

# NTD95N02R

## Power MOSFET 95 Amps, 24 Volts

### N-Channel DPAK

#### Features

- High Power and Current Handling Capability
- Fast Switching Performance
- Low  $R_{DS(on)}$  to Minimize Conduction Loss
- Low Gate Charge to Minimize Switching Losses
- Pb-Free Packages are Available

#### Applications

- CPU Motherboard Vcore Applications
- High Frequency DC-DC Converters
- Motor Drives
- Bridge Circuits

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

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DS}$	24	V
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.45	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	86	W
Drain Current -			
- Continuous @ $T_A = 25^\circ\text{C}$ , Limited by Package	$I_D$	95	A
- Continuous @ $T_A = 25^\circ\text{C}$ , Limited by Wires	$I_D$	32	A
Thermal Resistance, Junction-to-Ambient (Note 1)	$R_{\theta JA}$	52	$^\circ\text{C/W}$
- Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	2.4	W
- Drain Current - Continuous @ $T_A = 25^\circ\text{C}$	$I_D$	15.8	A
Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	100	$^\circ\text{C/W}$
- Total Power Dissipation @ $T_A = 25^\circ\text{C}$	$P_D$	1.25	W
- Drain Current - Continuous @ $T_A = 25^\circ\text{C}$	$I_D$	12	A
Operating Junction and Storage Temperature	$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$
Continuous Source Current (Body Diode)	$I_S$	45	A
Single Pulse Drain-to-Source Avalanche Energy - ( $V_{DD} = 25\text{ V}, V_G = 10, I_{PK} = 13\text{ A}, L = 1\text{ mH}, R_G = 25\ \Omega$ )	$E_{AS}$	84	mJ
Lead Temperature for Soldering Purposes (1/8 in from case for 10 seconds)	$T_L$	260	$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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 (Cu area = 0.412 in sq).

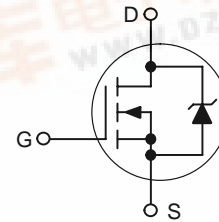


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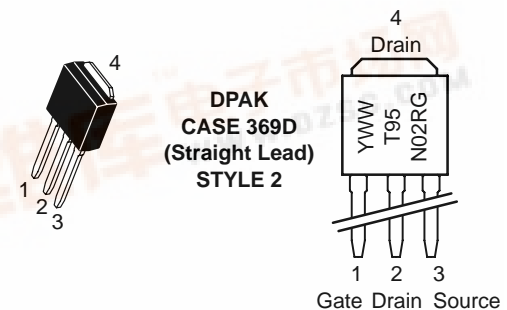
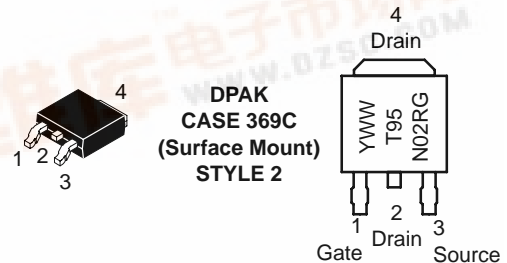
<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(ON)}$ TYP	$I_D$ MAX*
24 V	4.5 m $\Omega$ @ 10 V	95 A
	5.9 m $\Omega$ @ 4.5 V	

\* $I_D$  MAX in the product summary table is continuous and steady at  $25^\circ\text{C}$ .



#### MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year  
 WW = Work Week  
 T95N02R = Device Code  
 G = Pb-Free Package

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.



# NTD95N02R

## THERMAL RESISTANCE RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	1.45	°C/W
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	52	
Junction-to-Ambient – Steady State (Note 4)	$R_{\theta JA}$	100	

3. Surface mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).  
 4. Surface mounted on FR4 board using the minimum recommended pad size (Cu area = 0.412 in sq).

## 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	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	24	29		V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			15		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$			1.5	$\mu\text{A}$
		$T_J = 25^\circ\text{C}$			10	
Gate-to-Source Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.0		2.0	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			5.0		mV/°C
Drain-to-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$		5.9	8.0	m $\Omega$
		$V_{GS} = 10\text{ V}, I_D = 20\text{ A}$		4.5	5.0	
Forward Transconductance	gFS	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$		30		S

### CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 20\text{ V}$		2400		pF
Output Capacitance	$C_{OSS}$			1020		
Reverse Transfer Capacitance	$C_{RSS}$			390		
Total Gate Charge	$Q_T$	$V_{GS} = 4.5\text{ V}, V_{DS} = 10\text{ V}; I_D = 10\text{ A}$		21		nC
	$Q_{GS}$			4.4		
	$Q_{GD}$			9.1		

### SWITCHING CHARACTERISTICS

Turn-on Delay Time	$t_{d(on)}$	$V_{GS} = 10\text{ V}, V_{DD} = 10\text{ V}, I_D = 30\text{ A}, R_G = 3\ \Omega$		10		ns
Rise Time	$t_r$			82		
Turn-off Time	$t_{d(off)}$			26		
Fall Time	$t_f$			70		

### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 20\text{ A}$	$T_J = 25^\circ\text{C}$		0.83	1.2	V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, dI_{SD}/dt = 100\text{ A}/\mu\text{s}, I_S = 20\text{ A}$			45		ns
Charge Time	$T_a$				20		
Discharge Time	$T_b$				30		
Reverse Recovery Charge	$Q_{RR}$				50		nC

5. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

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## TYPICAL CHARACTERISTICS

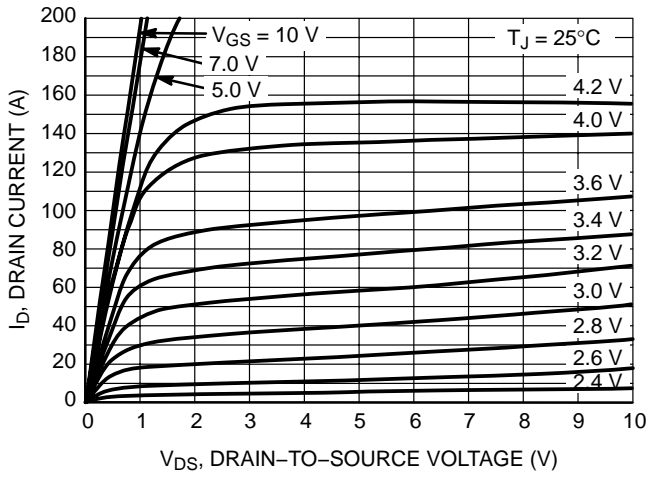


Figure 1. On-Region Characteristics

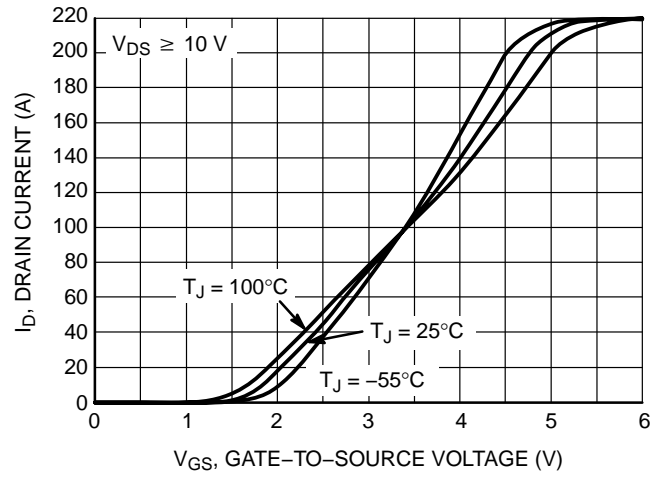


Figure 2. Transfer Characteristics

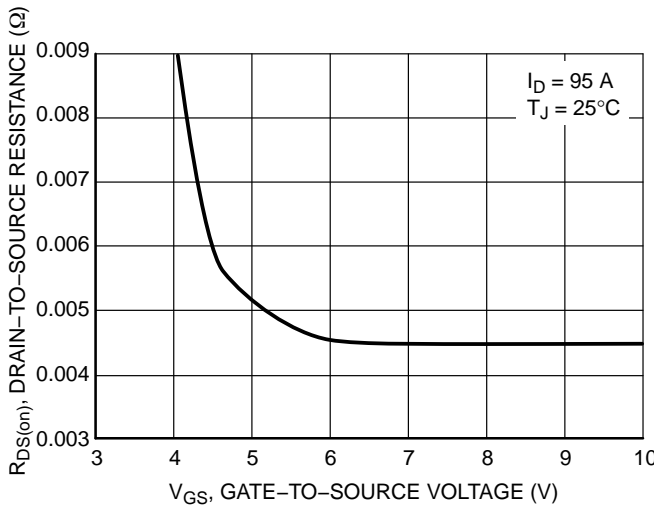


Figure 3. On-Resistance versus Gate-to-Source Voltage

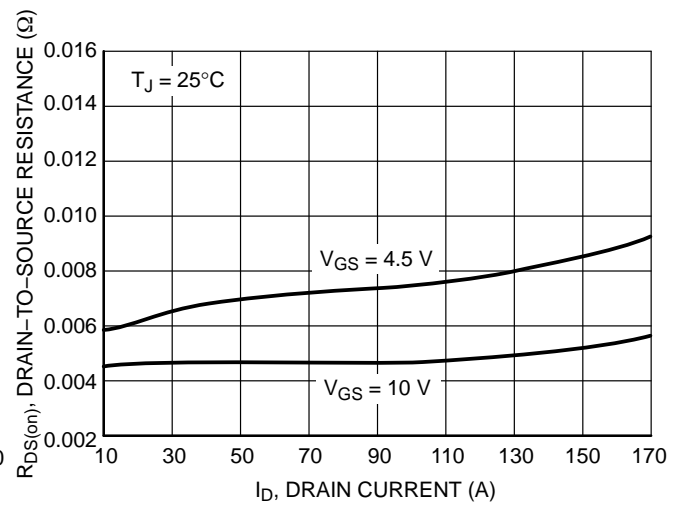


Figure 4. On-Resistance versus Drain Current and Gate Voltage

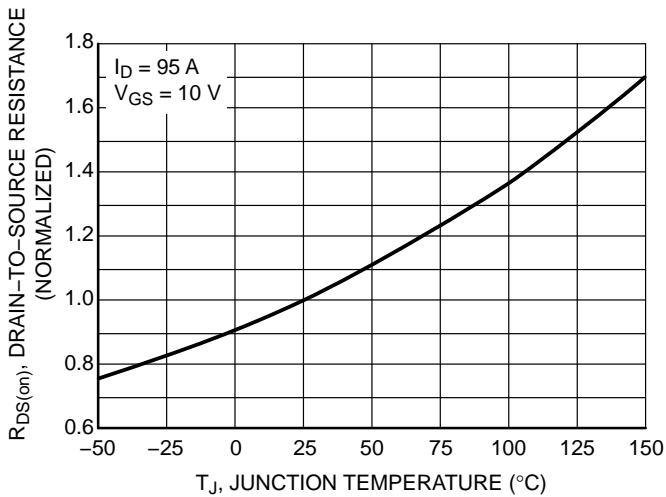


Figure 5. On-Resistance Variation with Temperature

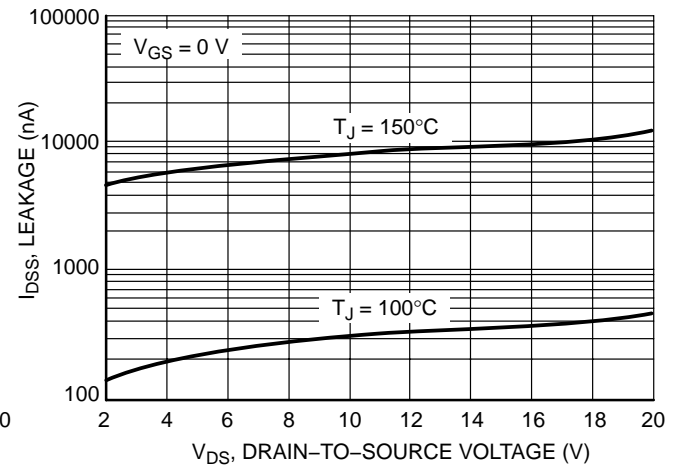


Figure 6. Drain-to-Source Leakage Current versus Voltage

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## TYPICAL CHARACTERISTICS

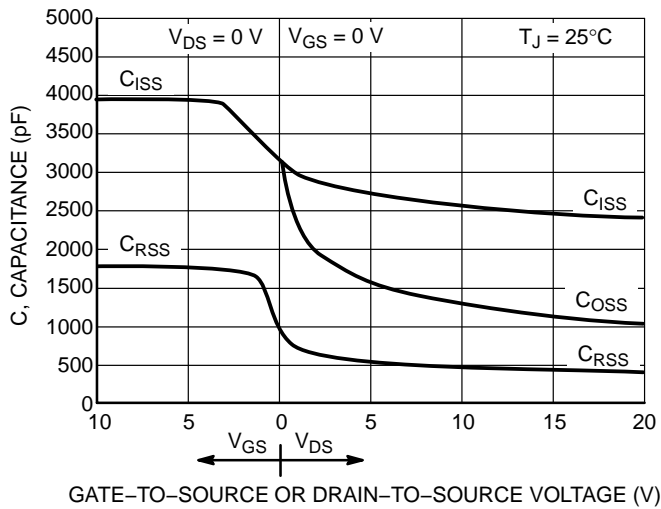


Figure 7. Capacitance Variation

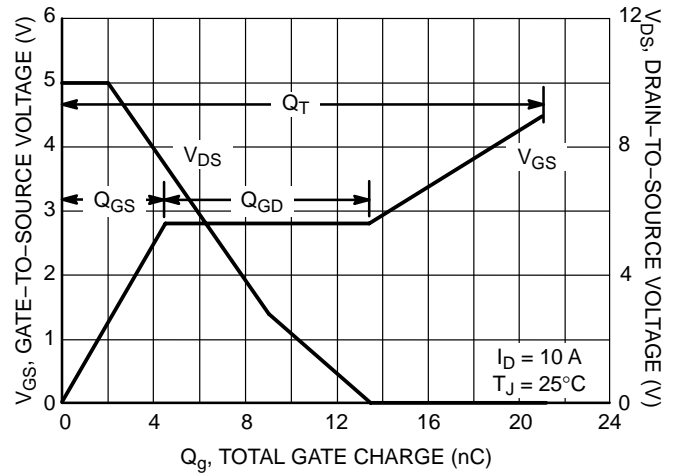


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

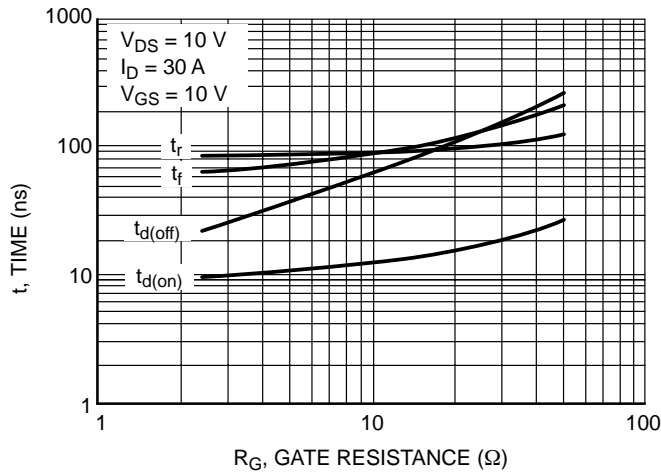


Figure 9. Resistive Switching Time Variation versus Gate Resistance

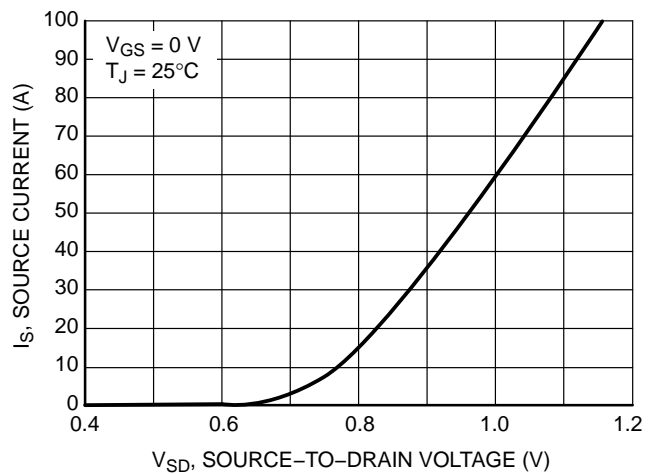


Figure 10. Diode Forward Voltage versus Current

### ORDERING INFORMATION

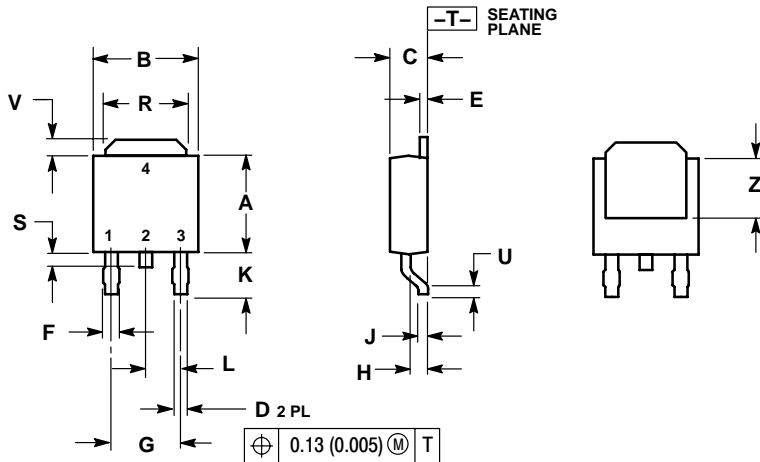
Device	Package	Shipping <sup>†</sup>
NTD95N02R	DPAK	75 Units / Rail
NTD95N02RG	DPAK (Pb-Free)	75 Units / Rail
NTD95N02R-001	DPAK	75 Units / Rail
NTD95N02R-001G	DPAK (Pb-Free)	75 Units / Rail
NTD95N02RT4	DPAK	2500 Units / Tape & Reel
NTD95N02RT4G	DPAK (Pb-Free)	2500 Units / Tape & Reel

<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.

# NTD95N02R

## PACKAGE DIMENSIONS

DPAK  
CASE 369C-01  
ISSUE O

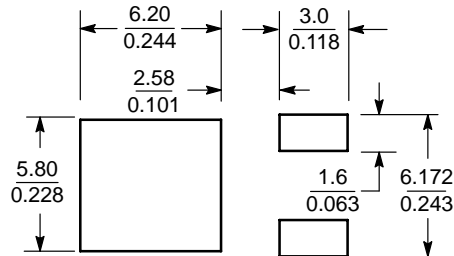


- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

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	---

STYLE 2:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

## SOLDERING FOOTPRINT\*



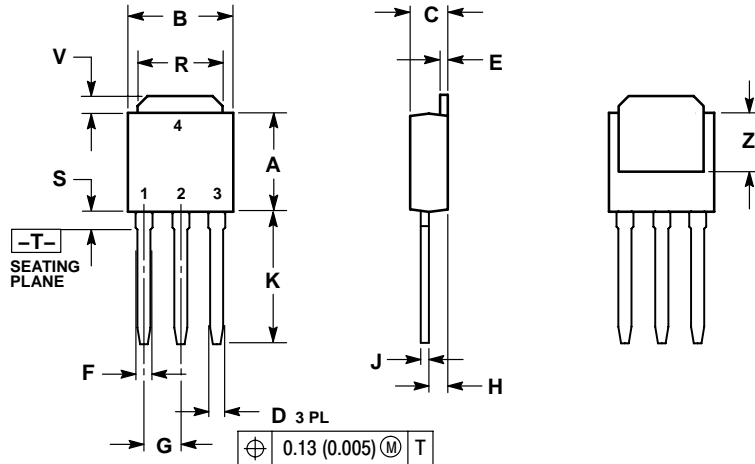
SCALE 3:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

# NTD95N02R

## 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
- DRAIN
- SOURCE
- DRAIN

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