

# NTD110N02R, STD110N02R

## MOSFET – Power, N-Channel, DPAK

24 V, 110 A

### 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
- Optimized for High Side Switching Requirements in High-Efficiency DC-DC Converters
- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

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

| Rating                                                                                                                                                                                                                  | Symbol          | Value          | Unit               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------|--------------------|
| Drain-to-Source Voltage                                                                                                                                                                                                 | $V_{DS}$        | 24             | V                  |
| Gate-to-Source Voltage – Continuous                                                                                                                                                                                     | $V_{GS}$        | $\pm 20$       | V                  |
| Thermal Resistance – Junction-to-Case                                                                                                                                                                                   | $R_{\theta JC}$ | 1.35           | $^\circ\text{C/W}$ |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$                                                                                                                                                                      | $P_D$           | 110            | W                  |
| Drain Current                                                                                                                                                                                                           | $I_D$           | 110            | A                  |
| – Continuous @ $T_C = 25^\circ\text{C}$ , Chip                                                                                                                                                                          | $I_D$           | 110            | A                  |
| – Continuous @ $T_C = 25^\circ\text{C}$                                                                                                                                                                                 | $I_D$           | 110            | A                  |
| Limited by Package                                                                                                                                                                                                      | $I_D$           | 32             | A                  |
| – Continuous @ $T_A = 25^\circ\text{C}$                                                                                                                                                                                 | $I_D$           | 110            | A                  |
| Limited by Wires                                                                                                                                                                                                        | $I_D$           | 110            | A                  |
| – Single Pulse ( $t_p = 10 \mu\text{s}$ )                                                                                                                                                                               | $I_D$           | 110            | A                  |
| Thermal Resistance                                                                                                                                                                                                      | $R_{\theta JA}$ | 52             | $^\circ\text{C/W}$ |
| – Junction-to-Ambient (Note 1)                                                                                                                                                                                          | $P_D$           | 2.88           | W                  |
| – Total Power Dissipation @ $T_A = 25^\circ\text{C}$                                                                                                                                                                    | $I_D$           | 17.5           | A                  |
| – Drain Current – Continuous @ $T_A = 25^\circ\text{C}$                                                                                                                                                                 | $I_D$           | 12.5           | A                  |
| Thermal Resistance                                                                                                                                                                                                      | $R_{\theta JA}$ | 100            | $^\circ\text{C/W}$ |
| – Junction-to-Ambient (Note 2)                                                                                                                                                                                          | $P_D$           | 1.5            | W                  |
| – Total Power Dissipation @ $T_A = 25^\circ\text{C}$                                                                                                                                                                    | $I_D$           | 12.5           | A                  |
| – Drain Current – Continuous @ $T_A = 25^\circ\text{C}$                                                                                                                                                                 | $I_D$           | 12.5           | A                  |
| Operating and Storage Temperature Range                                                                                                                                                                                 | $T_J, T_{stg}$  | $-55$ to $175$ | $^\circ\text{C}$   |
| Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$<br>( $V_{DD} = 50 \text{ Vdc}$ , $V_{GS} = 10 \text{ Vdc}$ ,<br>$I_L = 15.5 \text{ Apk}$ , $L = 1.0 \text{ mH}$ , $R_G = 25 \Omega$ ) | $E_{AS}$        | 120            | mJ                 |
| Maximum Lead Temperature for Soldering Purposes, ( $1/8"$ from case for 10 s)                                                                                                                                           | $T_L$           | 260            | $^\circ\text{C}$   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

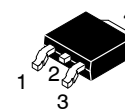
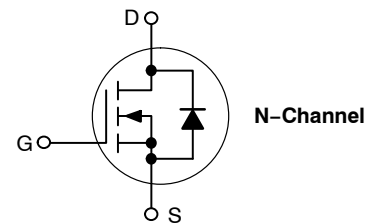
1. When surface mounted to an FR4 board using 0.5 sq in drain pad size.
2. When surface mounted to an FR4 board using the minimum recommended pad size.



ON Semiconductor®

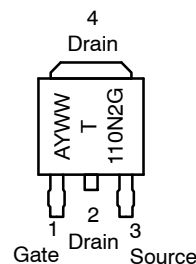
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP      | $I_D$ MAX |
|---------------|-----------------------|-----------|
| 24 V          | 4.1 m $\Omega$ @ 10 V | 110 A     |



DPAK  
CASE 369AA  
(Surface Mount)  
STYLE 2

### MARKING DIAGRAM & PIN ASSIGNMENT



A = Assembly Location\*  
Y = Year  
WW = Work Week  
T110N2 = Device Code  
G = Pb-Free Package

\* The Assembly Location code (A) is front side optional. In cases where the Assembly Location is stamped in the package, the front side assembly code may be blank.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

# NTD110N02R, STD110N02R

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                                                                               |                      |    |    |           |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|----|-----------|-------|
| Drain-to-Source Breakdown Voltage (Note 3)<br>(V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA)                                                                | V <sub>(BR)DSS</sub> | 24 | 28 |           | V     |
| Positive Temperature Coefficient                                                                                                                              |                      |    | 15 |           | mV/°C |
| Zero Gate Voltage Drain Current<br>(V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V)<br>(V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125°C) | I <sub>DSS</sub>     |    |    | 1.5<br>10 | μA    |
| Gate-Body Leakage Current (V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V)                                                                                    | I <sub>GSS</sub>     |    |    | ±100      | nA    |

### ON CHARACTERISTICS (Note 3)

|                                                                                                                                                                                                                                                              |                     |     |                          |            |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----|--------------------------|------------|-------|
| Gate Threshold Voltage (Note 3)<br>(V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA)                                                                                                                                                             | V <sub>GS(th)</sub> | 1.0 | 1.5                      | 2.0        | V     |
| Negative Threshold Temperature Coefficient                                                                                                                                                                                                                   |                     |     | 5.0                      |            | mV/°C |
| Static Drain-to-Source On-Resistance (Note 3)<br>(V <sub>GS</sub> = 10 V, I <sub>D</sub> = 110 A)<br>(V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 55 A)<br>(V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A)<br>(V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 20 A) | R <sub>DS(on)</sub> |     | 4.1<br>5.5<br>3.9<br>5.5 | 4.6<br>6.2 | mΩ    |
| Forward Transconductance (V <sub>DS</sub> = 10 V, I <sub>D</sub> = 15 A) (Note 3)                                                                                                                                                                            | g <sub>FS</sub>     |     | 44                       |            | Mhos  |

### DYNAMIC CHARACTERISTICS

|                      |                                                              |                  |  |      |      |    |
|----------------------|--------------------------------------------------------------|------------------|--|------|------|----|
| Input Capacitance    | (V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz) | C <sub>iss</sub> |  | 2710 | 3440 | pF |
| Output Capacitance   |                                                              | C <sub>oss</sub> |  | 1105 | 1670 |    |
| Transfer Capacitance |                                                              | C <sub>rss</sub> |  | 450  | 640  |    |

### SWITCHING CHARACTERISTICS (Note 4)

|                     |                                                                                                    |                     |  |      |    |    |
|---------------------|----------------------------------------------------------------------------------------------------|---------------------|--|------|----|----|
| Turn-On Delay Time  | (V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 10 V,<br>I <sub>D</sub> = 40 A, R <sub>G</sub> = 3.0 Ω) | t <sub>d(on)</sub>  |  | 11   | 22 | ns |
| Rise Time           |                                                                                                    | t <sub>r</sub>      |  | 39   | 80 |    |
| Turn-Off Delay Time |                                                                                                    | t <sub>d(off)</sub> |  | 27   | 40 |    |
| Fall Time           |                                                                                                    | t <sub>f</sub>      |  | 21   | 40 |    |
| Gate Charge         | (V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 40 A,<br>V <sub>DS</sub> = 10 V) (Note 3)               | Q <sub>T</sub>      |  | 23.6 | 28 | nC |
|                     |                                                                                                    | Q <sub>GS</sub>     |  | 5.1  |    |    |
|                     |                                                                                                    | Q <sub>GD</sub>     |  | 11   |    |    |

### SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |                                                                                                                                                                                     |                 |  |                      |     |    |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--|----------------------|-----|----|
| Forward On-Voltage             | (I <sub>S</sub> = 20 A, V <sub>GS</sub> = 0 V) (Note 3)<br>(I <sub>S</sub> = 55 A, V <sub>GS</sub> = 0 V)<br>(I <sub>S</sub> = 20 A, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125°C) | V <sub>SD</sub> |  | 0.82<br>0.99<br>0.65 | 1.2 | V  |
| Reverse Recovery Time          | (I <sub>S</sub> = 30 A, V <sub>GS</sub> = 0 V,<br>di <sub>S</sub> /dt = 100 A/μs) (Note 3)                                                                                          | t <sub>rr</sub> |  | 36.5                 |     | ns |
|                                |                                                                                                                                                                                     | t <sub>a</sub>  |  | 30                   |     |    |
|                                |                                                                                                                                                                                     | t <sub>b</sub>  |  | 25                   |     |    |
| Reverse Recovery Stored Charge |                                                                                                                                                                                     | Q <sub>rr</sub> |  | 0.048                |     | μC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

4. Switching characteristics are independent of operating junction temperatures.

# NTD110N02R, STD110N02R

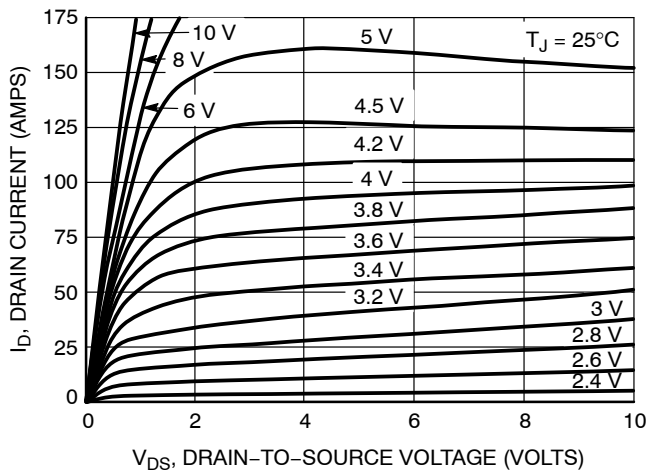


Figure 1. On-Region Characteristics

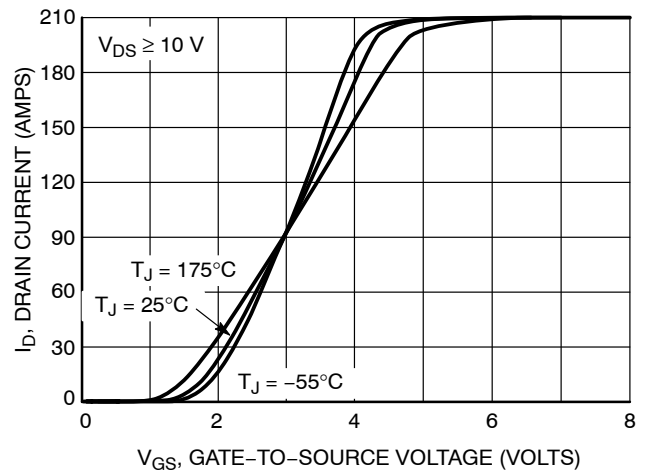


Figure 2. Transfer Characteristics

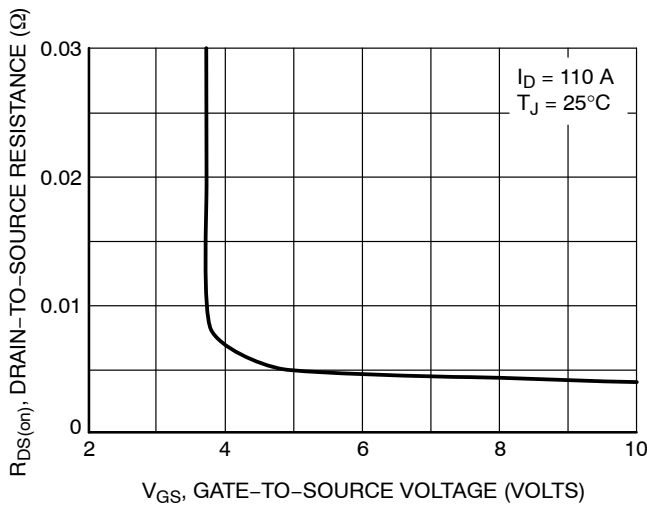


Figure 3. On-Resistance versus Gate-to-Source Voltage

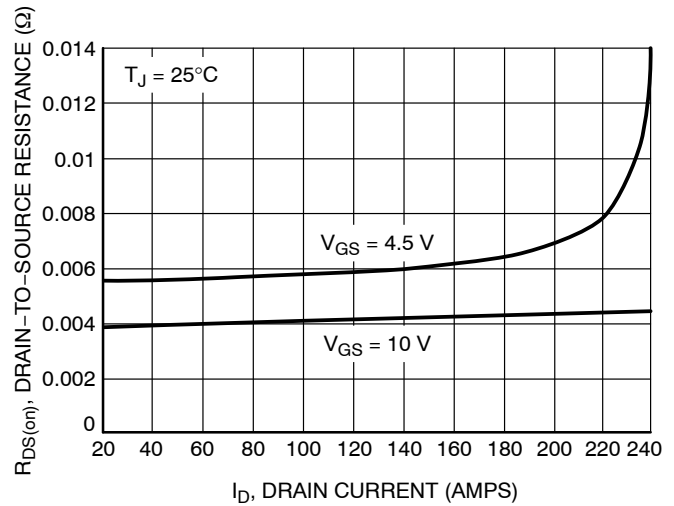


Figure 4. On-Resistance versus Drain Current and Gate Voltage

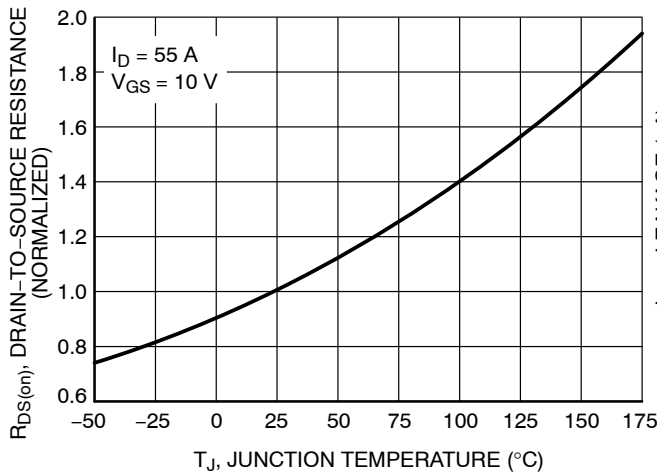


Figure 5. On-Resistance Variation with Temperature

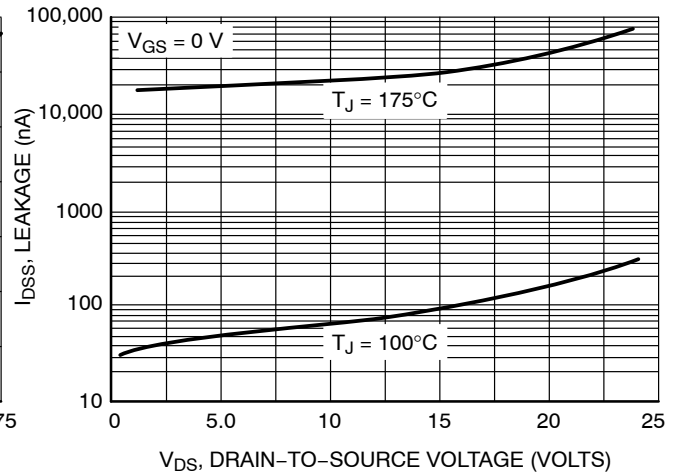
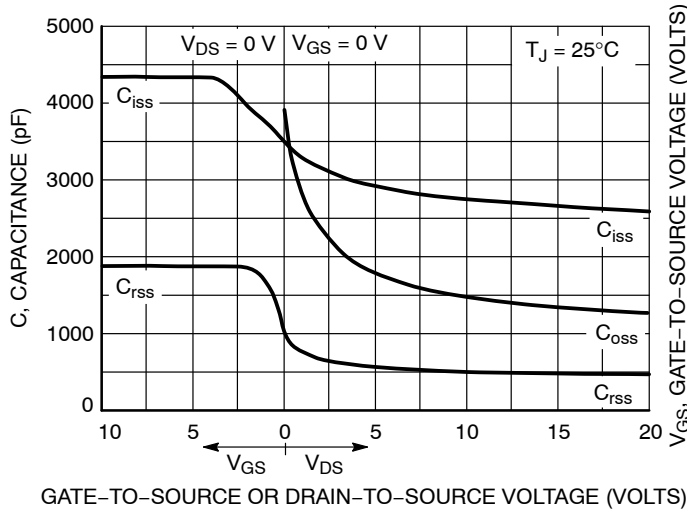
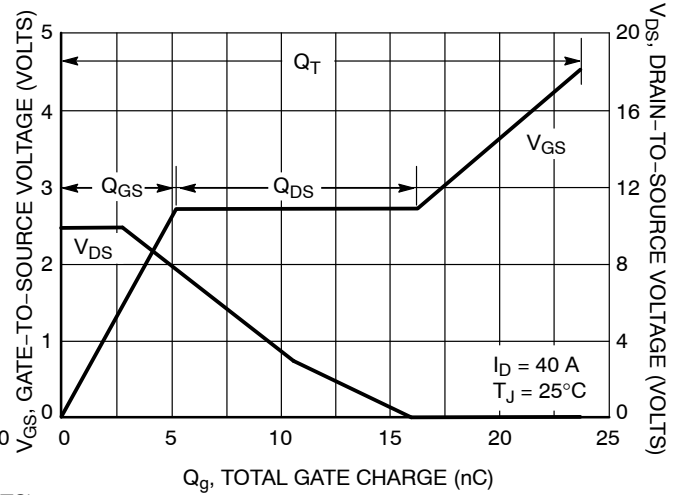


Figure 6. Drain-to-Source Leakage Current versus Voltage

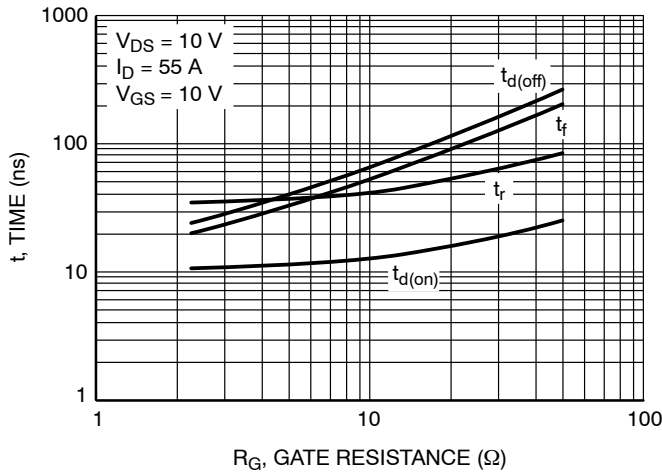
# NTD110N02R, STD110N02R



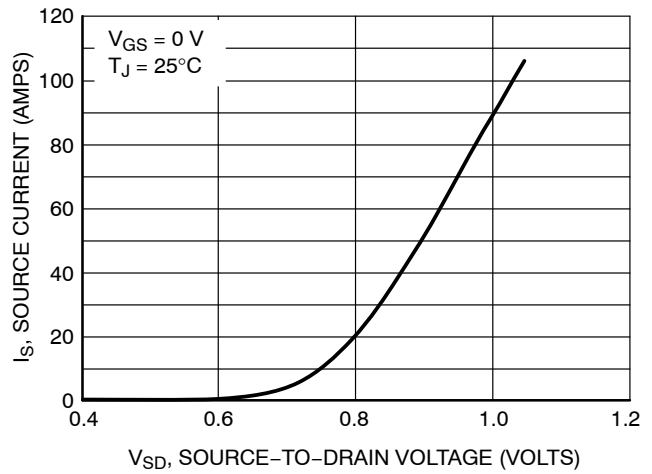
**Figure 7. Capacitance Variation**



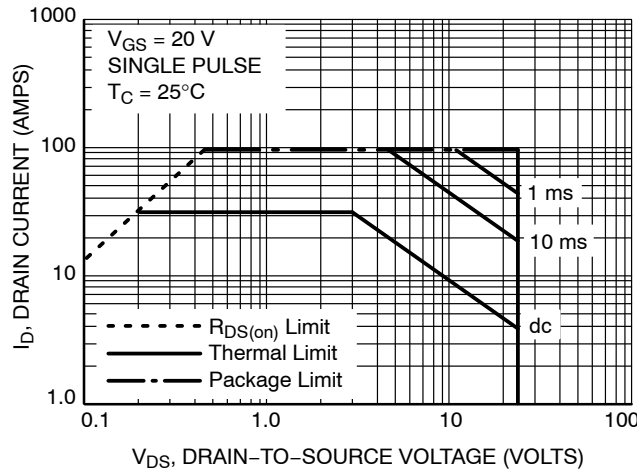
**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



**Figure 9. Resistive Switching Time Variation versus Gate Resistance**



**Figure 10. Diode Forward Voltage versus Current**



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

## NTD110N02R, STD110N02R

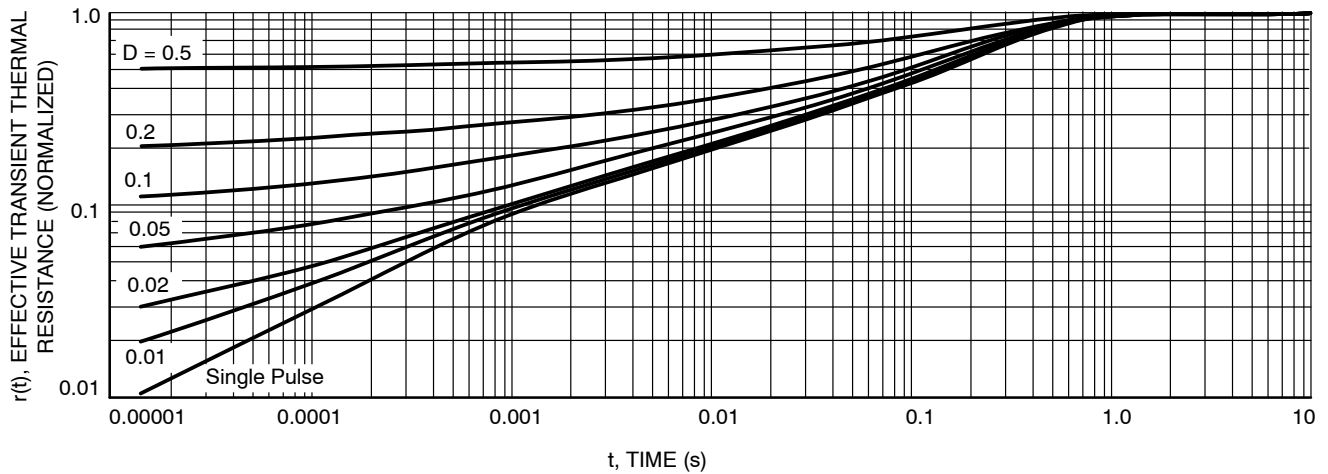


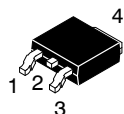
Figure 12. Thermal Response

### ORDERING INFORMATION

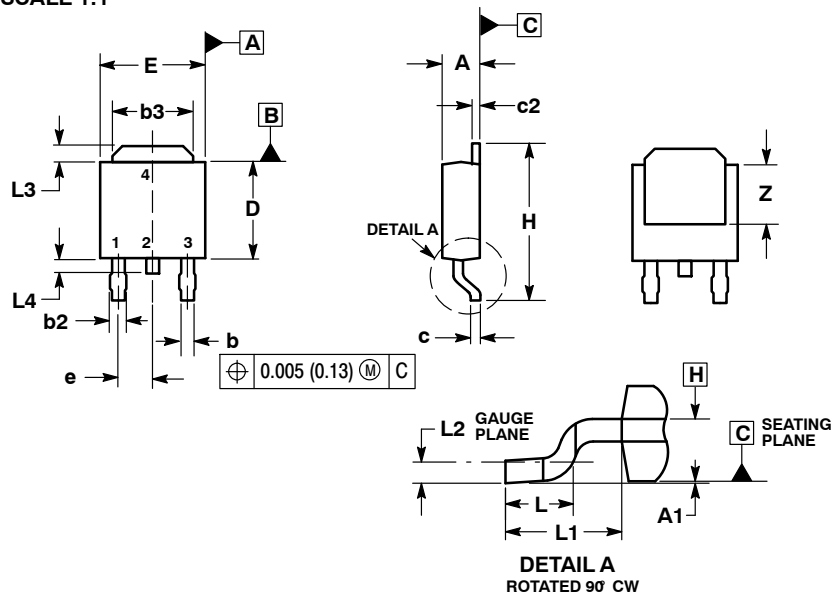
| Device         | Package           | Shipping <sup>†</sup> |
|----------------|-------------------|-----------------------|
| NTD110N02RT4G  | DPAK<br>(Pb-Free) | 2500 / Tape & Reel    |
| STD110N02RT4G* | DPAK<br>(Pb-Free) | 2500 / Tape & Reel    |

<sup>†</sup>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.

\*S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.



SCALE 1:1



STYLE 1:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

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

STYLE 3:  
PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE

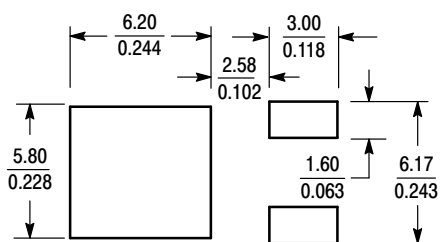
STYLE 4:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

STYLE 5:  
PIN 1. GATE  
2. ANODE  
3. CATHODE  
4. ANODE

STYLE 6:  
PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2

STYLE 7:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

#### SOLDERING FOOTPRINT\*



SCALE 3:1 (mm/inches)

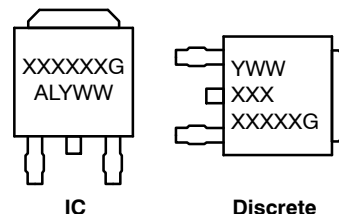
\*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

#### NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: INCHES.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
- DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.086     | 0.094 | 2.18        | 2.38  |
| A1  | 0.000     | 0.005 | 0.00        | 0.13  |
| b   | 0.025     | 0.035 | 0.63        | 0.89  |
| b2  | 0.030     | 0.045 | 0.76        | 1.14  |
| b3  | 0.180     | 0.215 | 4.57        | 5.46  |
| c   | 0.018     | 0.024 | 0.46        | 0.61  |
| c2  | 0.018     | 0.024 | 0.46        | 0.61  |
| D   | 0.235     | 0.245 | 5.97        | 6.22  |
| E   | 0.250     | 0.265 | 6.35        | 6.73  |
| e   | 0.090 BSC |       | 2.29 BSC    |       |
| H   | 0.370     | 0.410 | 9.40        | 10.41 |
| L   | 0.055     | 0.070 | 1.40        | 1.78  |
| L1  | 0.108 REF |       | 2.74 REF    |       |
| L2  | 0.020 BSC |       | 0.51 BSC    |       |
| L3  | 0.035     | 0.050 | 0.89        | 1.27  |
| L4  |           | 0.040 |             | 1.01  |
| Z   | 0.155     |       | 3.93        |       |

#### GENERIC MARKING DIAGRAM\*



XXXXXX = Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking.

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