

# NTD95N02R

## Power MOSFET

### 95 A, 24 V, 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

#### 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" 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).

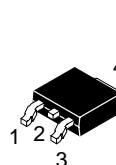
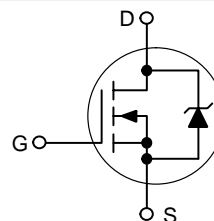


ON Semiconductor®

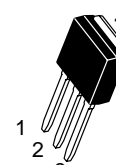
<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(ON)}$ 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  $25^\circ\text{C}$ .

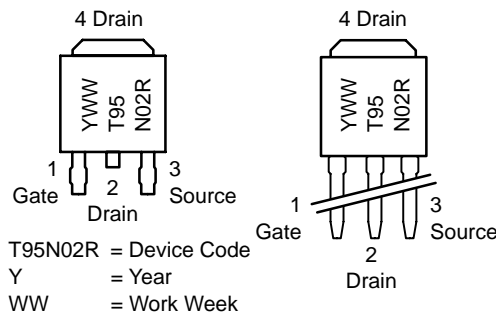


DPAK-3  
CASE 369C



DPAK-3  
CASE 369D

#### MARKING DIAGRAM & PIN ASSIGNMENTS



#### ORDERING INFORMATION

Device	Package	Shipping†
NTD95N02R	DPAK-3	75 Units/Rail
NTD95N02RT4	DPAK-3	2500 Tape & Reel
NTD95N02R-001	DPAK-3 Straight Lead	75 Units/Rail

†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

## 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
-----------	--------	----------------	-----	-----	-----	------

### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	24	29		V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			15		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$	$T_J = 25^\circ\text{C}$		1.5	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		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	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	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	$g_{FS}$	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$		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	$t_{d(on)}$	$V_{GS} = 10\text{ V}, V_{DD} = 10\text{ V}, I_D = 30\text{ A}, R_G = 3\text{ }\Omega$		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  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

TYPICAL CHARACTERISTICS

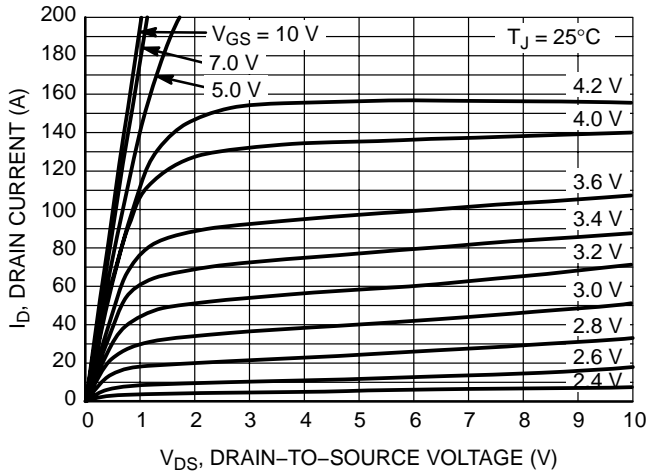


Figure 1. On-Region Characteristics

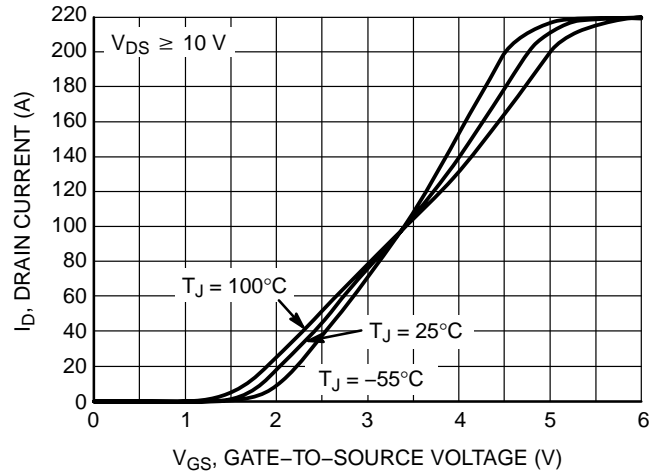


Figure 2. Transfer Characteristics

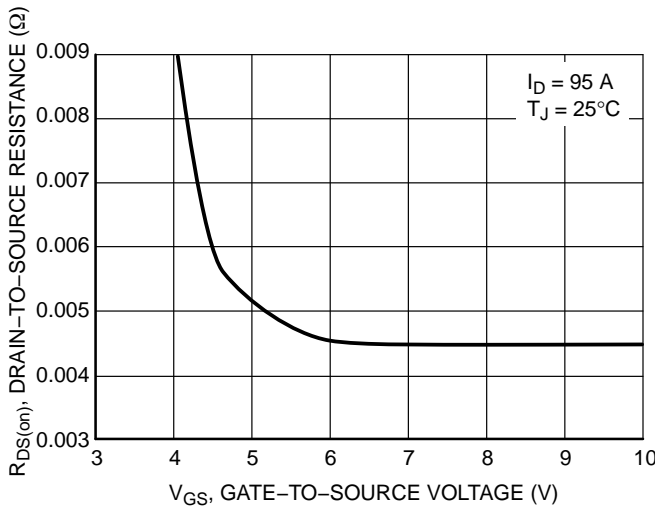


Figure 3. On-Resistance versus Gate-to-Source Voltage

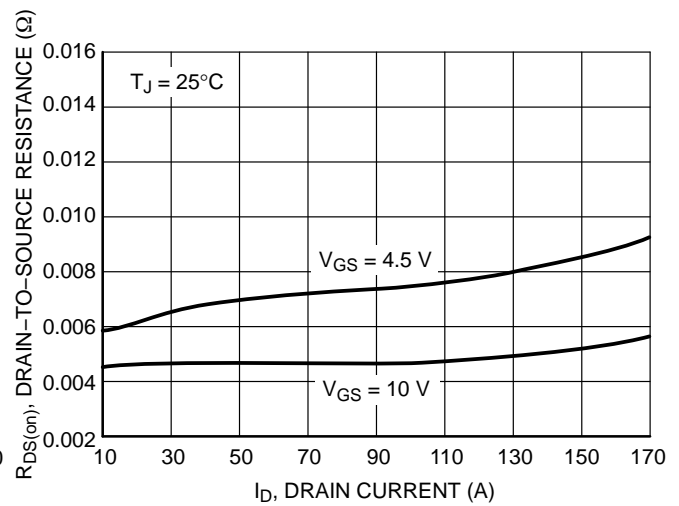


Figure 4. On-Resistance versus Drain Current and Gate Voltage

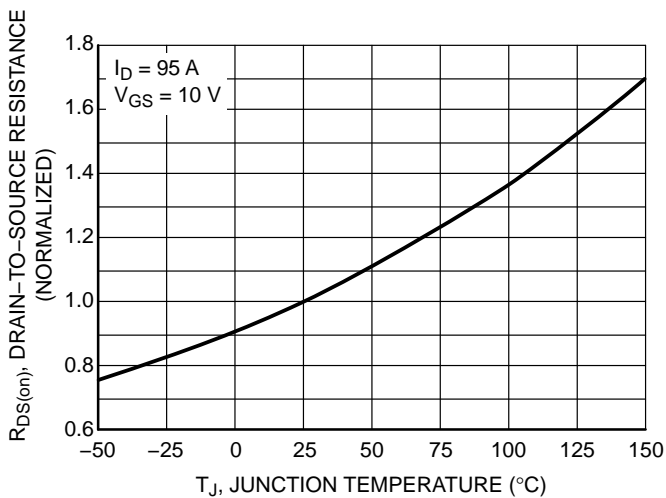


Figure 5. On-Resistance Variation with Temperature

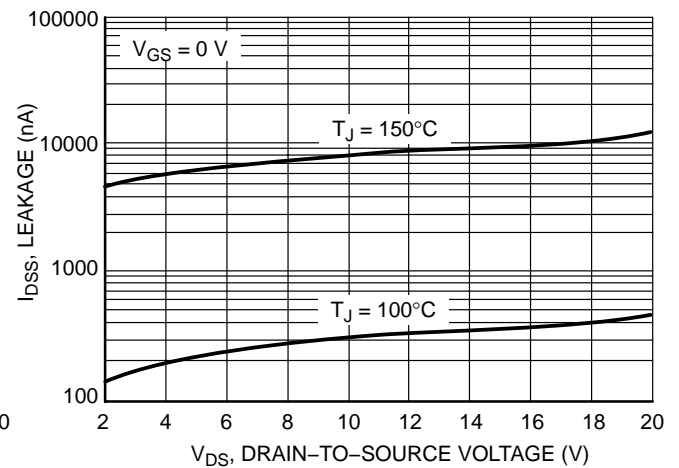


Figure 6. Drain-to-Source Leakage Current versus Voltage

TYPICAL CHARACTERISTICS

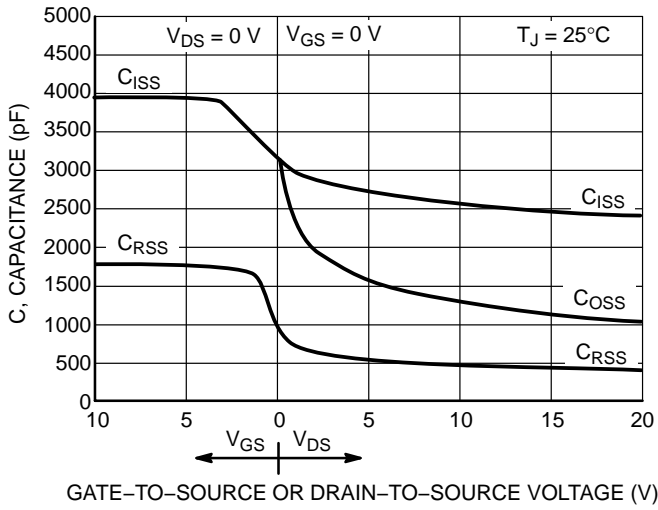


Figure 7. Capacitance Variation

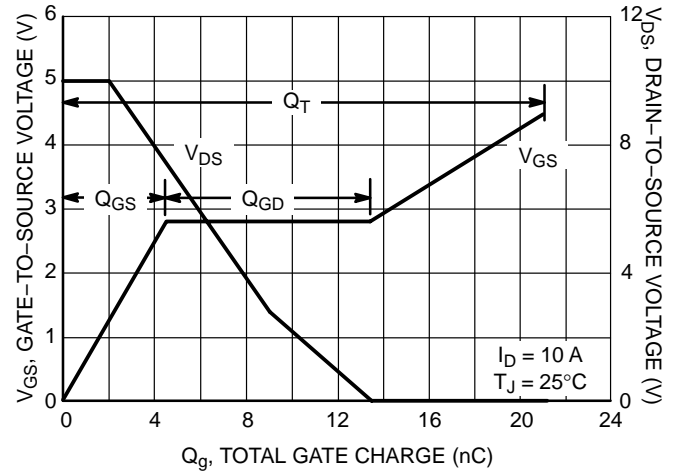


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

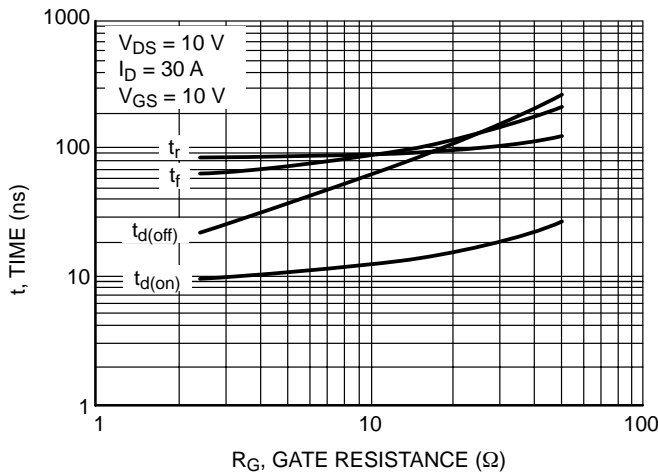


Figure 9. Resistive Switching Time Variation versus Gate Resistance

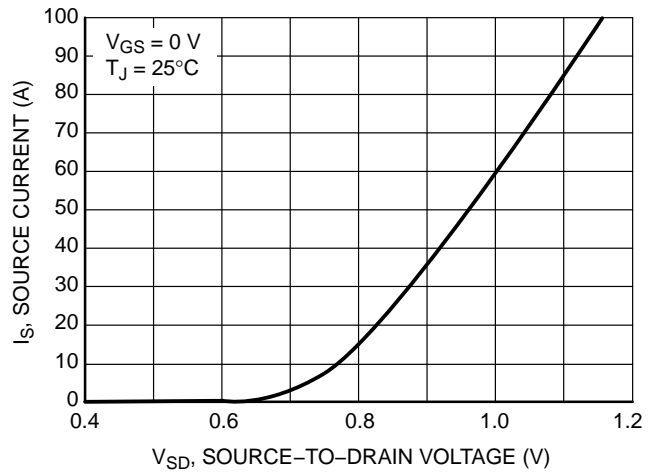
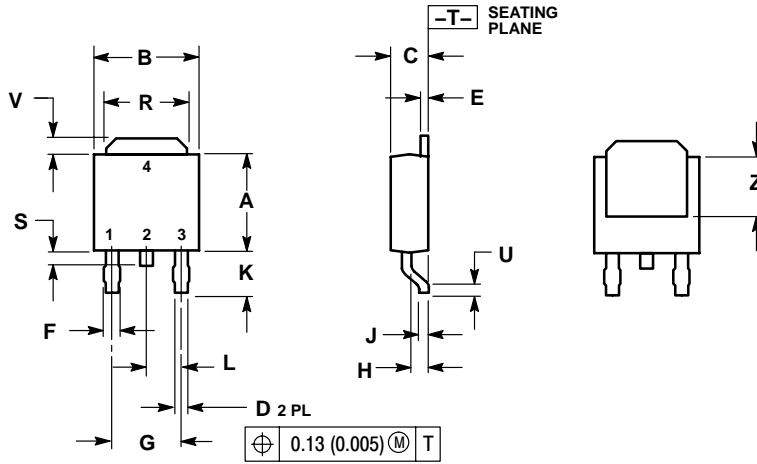


Figure 10. Diode Forward Voltage versus Current

# NTD95N02R

## PACKAGE DIMENSIONS

### DPAK-3 (SINGLE GAUGE) CASE 369C-01 ISSUE O

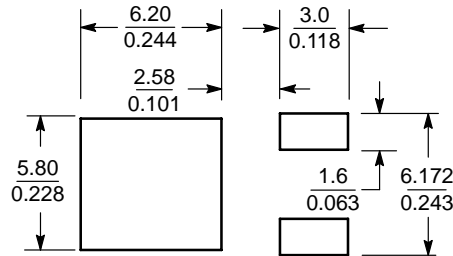


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

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 (mm/inches)

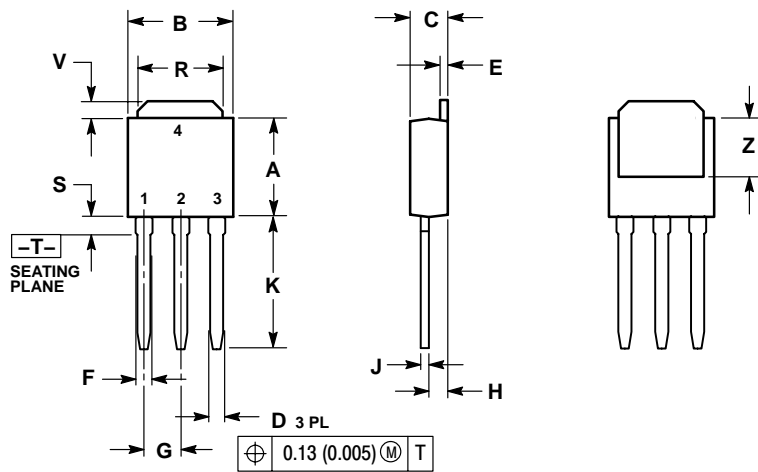
# NTD95N02R

## PACKAGE DIMENSIONS

### DPAK-3 (SINGLE GAUGE)

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

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

N. American Technical Support: 800-282-9855 Toll Free  
USA/Canada

Japan: ON Semiconductor, Japan Customer Focus Center  
2-9-1 Kamimeguro, Meguro-ku, Tokyo, Japan 153-0051  
Phone: 81-3-5773-3850

ON Semiconductor Website: <http://onsemi.com>

Order Literature: <http://www.onsemi.com/litorder>

For additional information, please contact your local Sales Representative.

NTD95N02R/D