

NTB65N02R, NTP65N02R

Power MOSFET 65 A, 24 V N-Channel TO-220, D²PAK

Features

- Planar HD3e Process for Fast Switching Performance
- Low $R_{DS(on)}$ to Minimize Conduction Loss
- Low C_{iss} to Minimize Driver Loss
- Low Gate Charge
- Pb-Free Packages are Available*

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

| Parameter | Symbol | Value | Unit |
|---|---------------------|------------|--------------------|
| Drain-to-Source Voltage | V_{DS} | 25 | V_{dc} |
| Gate-to-Source Voltage – Continuous | V_{GS} | ± 20 | V_{dc} |
| Thermal Resistance – Junction-to-Case | $R_{\theta JC}$ | 2.0 | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ | P_D | 62.5 | W |
| Drain Current – | | | |
| Continuous @ $T_C = 25^\circ\text{C}$, Chip | I_D | 65 | A |
| Continuous @ $T_C = 25^\circ\text{C}$, Limited by Package | I_D | 58 | A |
| Single Pulse ($t_p = 10 \mu\text{s}$) | I_{DM} | 160 | A |
| Thermal Resistance – | | | |
| Junction-to-Ambient (Note 1) | $R_{\theta JA}$ | 67 | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ | P_D | 1.86 | W |
| Drain Current – Continuous @ $T_A = 25^\circ\text{C}$ | I_D | 10 | A |
| Thermal Resistance – | | | |
| Junction-to-Ambient (Note 2) | $R_{\theta JA}$ | 120 | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ | P_D | 1.04 | W |
| Drain Current – Continuous @ $T_A = 25^\circ\text{C}$ | I_D | 7.6 | A |
| Operating and Storage Temperature Range | T_J and T_{stg} | -55 to 150 | $^\circ\text{C}$ |
| Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ($V_{DD} = 50 V_{dc}$, $V_{GS} = 10 V_{dc}$, $I_L = 11 A_{pk}$, $L = 1 \text{ mH}$, $R_G = 25 \Omega$) | E_{AS} | 60 | mJ |
| Maximum 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. When surface mounted to an FR4 board using 1 in. pad size, (Cu Area 1.127 in²).
2. When surface mounted to an FR4 board using minimum recommended pad size, (Cu Area 0.412 in²).

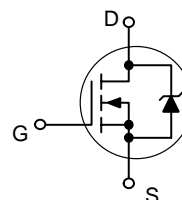
*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



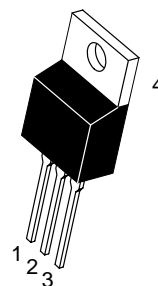
ON Semiconductor®

<http://onsemi.com>

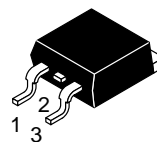
| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP | I_D MAX |
|---------------|-----------------------|-----------|
| 24 V | 8.4 m Ω @ 10 V | 65 A |



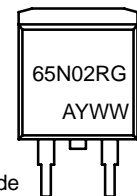
MARKING DIAGRAMS



TO-220AB
CASE 221A
STYLE 5



D²PAK
CASE 418AA
STYLE 2



65N02R = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

PIN ASSIGNMENT

| PIN | FUNCTION |
|-----|----------|
| 1 | Gate |
| 2 | Drain |
| 3 | Source |
| 4 | Drain |

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

NTB65N02R, NTP65N02R

ELECTRICAL CHARACTERISTICS (T_J = 25°C Unless otherwise specified)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|-----------------|--------|-----|-----|-----|------|
|-----------------|--------|-----|-----|-----|------|

OFF CHARACTERISTICS

| | | | | | |
|---|----------------------|---------|--------------|-----------|--------------------------|
| Drain-to-Source Breakdown Voltage (Note 3) (V _{GS} = 0 V _{dc} , I _D = 250 μA _{dc}) Temperature Coefficient (Positive) | V _{(BR)DSS} | 24 – | 27.5 25.5 | – – | V _{dc} mV/°C |
| Zero Gate Voltage Drain Current (V _{DS} = 20 V _{dc} , V _{GS} = 0 V _{dc}) (V _{DS} = 20 V _{dc} , V _{GS} = 0 V _{dc} , T _J = 150°C) | I _{DSS} | – – | – – | 1.5 10 | μA _{dc} |
| Gate-Body Leakage Current (V _{GS} = ±20 V _{dc} , V _{DS} = 0 V _{dc}) | I _{GSS} | – | – | ±100 | nA _{dc} |

ON CHARACTERISTICS (Note 3)

| | | | | | |
|---|---------------------|-------------|--------------------|-------------------|--------------------------|
| Gate Threshold Voltage (Note 3) (V _{DS} = V _{GS} , I _D = 250 μA _{dc}) Threshold Temperature Coefficient (Negative) | V _{GS(th)} | 1.0 – | 1.5 4.1 | 2.0 – | V _{dc} mV/°C |
| Static Drain-to-Source On-Resistance (Note 3) (V _{GS} = 4.5 V _{dc} , I _D = 15 A _{dc}) (V _{GS} = 10 V _{dc} , I _D = 20 A _{dc}) (V _{GS} = 10 V _{dc} , I _D = 30 A _{dc}) | R _{DS(on)} | – – – | 11.2 8.4 8.2 | 12.5 10.5 – | mΩ |
| Forward Transconductance (Note 3) (V _{DS} = 10 V _{dc} , I _D = 15 A _{dc}) | g _{FS} | – | 27 | – | Mhos |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|----------------------|---|------------------|---|-----|------|----|
| Input Capacitance | (V _{DS} = 20 V _{dc} , V _{GS} = 0 V, f = 1 MHz) | C _{ISS} | – | 948 | 1330 | pF |
| Output Capacitance | | C _{OSS} | – | 456 | 640 | |
| Transfer Capacitance | | C _{rSS} | – | 160 | 225 | |

SWITCHING CHARACTERISTICS (Note 4)

| | | | | | | |
|---------------------|---|---------------------|---|-----|---|----|
| Turn-On Delay Time | (V _{GS} = 10 V _{dc} , V _{DD} = 10 V _{dc} , I _D = 30 A _{dc} , R _G = 3 Ω) | t _{d(on)} | – | 7.0 | – | ns |
| Rise Time | | t _r | – | 53 | – | |
| Turn-Off Delay Time | | t _{d(off)} | – | 14 | – | |
| Fall Time | | t _f | – | 10 | – | |
| Gate Charge | (V _{GS} = 4.5 V _{dc} , I _D = 30 A _{dc} , V _{DS} = 10 V _{dc}) (Note 3) | Q _T | – | 9.5 | – | nC |
| | | Q ₁ | – | 3.0 | – | |
| | | Q ₂ | – | 4.4 | – | |

SOURCE-DRAIN DIODE CHARACTERISTICS

| | | | | | | |
|--------------------------------|---|-----------------|-------------|----------------------|---------------|-----------------|
| Forward On-Voltage | (I _S = 20 A _{dc} , V _{GS} = 0 V _{dc}) (Note 3) (I _S = 30 A _{dc} , V _{GS} = 0 V _{dc}) (I _S = 15 A _{dc} , V _{GS} = 0 V _{dc} , T _J = 125°C) | V _{SD} | – – – | 0.88 1.10 0.80 | 1.2 – – | V _{dc} |
| Reverse Recovery Time | (I _S = 30 A _{dc} , V _{GS} = 0 V _{dc} , dI _S /dt = 100 A/μs) (Note 3) | t _{rr} | – | 29.1 | – | ns |
| | | t _a | – | 13.6 | – | |
| | | t _b | – | 15.5 | – | |
| Reverse Recovery Stored Charge | | Q _{RR} | – | 0.02 | – | μC |

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

4. Switching characteristics are independent of operating junction temperatures.

NTB65N02R, NTP65N02R

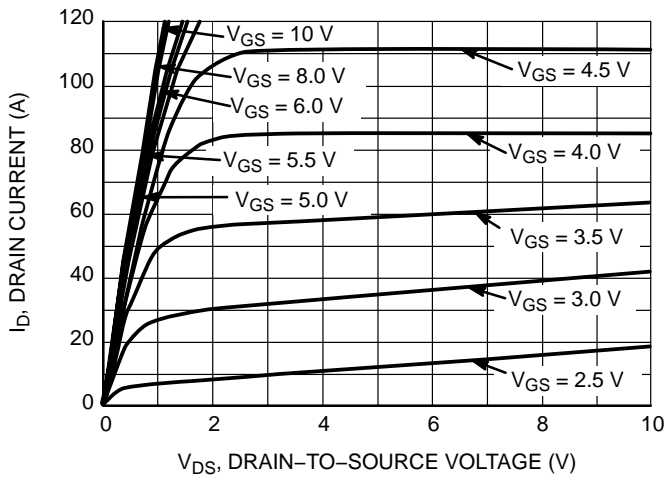


Figure 1. On-Region Characteristics

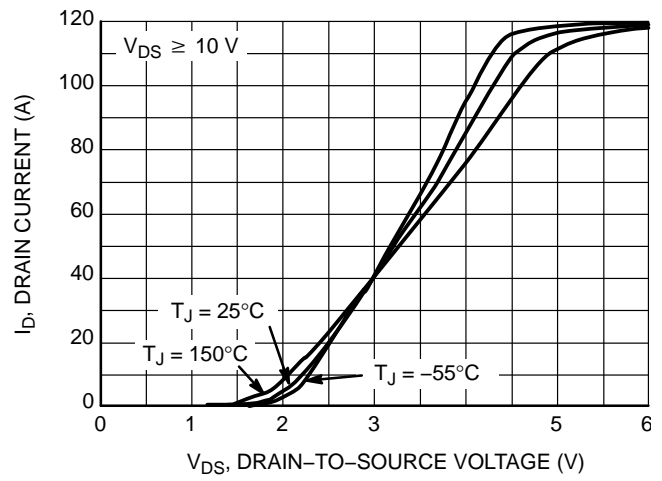


Figure 2. Transfer Characteristics

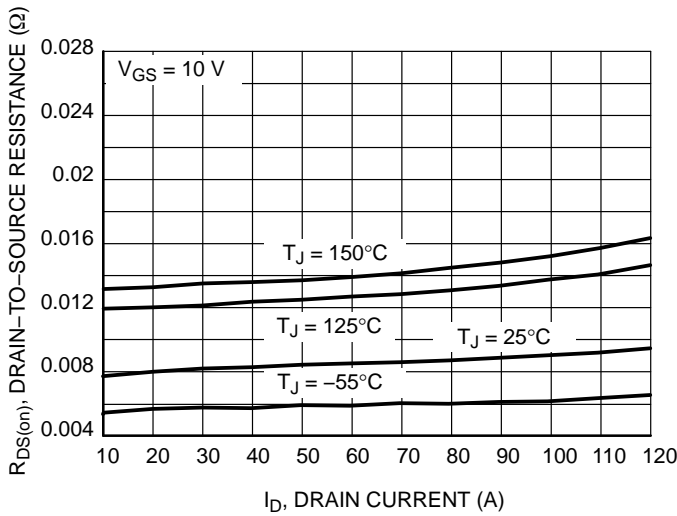


Figure 3. On-Resistance versus Drain Current and Temperature

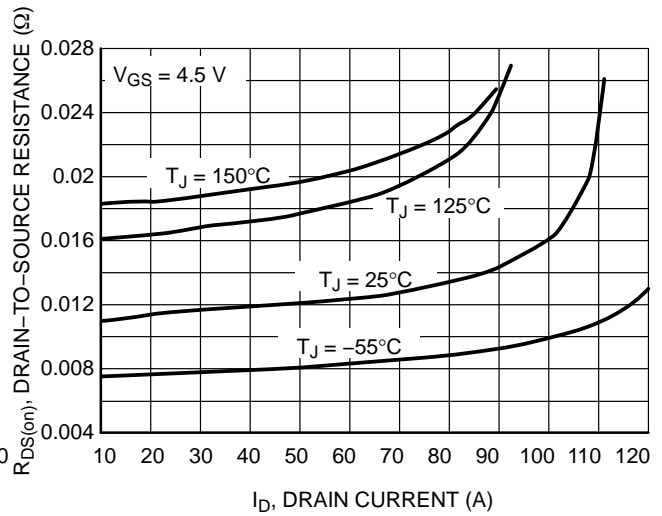


Figure 4. On-Resistance versus Drain Current and Temperature

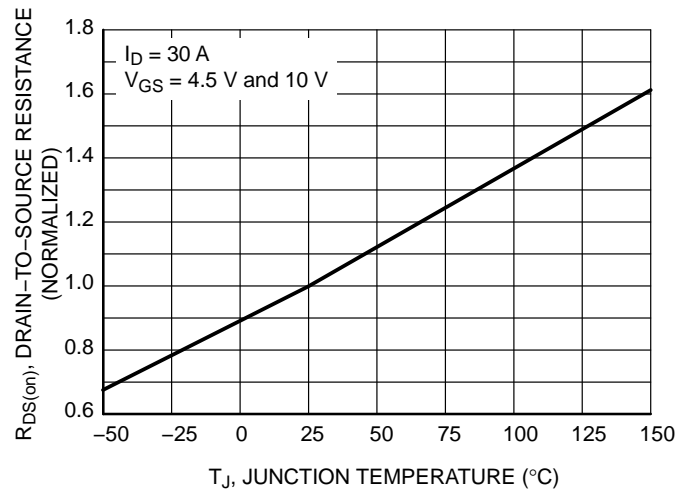


Figure 5. On-Resistance Variation with Temperature

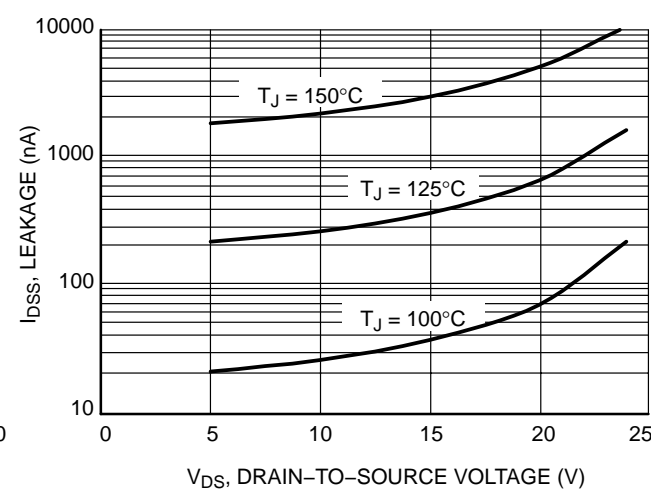
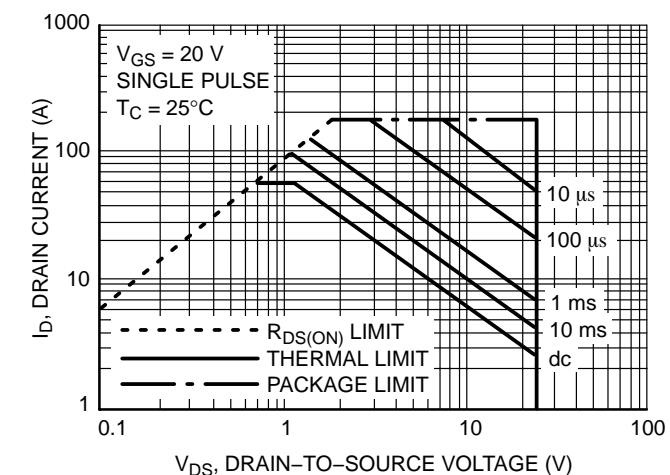
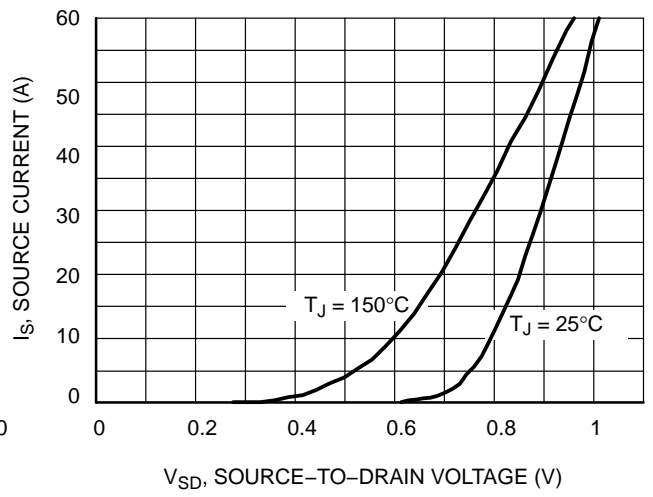
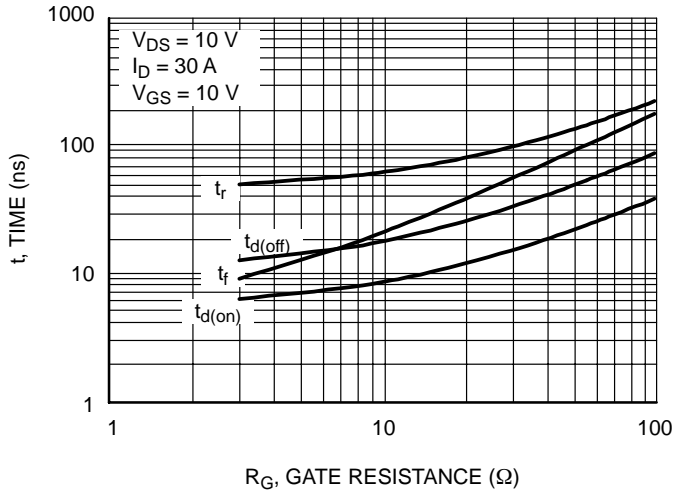
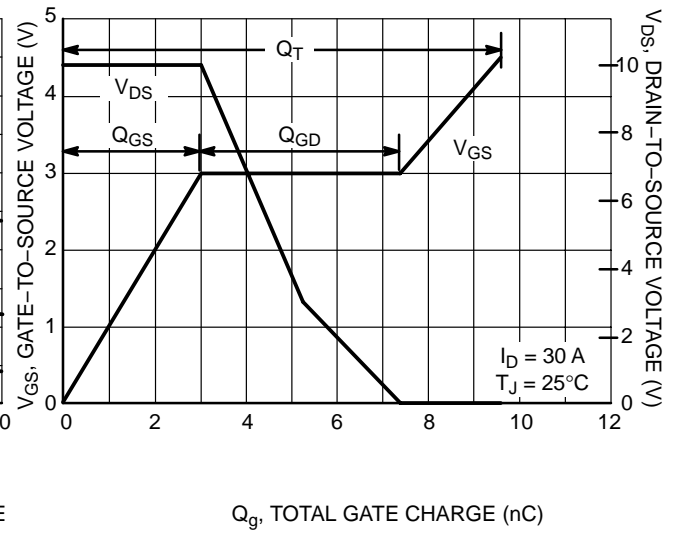
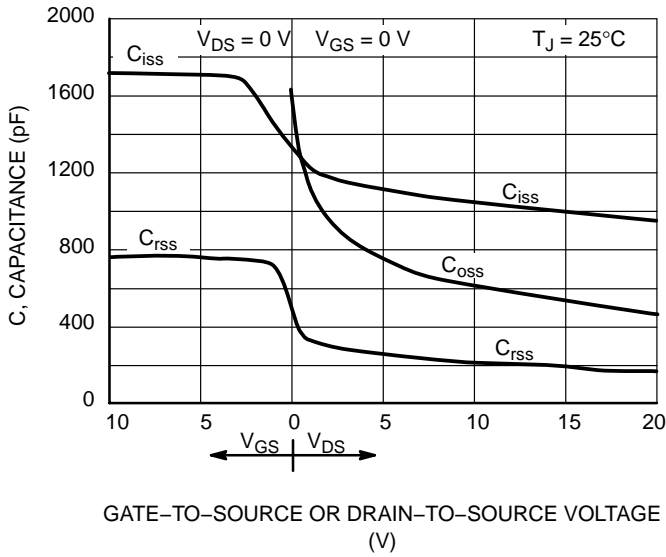


Figure 6. Drain-to-Source Leakage Current versus Voltage

NTB65N02R, NTP65N02R



NTB65N02R, NTP65N02R

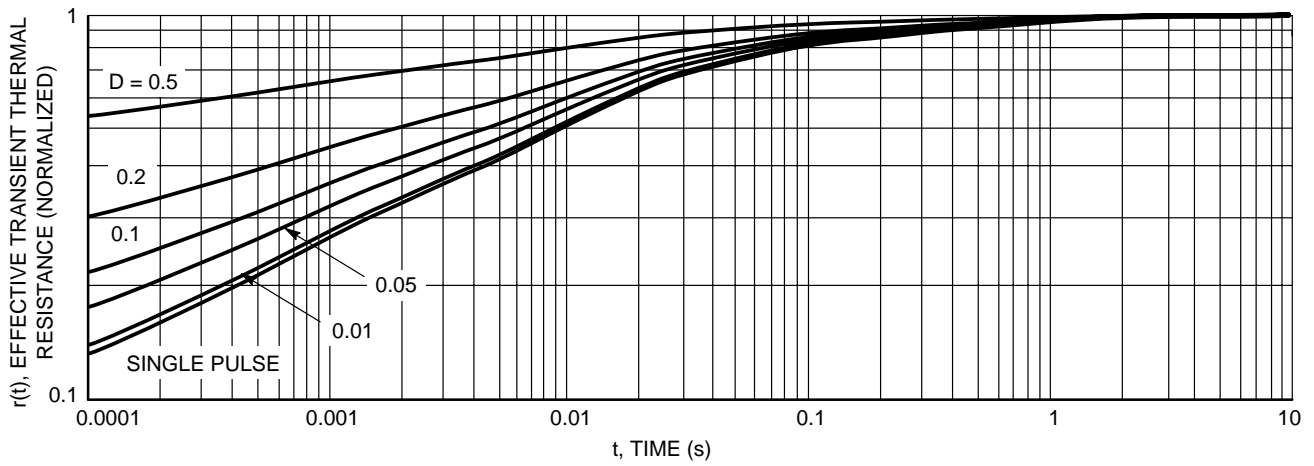


Figure 12. Thermal Response

ORDERING INFORMATION

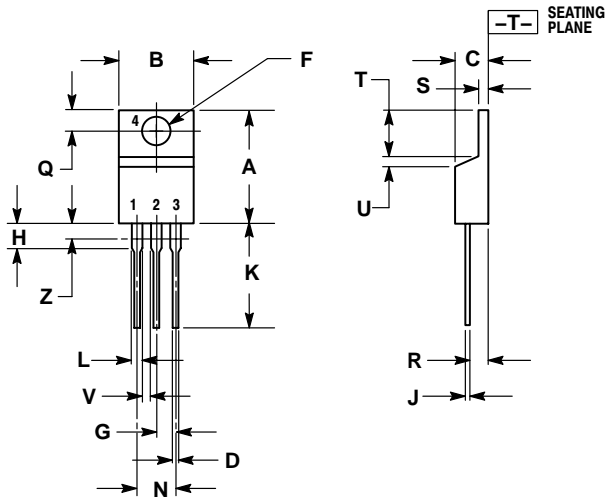
| Device | Package | Shipping† |
|--------------|---------------------------------|-------------------|
| NTB65N02R | D ² PAK | 50 Units / Rail |
| NTB65N02RG | D ² PAK (Pb-Free) | 50 Units / Rail |
| NTB65N02RT4 | D ² PAK | 800 / Tape & Reel |
| NTB65N02RT4G | D ² PAK (Pb-Free) | 800 / Tape & Reel |
| NTP65N02R | TO-220AB | 50 Units / Rail |
| NTP65N02RG | TO-220AB (Pb-Free) | 50 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.

NTB65N02R, NTP65N02R

PACKAGE DIMENSIONS

TO-220AB
CASE 221A-09
ISSUE AA



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

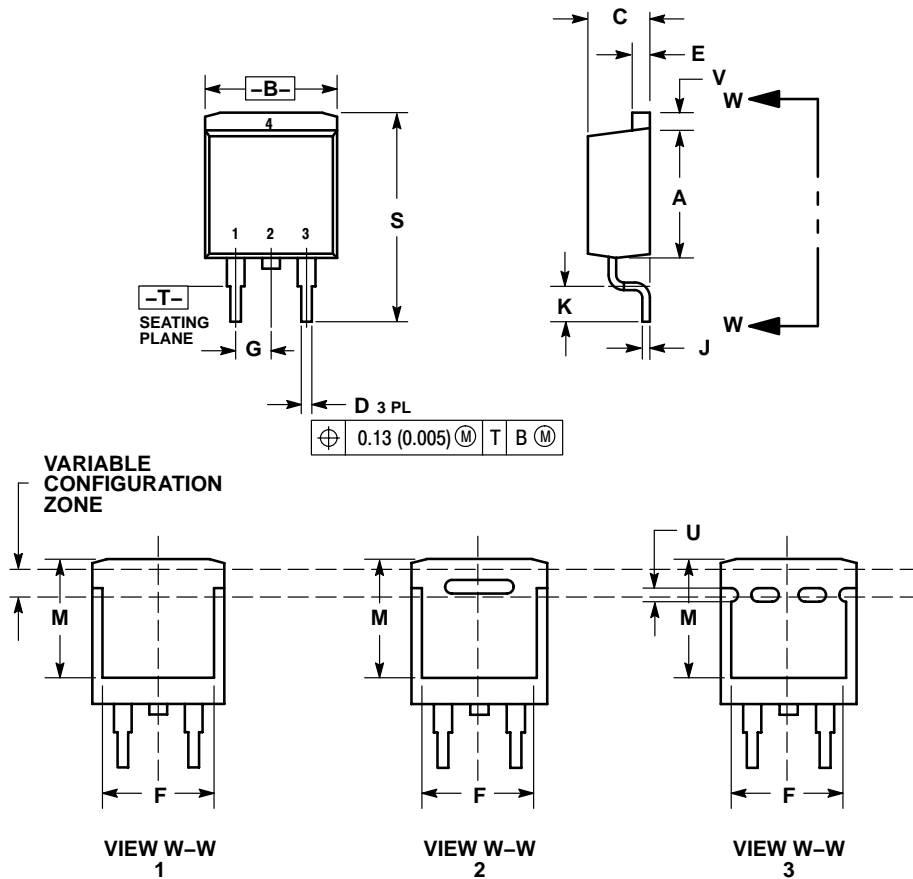
| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.570 | 0.620 | 14.48 | 15.75 |
| B | 0.380 | 0.405 | 9.66 | 10.28 |
| C | 0.160 | 0.190 | 4.07 | 4.82 |
| D | 0.025 | 0.035 | 0.64 | 0.88 |
| F | 0.142 | 0.147 | 3.61 | 3.73 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.155 | 2.80 | 3.93 |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.500 | 0.562 | 12.70 | 14.27 |
| L | 0.045 | 0.060 | 1.15 | 1.52 |
| N | 0.190 | 0.210 | 4.83 | 5.33 |
| Q | 0.100 | 0.120 | 2.54 | 3.04 |
| R | 0.080 | 0.110 | 2.04 | 2.79 |
| S | 0.045 | 0.055 | 1.15 | 1.39 |
| T | 0.235 | 0.255 | 5.97 | 6.47 |
| U | 0.000 | 0.050 | 0.00 | 1.27 |
| V | 0.045 | --- | 1.15 | --- |
| Z | --- | 0.080 | --- | 2.04 |

- STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

NTB65N02R, NTP65N02R

PACKAGE DIMENSIONS

D²PAK
CASE 418AA-01
ISSUE O

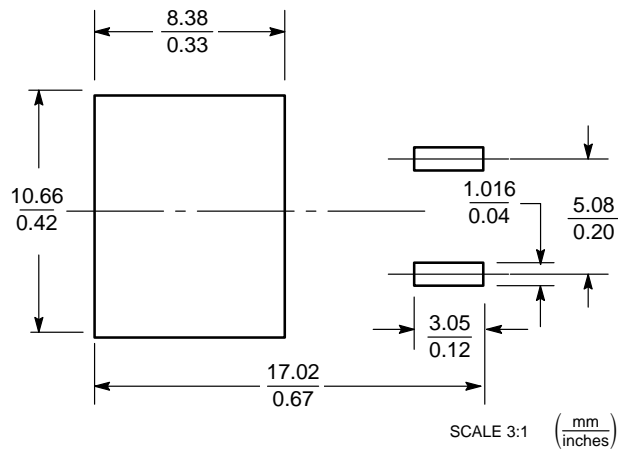


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.340 | 0.380 | 8.64 | 9.65 |
| B | 0.380 | 0.405 | 9.65 | 10.29 |
| C | 0.160 | 0.190 | 4.06 | 4.83 |
| D | 0.020 | 0.036 | 0.51 | 0.92 |
| E | 0.045 | 0.055 | 1.14 | 1.40 |
| F | 0.310 | --- | 7.87 | --- |
| G | 0.100 BSC | --- | 2.54 BSC | --- |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.090 | 0.110 | 2.29 | 2.79 |
| M | 0.280 | --- | 7.11 | --- |
| S | 0.575 | 0.625 | 14.60 | 15.88 |
| V | 0.045 | 0.055 | 1.14 | 1.40 |


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

SOLDERING FOOTPRINT*



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

NTB65N02R, NTP65N02R

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 61312, Phoenix, Arizona 85082-1312 USA
Phone: 480-829-7710 or 800-344-3860 Toll Free USA/Canada
Fax: 480-829-7709 or 800-344-3867 Toll Free USA/Canada
Email: 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.