

NTD4965N

Power MOSFET

30 V, 68 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
- Three Package Variations for Design Flexibility
- 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 stated)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		V_{DSS}	30	V	
Gate-to-Source Voltage		V_{GS}	± 20	V	
Continuous Drain Current $R_{\theta JA}$ (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	I_D	17.8	A
		$T_A = 100^\circ\text{C}$		12.6	
Power Dissipation $R_{\theta JA}$ (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	P_D	2.6	W
Continuous Drain Current $R_{\theta JA}$ (Note 2)		$T_A = 25^\circ\text{C}$	I_D	13.0	A
Power Dissipation $R_{\theta JA}$ (Note 2)	Steady State	$T_A = 100^\circ\text{C}$		9.2	
		$T_A = 25^\circ\text{C}$	P_D	1.39	W
Continuous Drain Current $R_{\theta JC}$ (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	I_D	68	A
		$T_C = 100^\circ\text{C}$		48	
Power Dissipation $R_{\theta JC}$ (Note 1)	Steady State	$T_C = 25^\circ\text{C}$	P_D	38.5	W
Pulsed Drain Current		$t_p = 10\mu\text{s}$	$T_A = 25^\circ\text{C}$	I_{DM}	248
Current Limited by Package	$T_A = 25^\circ\text{C}$	$I_{DmaxPkg}$	76	A	
Operating Junction and Storage Temperature		T_J, T_{STG}	-55 to +175	$^\circ\text{C}$	
Source Current (Body Diode)		I_S	35	A	
Drain to Source dV/dt		dV/dt	6.0	V/ns	
Single Pulse Drain-to-Source Avalanche Energy ($T_J = 25^\circ\text{C}, V_{DD} = 24\text{ V}, V_{GS} = 10\text{ V}, I_L = 28\text{ A}_{pk}, L = 0.1\text{ mH}, R_G = 25\ \Omega$)		EAS	39	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.

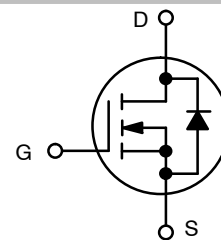
1. Surface-mounted on FR4 board using 1 sq-in pad, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.



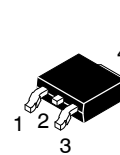
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<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
30 V	4.7 m Ω @ 10 V	68 A
	10 m Ω @ 4.5 V	



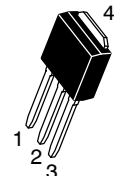
N-CHANNEL MOSFET



CASE 369AA
DPAK
(Bent Lead)
STYLE 2

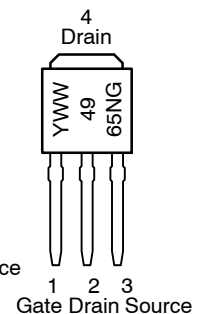
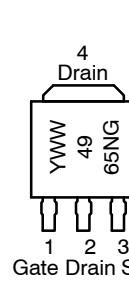
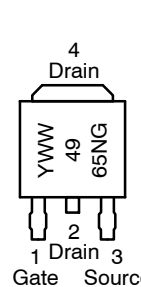


CASE 369AC
3 IPAK
(Straight Lead)



CASE 369D
IPAK
(Straight Lead
DPAK)

MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year
WW = Work Week
4965N = Device Code
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

NTD4965N

THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	3.9	°C/W
Junction-to-TAB (Drain)	$R_{\theta JC-TAB}$	4.3	
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	57.6	
Junction-to-Ambient – Steady State (Note 4)	$R_{\theta JA}$	107.6	

3. Surface-mounted on FR4 board using 1 sq-in pad, 1 oz Cu.

4. Surface-mounted on FR4 board using the minimum recommended pad size.

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

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	$V_{(BR)DSS}/T_J$			21.5		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	μA
			$T_J = 125^\circ\text{C}$		10	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			± 100	nA

ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.5	1.8	2.5	V	
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			4.1		mV/°C	
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 30\text{ A}$		3.4	4.7	m Ω
			$I_D = 15\text{ A}$		3.4		
		$V_{GS} = 4.5\text{ V}$	$I_D = 30\text{ A}$		5.4	10	
			$I_D = 15\text{ A}$		5.3		
Forward Transconductance	g_{FS}	$V_{DS} = 1.5\text{ V}, I_D = 30\text{ A}$		52		S	

CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 15\text{ V}$		1710		pF
Output Capacitance	C_{OSS}			664		
Reverse Transfer Capacitance	C_{RSS}			340		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		17.2		nC
Threshold Gate Charge	$Q_{G(TH)}$			2.7		
Gate-to-Source Charge	Q_{GS}			5.1		
Gate-to-Drain Charge	Q_{GD}			8.5		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		28.2		nC

SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\ \Omega$		12.1		ns
Rise Time	t_r			34.2		
Turn-Off Delay Time	$t_{d(OFF)}$			18.9		
Fall Time	t_f			14.2		

5. Pulse Test: pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.

6. Switching characteristics are independent of operating junction temperatures.

7. Assume terminal length of 110 mils.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS (Note 6)						
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V},$ $I_D = 15\text{ A}, R_G = 3.0\ \Omega$		8.3		ns
Rise Time	t_r			21.5		
Turn-Off Delay Time	$t_{d(OFF)}$			24.4		
Fall Time	t_f			7.8		

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V},$ $I_S = 30\text{ A}$	$T_J = 25^\circ\text{C}$		0.86	1.1	V
			$T_J = 125^\circ\text{C}$		0.74		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s},$ $I_S = 30\text{ A}$			28.3		ns
Charge Time	t_a				13.3		
Discharge Time	t_b				15		
Reverse Recovery Charge	Q_{RR}				16		

PACKAGE PARASITIC VALUES

Source Inductance (Note 7)	L_S	$T_A = 25^\circ\text{C}$		2.85		nH
Drain Inductance, DPAK	L_D			0.0164		
Drain Inductance, IPAK (Note 7)	L_D			1.88		
Gate Inductance (Note 7)	L_G			4.9		
Gate Resistance	R_G			1.0	2.2	

- Pulse Test: pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.
- Switching characteristics are independent of operating junction temperatures.
- Assume terminal length of 110 mils.

ORDERING INFORMATION

Device	Package	Shipping [†]
NTD4965NT4G	DPAK (Pb-Free)	2500 / Tape & Reel
NTD4965N-1G	IPAK (Pb-Free)	75 Units / Rail
NTD4965N-35G	IPAK Trimmed Lead (Pb-Free)	75 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.

TYPICAL PERFORMANCE CURVES

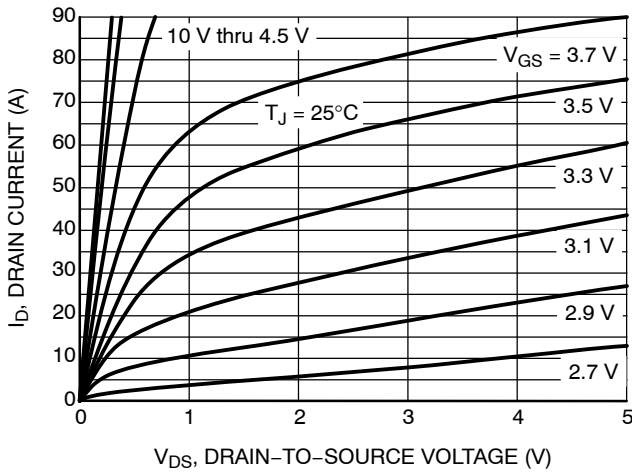


Figure 1. On-Region Characteristics

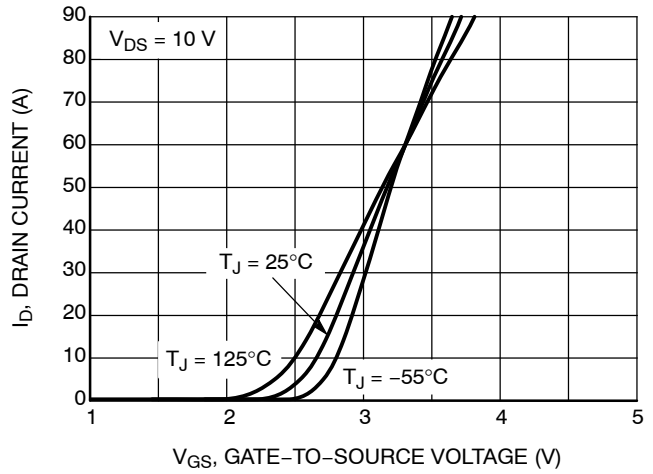


Figure 2. Transfer Characteristics

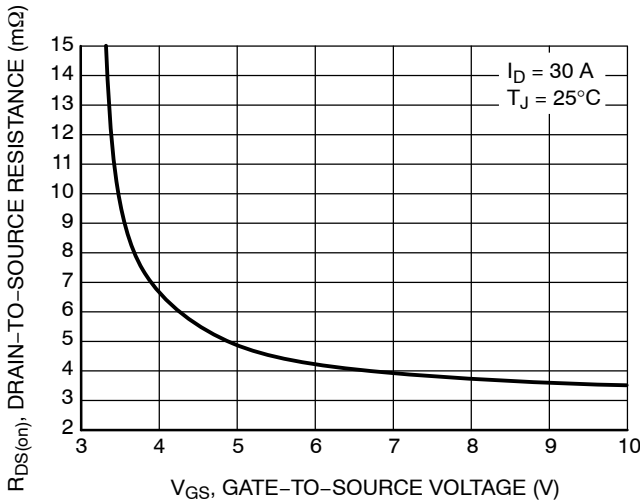


Figure 3. On-Resistance vs. Gate-to-Source Voltage

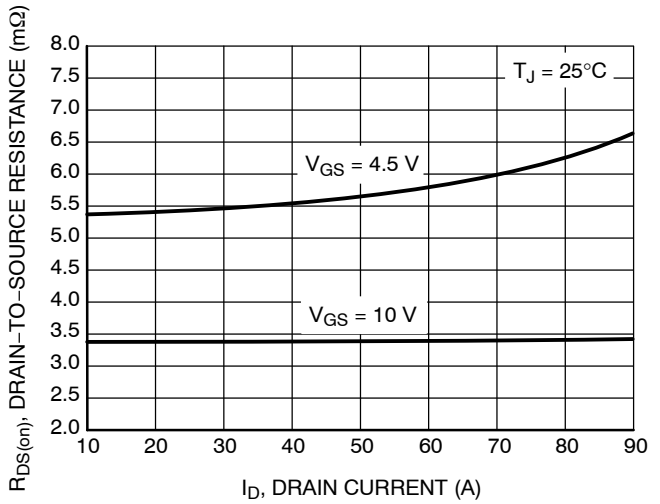


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

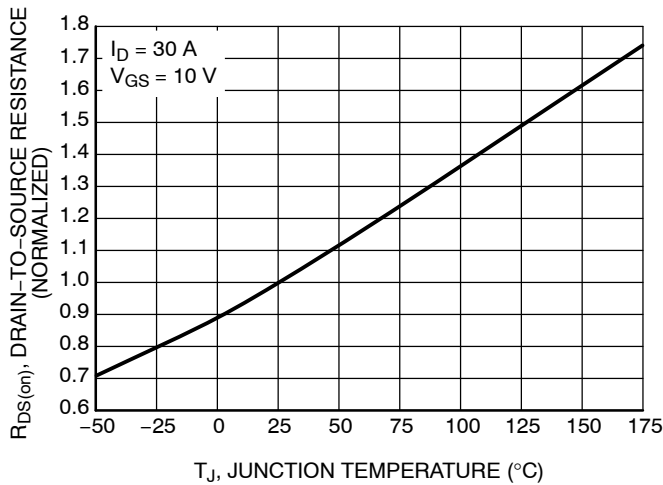


Figure 5. On-Resistance Variation with Temperature

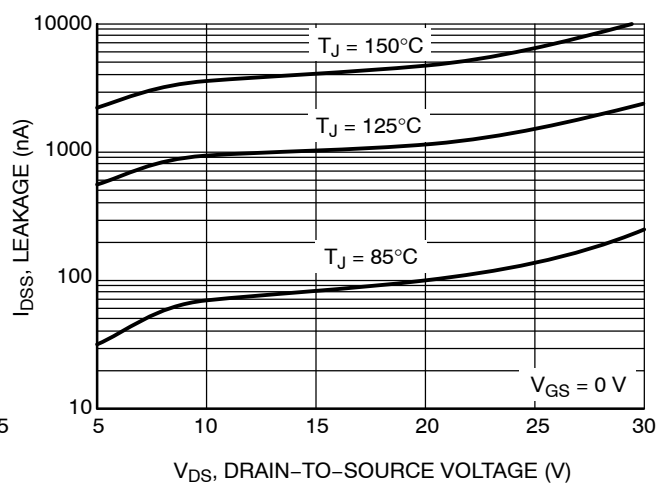


Figure 6. Drain-to-Source Leakage Current vs. Voltage

NTD4965N

TYPICAL PERFORMANCE CURVES

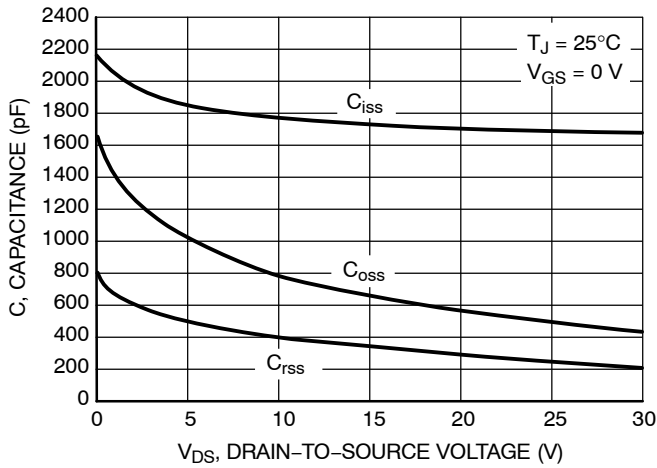


Figure 7. Capacitance Variation

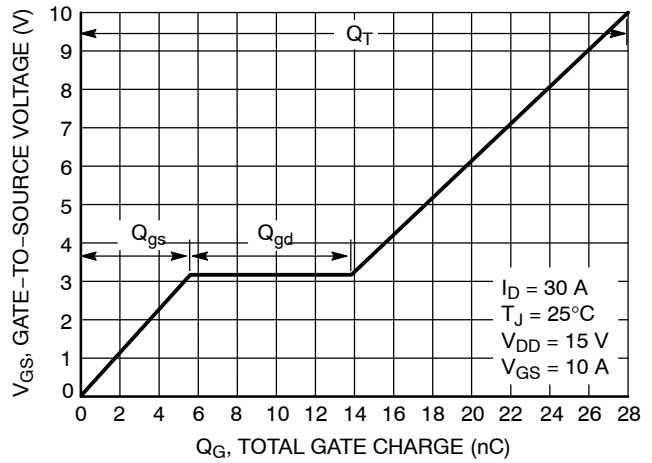


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

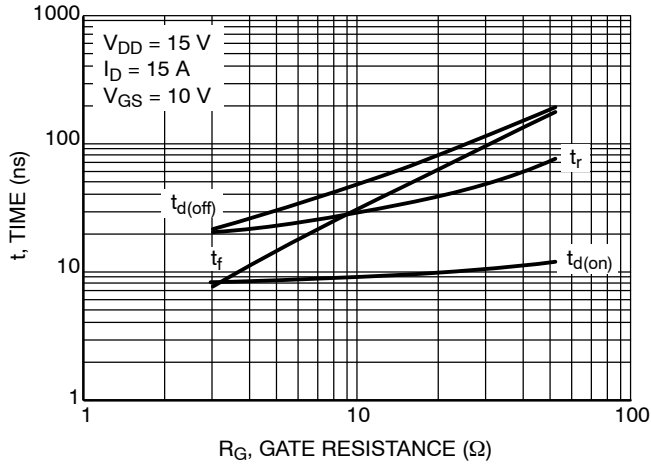


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

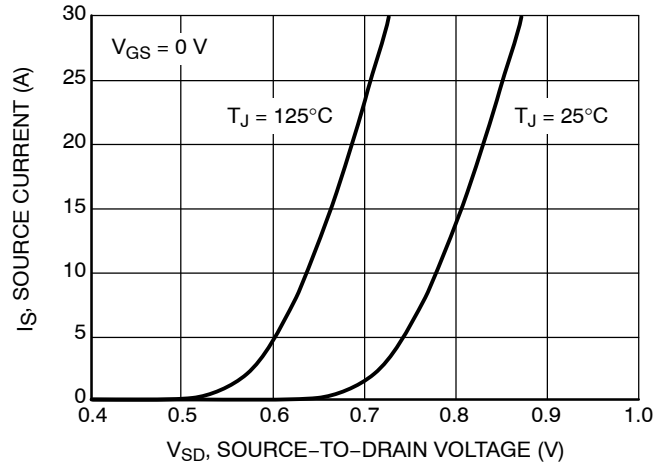


Figure 10. Diode Forward Voltage vs. Current

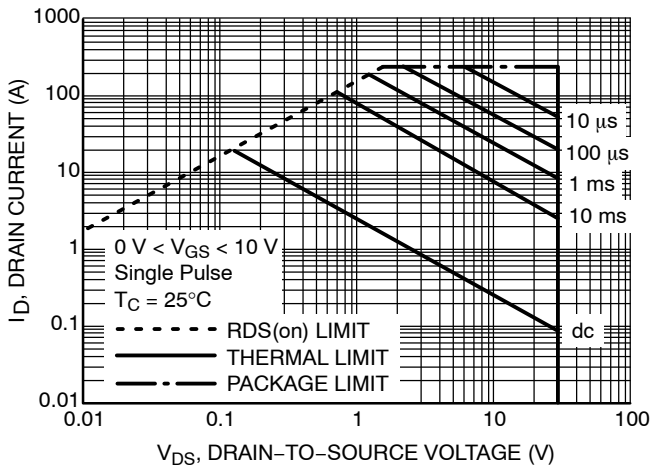


Figure 11. Maximum Rated Forward Biased Safe Operating Area

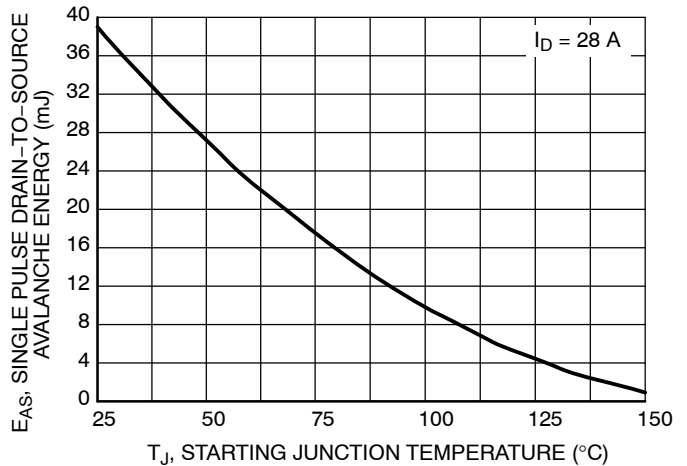
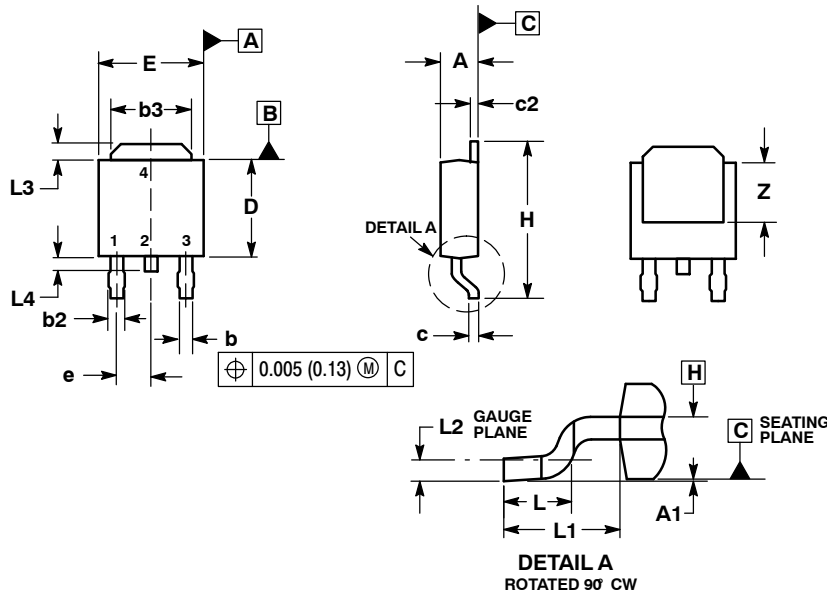


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

NTD4965N

PACKAGE DIMENSIONS

DPAK (SINGLE GUAGE)
CASE 369AA-01
ISSUE B

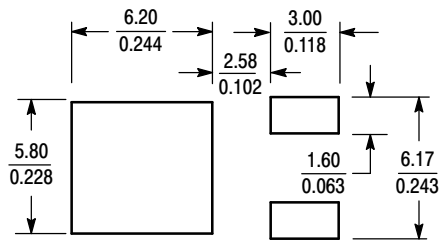


NOTES:

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:

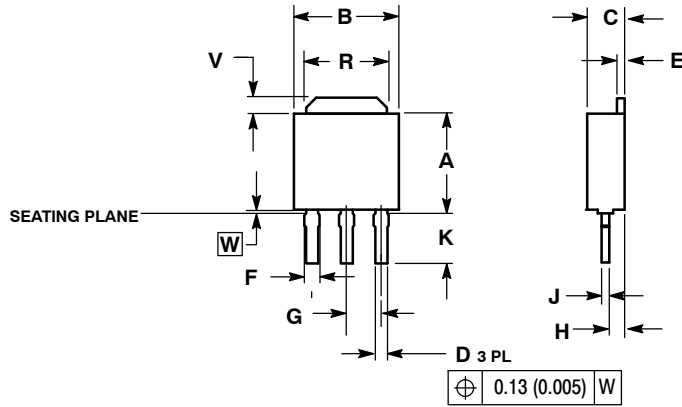
- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN

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

NTD4965N

PACKAGE DIMENSIONS

3 IPAK, STRAIGHT LEAD CASE 369AC-01 ISSUE O

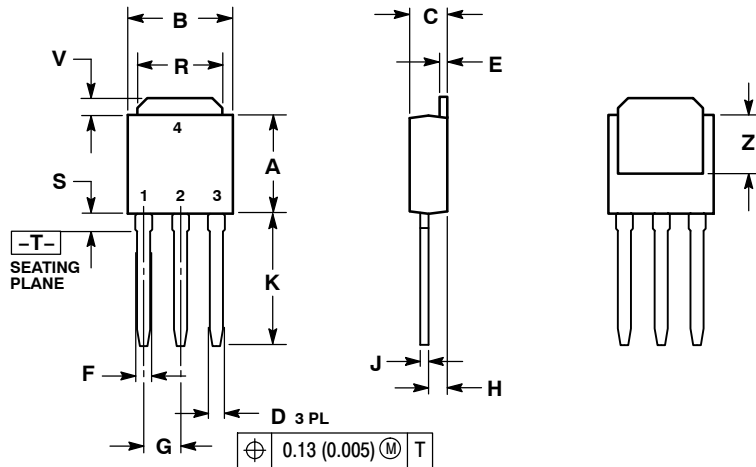


NOTES:

- 1.. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2.. CONTROLLING DIMENSION: INCH.
3. SEATING PLANE IS ON TOP OF DAMBAR POSITION.
4. DIMENSION A DOES NOT INCLUDE DAMBAR POSITION OR MOLD GATE.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
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	0.043	0.94	1.09
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	0.134	0.142	3.40	3.60
R	0.180	0.215	4.57	5.46
V	0.035	0.050	0.89	1.27
W	0.000	0.010	0.000	0.25

IPAK CASE 369D-01 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	---

STYLE 2:

- PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

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