

NTHD3102C

Power MOSFET

Complementary, 20 V, +5.5 A / -4.2 A,
ChipFET™

Features

- Complementary N-Channel and P-Channel MOSFET
- Small Size, 40% Smaller than TSOP-6 Package
- Leadless SMD Package Provides Great Thermal Characteristics
- Leading Edge Trench Technology for Low On Resistance
- Reduced Gate Charge to Improve Switching Response
- This is a Pb-Free Device

Applications

- DC-DC Conversion Circuits
- Load/Power Switching
- Single or Dual Cell Li-Ion Battery Supplied Devices
- Ideal for Power Management Applications in Portable, Battery Powered Products

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

| Parameter | Symbol | Value | Unit | |
|--|------------------|-----------------------|--------------------|---|
| Drain-to-Source Voltage | V _{DSS} | 20 | V | |
| Gate-to-Source Voltage | N-Ch | ±8.0 | V | |
| | P-Ch | ±8.0 | V | |
| N-Channel Continuous Drain Current (Note 1) | Steady State | T _A = 25°C | I _D 4.0 | A |
| | | T _A = 85°C | 2.9 | |
| | t ≤ 5 s | T _A = 25°C | 5.5 | |
| P-Channel Continuous Drain Current (Note 1) | Steady State | T _A = 25°C | I _D 3.1 | A |
| | | T _A = 85°C | 2.2 | |
| | t ≤ 5 s | T _A = 25°C | 4.2 | |
| Power Dissipation (Note 1) | Steady State | T _A = 25°C | P _D 1.1 | W |
| | | t ≤ 5 s | 2.1 | |
| Gate-to-Source ESD Rating – (Human Body Model, Method 3015) | ESD | 100 | V | |

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.

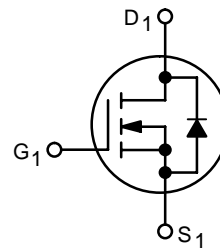
1. Surface-mounted on FR4 board using 1 in sq pad size (Cu. area = 1.127 in sq [1 oz] including traces).



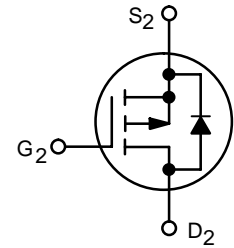
ON Semiconductor®

<http://onsemi.com>

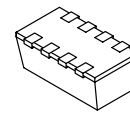
| V _{(BR)DSS} | R _{DS(on)} TYP | I _D MAX (Note 1) |
|----------------------|-------------------------|--------------------------------|
| N-Channel 20 V | 29 mΩ @ 4.5 V | 5.5 A |
| | 37 mΩ @ 2.5 V | |
| | 48 mΩ @ 1.8 V | |
| P-Channel -20 V | 64 mΩ @ 4.5 V | -4.2 A |
| | 83 mΩ @ 2.5 V | |
| | 105 mΩ @ 1.8 V | |



N-Channel MOSFET

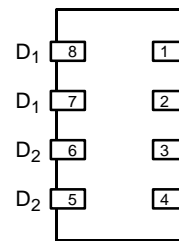


P-Channel MOSFET



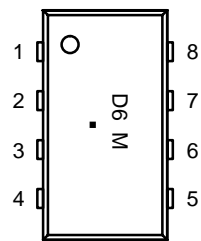
ChipFET
CASE 1206A
STYLE 2

PIN CONNECTIONS



(Bottom View)

MARKING DIAGRAM



(Top View)

- D6 = Specific Device Code
- M = Date Code
- = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

NTHD3102C

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

| Parameter | | | Symbol | Value | Unit |
|---|--------------|--------------------------|----------------|------------|------------------|
| N-Channel Continuous Drain Current (Note 3) | Steady State | $T_A = 25^\circ\text{C}$ | I_D | 3.0 | A |
| | | $T_A = 85^\circ\text{C}$ | | 2.2 | |
| P-Channel Continuous Drain Current (Note 3) | Steady State | $T_A = 25^\circ\text{C}$ | I_D | 2.3 | A |
| | | $T_A = 85^\circ\text{C}$ | | 1.7 | |
| Power Dissipation (Note 3) | | $T_A = 25^\circ\text{C}$ | P_D | 0.6 | W |
| Pulsed Drain Current | N-Ch | $t_p = 10 \mu\text{s}$ | I_{DM} | 16 | A |
| | P-Ch | | | 12.6 | |
| Operating Junction and Storage Temperature | | | T_J, T_{STG} | -55 to 150 | $^\circ\text{C}$ |
| Source Current (Body Diode) | | | I_S | 1.7 | A |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 seconds) | | | T_L | 260 | $^\circ\text{C}$ |

THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Max | Unit |
|---|-----------------|-----|--------------------|
| Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 110 | $^\circ\text{C/W}$ |
| Junction-to-Ambient – $t \leq 5 \text{ s}$ (Note 2) | | 60 | |
| Junction-to-Ambient – Steady State (Note 3) | | 195 | |

ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | N/P | Test Conditions | Min | Typ | Max | Unit |
|-----------|--------|-----|-----------------|-----|-----|-----|------|
|-----------|--------|-----|-----------------|-----|-----|-----|------|

OFF CHARACTERISTICS

| | | | | | | | |
|---|-------------------|---|--|--------------------------|------|-----------|----------------------|
| Drain-to-Source Breakdown Voltage (Note 4) | $V_{(BR)DSS}$ | N | $V_{GS} = 0 \text{ V}$ | $I_D = 250 \mu\text{A}$ | 20 | | V |
| | | P | | $I_D = -250 \mu\text{A}$ | -20 | | |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | N | | | 20.2 | | mV/ $^\circ\text{C}$ |
| | | P | | | 16.2 | | |
| Zero Gate Voltage Drain Current | I_{DSS} | N | $V_{GS} = 0 \text{ V}, V_{DS} = 16 \text{ V}$ | $T_J = 25^\circ\text{C}$ | | 1.0 | μA |
| | | P | $V_{GS} = 0 \text{ V}, V_{DS} = -16 \text{ V}$ | | | -1.0 | |
| | | N | $V_{GS} = 0 \text{ V}, V_{DS} = 16 \text{ V}$ | $T_J = 85^\circ\text{C}$ | | 5.0 | |
| | | P | $V_{GS} = 0 \text{ V}, V_{DS} = -16 \text{ V}$ | | | -5.0 | |
| Gate-to-Source Leakage Current | I_{GSS} | N | $V_{DS} = 0 \text{ V}, V_{GS} = \pm 8.0 \text{ V}$ | | | ± 100 | nA |
| | | P | $V_{DS} = 0 \text{ V}, V_{GS} = \pm 8.0 \text{ V}$ | | | ± 100 | |

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.

2. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
3. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = TBD in sq).
4. Switching characteristics are independent of operating junction temperatures.

NTHD3102C

ELECTRICAL CHARACTERISTICS (continued) ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | N/P | Test Conditions | Min | Typ | Max | Unit |
|------------------------------------|--------------|-----|---|--------------------------|------|------|------------|
| ON CHARACTERISTICS (Note 5) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | N | $V_{GS} = V_{DS}$ | $I_D = 250 \mu\text{A}$ | 0.4 | 1.2 | V |
| | | P | | $I_D = -250 \mu\text{A}$ | -0.4 | -1.2 | |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | N | $V_{GS} = 4.5 \text{ V}, I_D = 4.4 \text{ A}$ | | 29 | 45 | m Ω |
| | | P | $V_{GS} = -4.5 \text{ V}, I_D = -3.2 \text{ A}$ | | 64 | 80 | |
| | | N | $V_{GS} = 2.5 \text{ V}, I_D = 4.1 \text{ A}$ | | 37 | 50 | |
| | | P | $V_{GS} = -2.5 \text{ V}, I_D = -2.5 \text{ A}$ | | 83 | 110 | |
| | | N | $V_{GS} = 1.8 \text{ V}, I_D = 1.9 \text{ A}$ | | 48 | 70 | |
| | | P | $V_{GS} = -1.8 \text{ V}, I_D = -0.6 \text{ A}$ | | 105 | 150 | |
| Forward Transconductance | g_{FS} | N | $V_{DS} = 10 \text{ V}, I_D = 4.4 \text{ A}$ | | 7.7 | | S |
| | | P | $V_{DS} = -10 \text{ V}, I_D = -3.2 \text{ A}$ | | 5.9 | | |

CHARGES, CAPACITANCES AND GATE RESISTANCE

| | | | | | | | |
|------------------------------|--------------|---|---|--------------------------|------|-----|----|
| Input Capacitance | C_{ISS} | N | $f = 1.0 \text{ MHz}, V_{GS} = 0 \text{ V}$ | $V_{DS} = 10 \text{ V}$ | | 510 | pF |
| | | P | | $V_{DS} = -10 \text{ V}$ | | 650 | |
| Output Capacitance | C_{OSS} | N | | $V_{DS} = 10 \text{ V}$ | | 100 | |
| | | P | | $V_{DS} = -10 \text{ V}$ | | 100 | |
| Reverse Transfer Capacitance | C_{RSS} | N | | $V_{DS} = 10 \text{ V}$ | | 50 | |
| | | P | | $V_{DS} = -10 \text{ V}$ | | 50 | |
| Total Gate Charge | $Q_{G(TOT)}$ | N | $V_{GS} = 4.5 \text{ V}, V_{DS} = 10 \text{ V}, I_D = 4.4 \text{ A}$ | | 5.8 | 7.9 | nC |
| | | P | $V_{GS} = -4.5 \text{ V}, V_{DS} = -10 \text{ V}, I_D = -3.2 \text{ A}$ | | 6.6 | 8.9 | |
| Threshold Gate Charge | $Q_{G(TH)}$ | N | $V_{GS} = 4.5 \text{ V}, V_{DS} = 10 \text{ V}, I_D = 4.4 \text{ A}$ | | 0.96 | | |
| | | P | $V_{GS} = -4.5 \text{ V}, V_{DS} = -10 \text{ V}, I_D = -3.2 \text{ A}$ | | 0.98 | | |
| Gate-to-Source Charge | Q_{GS} | N | $V_{GS} = 4.5 \text{ V}, V_{DS} = 10 \text{ V}, I_D = 4.4 \text{ A}$ | | 1.2 | | |
| | | P | $V_{GS} = -4.5 \text{ V}, V_{DS} = -10 \text{ V}, I_D = -3.2 \text{ A}$ | | 1.4 | | |
| Gate-to-Drain Charge | Q_{GD} | N | $V_{GS} = 4.5 \text{ V}, V_{DS} = 10 \text{ V}, I_D = 4.4 \text{ A}$ | | 1.56 | | |
| | | P | $V_{GS} = -4.5 \text{ V}, V_{DS} = -10 \text{ V}, I_D = -3.2 \text{ A}$ | | 1.64 | | |

SWITCHING CHARACTERISTICS (Note 6)

| | | | | | | |
|---------------------|--------------|---|---|--|------|----|
| Turn-On Delay Time | $t_{d(ON)}$ | N | $V_{GS} = 4.5 \text{ V}, V_{DD} = 10 \text{ V}, I_D = 4.4 \text{ A}, R_G = 2.5 \Omega$ | | 7.2 | ns |
| Rise Time | t_r | | | | 15.9 | |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | | 15.7 | |
| Fall Time | t_f | | | | 4.6 | |
| Turn-On Delay Time | $t_{d(ON)}$ | P | $V_{GS} = -4.5 \text{ V}, V_{DD} = -10 \text{ V}, I_D = -3.2 \text{ A}, R_G = 2.5 \Omega$ | | 6.4 | |
| Rise Time | t_r | | | | 16.9 | |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | | 16.4 | |
| Fall Time | t_f | | | | 15.0 | |

5. Pulse Test: pulse width $\leq 300 \mu\text{s}$, duty cycle $\leq 2\%$.

6. Switching characteristics are independent of operating junction temperatures.

NTHD3102C

ELECTRICAL CHARACTERISTICS (continued) ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | N/P | Test Conditions | Min | Typ | Max | Unit |
|---|----------|-----|--|-----------------------|------|------|------|
| DRAIN-SOURCE DIODE CHARACTERISTICS | | | | | | | |
| Forward Diode Voltage | V_{SD} | N | $V_{GS} = 0\text{ V}, T_J = 25^\circ\text{C}$ | $I_S = 1.7\text{ A}$ | 0.68 | 1.2 | V |
| | | P | | $I_S = -1.7\text{ A}$ | -0.7 | -1.2 | |
| Reverse Recovery Time | t_{RR} | N | $V_{GS} = 0\text{ V},$ $dI_S / dt = 100\text{ A}/\mu\text{s}$ | $I_S = 1.7\text{ A}$ | 13.5 | | ns |
| | | P | | $I_S = -1.7\text{ A}$ | 12.6 | | |
| Charge Time | t_a | N | | $I_S = 1.7\text{ A}$ | 8.6 | | |
| | | P | | $I_S = -1.7\text{ A}$ | 8.4 | | |
| Discharge Time | t_b | N | | $I_S = 1.7\text{ A}$ | 4.9 | | |
| | | P | | $I_S = -1.7\text{ A}$ | 4.2 | | |
| Reverse Recovery Charge | Q_{RR} | N | | $I_S = 1.7\text{ A}$ | 7.0 | | nC |
| | | P | | $I_S = -1.7\text{ A}$ | 6.0 | | |

NTHD3102C

TYPICAL N-CHANNEL PERFORMANCE CURVES

($T_J = 25^\circ\text{C}$ unless otherwise noted)

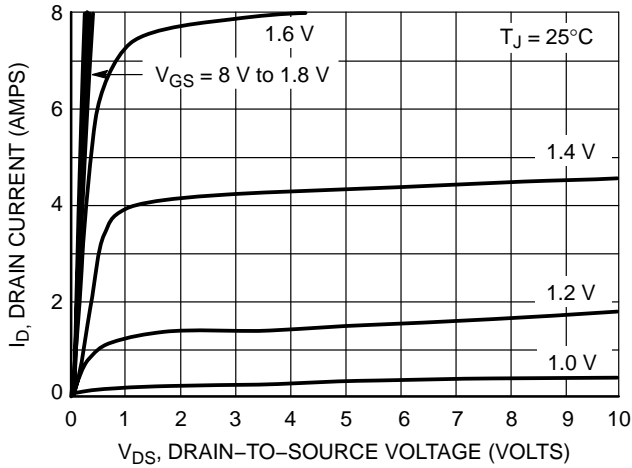


Figure 1. On-Region Characteristics

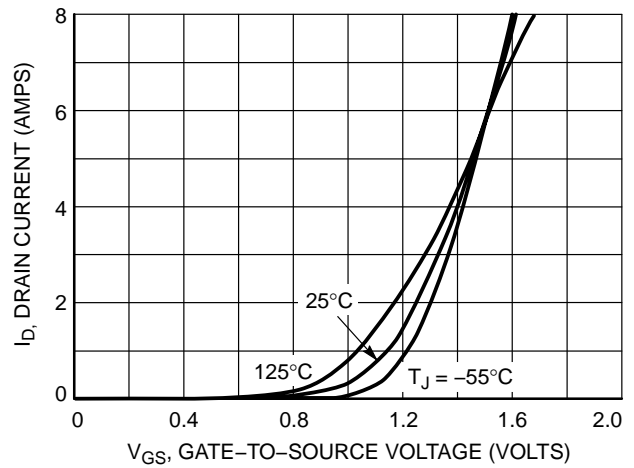


Figure 2. Transfer Characteristics

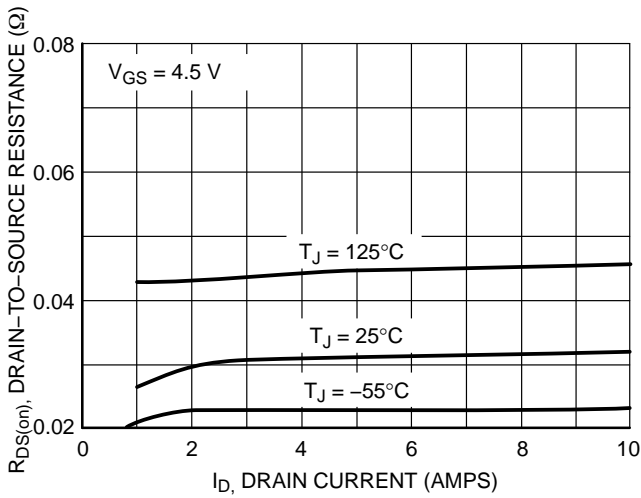


Figure 3. On-Resistance vs. Drain Current

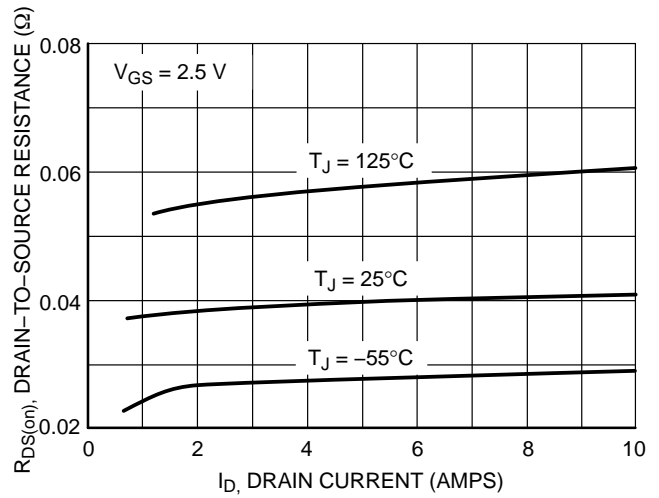


Figure 4. On-Resistance vs. Drain Current and Temperature

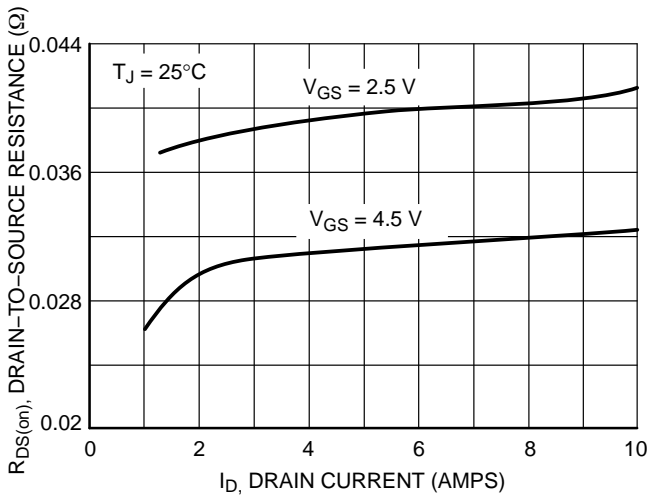


Figure 5. On-Resistance vs. Drain Current

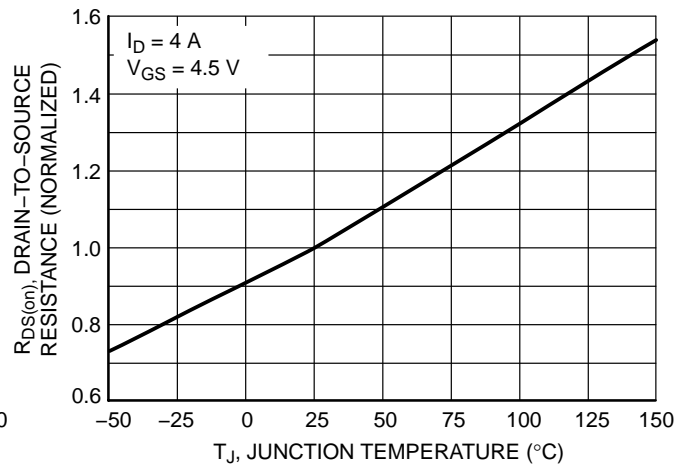


Figure 6. On-Resistance Variation with Temperature

NTHD3102C

TYPICAL N-CHANNEL PERFORMANCE CURVES

($T_J = 25^\circ\text{C}$ unless otherwise noted)

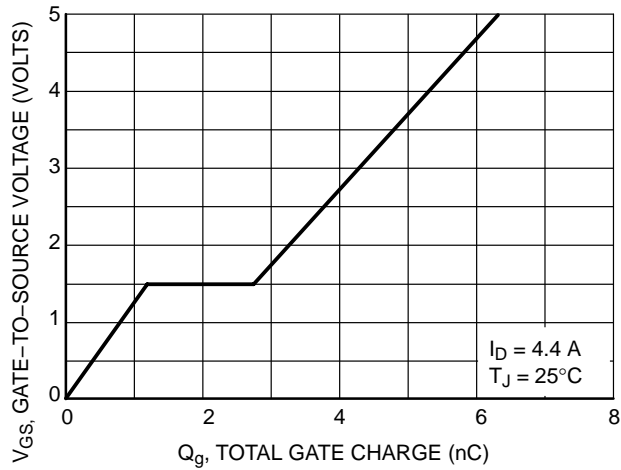


Figure 7. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

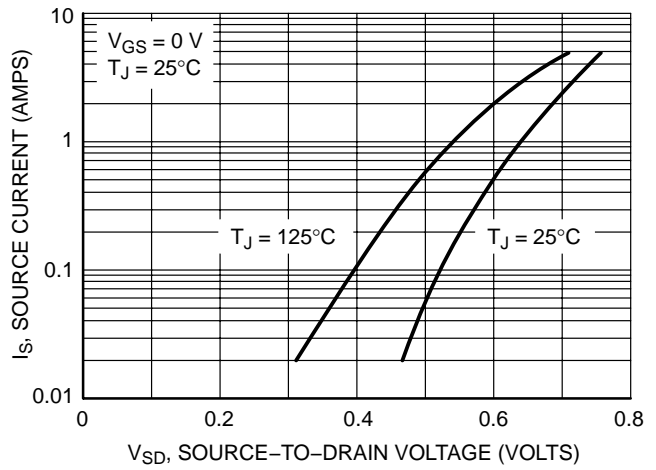


Figure 8. Diode Forward Voltage vs. Current

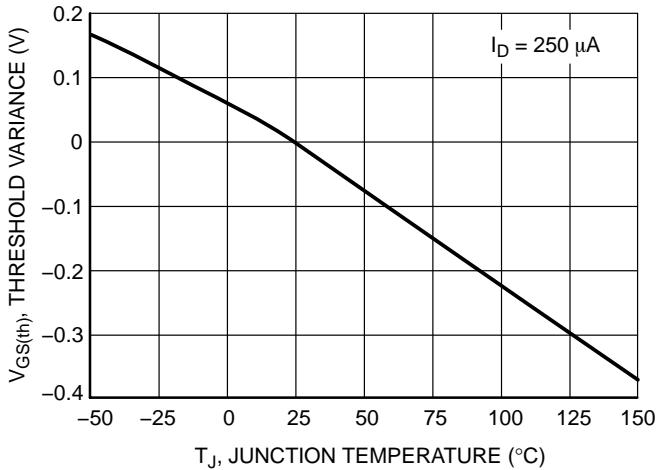


Figure 9. Threshold Voltage

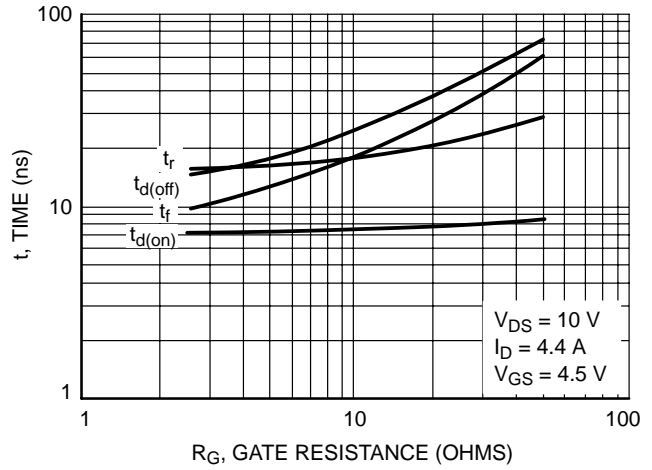


Figure 10. Resistive Switching Time Variation vs. Gate Resistance

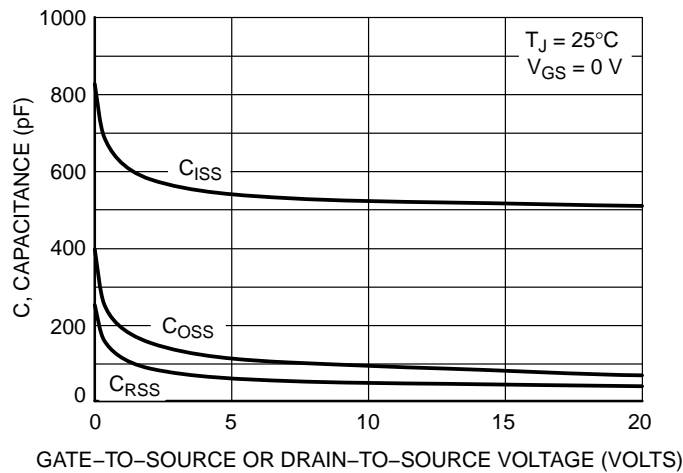


Figure 11. Capacitance Variation

NTHD3102C

TYPICAL P-CHANNEL PERFORMANCE CURVES

($T_J = 25^\circ\text{C}$ unless otherwise noted)

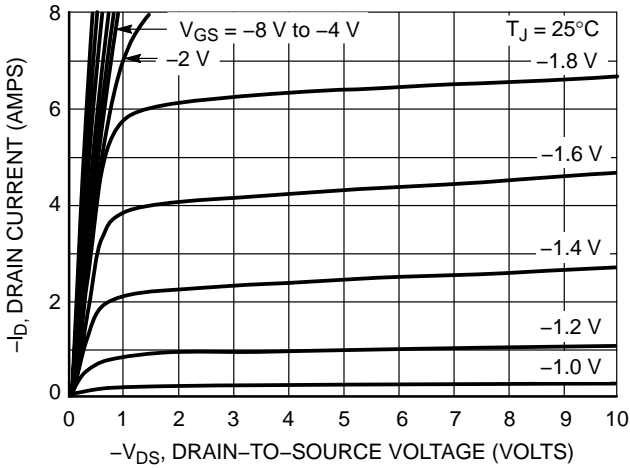


Figure 12. On-Region Characteristics

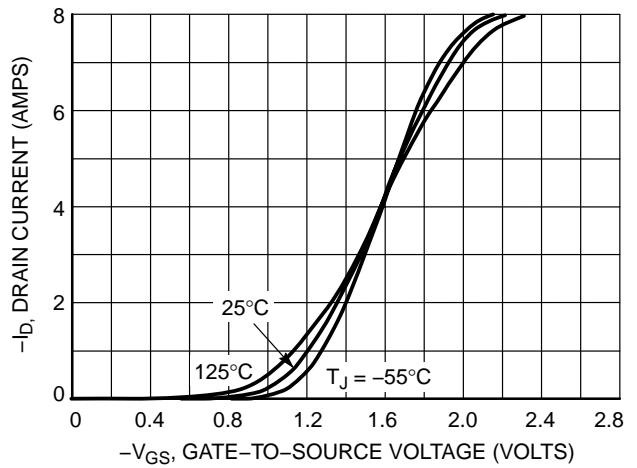


Figure 13. Transfer Characteristics

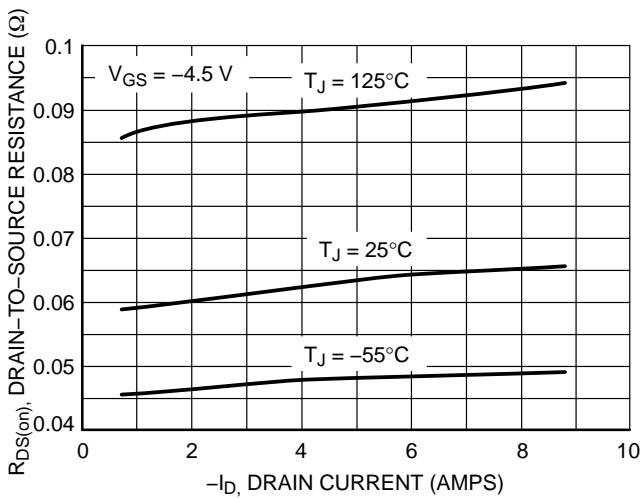


Figure 14. On-Resistance vs. Drain Current

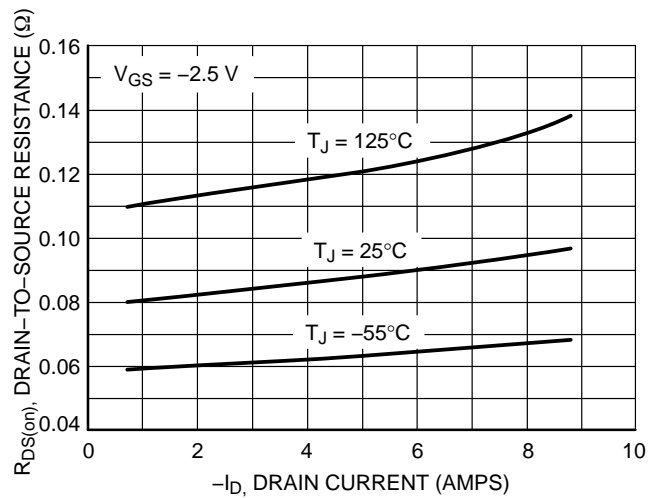


Figure 15. On-Resistance vs. Drain Current and Temperature

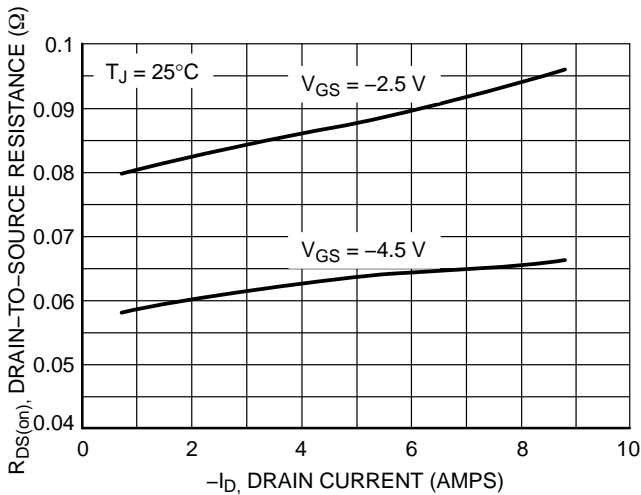


Figure 16. On-Resistance vs. Drain Current

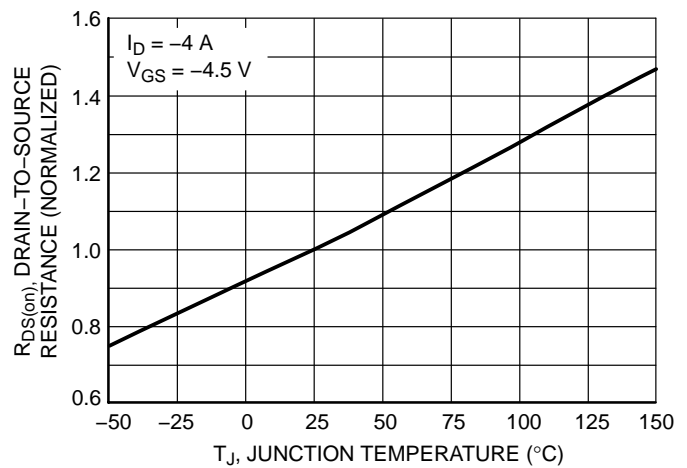


Figure 17. On-Resistance Variation with Temperature

NTHD3102C

TYPICAL P-CHANNEL PERFORMANCE CURVES

($T_J = 25^\circ\text{C}$ unless otherwise noted)

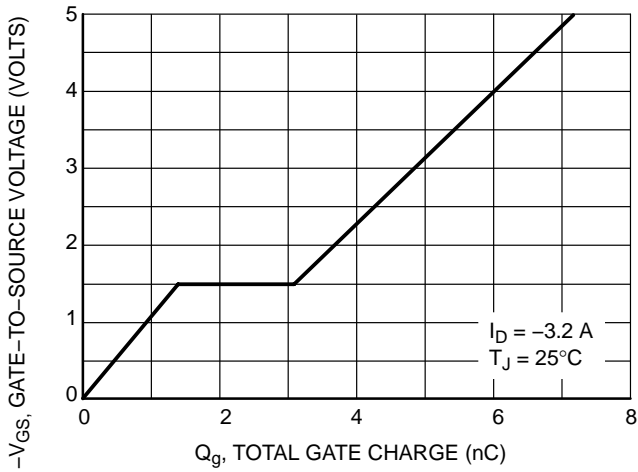


Figure 18. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

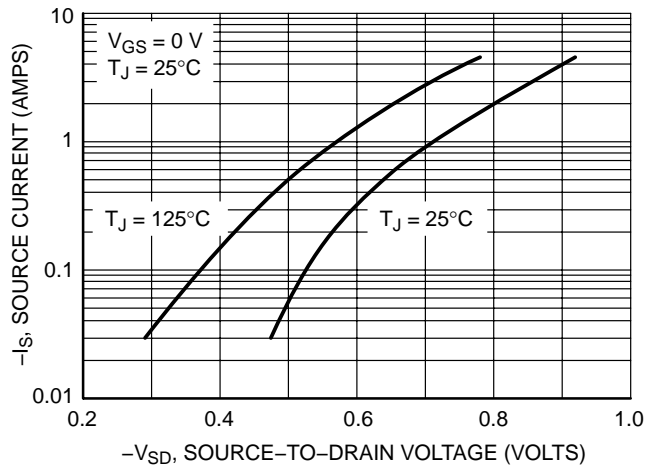


Figure 19. Diode Forward Voltage vs. Current

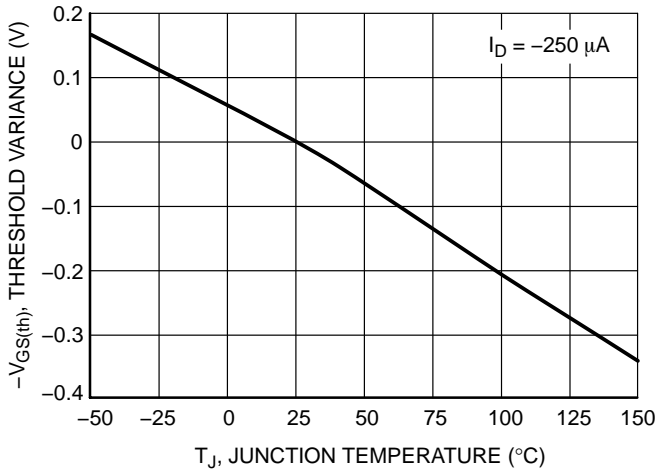


Figure 20. Threshold Voltage

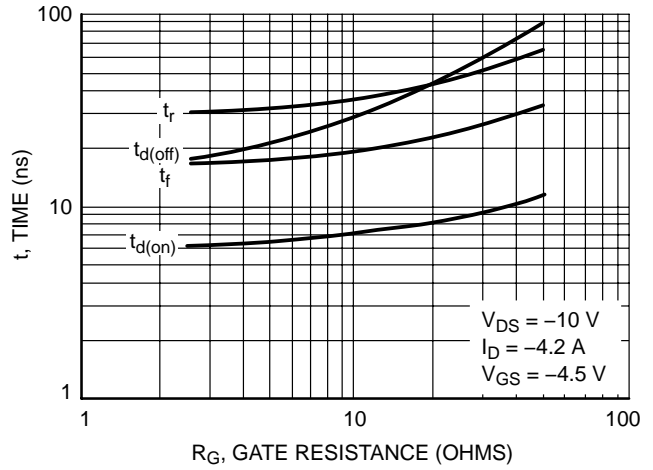


Figure 21. Resistive Switching Time Variation vs. Gate Resistance

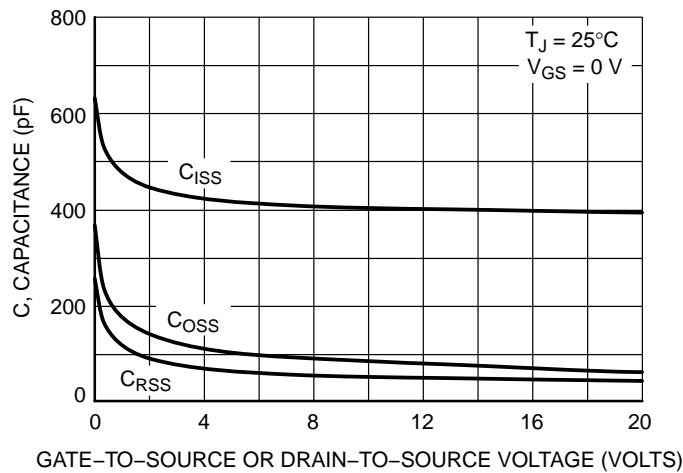


Figure 22. Capacitance Variation

NTHD3102C

TYPICAL PERFORMANCE CURVES

($T_J = 25^\circ\text{C}$ unless otherwise noted)

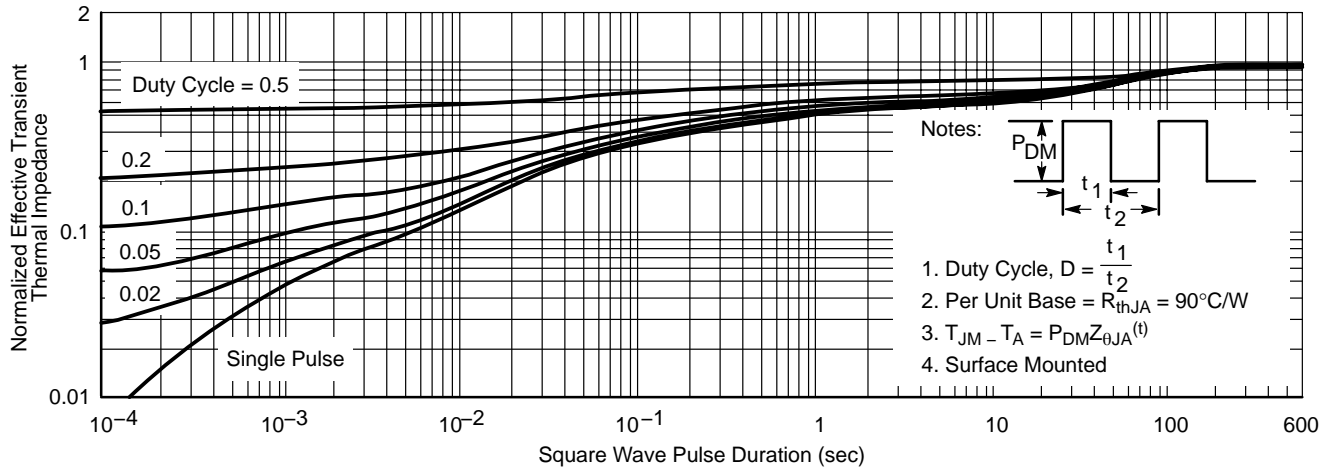


Figure 23. Thermal Response

ORDERING INFORMATION

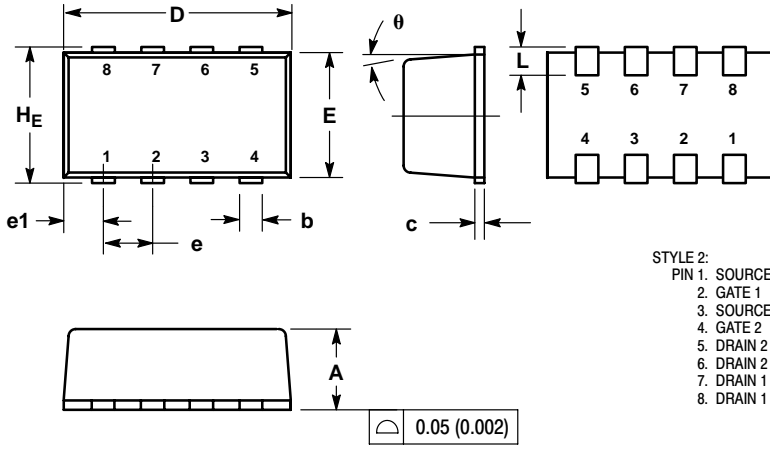
| Device | Package | Shipping† |
|--------------|----------------------|------------------|
| NTHD3102CT1G | ChipFET (Pb-Free) | 3000 Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

NTHD3102C

PACKAGE DIMENSIONS

ChipFET™
CASE 1206A-03
ISSUE G



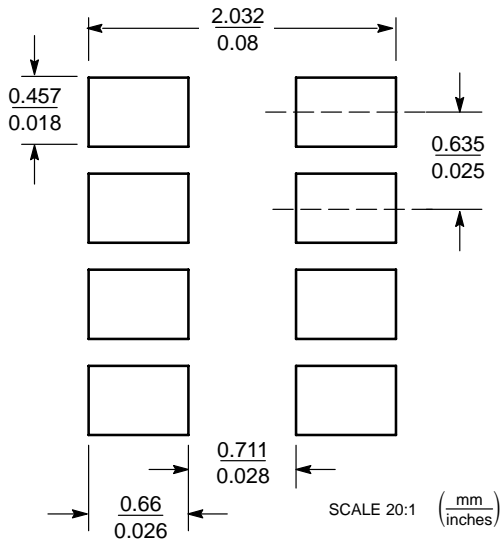
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MOLD GATE BURRS SHALL NOT EXCEED 0.13 MM PER SIDE.
4. LEADFRAME TO MOLDED BODY OFFSET IN HORIZONTAL AND VERTICAL SHALL NOT EXCEED 0.08 MM.
5. DIMENSIONS A AND B EXCLUSIVE OF MOLD GATE BURRS.
6. NO MOLD FLASH ALLOWED ON THE TOP AND BOTTOM LEAD SURFACE.

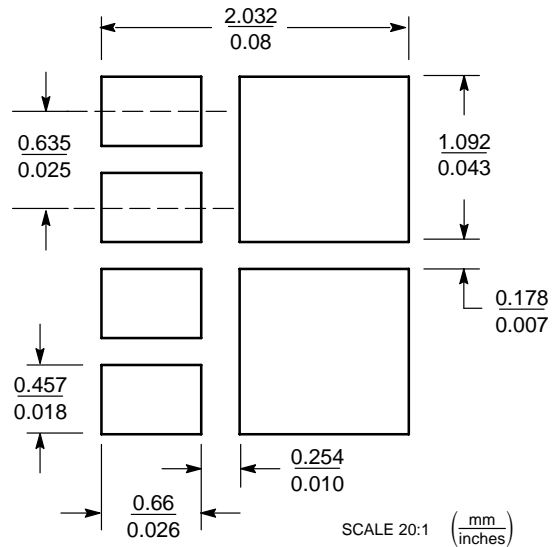
| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 1.00 | 1.05 | 1.10 | 0.039 | 0.041 | 0.043 |
| b | 0.25 | 0.30 | 0.35 | 0.010 | 0.012 | 0.014 |
| c | 0.10 | 0.15 | 0.20 | 0.004 | 0.006 | 0.008 |
| D | 2.95 | 3.05 | 3.10 | 0.116 | 0.120 | 0.122 |
| E | 1.55 | 1.65 | 1.70 | 0.061 | 0.065 | 0.067 |
| e | 0.65 BSC | | | 0.025 BSC | | |
| e1 | 0.55 BSC | | | 0.022 BSC | | |
| L | 0.28 | 0.35 | 0.42 | 0.011 | 0.014 | 0.017 |
| HE | 1.80 | 1.90 | 2.00 | 0.071 | 0.075 | 0.079 |
| θ | 5° NOM | | | 5° NOM | | |

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

SOLDERING FOOTPRINT*



Basic




Style 2

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

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