

# NTD4906N

## Power MOSFET

30 V, 54 A, Single N-Channel, DPAK/IPAK

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low Capacitance to Minimize Driver Losses
- Optimized Gate Charge to Minimize Switching Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- CPU Power Delivery
- DC-DC Converters

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

Parameter	Symbol	Value	Unit					
Drain-to-Source Voltage	$V_{DS}$	30	V					
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V					
Continuous Drain Current ( $R_{\theta JA}$ ) (Note 1)	$I_D$	$T_A = 25^\circ\text{C}$	14	A				
		$T_A = 100^\circ\text{C}$	9.9					
		Power Dissipation ( $R_{\theta JA}$ ) (Note 1)	$P_D$	$T_A = 25^\circ\text{C}$	2.6	W		
				Steady State	$T_A = 25^\circ\text{C}$	$I_D$	10.3	A
					$T_A = 100^\circ\text{C}$	7.3		
				Power Dissipation ( $R_{\theta JA}$ ) (Note 2)	$P_D$	$T_A = 25^\circ\text{C}$	1.38	W
$T_C = 25^\circ\text{C}$	$I_D$	54	A					
Continuous Drain Current ( $R_{\theta JC}$ ) (Note 2)	$I_D$	$T_C = 100^\circ\text{C}$	38					
		$T_C = 25^\circ\text{C}$	$P_D$	37.5	W			
Power Dissipation ( $R_{\theta JC}$ ) (Note 1)	$P_D$	37.5	W					
Pulsed Drain Current	$t_p=10\mu\text{s}$	$T_A = 25^\circ\text{C}$	$I_{DM}$	223	A			
Current Limited by Package	$T_A = 25^\circ\text{C}$	$I_{DmaxPkg}$	90	A				
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to 175	$^\circ\text{C}$					
Source Current (Body Diode)	$I_S$	32	A					
Drain to Source dV/dt	dV/dt	6.5	V/ns					
Single Pulse Drain-to-Source Avalanche Energy ( $T_J = 25^\circ\text{C}$ , $V_{DD} = 50\text{ V}$ , $V_{GS} = 10\text{ V}$ , $L = 0.1\text{ mH}$ , $I_{L(pk)} = 31\text{ A}$ , $R_G = 25\ \Omega$ )	$E_{AS}$	48	mJ					
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$					

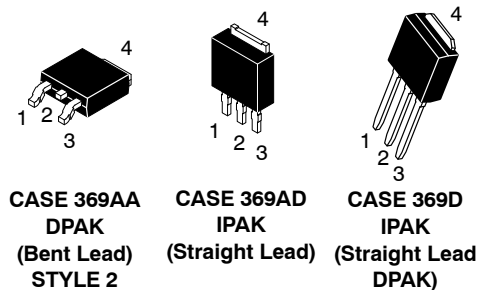
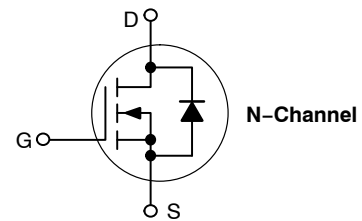
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



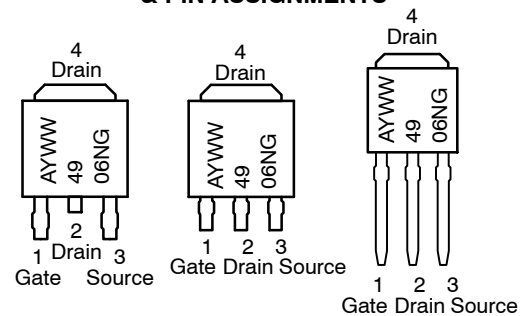
ON Semiconductor®

<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
30 V	5.5 m $\Omega$ @ 10 V	54 A
	8.0 m $\Omega$ @ 4.5 V	



### MARKING DIAGRAMS & PIN ASSIGNMENTS



A = Assembly Location  
 Y = Year  
 WW = Work Week  
 4906N = Device Code  
 G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

# NTD4906N

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	4.0	°C/W
Junction-to-Tab (Drain)	$R_{\theta JC-TAB}$	4.3	
Junction-to-Ambient - Steady State (Note 1)	$R_{\theta JA}$	58	
Junction-to-Ambient - Steady State (Note 2)	$R_{\theta JA}$	109	

- Surface-mounted on FR4 board using 1 in sq pad size, 1 oz Cu.
- Surface-mounted on FR4 board using the minimum recommended pad size.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			15		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$	$T_J = 25^\circ\text{C}$		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	1.6	2.2	V	
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			4.0		mV/°C	
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 30\text{ A}$		4.6	5.5	m $\Omega$
			$I_D = 15\text{ A}$		4.6		
		$V_{GS} = 4.5\text{ V}$	$I_D = 30\text{ A}$		6.5	8.0	
			$I_D = 15\text{ A}$		6.5		
Forward Transconductance	$g_{FS}$	$V_{DS} = 1.5\text{ V}, I_D = 30\text{ A}$		52		S	

### CHARGES AND CAPACITANCES

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 15\text{ V}$		1932		pF
Output Capacitance	$C_{oss}$			642		
Reverse Transfer Capacitance	$C_{rss}$			19		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		11		nC
Threshold Gate Charge	$Q_{G(TH)}$			3.0		
Gate-to-Source Charge	$Q_{GS}$			5.9		
Gate-to-Drain Charge	$Q_{GD}$			1.8		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		24		nC

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\ \Omega$		13		ns
Rise Time	$t_r$			21		
Turn-Off Delay Time	$t_{d(off)}$			20		
Fall Time	$t_f$			3.7		
Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\ \Omega$		7.7		ns
Rise Time	$t_r$			19		
Turn-Off Delay Time	$t_{d(off)}$			22		
Fall Time	$t_f$			2.3		

- Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

# NTD4906N

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 30 A	T <sub>J</sub> = 25°C		0.87	1.1	V
			T <sub>J</sub> = 125°C		0.76		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, dI <sub>S</sub> /dt = 100 A/μs, I <sub>S</sub> = 30 A		33		ns	
Charge Time	t <sub>a</sub>			17			
Discharge Time	t <sub>b</sub>			16			
Reverse Recovery Time	Q <sub>RR</sub>			25			nC

### PACKAGE PARASITIC VALUES

Source Inductance (Note 5)	L <sub>S</sub>	T <sub>A</sub> = 25°C		2.85		nH
Drain Inductance, DPAK	L <sub>D</sub>			0.0164		
Drain Inductance, IPAK (Note 5)	L <sub>D</sub>			1.88		
Gate Inductance (Note 5)	L <sub>G</sub>			4.9		
Gate Resistance	R <sub>G</sub>			1.0	2.0	

5. Assume terminal length of 110 mils.

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## TYPICAL PERFORMANCE CURVES

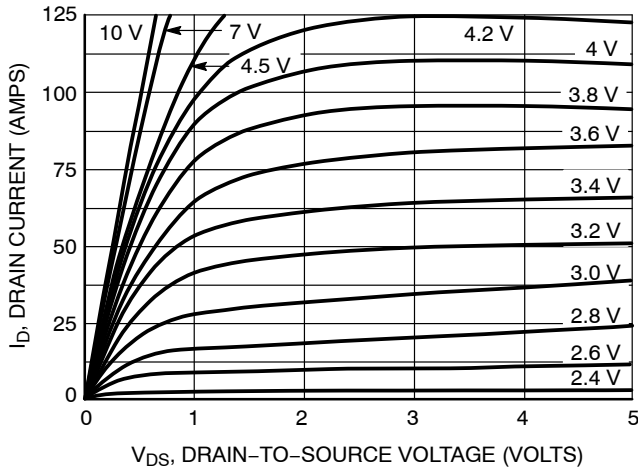


Figure 1. On-Region Characteristics

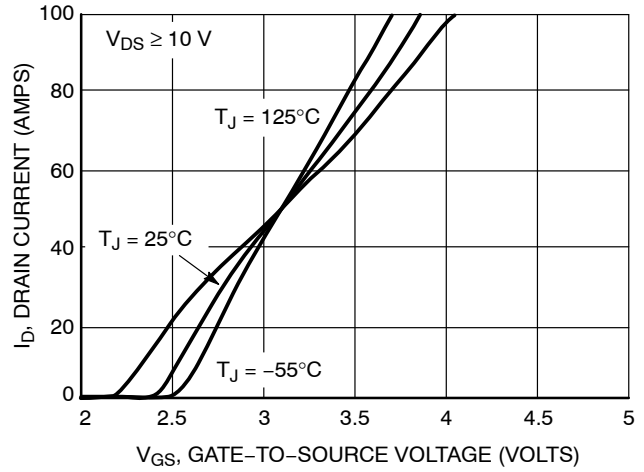


Figure 2. Transfer Characteristics

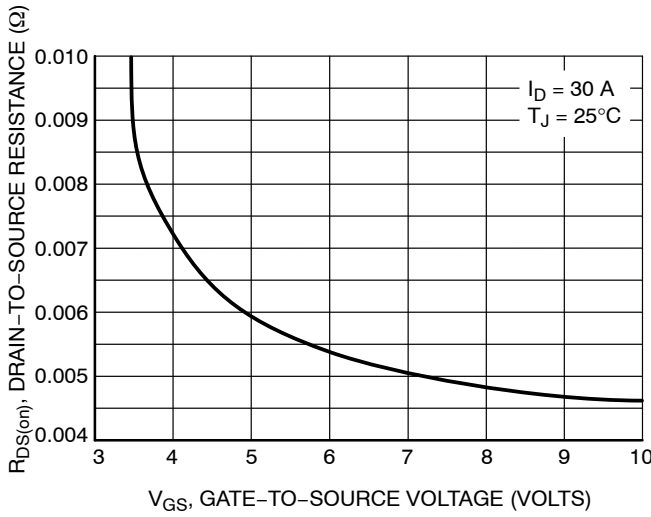


Figure 3. On-Resistance vs. Gate-to-Source Voltage

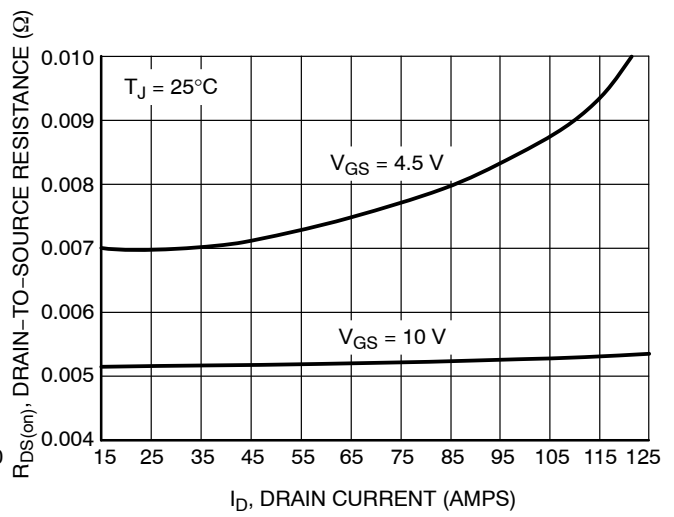


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

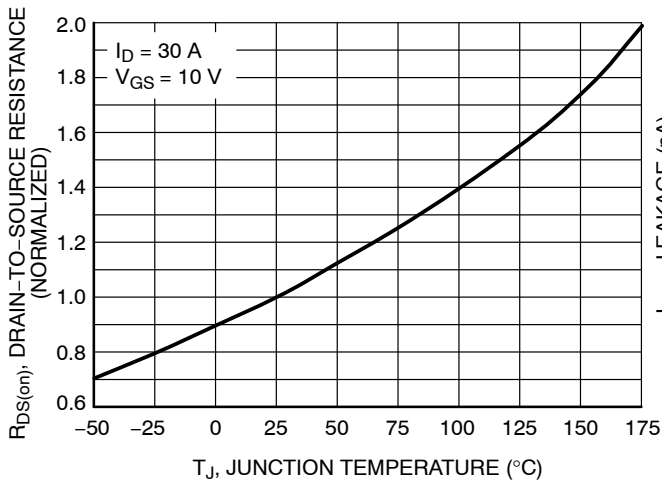


Figure 5. On-Resistance Variation with Temperature

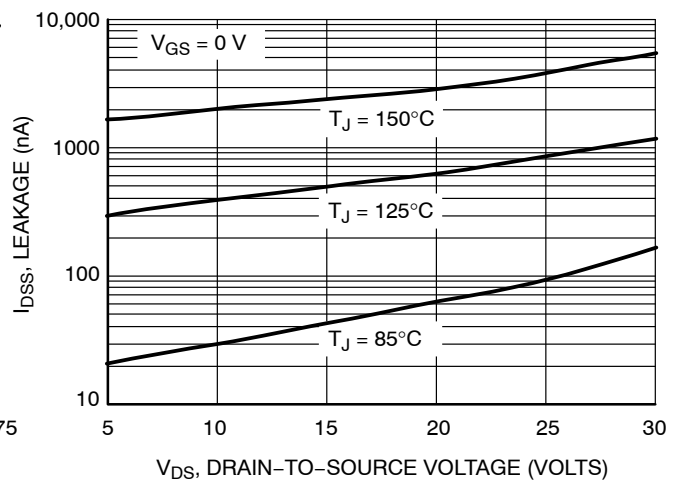


Figure 6. Drain-to-Source Leakage Current vs. Drain Voltage

TYPICAL PERFORMANCE CURVES

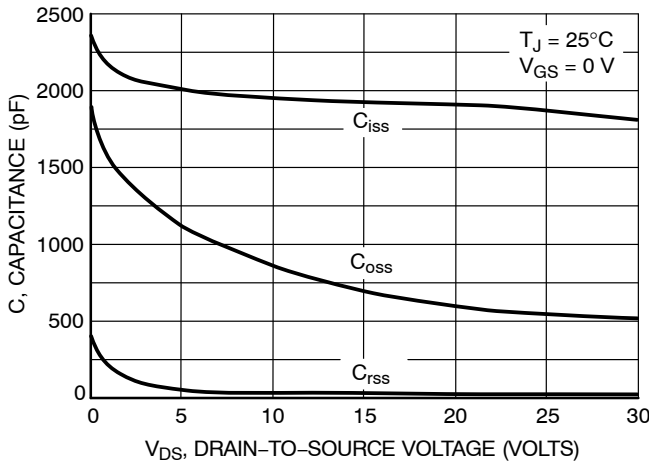


Figure 7. Capacitance Variation

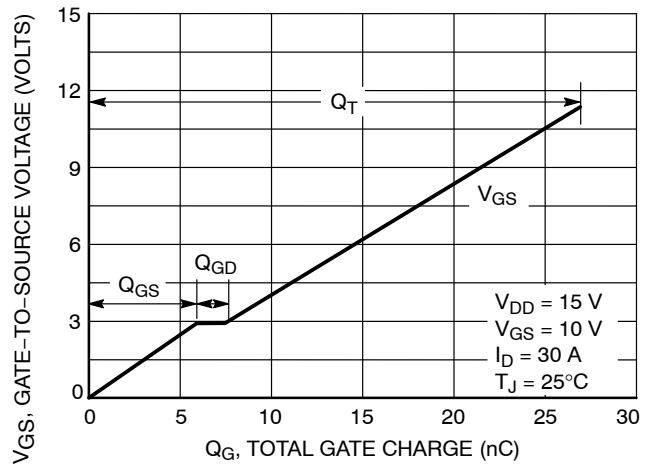


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

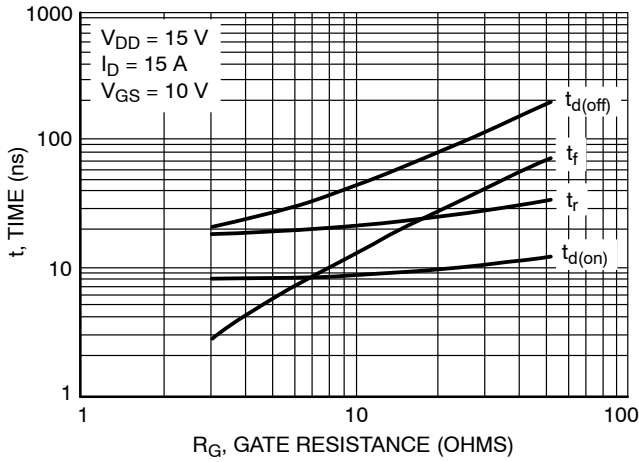


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

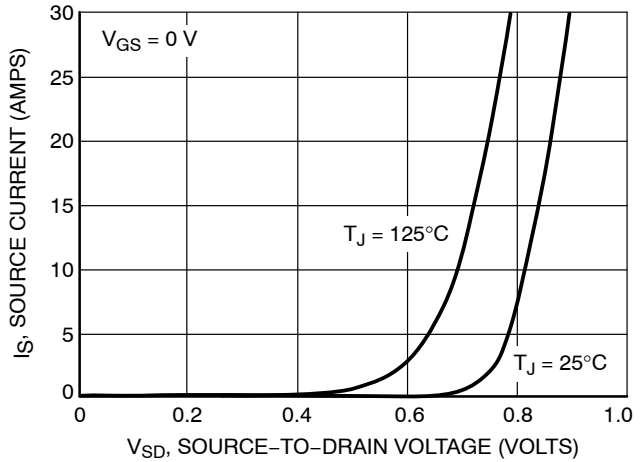


Figure 10. Diode Forward Voltage vs. Current

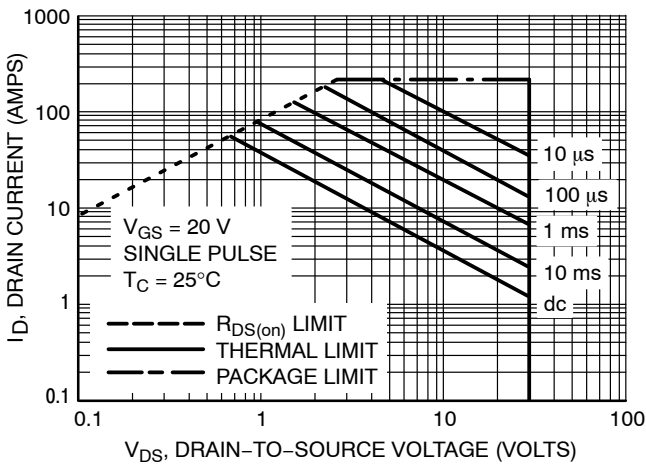


Figure 11. Maximum Rated Forward Biased Safe Operating Area

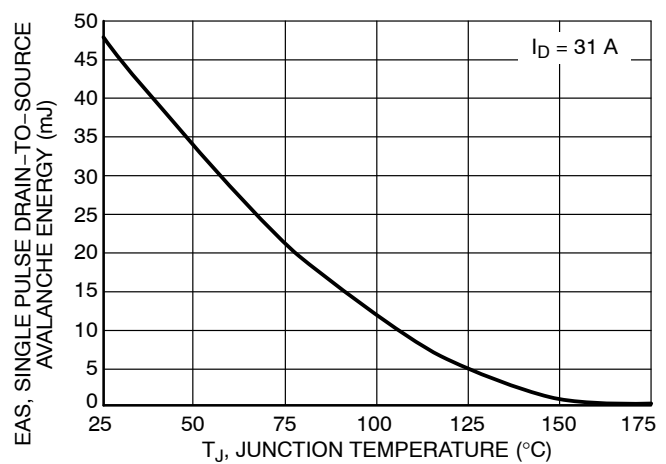


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

# NTD4906N

## TYPICAL PERFORMANCE CURVES

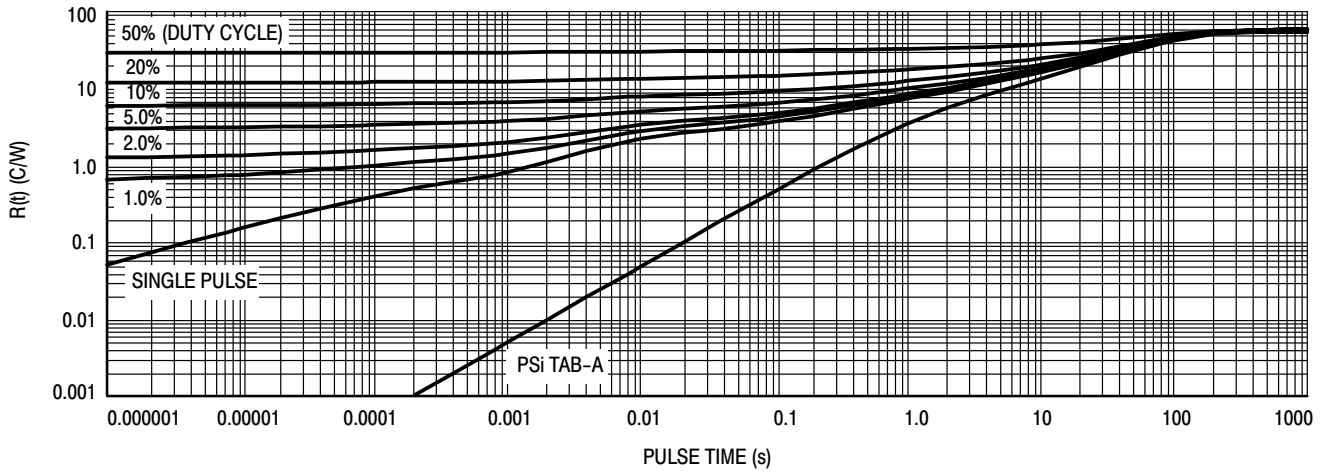


Figure 13. FET Thermal Response

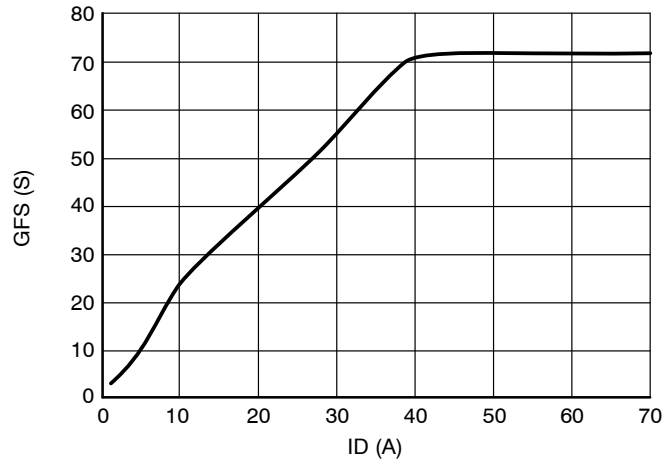


Figure 14. GFS vs ID

### ORDERING INFORMATION

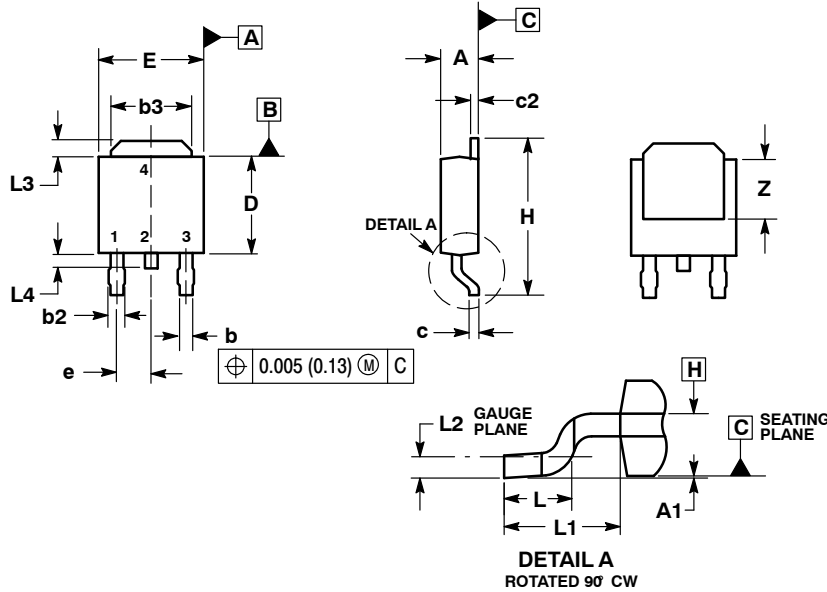
Order Number	Package	Shipping <sup>†</sup>
NTD4906NT4G	DPAK (Pb-Free, Halide-Free)	2500 / Tape & Reel
NTD4906N-1G	IPAK (Pb-Free, Halide-Free)	75 Units / Rail
NTD4906N-35G	IPAK Trimmed Lead (Pb-Free, Halide-Free)	75 Units / Rail
NTD4906NT4H	DPAK (Pb-Free, Halide-Free)	2500 / Tape & Reel
NTD4906N-1H	IPAK (Pb-Free, Halide-Free)	75 Units / Rail
NTD4906N-35H	IPAK Trimmed Lead (Pb-Free, Halide-Free)	75 Units / Rail

<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.

# NTD4906N

## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369AA ISSUE B

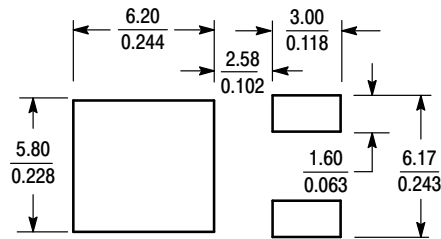


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. 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.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. 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	---

### SOLDERING FOOTPRINT\*



SCALE 3:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

**STYLE 2:**

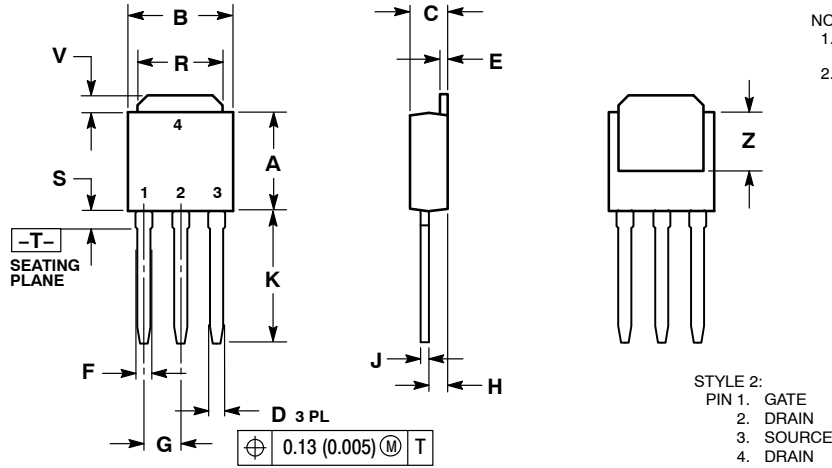
- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN

\*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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## PACKAGE DIMENSIONS

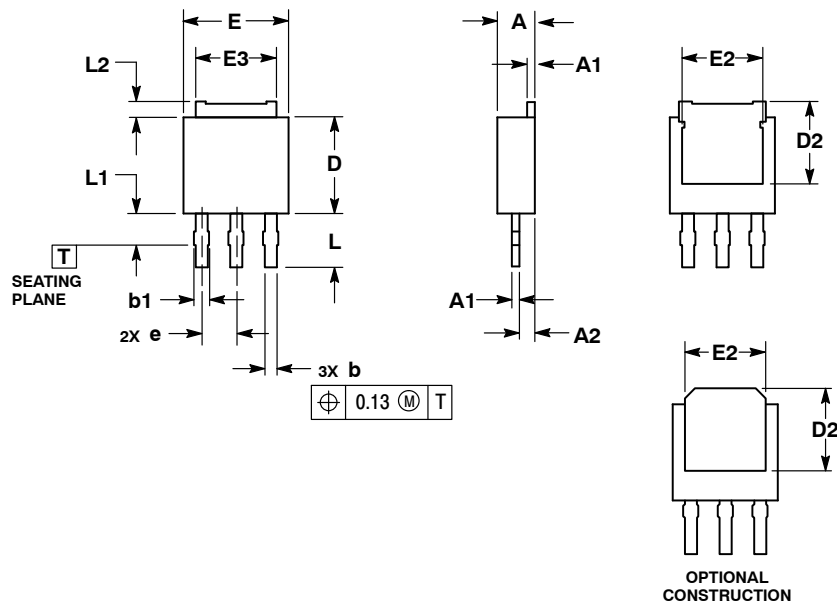
### IPAK (STRAIGHT LEAD DPAK) CASE 369D ISSUE C



- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.35
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.090 BSC		2.29 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.350	0.380	8.89	9.65
R	0.180	0.215	4.45	5.45
S	0.025	0.040	0.63	1.01
V	0.035	0.050	0.89	1.27
Z	0.155	---	3.93	---

### 3.5 MM IPAK, STRAIGHT LEAD CASE 369AD ISSUE B



- NOTES:  
1.. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.  
2.. CONTROLLING DIMENSION: MILLIMETERS.  
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP.  
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD GATE OR MOLD FLASH.

DIM	MILLIMETERS	
	MIN	MAX
A	2.19	2.38
A1	0.46	0.60
A2	0.87	1.10
b	0.69	0.89
b1	0.77	1.10
D	5.97	6.22
D2	4.80	---
E	6.35	6.73
E2	4.57	5.45
E3	4.45	5.46
e	2.28 BSC	
L	3.40	3.60
L1	---	2.10
L2	0.89	1.27

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