

# NTP5863N

## N-Channel Power MOSFET

60 V, 97 A, 7.8 mΩ

### Features

- Low  $R_{DS(on)}$
- High Current Capability
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

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

| Parameter                                                                                           |                  |                      | Symbol         | Value       | Unit        |
|-----------------------------------------------------------------------------------------------------|------------------|----------------------|----------------|-------------|-------------|
| Drain-to-Source Voltage                                                                             |                  |                      | $V_{DSS}$      | 60          | V           |
| Gate-to-Source Voltage – Continuous                                                                 |                  |                      | $V_{GS}$       | $\pm 20$    | V           |
| Gate-to-Source Voltage – Nonrepetitive<br>( $T_P < 10 \mu s$ )                                      |                  |                      | $V_{GS}$       | 30          | V           |
| Continuous Drain Current                                                                            | Steady State     | $T_C = 25^{\circ}C$  | $I_D$          | 97          | A           |
|                                                                                                     |                  | $T_C = 100^{\circ}C$ |                | 68          |             |
| Power Dissipation                                                                                   | Steady State     | $T_C = 25^{\circ}C$  | $P_D$          | 150         | W           |
| Pulsed Drain Current                                                                                | $t_p = 10 \mu s$ |                      | $I_{DM}$       | 383         | A           |
| Operating and Storage Temperature Range                                                             |                  |                      | $T_J, T_{stg}$ | -55 to +175 | $^{\circ}C$ |
| Source Current (Body Diode)                                                                         |                  |                      | $I_S$          | 97          | A           |
| Single Pulse Drain-to-Source Avalanche Energy ( $L = 0.1 \text{ mH}$ , $I_{L(pk)} = 56 \text{ A}$ ) |                  |                      | $E_{AS}$       | 157         | mJ          |
| Peak Diode Recovery ( $dV/dt$ )                                                                     |                  |                      | $dV/dt$        | 4.1         | V/ns        |
| Lead Temperature for Soldering Purposes (1/8" from Case for 10 Seconds)                             |                  |                      | $T_L$          | 260         | $^{\circ}C$ |

### THERMAL RESISTANCE RATINGS

| Parameter                                   | Symbol          | Max | Unit               |
|---------------------------------------------|-----------------|-----|--------------------|
| Junction-to-Case (Drain) Steady State       | $R_{\theta JC}$ | 1.0 | $^\circ\text{C/W}$ |
| Junction-to-Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 36  |                    |

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.

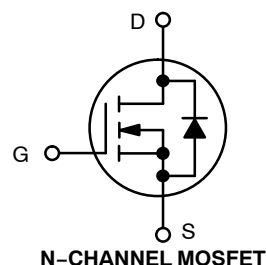
1. Surface mounted on FR4 board using 1 sq in pad size, (Cu Area 1.127 sq in [2 oz] including traces).



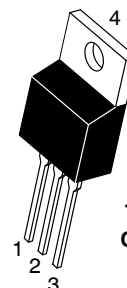
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| $V_{(BR)DS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|--------------|------------------|-----------|
| 60 V         | 7.8 mΩ @ 10 V    | 97 A      |

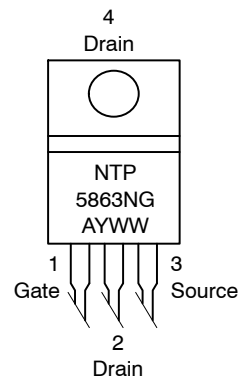


N-CHANNEL MOSFET



TO-220AB  
CASE 221A  
STYLE 5

### MARKING DIAGRAMS & PIN ASSIGNMENTS



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

### ORDERING INFORMATION

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

# NTP5863N

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ Unless otherwise specified)

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

### OFF CHARACTERISTICS

|                                                           |                   |                                                            |                           |    |           |                      |
|-----------------------------------------------------------|-------------------|------------------------------------------------------------|---------------------------|----|-----------|----------------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{DS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$        | 60                        |    |           | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = 250\text{ }\mu\text{A}$ , ref to $25^\circ\text{C}$ |                           | 47 |           | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}$<br>$V_{DS} = 60\text{ V}$            | $T_J = 25^\circ\text{C}$  |    | 1.0       | $\mu\text{A}$        |
|                                                           |                   |                                                            | $T_J = 125^\circ\text{C}$ |    | 50        |                      |
| Gate-Body Leakage Current                                 | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$            |                           |    | $\pm 100$ | nA                   |

### ON CHARACTERISTICS (Note 2)

|                                            |                  |                                                 |     |     |     |                      |
|--------------------------------------------|------------------|-------------------------------------------------|-----|-----|-----|----------------------|
| Gate Threshold Voltage                     | $V_{GS(th)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 2.0 |     | 4.0 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(th)}/T_J$ |                                                 |     | 9.1 |     | mV/ $^\circ\text{C}$ |
| Drain-to-Source On-Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 20\text{ A}$       |     | 6.5 | 7.8 | m $\Omega$           |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 15\text{ V}, I_D = 30\text{ A}$       |     | 12  |     | S                    |

### CHARGES, CAPACITANCES & GATE RESISTANCE

|                       |              |                                                                      |  |      |  |          |
|-----------------------|--------------|----------------------------------------------------------------------|--|------|--|----------|
| Input Capacitance     | $C_{iss}$    | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$   |  | 3200 |  | pF       |
| Output Capacitance    | $C_{oss}$    |                                                                      |  | 350  |  |          |
| Transfer Capacitance  | $C_{rss}$    |                                                                      |  | 230  |  |          |
| Total Gate Charge     | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 48\text{ V},$<br>$I_D = 48\text{ A}$ |  | 55   |  | nC       |
| Threshold Gate Charge | $Q_{G(TH)}$  |                                                                      |  | 3.4  |  |          |
| Gate-to-Source Charge | $Q_{GS}$     |                                                                      |  | 14.5 |  |          |
| Gate-to-Drain Charge  | $Q_{GD}$     |                                                                      |  | 19   |  |          |
| Gate Resistance       | $R_G$        |                                                                      |  | 0.4  |  | $\Omega$ |

### SWITCHING CHARACTERISTICS, $V_{GS} = 10\text{ V}$ (Note 3)

|                     |              |                                                                                               |  |     |  |    |
|---------------------|--------------|-----------------------------------------------------------------------------------------------|--|-----|--|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = 10\text{ V}, V_{DD} = 48\text{ V},$<br>$I_D = 48\text{ A}, R_G = 2.5\text{ }\Omega$ |  | 10  |  | ns |
| Rise Time           | $t_r$        |                                                                                               |  | 34  |  |    |
| Turn-Off Delay Time | $t_{d(off)}$ |                                                                                               |  | 25  |  |    |
| Fall Time           | $t_f$        |                                                                                               |  | 9.0 |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                                |          |                                                                                             |                           |    |      |     |          |
|--------------------------------|----------|---------------------------------------------------------------------------------------------|---------------------------|----|------|-----|----------|
| Forward Diode Voltage          | $V_{SD}$ | $V_{GS} = 0\text{ V}$<br>$I_S = 48\text{ A}$                                                | $T_J = 25^\circ\text{C}$  |    | 0.96 | 1.5 | $V_{dc}$ |
|                                |          |                                                                                             | $T_J = 150^\circ\text{C}$ |    | 0.85 |     |          |
| Reverse Recovery Time          | $t_{rr}$ | $V_{GS} = 0\text{ V}_{dc}, I_S = 48\text{ A}_{dc},$<br>$di_S/dt = 100\text{ A}/\mu\text{s}$ |                           | 32 |      |     | ns       |
| Charge Time                    | $t_a$    |                                                                                             |                           | 20 |      |     |          |
| Discharge Time                 | $t_b$    |                                                                                             |                           | 12 |      |     |          |
| Reverse Recovery Stored Charge | $Q_{RR}$ |                                                                                             |                           | 28 |      |     | nC       |

2. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

3. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CHARACTERISTICS

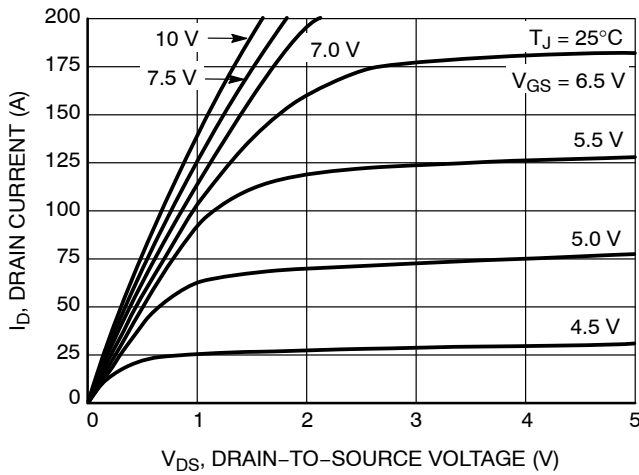


Figure 1. On-Region Characteristics

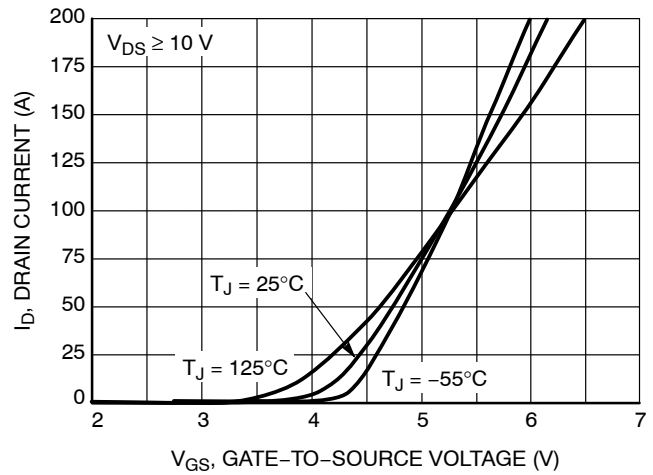


Figure 2. Transfer Characteristics

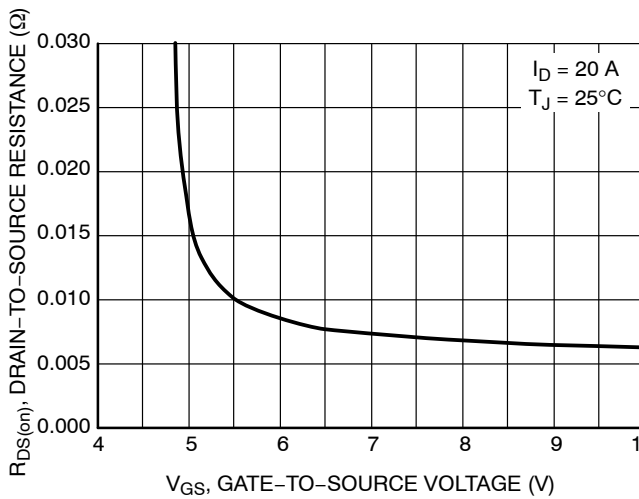


Figure 3. On-Resistance vs. Gate Voltage

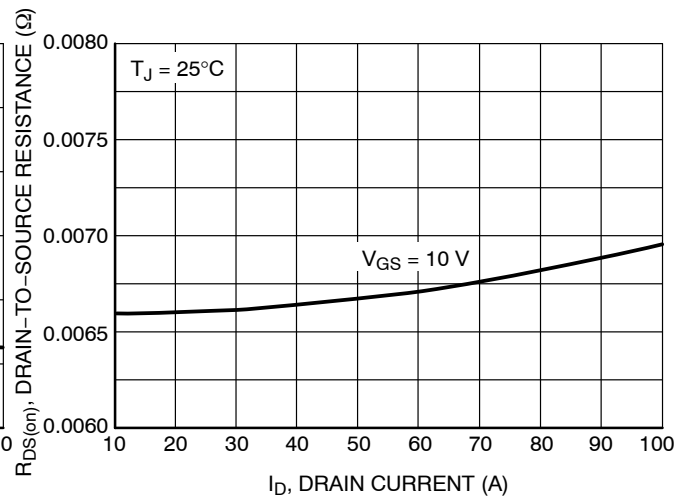


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

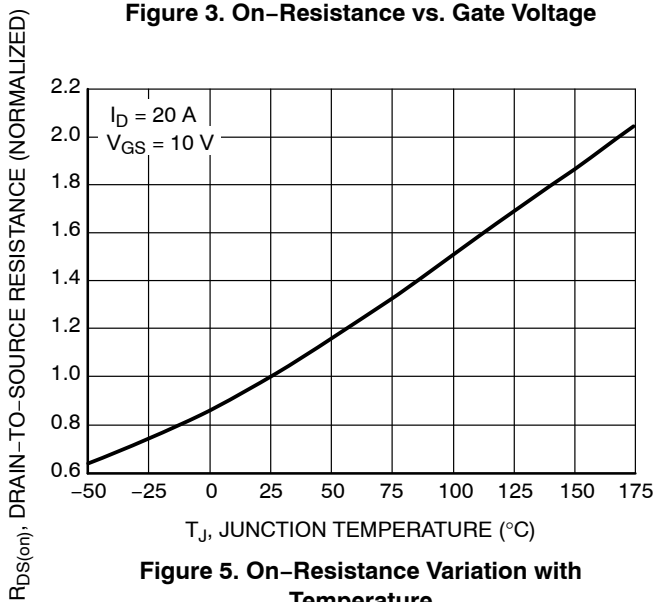


Figure 5. On-Resistance Variation with Temperature

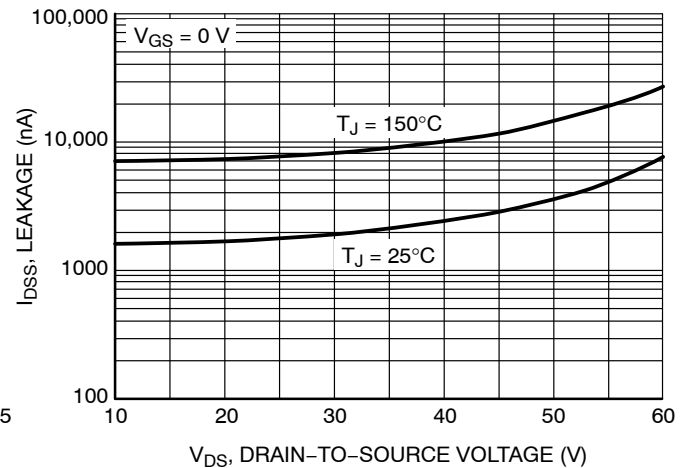


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CHARACTERISTICS

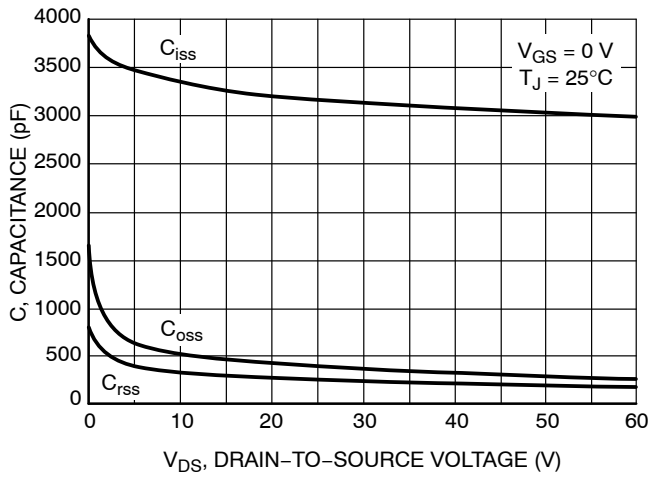


Figure 7. Capacitance Variation

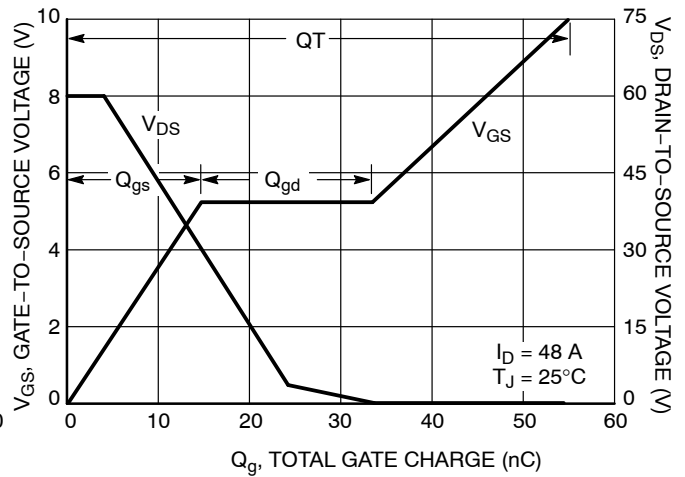


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

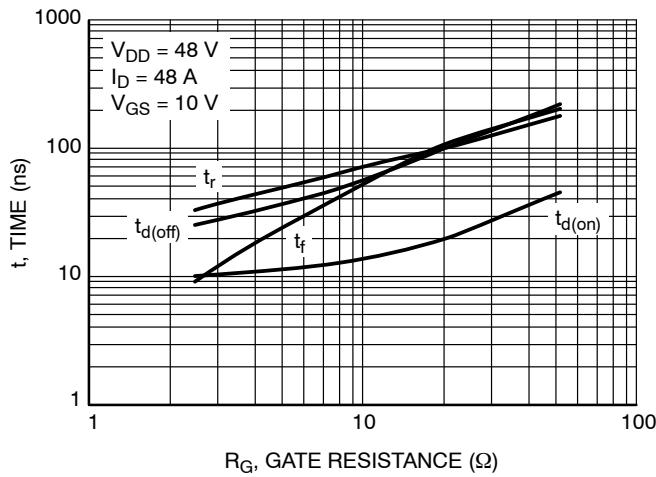


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

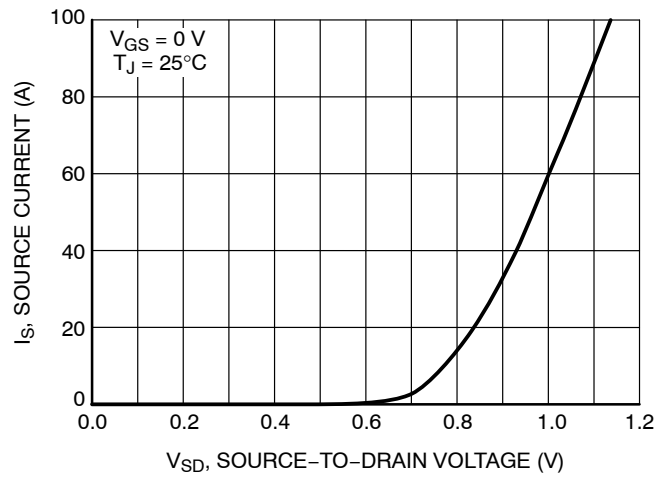


Figure 10. Diode Forward Voltage vs. Current

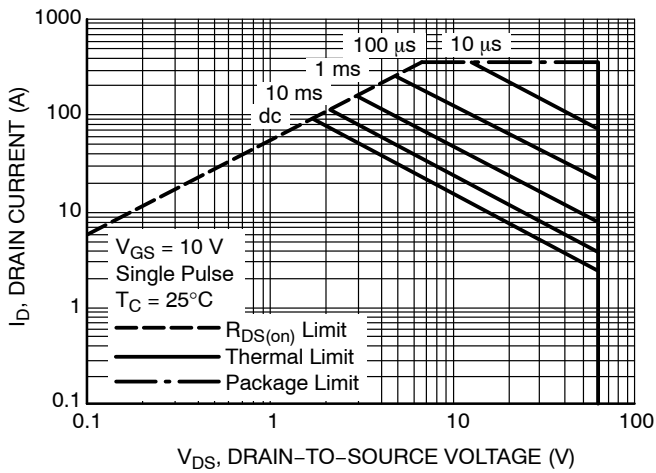


Figure 11. Maximum Rated Forward Biased Safe Operating Area

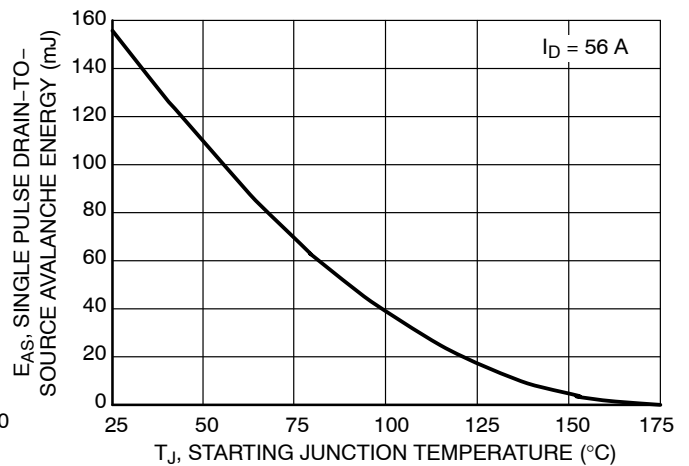
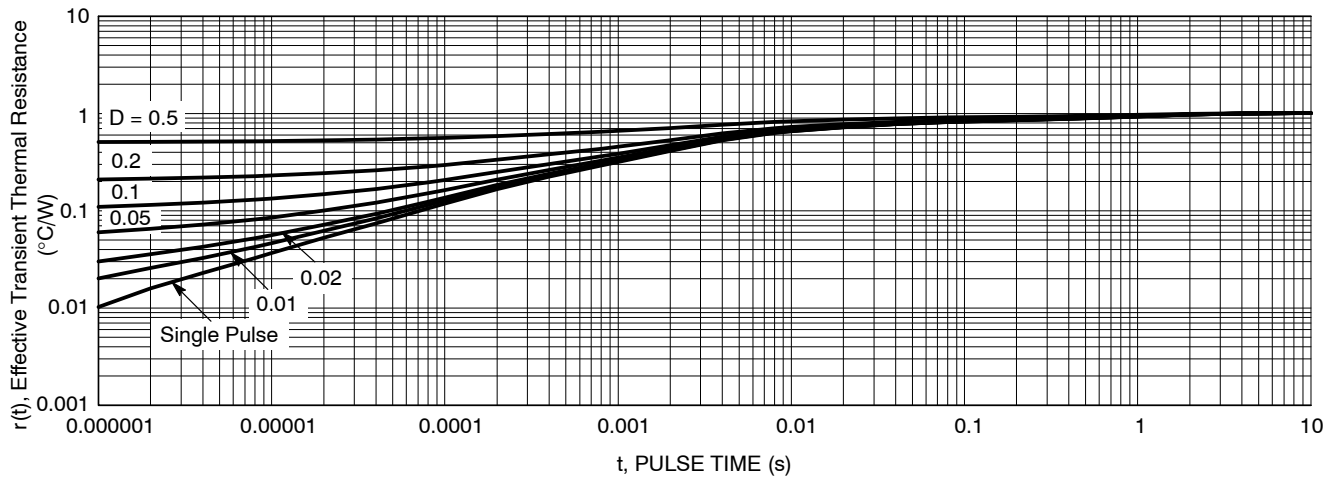


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

# NTP5863N

## TYPICAL PERFORMANCE CHARACTERISTICS



**Figure 13. Thermal Response**

### ORDERING INFORMATION

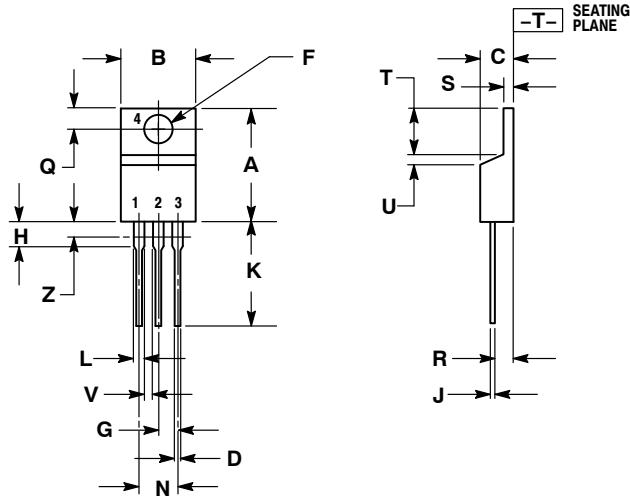
| Device    | Package               | Shipping†       |
|-----------|-----------------------|-----------------|
| NTP5863NG | TO-220AB<br>(Pb-Free) | 50 Units / Rail |

†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.

# NTP5863N

## 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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