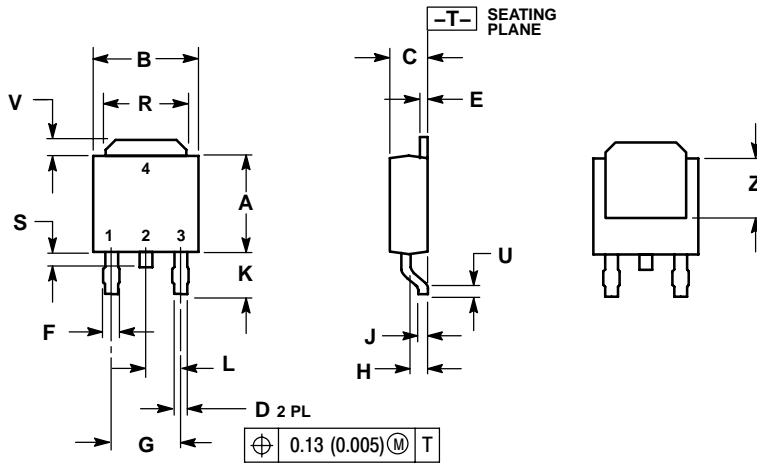
Order Number	Package	Shipping <sup>†</sup>
NTD50N03R	DPAK-3	75 Units / Rail
NTD50N03RG	DPAK-3 (Pb-Free)	75 Units / Rail
NTD50N03RT4	DPAK-3	2500 / Tape & Reel
NTD50N03RT4G	DPAK-3 (Pb-Free)	2500 / Tape & Reel
NTD50N03R-1	DPAK-3 Straight Lead	75 Units / Rail
NTD50N03R-1G	DPAK-3 Straight Lead (Pb-Free)	75 Units / Rail
NTD50N03R-35	DPAK-3 Straight Lead Trimmed (3.5 ± 0.15 mm)	75 Units / Rail
NTD50N03R-35G	DPAK-3 Straight Lead Trimmed (3.5 ± 0.15 mm) (Pb-Free)	75 Units / Rail

<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.

# NTD50N03R

## PACKAGE DIMENSIONS

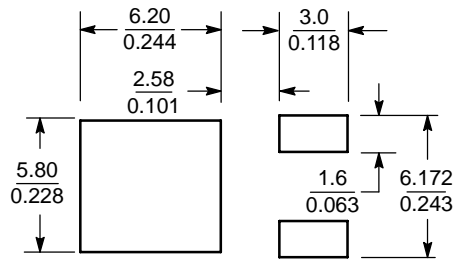
DPAK  
CASE 369C-01  
ISSUE O



- 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	---

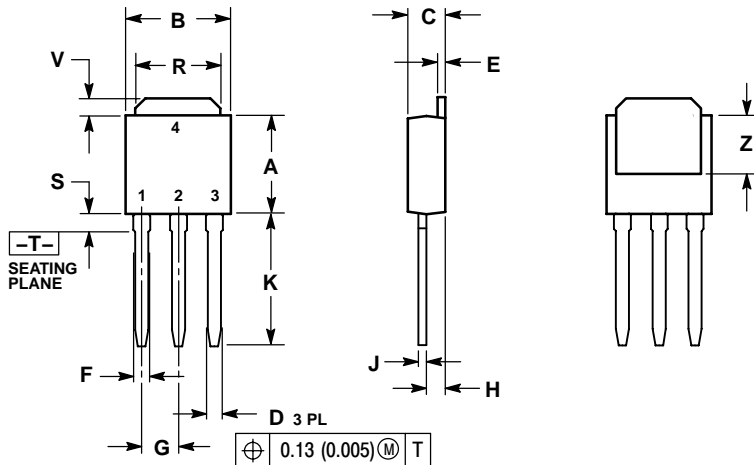
### SOLDERING FOOTPRINT\*



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.

DPAK  
CASE 369D-01  
ISSUE B



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

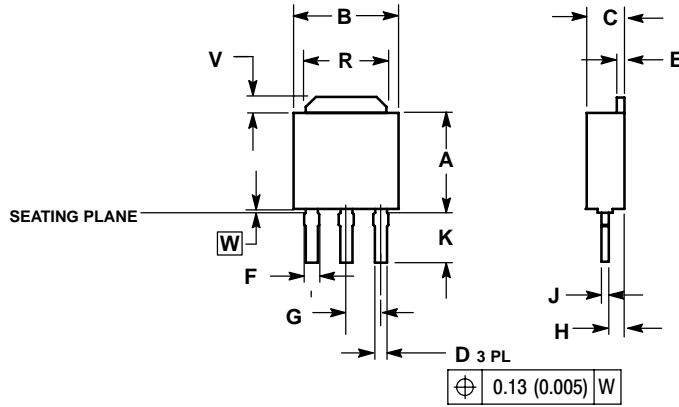
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.090 BSC		2.29 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.350	0.380	8.89	9.65
R	0.180	0.215	4.45	5.45
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

# NTD50N03R

## 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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