

NTD95N02RG Datasheet

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| | |
|------------------------------|---|
| DiGi Electronics Part Number | NTD95N02RG-DG |
| Manufacturer | onsemi |
| Manufacturer Product Number | NTD95N02RG |
| Description | MOSFET N-CH 24V 12A/32A DPAK |
| Detailed Description | N-Channel 24 V 12A (Ta), 32A (Tc) 1.25W (Ta), 86W (Tc) Surface Mount DPAK |



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DiGi is a global authorized distributor of electronic components.

Purchase and inquiry

Manufacturer Product Number:

NTD95N02RG

Series:

-

FET Type:

N-Channel

Drain to Source Voltage (Vdss):

24 V

Drive Voltage (Max Rds On, Min Rds On):

4.5V, 10V

Vgs(th) (Max) @ Id:

2V @ 250μA

Vgs (Max):

±20V

FET Feature:

-

Operating Temperature:

-55°C ~ 150°C (Tj)

Supplier Device Package:

DPAK

Base Product Number:

NTD95

Manufacturer:

onsemi

Product Status:

Obsolete

Technology:

MOSFET (Metal Oxide)

Current - Continuous Drain (Id) @ 25°C:

12A (Ta), 32A (Tc)

Rds On (Max) @ Id, Vgs:

5mOhm @ 20A, 10V

Gate Charge (Qg) (Max) @ Vgs:

21 nC @ 4.5 V

Input Capacitance (Ciss) (Max) @ Vds:

2400 pF @ 20 V

Power Dissipation (Max):

1.25W (Ta), 86W (Tc)

Mounting Type:

Surface Mount

Package / Case:

TO-252-3, DPAK (2 Leads + Tab), SC-63

Environmental & Export classification

Moisture Sensitivity Level (MSL):

1 (Unlimited)

ECCN:

EAR99

REACH Status:

REACH Unaffected

HTSUS:

8541.29.0095

ON Semiconductor

Is Now

The logo for onsemi, featuring the word "onsemi" in a dark teal, lowercase, sans-serif font. The letter "i" is stylized with a white dot and a teal vertical bar. A small orange triangle is positioned above the top right of the "i". A trademark symbol (TM) is located to the right of the logo.

To learn more about onsemi™, please visit our website at
www.onsemi.com

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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_{DSS} | 24 | V |
| Gate-to-Source Voltage | V_{GS} | ± 20 | V |
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 1.45 | $^\circ\text{C}/\text{W}$ |
| 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 | $^\circ\text{C}/\text{W}$ |
| – 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 | $^\circ\text{C}/\text{W}$ |
| – 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 | $^\circ\text{C}$ |

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 (Cu area = 0.412 in sq).

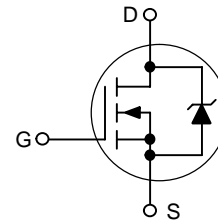


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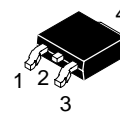
<http://onsemi.com>

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

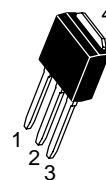
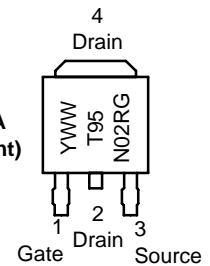
* I_D MAX in the product summary table is continuous and steady at 25°C .



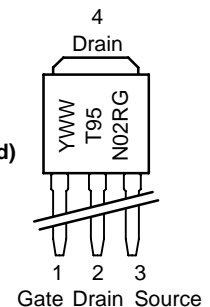
MARKING DIAGRAMS & PIN ASSIGNMENTS



**DPAK
CASE 369AA
(Surface Mount)
STYLE 2**



**DPAK
CASE 369D
(Straight Lead)
STYLE 2**



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 |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

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} | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$ | $T_J = 25^\circ\text{C}$ | | 1.5 | μA |
| | | | $T_J = 125^\circ\text{C}$ | | 10 | |
| Gate-to-Source Leakage | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$ | | | ± 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 Ω |
| | | $V_{GS} = 10\text{ V}, I_D = 20\text{ A}$ | | 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 | $t_{d(on)}$ | $V_{GS} = 10\text{ V}, V_{DD} = 10\text{ V}, I_D = 30\text{ A}, R_G = 3\ \Omega$ | | 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 $\leq 2\%$.

NTD95N02R

TYPICAL CHARACTERISTICS

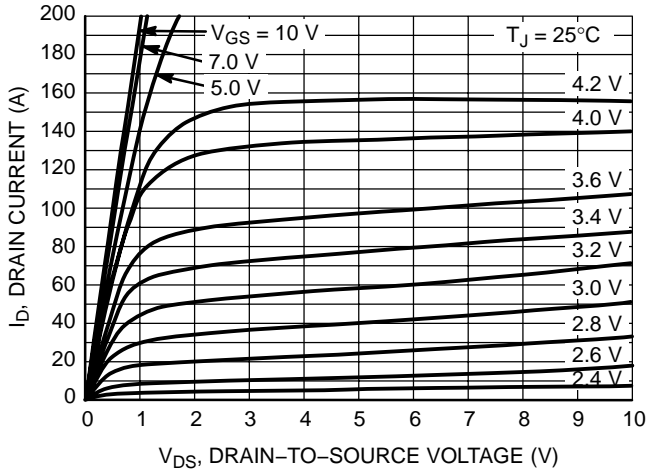


Figure 1. On-Region Characteristics

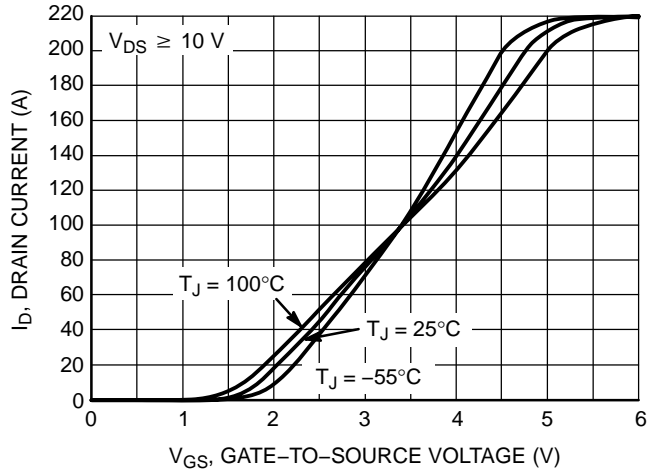


Figure 2. Transfer Characteristics

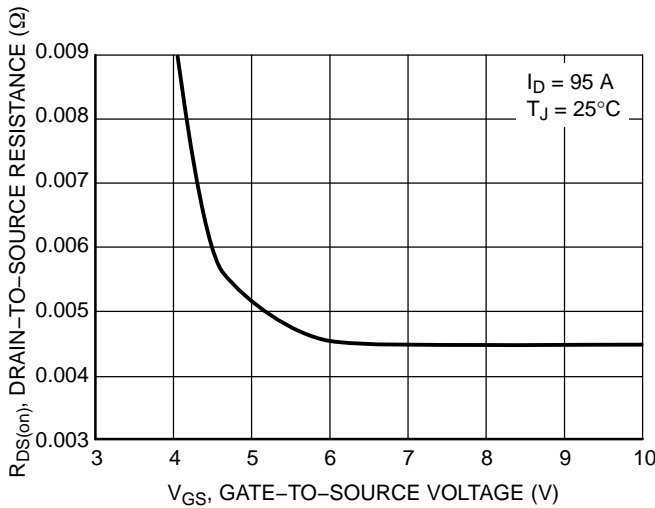


Figure 3. On-Resistance versus Gate-to-Source Voltage

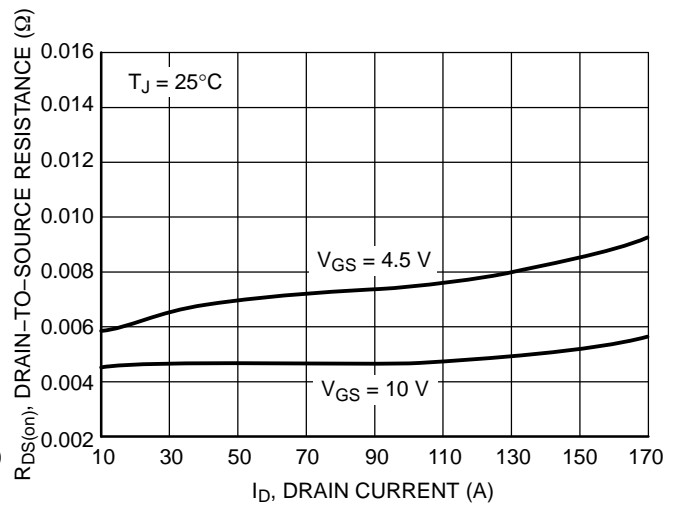


Figure 4. On-Resistance versus Drain Current and Gate Voltage

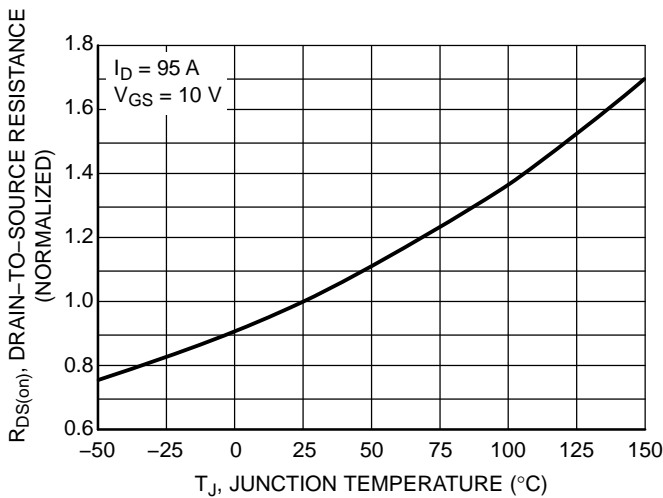


Figure 5. On-Resistance Variation with Temperature

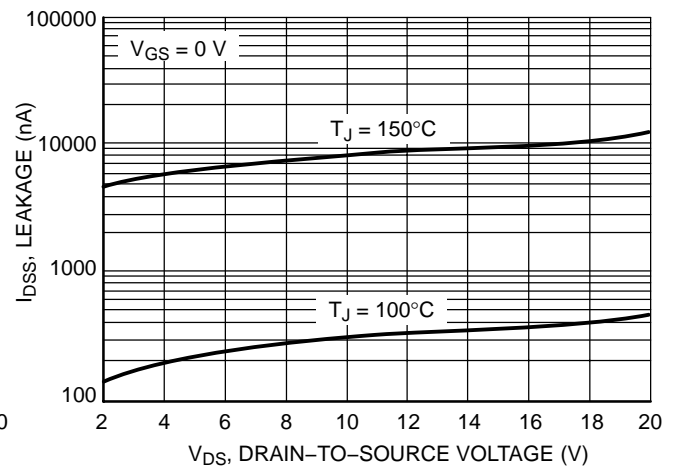


Figure 6. Drain-to-Source Leakage Current versus Voltage

NTD95N02R

TYPICAL CHARACTERISTICS

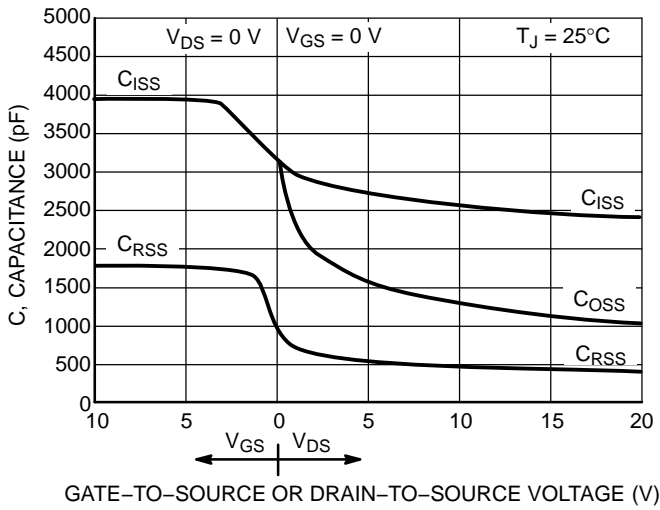


Figure 7. Capacitance Variation

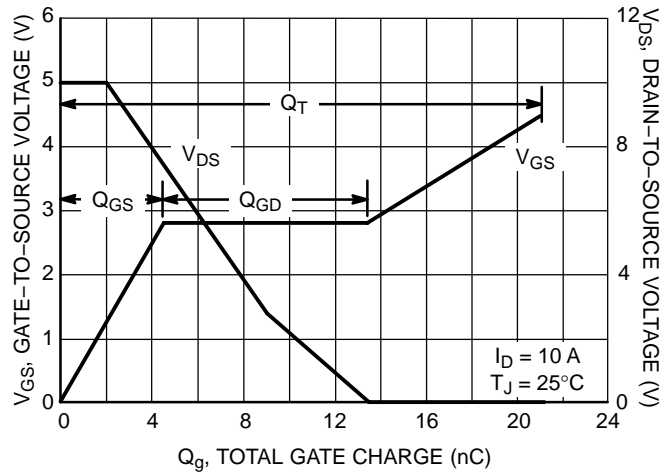


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

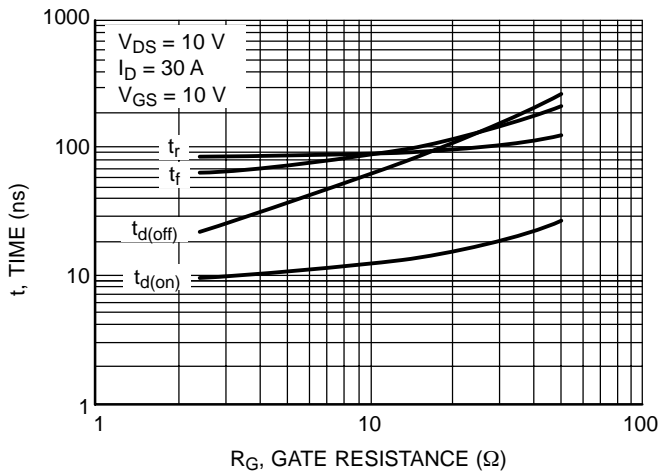


Figure 9. Resistive Switching Time Variation versus Gate Resistance

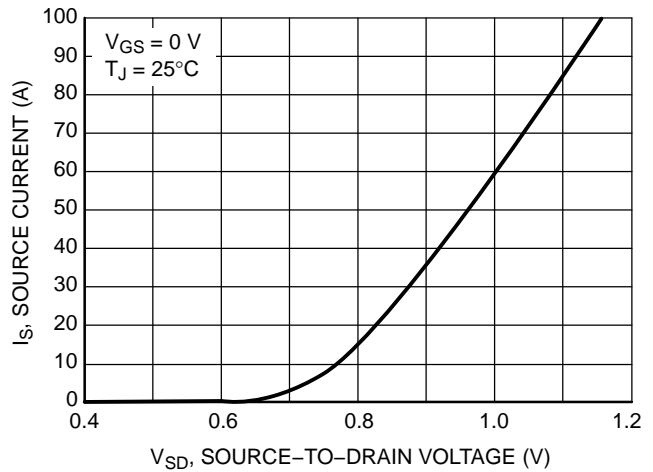


Figure 10. Diode Forward Voltage versus Current

ORDERING INFORMATION

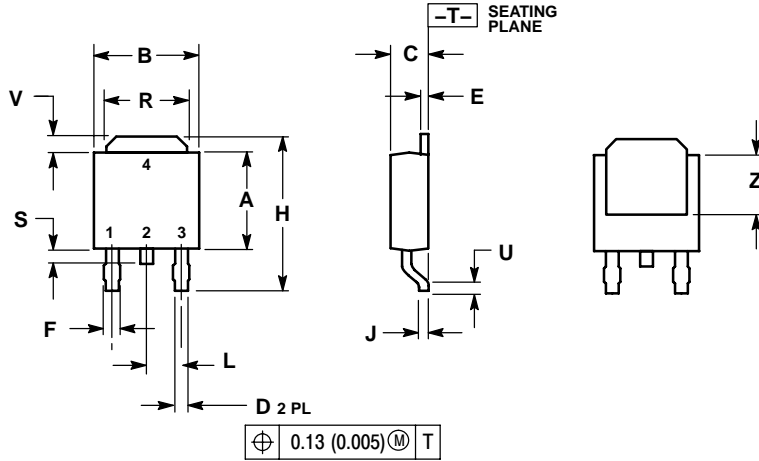
| Device | Package | Shipping† |
|----------------|----------------|--------------------------|
| NTD95N02R | DPAK | 75 Units / Rail |
| NTD95N02RG | DPAK (Pb-Free) | 75 Units / Rail |
| NTD95N02R-001 | DPAK | 75 Units / Rail |
| NTD95N02R-001G | DPAK (Pb-Free) | 75 Units / Rail |
| NTD95N02RT4 | DPAK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

†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 (SINGLE GAUGE)
CASE 369AA-01
ISSUE A

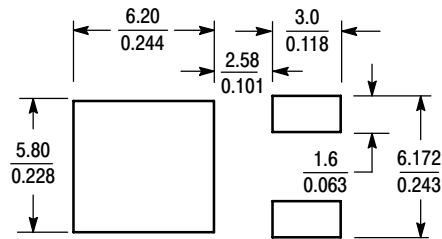


- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

| 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*



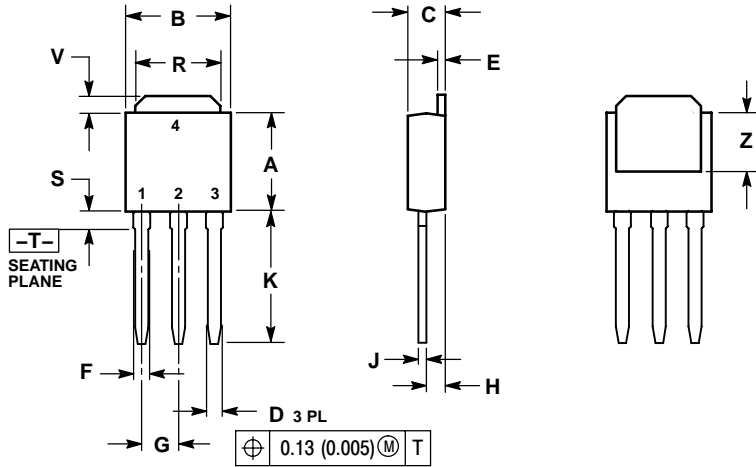
SCALE 3:1 $\left(\frac{\text{mm}}{\text{inches}} \right)$

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

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
2. DRAIN
3. SOURCE
4. DRAIN

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