

# NTB5605P

## Power MOSFET

-60 V, -18.5 A, P-Channel, D<sup>2</sup>PAK

### Features

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

### Applications

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

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

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

### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Case (Drain) - Steady State	$R_{\theta JC}$	1.7	$^\circ\text{C/W}$

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 in<sup>2</sup>).
2. When surface mounted to an FR4 board using the minimum recommended pad size (Cu Area 0.41 in<sup>2</sup>).

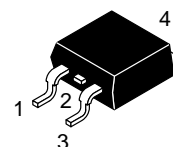
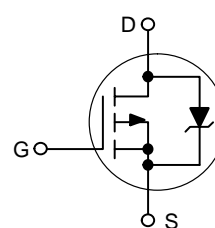


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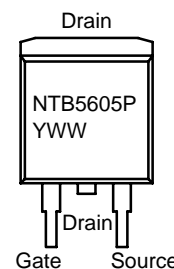
$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
-60 V	120 m $\Omega$ @ -5.0 V	-18.5 A

### P-Channel



D<sup>2</sup>PAK  
CASE 418B  
STYLE 2

### MARKING DIAGRAM & PIN ASSIGNMENT



NTB5605P = Device Code  
Y = Year  
WW = Work Week

### ORDERING INFORMATION

Device	Package	Shipping†
NTB5605P	D <sup>2</sup> PAK	50 Units/Rail
NTB5605PT4	D <sup>2</sup> PAK	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.

# NTB5605P

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

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-60			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			-64		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}$ $V_{DS} = -60\text{ V}$	$T_J = 25^\circ\text{C}$		-1.0	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		-10	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

## ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$	-1.0	-1.5	-2.0	V
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = -5.0\text{ V}, I_D = -8.5\text{ A}$ $V_{GS} = -5.0\text{ V}, I_D = -17\text{ A}$		120 140	140	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = -10\text{ V}, I_D = -8.5\text{ A}$		12		S
Drain-to-Source On Voltage	$V_{DS(on)}$	$V_{GS} = -5.0\text{ V}, I_D = -8.5\text{ A}$			-1.3	V

## CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz},$ $V_{DS} = -25\text{ V}$		730	1190	pF
Output Capacitance	$C_{oss}$			211	300	
Reverse Transfer Capacitance	$C_{rss}$			67	120	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -5.0\text{ V}, V_{DS} = -48\text{ V},$ $I_D = -17\text{ A}$		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	$t_{d(on)}$	$V_{GS} = -5.0\text{ V}, V_{DD} = -30\text{ V},$ $I_D = -17\text{ A}, R_G = 9.1\ \Omega$		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	

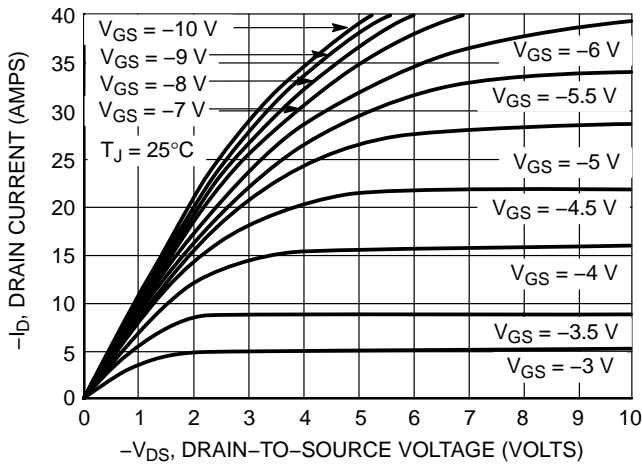
## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}$ $I_S = -17\text{ A}$	$T_J = 25^\circ\text{C}$	-1.55	-2.5	V
			$T_J = 125^\circ\text{C}$	-1.4		
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0\text{ V}, di_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = -17\text{ A}$		60		ns
Charge Time	$t_a$			39		
Discharge Time	$t_b$			21		
Reverse Recovery Charge	$Q_{RR}$			0.14		

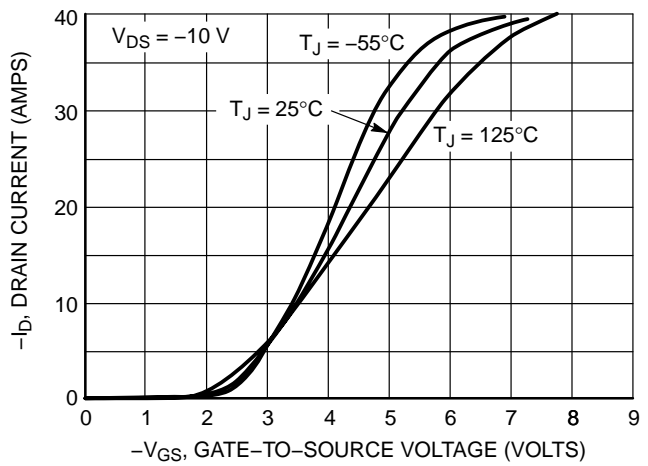
3. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperatures.

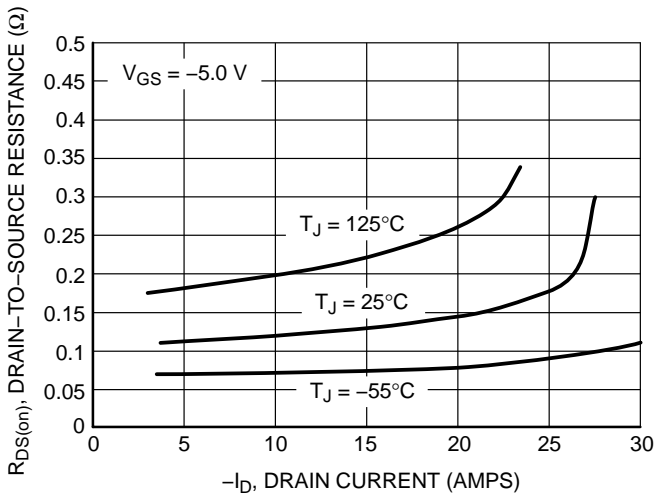
# NTB5605P



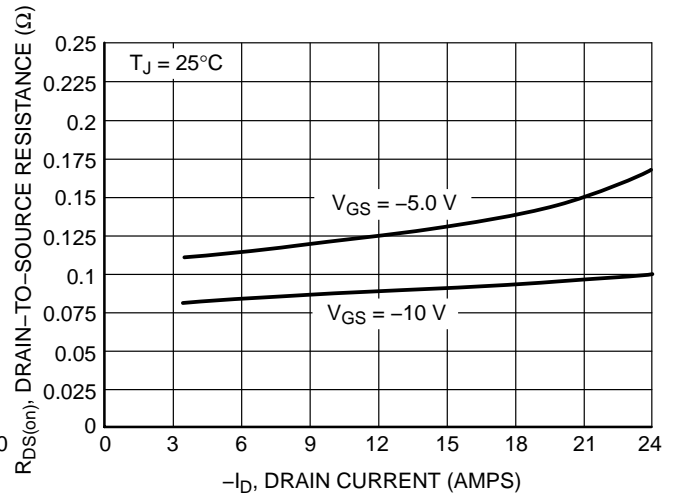
**Figure 1. On-Region Characteristics**



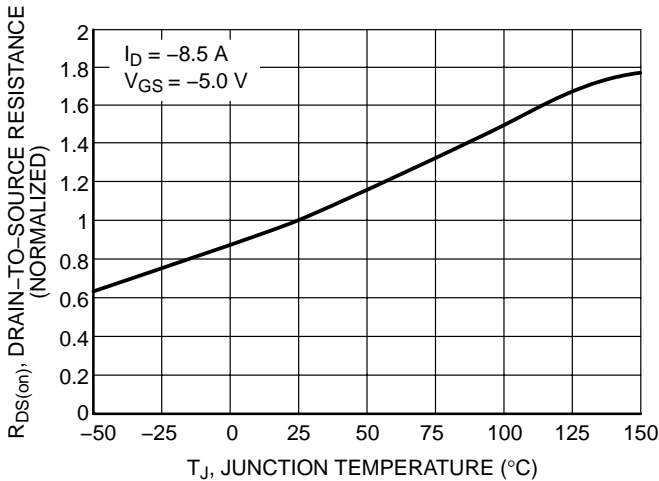
**Figure 2. Transfer Characteristics**



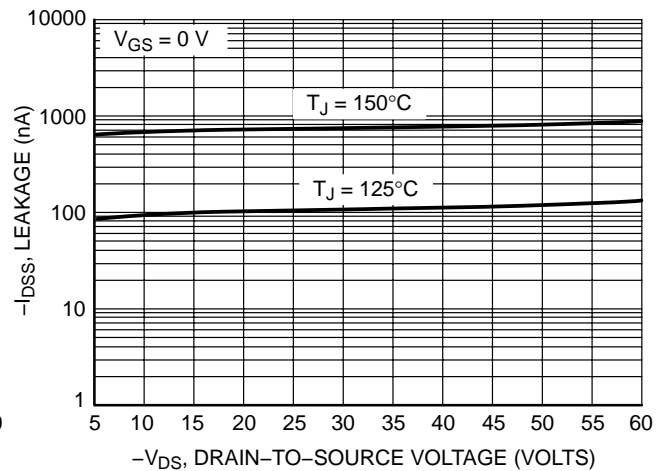
**Figure 3. On-Resistance vs. Drain Current and Temperature**



**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**

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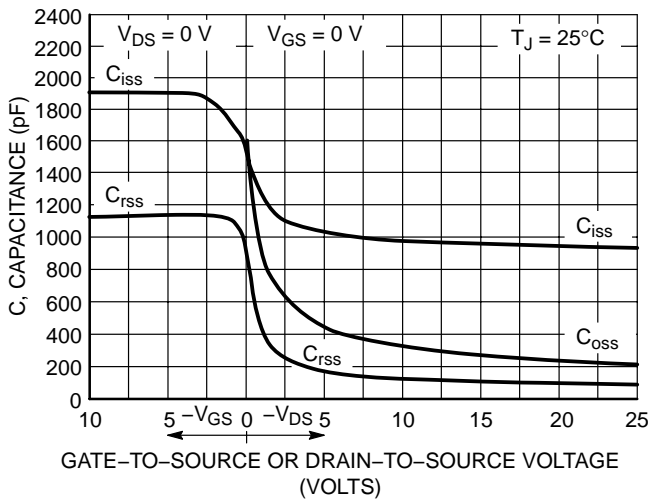


Figure 7. Capacitance Variation

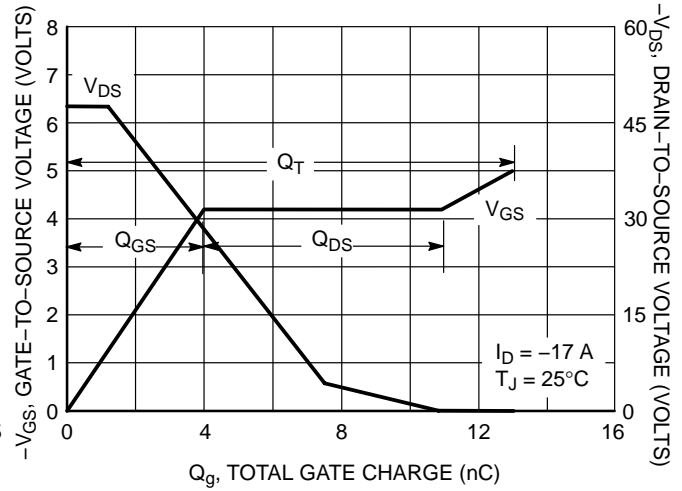


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

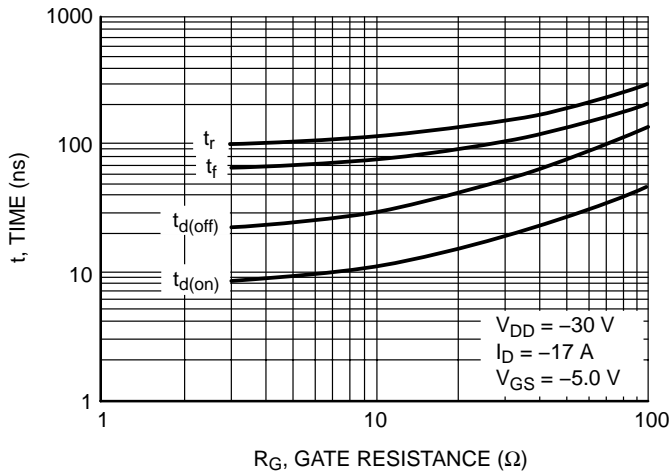


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

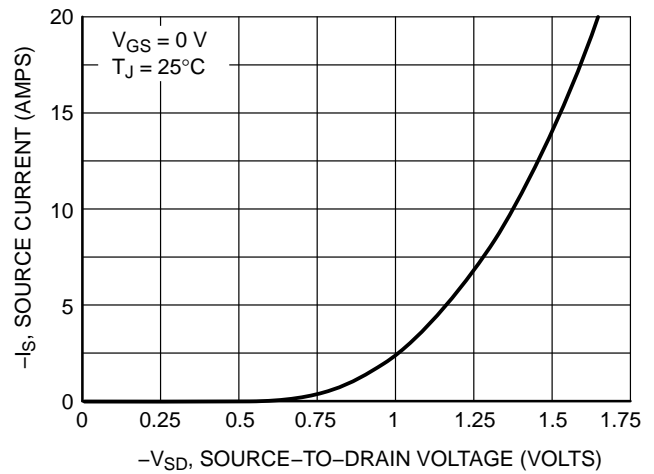


Figure 10. Diode Forward Voltage vs. Current

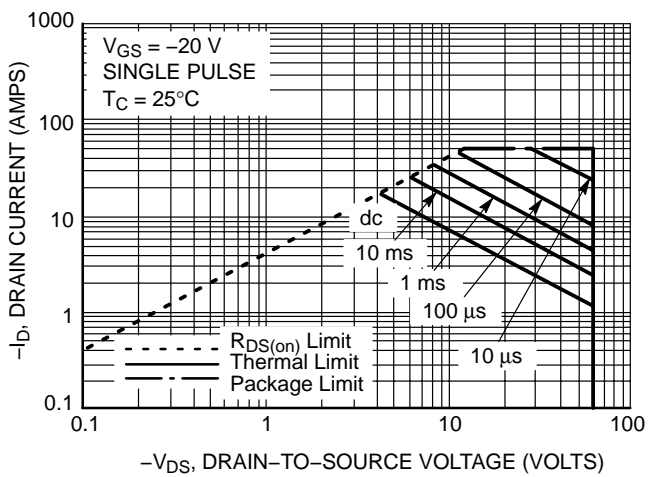


Figure 11. Maximum Rated Forward Biased Safe Operating Area

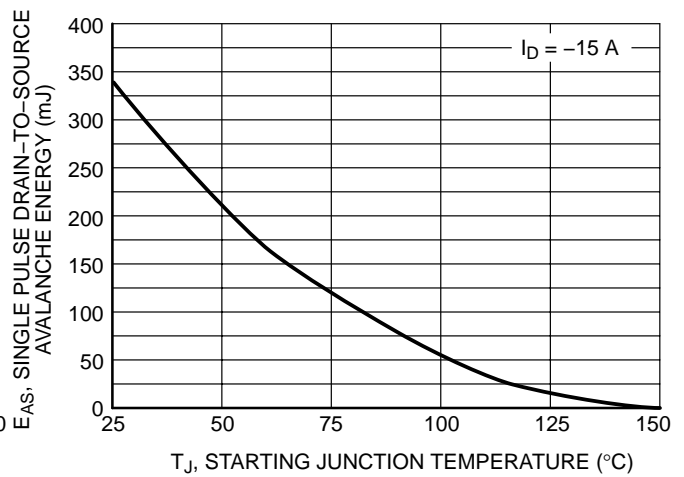


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

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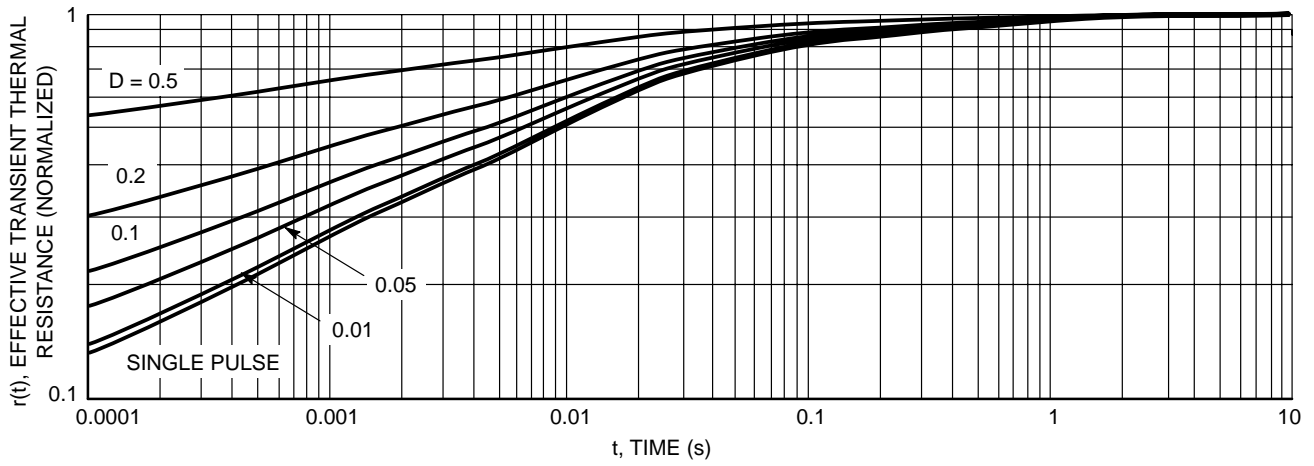


Figure 13. Thermal Response

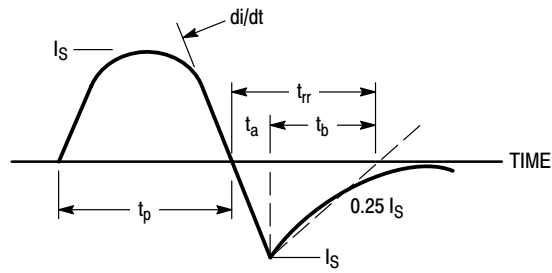
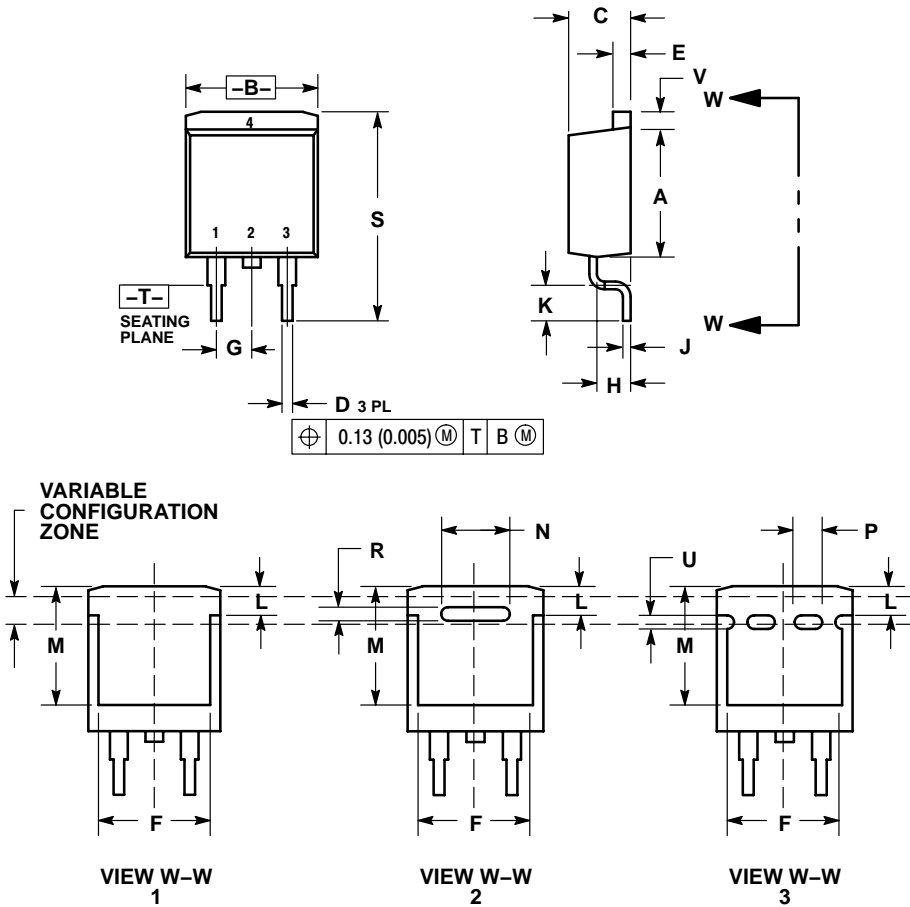


Figure 14. Diode Reverse Recovery Waveform

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## PACKAGE DIMENSIONS

D<sup>2</sup>PAK  
CASE 418B-04  
ISSUE H

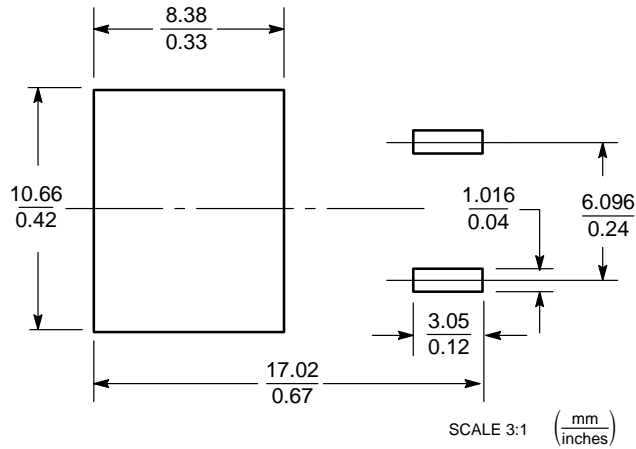


- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.  
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

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  
2. DRAIN  
3. SOURCE  
4. DRAIN

## SOLDERING FOOTPRINT



**Notes**

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