# NTB5605P

# Power MOSFET

## −60 V, −18.5 A, P−Channel, D²PAK

ON Semiconductor®

http://onsemi.com

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP | $I_D$ MAX |
|---|---|---|
| −60 V | 120 mΩ @ −5.0 V | −18.5 A |

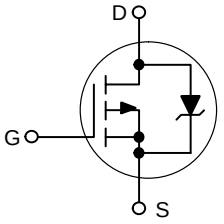
### Features

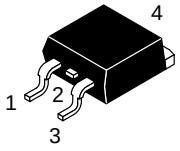
- Designed for Low $R_{DS(on)}$
- Withstands High Energy in Avalanche and Commutation Modes

### Applications

- Power Supplies
- PWM Motor Control
- Converters
- Power Management

**P−Channel**




**D²PAK**
**CASE 418B**
**STYLE 2**

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

| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | −60 | V |
| Gate−to−Source Voltage | | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current (Note 1) | Steady State | $T_A$ = 25°C | $I_D$ | −18.5 | A |
| Power Dissipation (Note 1) | Steady State | $T_A$ = 25°C | $P_D$ | 88 | W |
| Pulsed Drain Current | $t_p$ = 10 μs | | $I_{DM}$ | −55 | A |
| Operating Junction and Storage Temperature | | | $T_J$, $T_{STG}$ | −55 to 175 | °C |
| Single Pulse Drain−to−Source Avalanche Energy ($V_{DD}$ = 25 V, $V_{GS}$ = 5.0 V, $I_{PK}$ = 15 A, L = 3.0 mH, $R_G$ = 25 Ω) | | | $E_{AS}$ | 338 | mJ |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) | | | $T_L$ | 260 | °C |

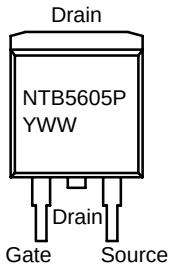
**THERMAL RESISTANCE RATINGS**

| Parameter | Symbol | Max | Unit |
|---|---|---|---|
| Junction−to−Case (Drain) – Steady State | $R_{\theta JC}$ | 1.7 | °C/W |

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″ pad size (Cu Area 1.127 in²).
2. When surface mounted to an FR4 board using the minimum recommended pad size (Cu Area 0.41 in²).

**MARKING DIAGRAM & PIN ASSIGNMENT**




NTB5605P = Device Code
Y = Year
WW = Work Week

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NTB5605P | D²PAK | 50 Units/Rail |
| NTB5605PT4 | D²PAK | 800/Tape & Reel |

†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.

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Characteristic | 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 | | −60 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(Br)DSS}/T_J$ | | | | −64 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $T_J$ = 25°C | | | −1.0 | μA |
| | | $V_{DS}$ = −60 V | $T_J$ = 125°C | | | −10 | |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | | ±100 | nA |
| **ON CHARACTERISTICS** (Note 3) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = −250 μA | | −1.0 | −1.5 | −2.0 | V |
| Drain−to−Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = −5.0 V, $I_D$ = −8.5 A<br>$V_{GS}$ = −5.0 V, $I_D$ = −17 A | | | 120<br>140 | 140 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = −10 V, $I_D$ = −8.5 A | | | 12 | | S |
| Drain−to−Source On Voltage | $V_{DS(on)}$ | $V_{GS}$ = −5.0 V, $I_D$ = −8.5 A | | | | −1.3 | V |
| **CHARGES, CAPACITANCES AND GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, f = 1.0 MHz, $V_{DS}$ = −25 V | | | 730 | 1190 | pF |
| Output Capacitance | $C_{oss}$ | | | | 211 | 300 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | | 67 | 120 | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = −5.0 V, $V_{DS}$ = −48 V, $I_D$ = −17 A | | | 13 | 22 | nC |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 4.0 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 7.0 | | |
| **SWITCHING CHARACTERISTICS** (Note 4) | | | | | | | |
| Turn−On Delay Time | $t_{d(on)}$ | $V_{GS}$ = −5.0 V, $V_{DD}$ = −30 V, $I_D$ = −17 A, $R_G$ = 9.1 Ω | | | 12.5 | 25 | ns |
| Rise Time | $t_r$ | | | | 122 | 183 | |
| Turn−Off Delay Time | $t_{d(off)}$ | | | | 29 | 58 | |
| Fall Time | $t_f$ | | | | 75 | 150 | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = −17 A | $T_J$ = 25°C | | −1.55 | −2.5 | V |
| | | | $T_J$ = 125°C | | −1.4 | | |
| Reverse Recovery Time | $t_{rr}$ | $V_{GS}$ = 0 V, $dI_S/dt$ = 100 A/μs, $I_S$ = −17 A | | | 60 | | ns |
| Charge Time | $t_a$ | | | | 39 | | |
| Discharge Time | $t_b$ | | | | 21 | | |
| Reverse Recovery Charge | $Q_{RR}$ | | | | 0.14 | | nC |

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
4. Switching characteristics are independent of operating junction temperatures.

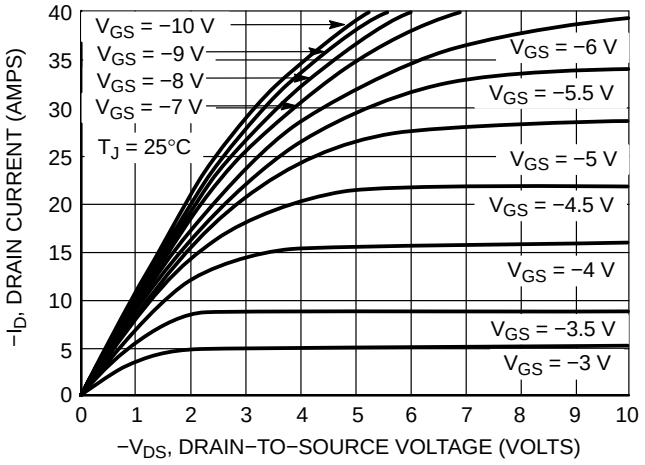



**Figure 1. On−Region Characteristics**

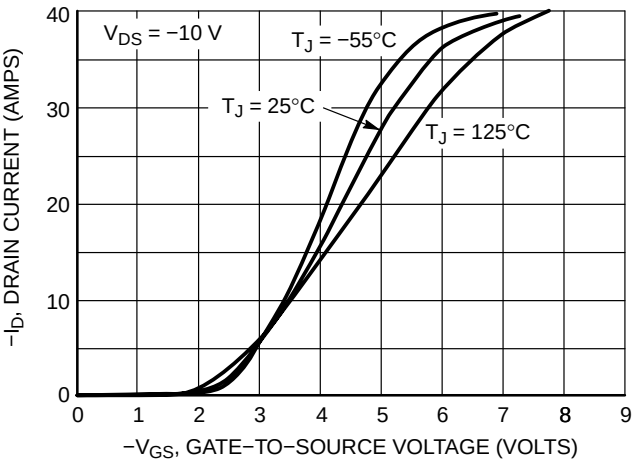



**Figure 2. Transfer Characteristics**

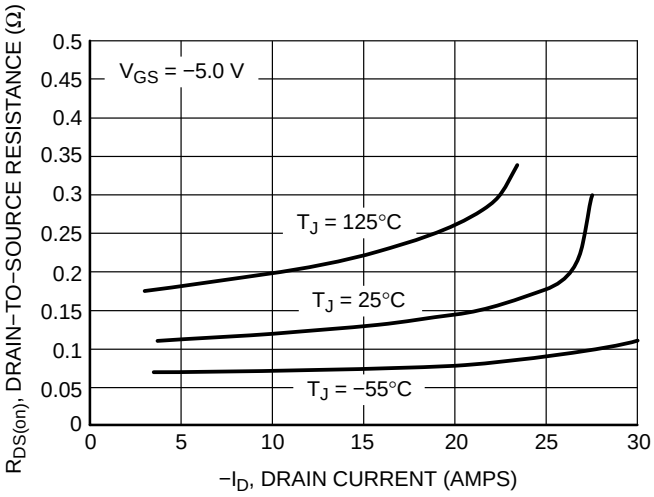



**Figure 3. On−Resistance vs. Drain Current and Temperature**

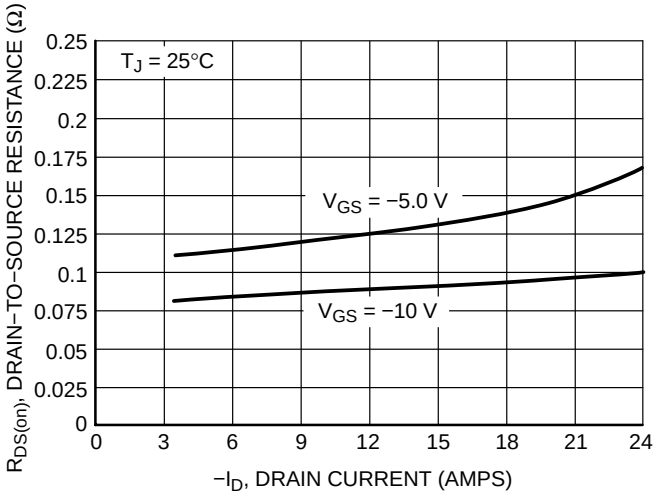



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

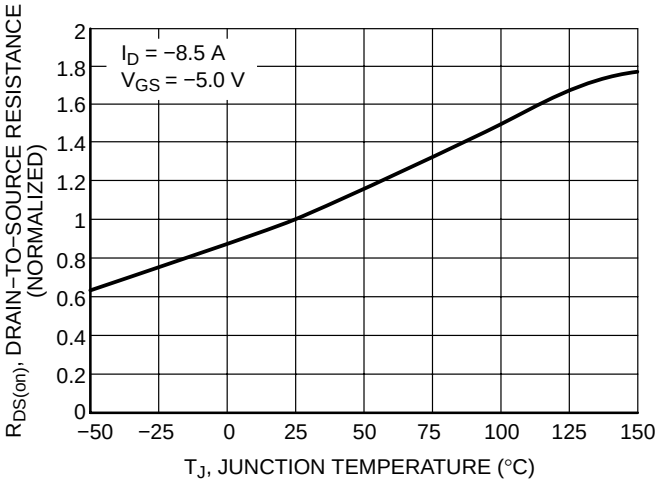



**Figure 5. On−Resistance Variation with Temperature**

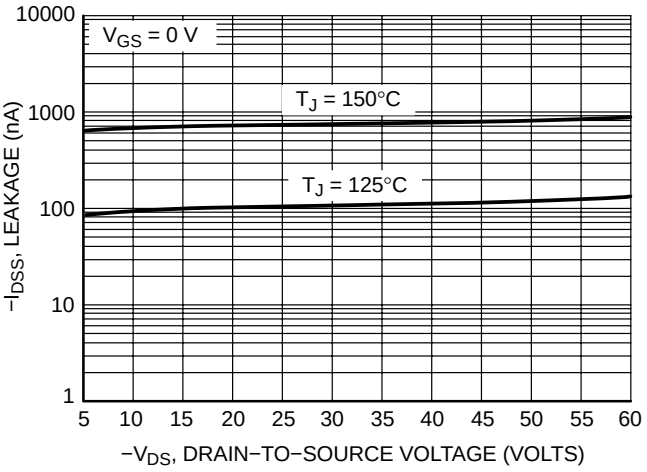



**Figure 6. Drain−to−Source Leakage Current vs. Voltage**

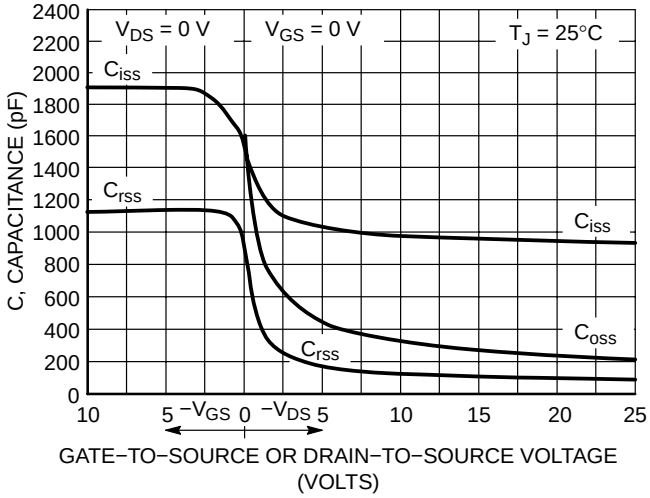



**Figure 7. Capacitance Variation**

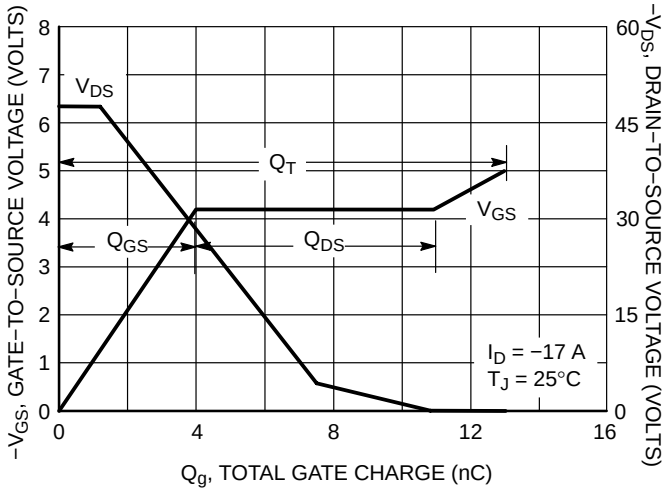



**Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge**

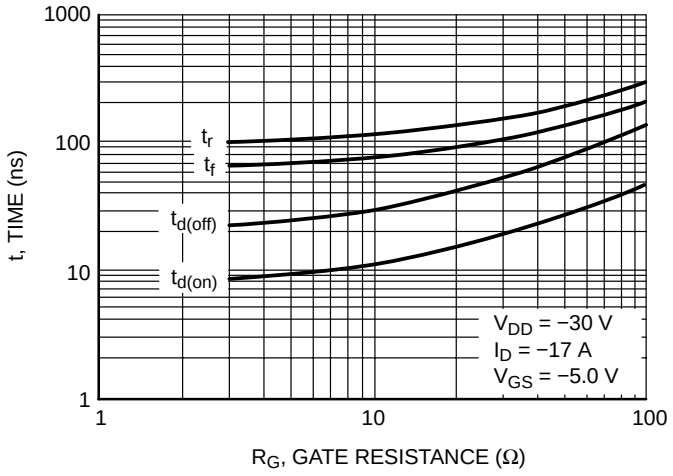



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

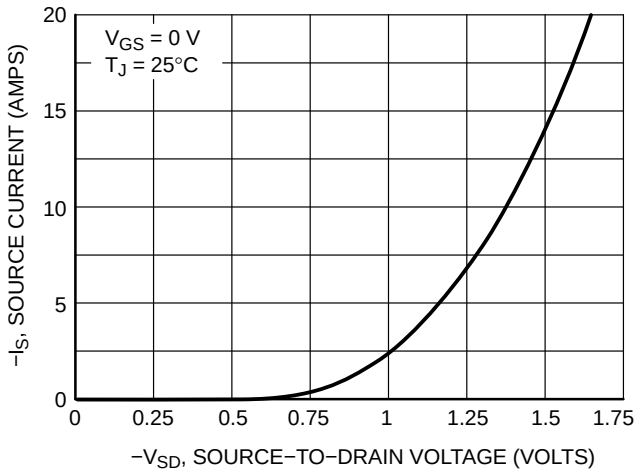



**Figure 10. Diode Forward Voltage vs. Current**

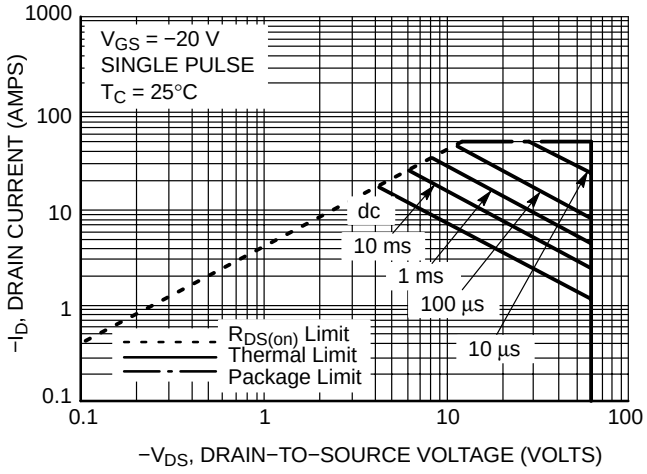



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

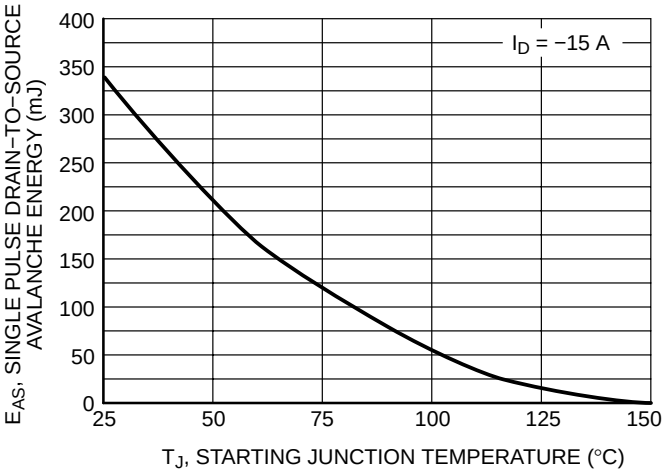



**Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature**

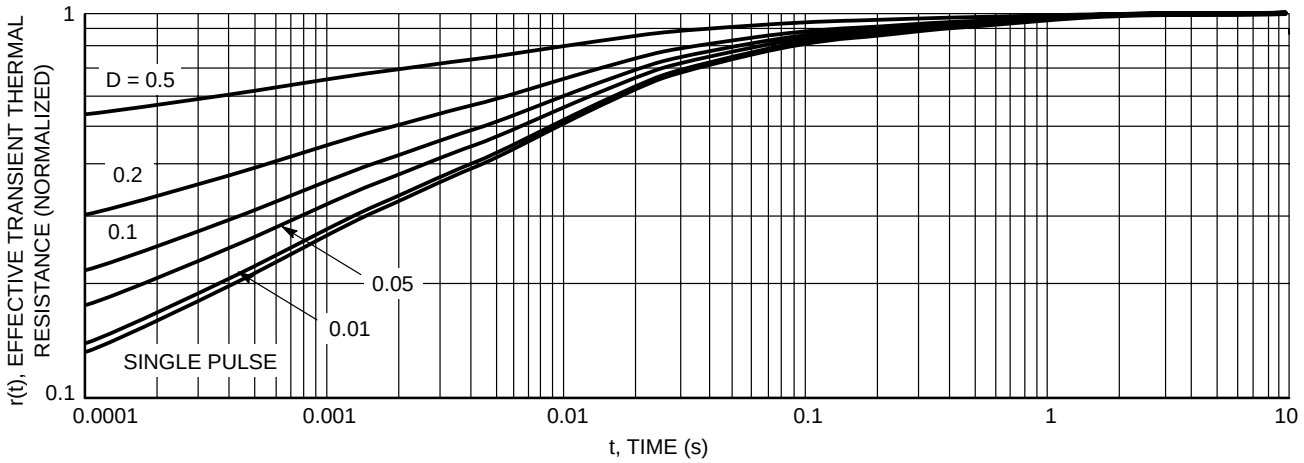



**Figure 13. Thermal Response**

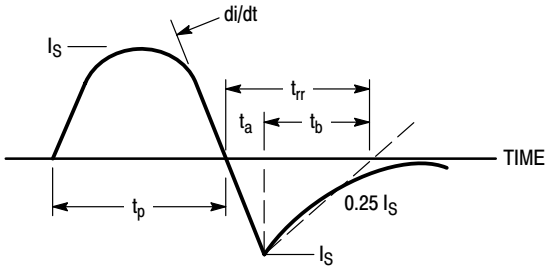
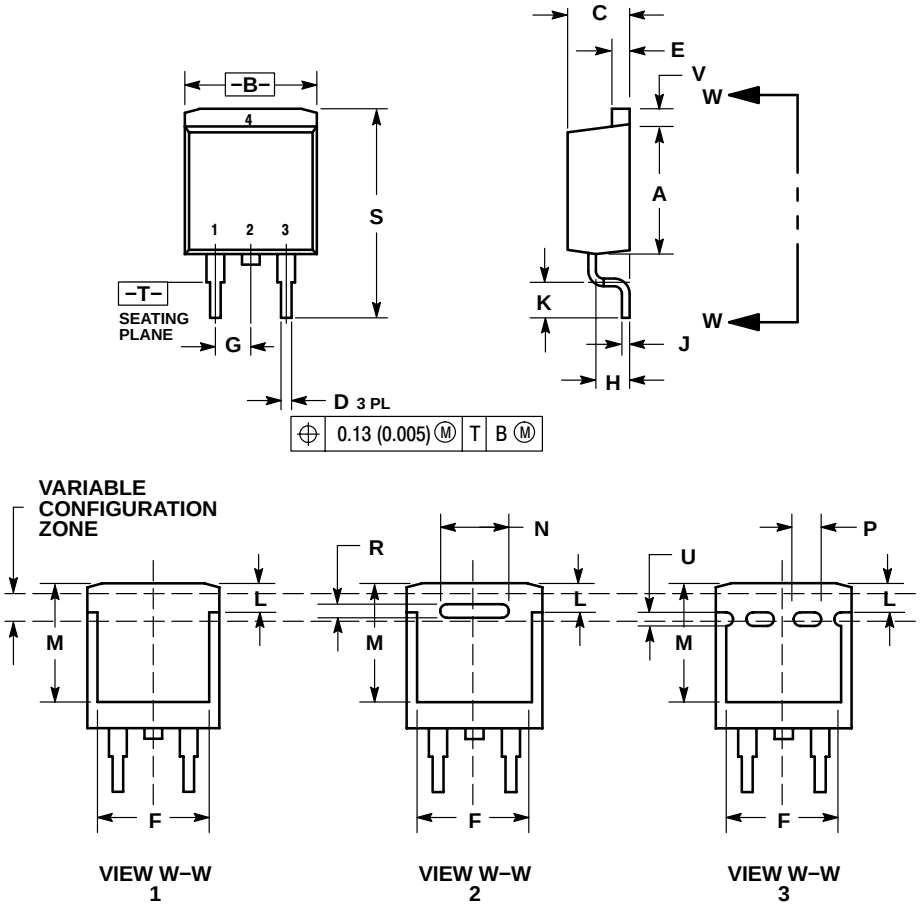



**Figure 14. Diode Reverse Recovery Waveform**

## PACKAGE DIMENSIONS

**D²PAK**
CASE 418B−04
ISSUE H

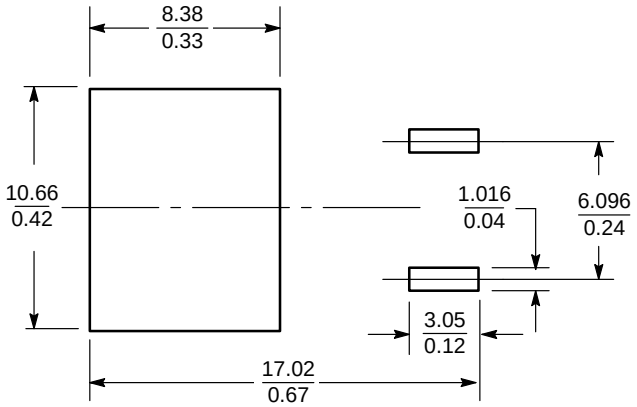



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B−01 THRU 418B−03 OBSOLETE, NEW STANDARD 418B−04.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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
2. DRAIN
3. SOURCE
4. DRAIN

## SOLDERING FOOTPRINT



# Notes

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