

NTB5404N, NTP5404N

Power MOSFET

40 V, 136 A, Single N-Channel, D²PAK & TO-220

Features

- Low $R_{DS(on)}$
- High Current Capability
- Low Gate Charge
- This is a Pb-Free Device

Applications

- Electronic Brake Systems
- Electronic Power Steering
- Bridge Circuits

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

| Parameter | Symbol | Value | Units | | |
|--|----------------|---------------------------|----------|-----|------------------|
| Drain-to-Source Voltage | V_{DSS} | 40 | V | | |
| Gate-to-Source Voltage | V_{GS} | ± 20 | V | | |
| Continuous Drain Current - $R_{\theta JC}$ (Note 1) | Steady State | $T_C = 25^\circ\text{C}$ | 136 | A | |
| | | $T_C = 100^\circ\text{C}$ | 96 | | |
| Power Dissipation - $R_{\theta JC}$ (Note 1) | Steady State | $T_C = 25^\circ\text{C}$ | P_D | 167 | W |
| Pulsed Drain Current | | $t_p = 10 \mu\text{s}$ | I_{DM} | 258 | A |
| Operating Junction and Storage Temperature | T_J, T_{STG} | -55 to 175 | | | $^\circ\text{C}$ |
| Source Current (Body Diode) Pulsed | I_S | 75 | | | A |
| Single Pulse Drain-to-Source Avalanche Energy - ($V_{DD} = 50 \text{ V}, V_{GS} = 10 \text{ V}, I_{PK} = 45 \text{ A}, L = 1 \text{ mH}, R_G = 25 \Omega$) | EAS | 1000 | | | 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.

THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Max | Units |
|--------------------------|-----------------|-----|--------------------|
| Junction-to-Case (Drain) | $R_{\theta JC}$ | 0.9 | $^\circ\text{C/W}$ |

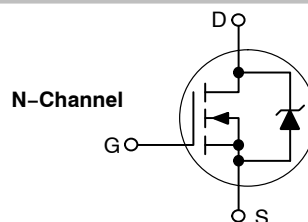
1. Surface mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).



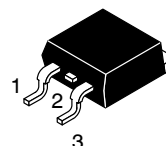
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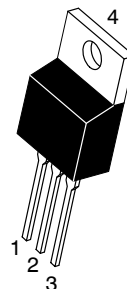
| $V_{(BR)DSS}$ | $R_{DS(ON)}$ TYP | I_D MAX (Note 1) |
|---------------|-----------------------|--------------------|
| 40 V | 3.5 m Ω @ 10 V | 136 A |



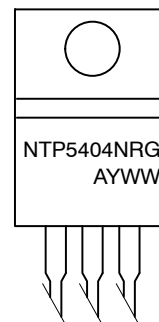
MARKING DIAGRAMS



D²PAK
CASE 418B
STYLE 2



TO-220AB
CASE 221A
STYLE 5



G = Pb-Free Device
A = Assembly Location
Y = Year
WW = Work Week

ORDERING INFORMATION

| Device | Package | Shipping† |
|-------------|------------------------------|-------------------|
| NTB5404NT4G | D ² PAK (Pb-Free) | 800 / Tape & Reel |
| NTP5404NRG | TO-220 (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.

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ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise stated)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|--------------------------------------|--|------------------------|-----|------|-------|
| OFF CHARACTERISTICS | | | | | | |
| Drain-to-Source Breakdown Voltage | V _{(BR)DSS} | V _{GS} = 0 V, I _D = 250 μA | 40 | | | V |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | V _{(BR)DSS} /T _J | | | 34 | | mV/°C |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{GS} = 0 V, V _{DS} = 40 V | T _J = 25°C | | 1.0 | μA |
| | | | T _J = 100°C | | 10 | |
| Gate-to-Source Leakage Current | I _{GSS} | V _{DS} = 0 V, V _{GS} = ±30 V | | | ±100 | nA |

ON CHARACTERISTICS (Note 2)

| | | | | | | |
|--|-------------------------------------|---|-----|------|-----|-------|
| Gate Threshold Voltage | V _{GS(TH)} | V _{GS} = V _{DS} , I _D = 250 μA | 1.5 | | 3.5 | V |
| Gate Threshold Temperature Coefficient | V _{GS(TH)} /T _J | | | -8.2 | | mV/°C |
| Drain-to-Source On Resistance | R _{DS(on)} | V _{GS} = 10 V, I _D = 40 A | | 3.5 | 4.5 | mΩ |
| | | V _{GS} = 5.0 V, I _D = 15 A | | 5.1 | 7.0 | |
| Forward Transconductance | g _{FS} | V _{DS} = 10 V, I _D = 15 A | | 35 | | S |

CHARGES AND CAPACITANCES

| | | | | | | |
|------------------------------|---------------------|---|--|------|------|----|
| Input Capacitance | C _{ISS} | V _{GS} = 0 V, f = 1.0 MHz, V _{DS} = 32 V | | 4300 | 7000 | pF |
| Output Capacitance | C _{OSS} | | | 1075 | 1700 | |
| Reverse Transfer Capacitance | C _{RSS} | | | 450 | 1000 | |
| Total Gate Charge | Q _{G(TOT)} | V _{GS} = 10 V, V _{DS} = 32 V, I _D = 40 A | | 125 | | nC |
| Threshold Gate Charge | Q _{G(TH)} | | | 5.5 | | |
| Gate-to-Source Charge | Q _{GS} | | | 12.5 | | |
| Gate-to-Drain Charge | Q _{GD} | | | 55 | | |

SWITCHING CHARACTERISTICS, V_{GS} = 10 V (Note 3)

| | | | | | | |
|---------------------|---------------------|---|--|----|--|----|
| Turn-On Delay Time | t _{d(ON)} | V _{GS} = 10 V, V _{DD} = 32 V, I _D = 40 A, R _G = 2.5 Ω | | 10 | | ns |
| Rise Time | t _r | | | 65 | | |
| Turn-Off Delay Time | t _{d(OFF)} | | | 85 | | |
| Fall Time | t _f | | | 85 | | |

SWITCHING CHARACTERISTICS, V_{GS} = 5 V (Note 3)

| | | | | | | |
|---------------------|---------------------|--|--|-----|--|----|
| Turn-On Delay Time | t _{d(ON)} | V _{GS} = 5 V, V _{DD} = 20 V, I _D = 20 A, R _G = 2.5 Ω | | 25 | | ns |
| Rise Time | t _r | | | 175 | | |
| Turn-Off Delay Time | t _{d(OFF)} | | | 46 | | |
| Fall Time | t _f | | | 62 | | |

DRAIN-SOURCE DIODE CHARACTERISTICS

| | | | | | | | |
|-------------------------|-----------------|---|------------------------|--|------|-----|----|
| Forward Diode Voltage | V _{SD} | V _{GS} = 0 V, I _S = 20 A | T _J = 25°C | | 0.8 | 1.1 | V |
| | | | T _J = 125°C | | 0.65 | | |
| Reverse Recovery Time | t _{RR} | V _{GS} = 0 V, dI _{SD} /dt = 100 A/μs, I _S = 20 A | | | 75 | | ns |
| Charge Time | t _a | | | | 38 | | |
| Discharge Time | t _b | | | | 38 | | |
| Reverse Recovery Charge | Q _{RR} | | | | 140 | | |

2. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
3. Switching characteristics are independent of operating junction temperatures.

NTB5404N, NTP5404N

TYPICAL PERFORMANCE CURVES

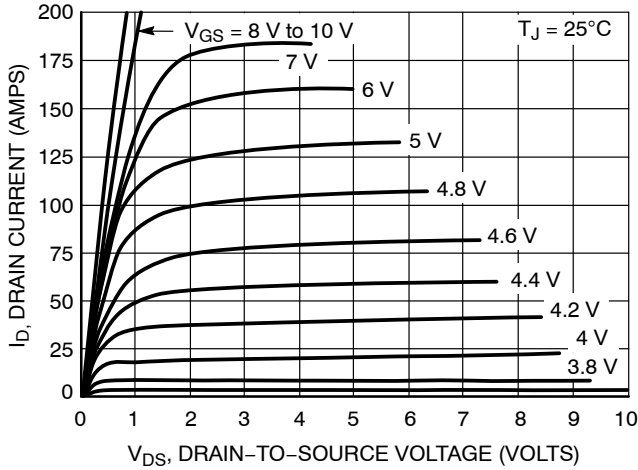


Figure 1. On-Region Characteristics

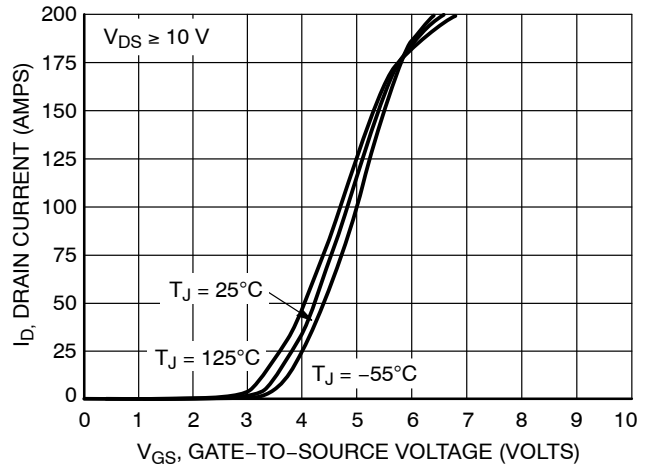


Figure 2. Transfer Characteristics

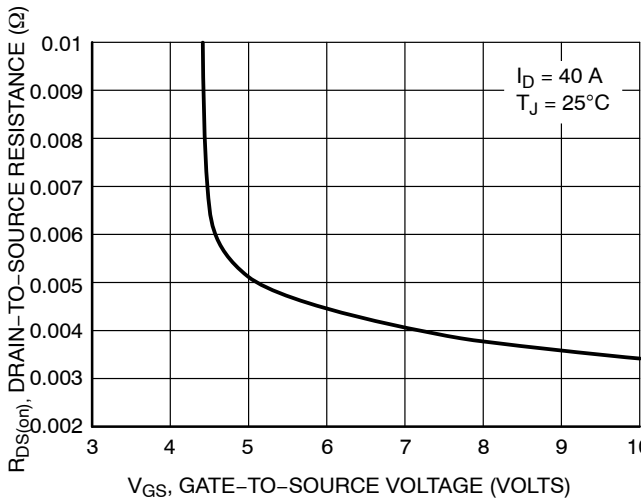


Figure 3. On-Resistance vs. Gate-to-Source Voltage

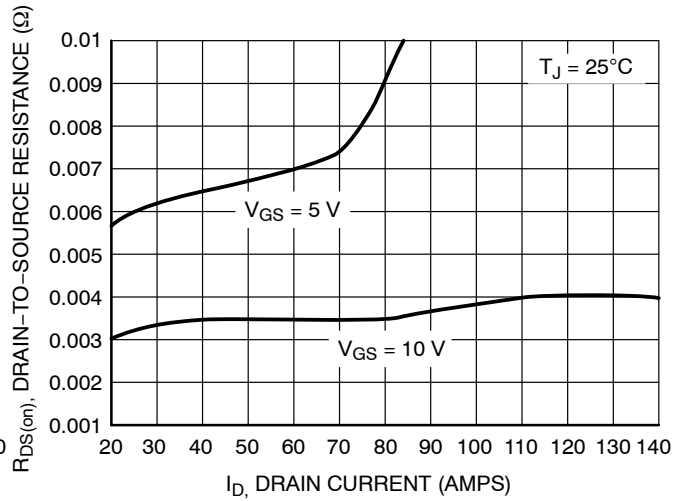


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

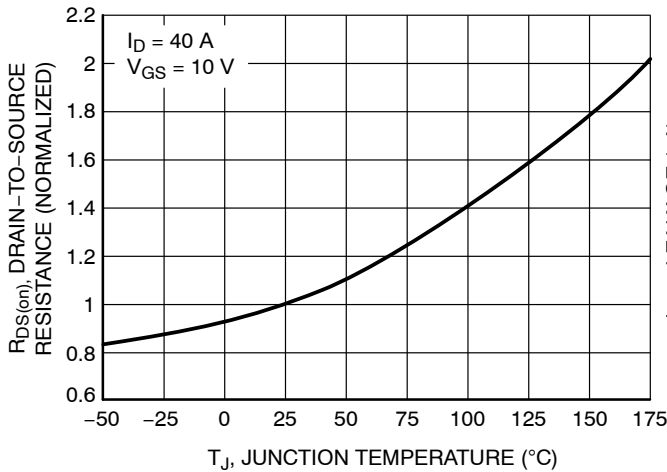


Figure 5. On-Resistance Variation with Temperature

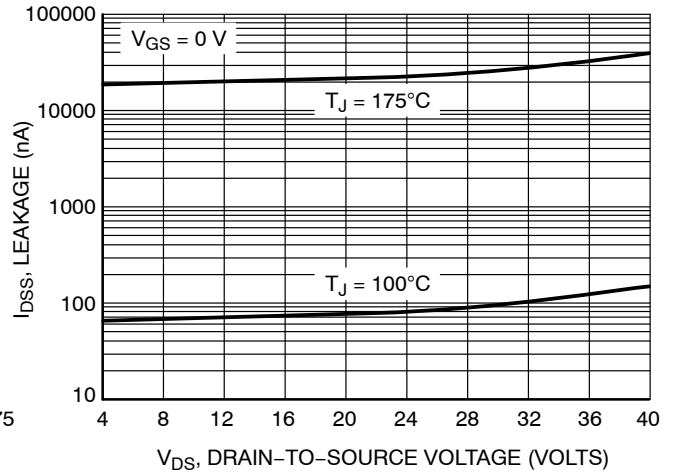


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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TYPICAL PERFORMANCE CURVES

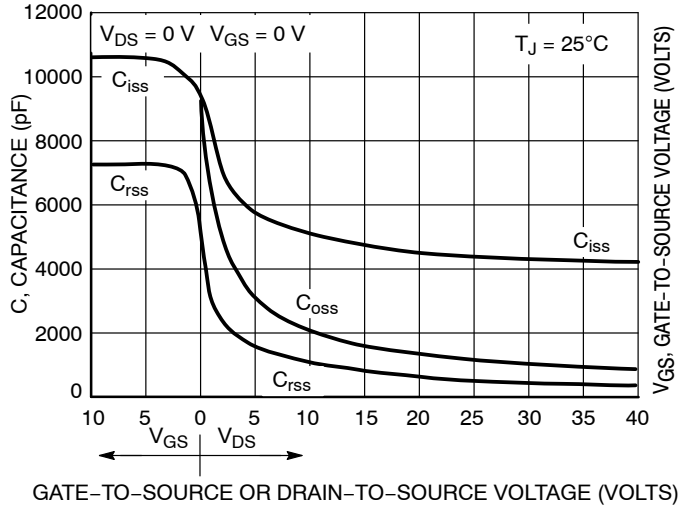


Figure 7. Capacitance Variation

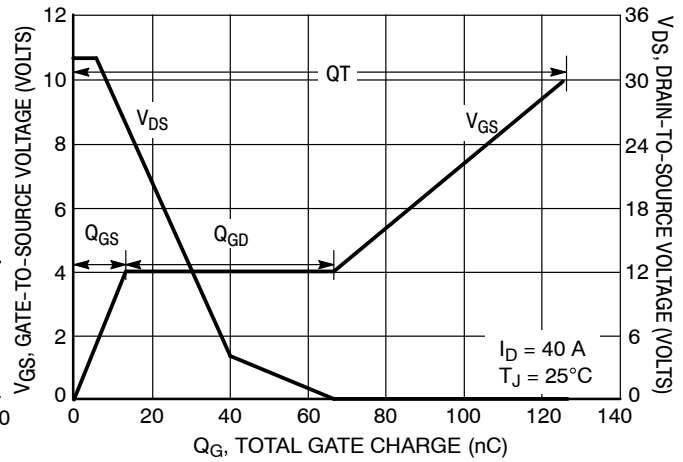


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

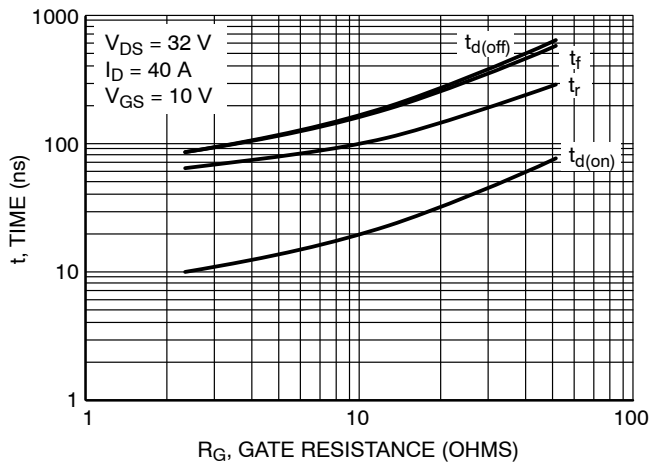


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

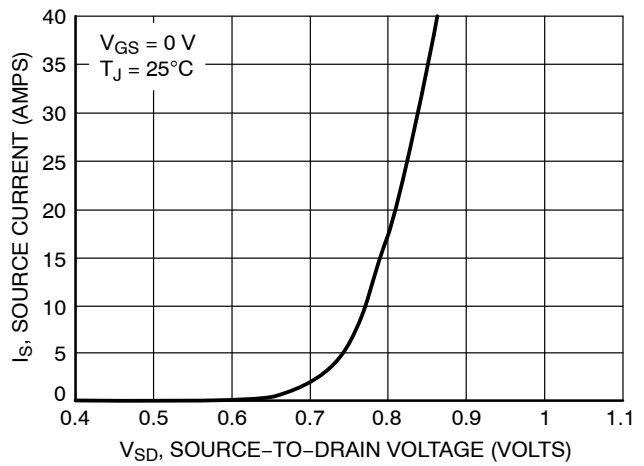


Figure 10. Diode Forward Voltage vs. Current

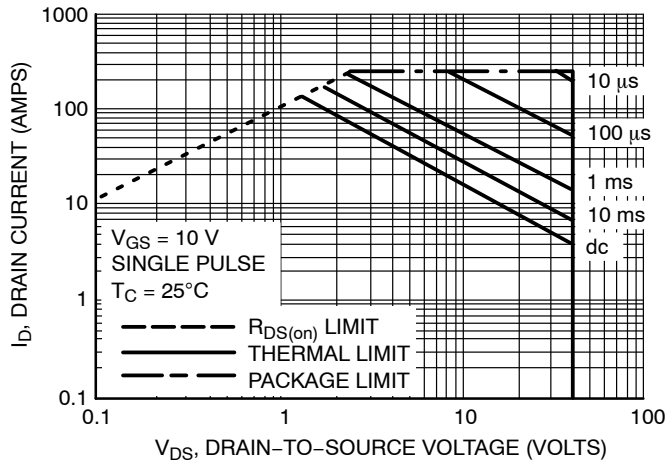


Figure 11. Maximum Rated Forward Biased Safe Operating Area

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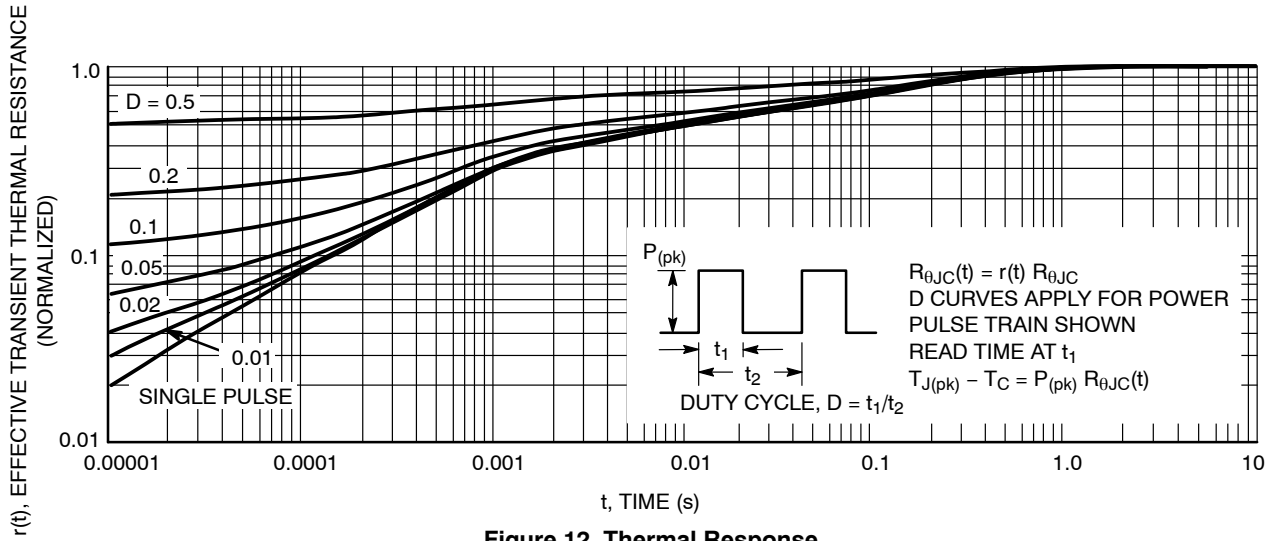
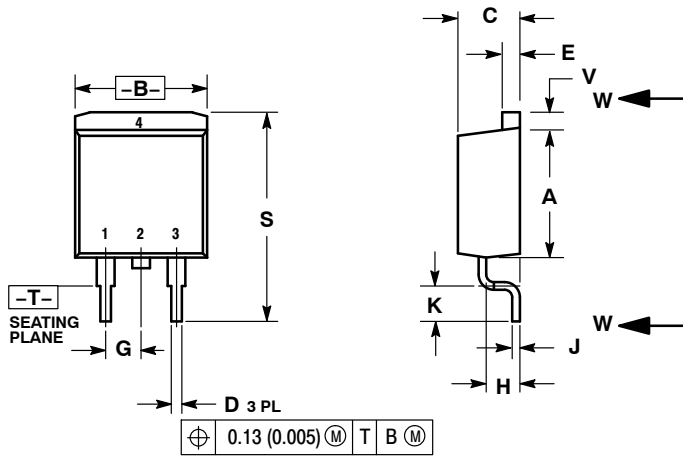


Figure 12. Thermal Response

NTB5404N, NTP5404N

PACKAGE DIMENSIONS

D²PAK
CASE 418B-04
ISSUE K



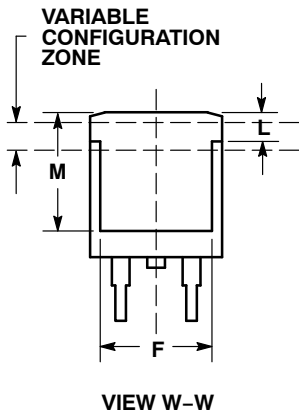
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

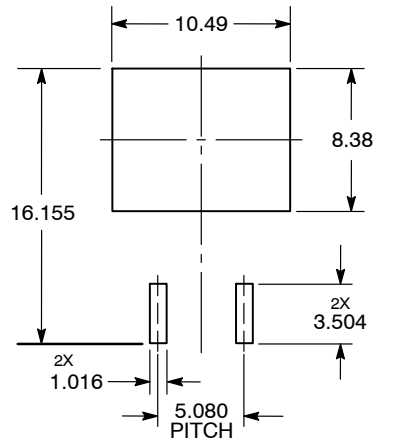
| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.340 | 0.380 | 8.64 | 9.65 |
| B | 0.380 | 0.405 | 9.65 | 10.29 |
| C | 0.160 | 0.190 | 4.06 | 4.83 |
| D | 0.020 | 0.035 | 0.51 | 0.89 |
| E | 0.045 | 0.055 | 1.14 | 1.40 |
| F | 0.310 | 0.350 | 7.87 | 8.89 |
| G | 0.100 | BSC | 2.54 | BSC |
| H | 0.080 | 0.110 | 2.03 | 2.79 |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.090 | 0.110 | 2.29 | 2.79 |
| L | 0.052 | 0.072 | 1.32 | 1.83 |
| M | 0.280 | 0.320 | 7.11 | 8.13 |
| N | 0.197 | REF | 5.00 | REF |
| P | 0.079 | REF | 2.00 | REF |
| R | 0.039 | REF | 0.99 | REF |
| S | 0.575 | 0.625 | 14.60 | 15.88 |
| V | 0.045 | 0.055 | 1.14 | 1.40 |

STYLE 2:

- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN



SOLDERING FOOTPRINT*



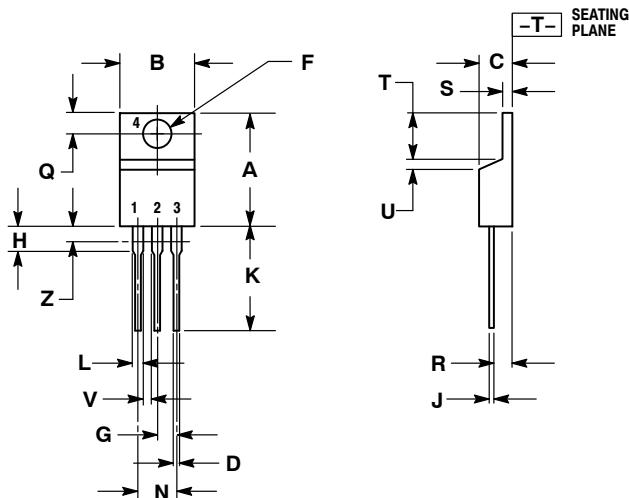
DIMENSIONS: MILLIMETERS

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

NTB5404N, NTP5404N

PACKAGE DIMENSIONS

TO-220
CASE 221A-09
ISSUE AF



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 | 0.161 | 3.61 | 4.09 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.155 | 2.80 | 3.93 |
| J | 0.014 | 0.025 | 0.36 | 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:

1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

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