

# NTD4959NH

## Power MOSFET

30 V, 58 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 are Pb-Free Devices

### Applications

- CPU Power Delivery
- DC-DC Converters
- Low Side Switching

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

Parameter			Symbol	Value	Unit
Drain-to-Source Voltage			V <sub>DSS</sub>	30	V
Gate-to-Source Voltage			V <sub>GS</sub>	± 20	V
Continuous Drain Current (R <sub>θJA</sub> ) (Note 1)	Steady State	T <sub>A</sub> = 25°C	I <sub>D</sub>	11.5	A
		T <sub>A</sub> = 85°C		9.0	
Power Dissipation (R <sub>θJA</sub> ) (Note 1)		T <sub>A</sub> = 25°C	P <sub>D</sub>	2.0	W
Continuous Drain Current (R <sub>θJA</sub> ) (Note 2)		T <sub>A</sub> = 25°C	I <sub>D</sub>	9.0	A
		T <sub>A</sub> = 85°C		7.0	
Power Dissipation (R <sub>θJA</sub> ) (Note 2)		T <sub>A</sub> = 25°C	P <sub>D</sub>	1.3	W
Continuous Drain Current (R <sub>θJC</sub> ) (Note 1)		T <sub>C</sub> = 25°C	I <sub>D</sub>	58	A
		T <sub>C</sub> = 85°C		45	
Power Dissipation (R <sub>θJC</sub> ) (Note 1)		T <sub>C</sub> = 25°C	P <sub>D</sub>	52	W
Pulsed Drain Current	t <sub>p</sub> =10μs	T <sub>A</sub> = 25°C	I <sub>DM</sub>	130	A
Current Limited by Package		T <sub>A</sub> = 25°C	I <sub>DmaxPkg</sub>	45	A
Operating Junction and Storage Temperature			T <sub>J</sub> , T <sub>stg</sub>	-55 to 175	°C
Source Current (Body Diode)			I <sub>S</sub>	43	A
Drain to Source dV/dt			dV/dt	6.0	V/ns
Single Pulse Drain-to-Source Avalanche Energy (V <sub>DD</sub> = 24 V, V <sub>GS</sub> = 10 V, L = 1.0 mH, I <sub>L(pk)</sub> = 15 A, R <sub>G</sub> = 25 Ω)			E <sub>AS</sub>	112.5	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)			T <sub>L</sub>	260	°C

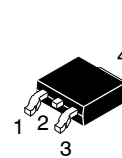
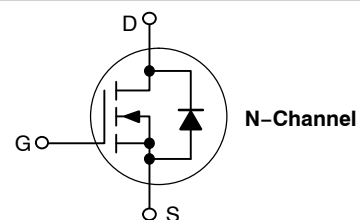
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



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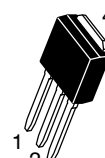
$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	$I_D$ MAX
30 V	9.0 m $\Omega$ @ 10 V	58 A
	12.5 m $\Omega$ @ 4.5 V	



DPAK  
CASE 369AA  
(Bent Lead)  
STYLE 2

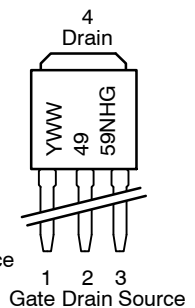
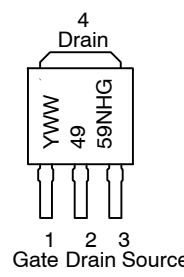
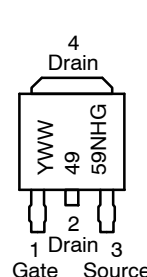


3 IPAK  
CASE 369AD  
(Straight Lead)



IPAK  
CASE 369D  
(Straight Lead DPAK)

### MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year  
WW = Work Week  
4959NH = 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.

# NTD4959NH

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	2.9	°C/W
Junction-to-TAB (Drain)	$R_{\theta JC-TAB}$	3.5	
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	74	
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	116	

1. Surface-mounted on FR4 board using 1 in sq pad size, 1 oz Cu.
2. 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	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	30			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			25		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	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	1.5	2.1	2.5	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			5.7		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ to }11.5\text{ V}$	$I_D = 30\text{ A}$	7.0	9.0	m $\Omega$
			$I_D = 15\text{ A}$	7.0		
		$V_{GS} = 4.5\text{ V}$	$I_D = 30\text{ A}$	10.45	12.5	
			$I_D = 15\text{ A}$	9.95		
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 15\text{ A}$		9.0		S

### CHARGES AND CAPACITANCES

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 12\text{ V}$		1596	2155	pF
Output Capacitance	$C_{oss}$			331	447	
Reverse Transfer Capacitance	$C_{rss}$			190	294	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		12.5	15	nC
Threshold Gate Charge	$Q_{G(TH)}$			2.4	3.6	
Gate-to-Source Charge	$Q_{GS}$			5.3	7.9	
Gate-to-Drain Charge	$Q_{GD}$			5.1	7.7	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 11.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 30\text{ A}$		29.3	44	nC

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\text{ }\Omega$		12.0	18	ns
Rise Time	$t_r$			20	30	
Turn-Off Delay Time	$t_{d(off)}$			14	21	
Fall Time	$t_f$			5.0	7.5	
Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 11.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 15\text{ A}, R_G = 3.0\text{ }\Omega$		7.0	10.4	ns
Rise Time	$t_r$			18	27	
Turn-Off Delay Time	$t_{d(off)}$			22	33	
Fall Time	$t_f$			3.0	4.6	

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

# NTD4959NH

## 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		0.95	1.2	V
			T <sub>J</sub> = 125°C		0.83		
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			15.6		ns
Charge Time	t <sub>a</sub>				10.6		
Discharge Time	t <sub>b</sub>				5.0		
Reverse Recovery Time	Q <sub>RR</sub>				7.5		nC

### PACKAGE PARASITIC VALUES

Source Inductance	L <sub>S</sub>	T <sub>A</sub> = 25°C		2.49		nH
Drain Inductance, DPAK	L <sub>D</sub>			0.0164		
Drain Inductance, IPAK	L <sub>D</sub>			1.88		
Gate Inductance	L <sub>G</sub>			3.46		
Gate Resistance	R <sub>G</sub>			0.75		Ω

TYPICAL PERFORMANCE CURVES

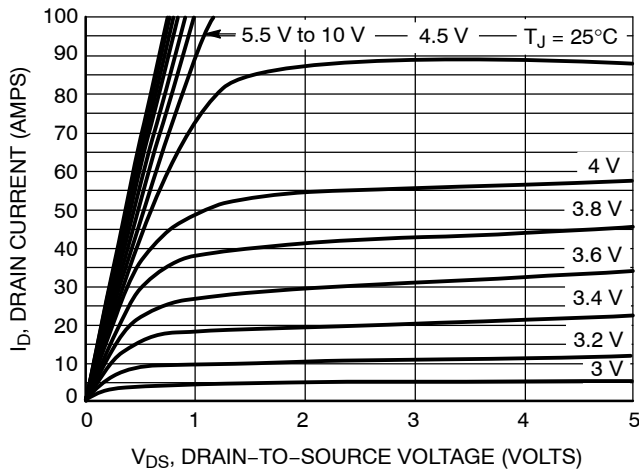


Figure 1. On-Region Characteristics

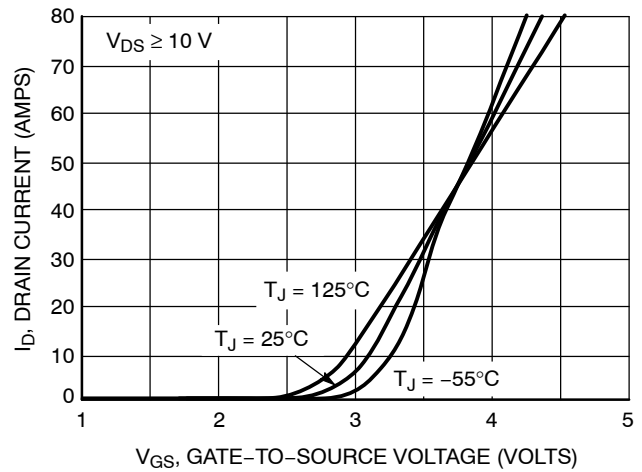


Figure 2. Transfer Characteristics

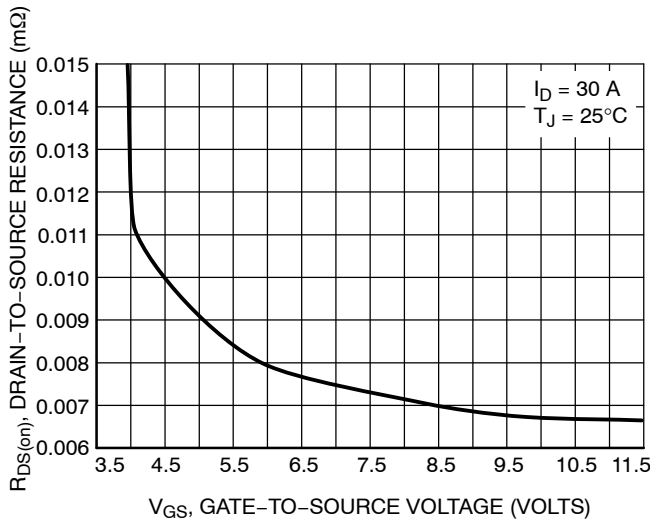


Figure 3. On-Resistance vs. Gate-to-Source Voltage

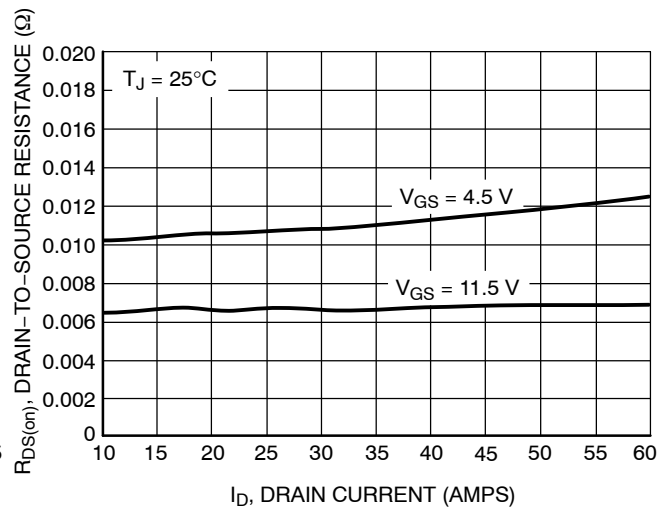


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

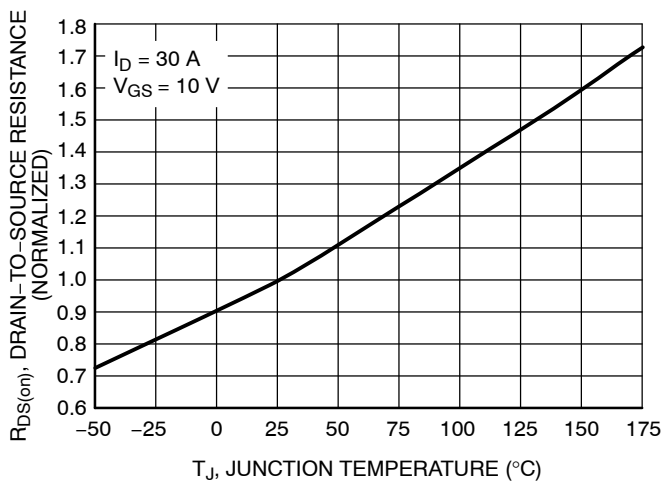


Figure 5. On-Resistance Variation with Temperature

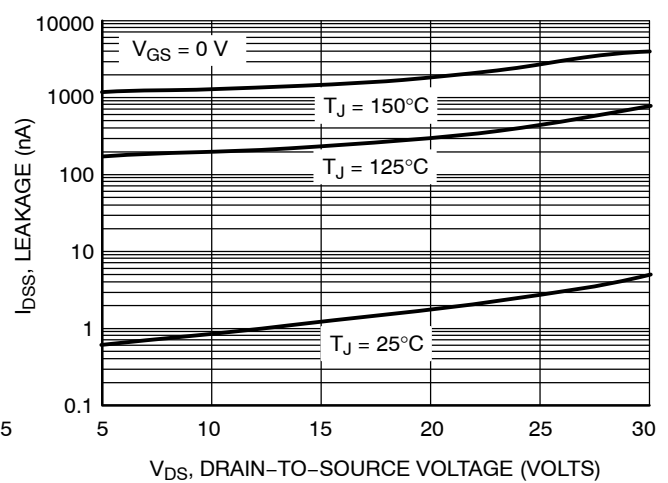


Figure 6. Drain-to-Source Leakage Current vs. Drain Voltage

TYPICAL PERFORMANCE CURVES

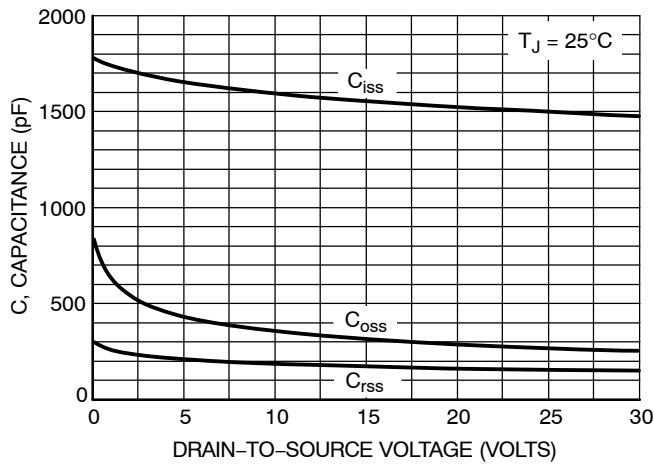


Figure 7. Capacitance Variation

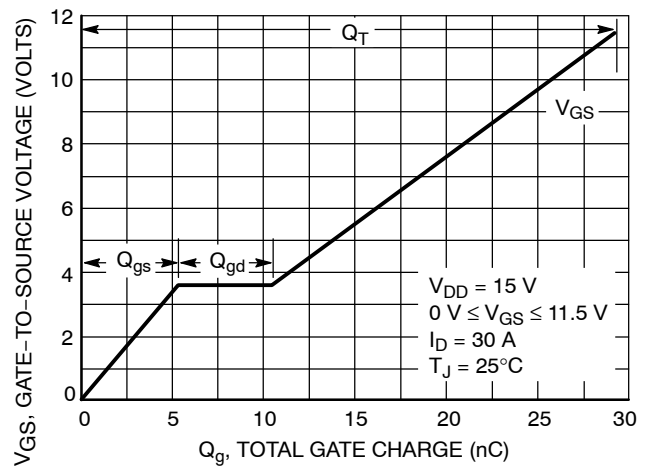


Figure 8. Gate-to-Source Voltage vs. Total Charge

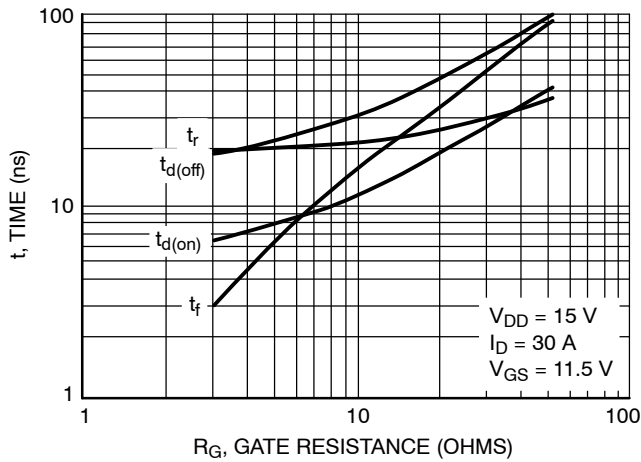


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

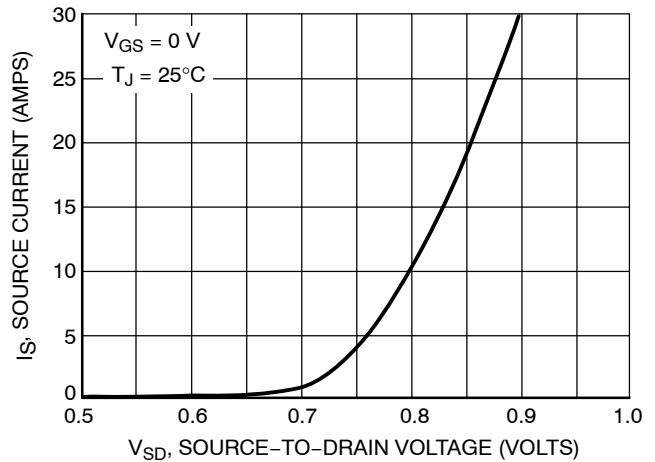


Figure 10. Diode Forward Voltage vs. Current

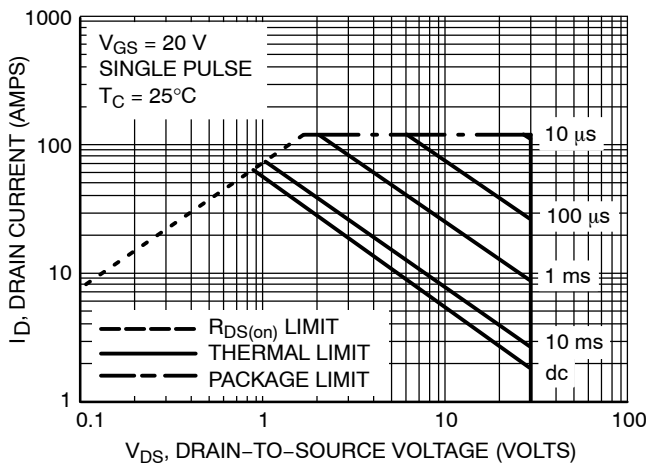


Figure 11. Maximum Rated Forward Biased Safe Operating Area

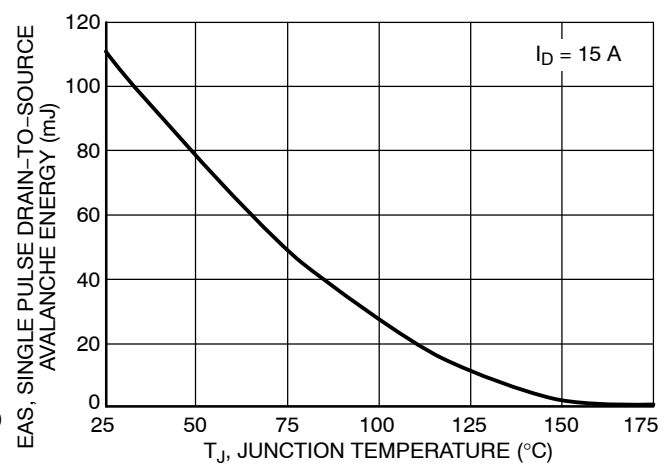


Figure 12. Maximum Avalanche Energy vs. Starting Junction Temperature

# NTD4959NH

## TYPICAL PERFORMANCE CURVES

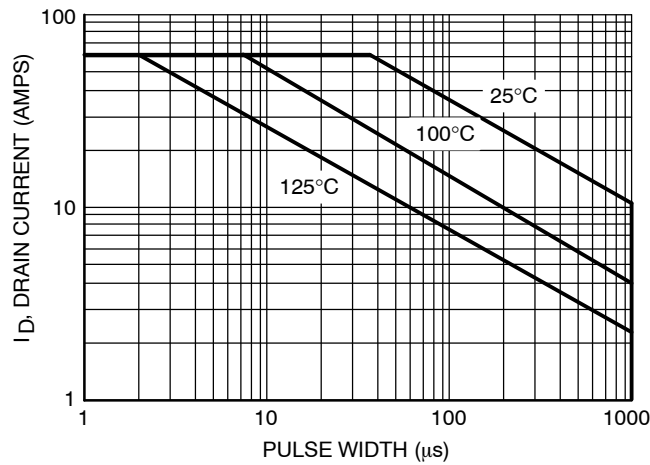


Figure 13. Avalanche Characteristics

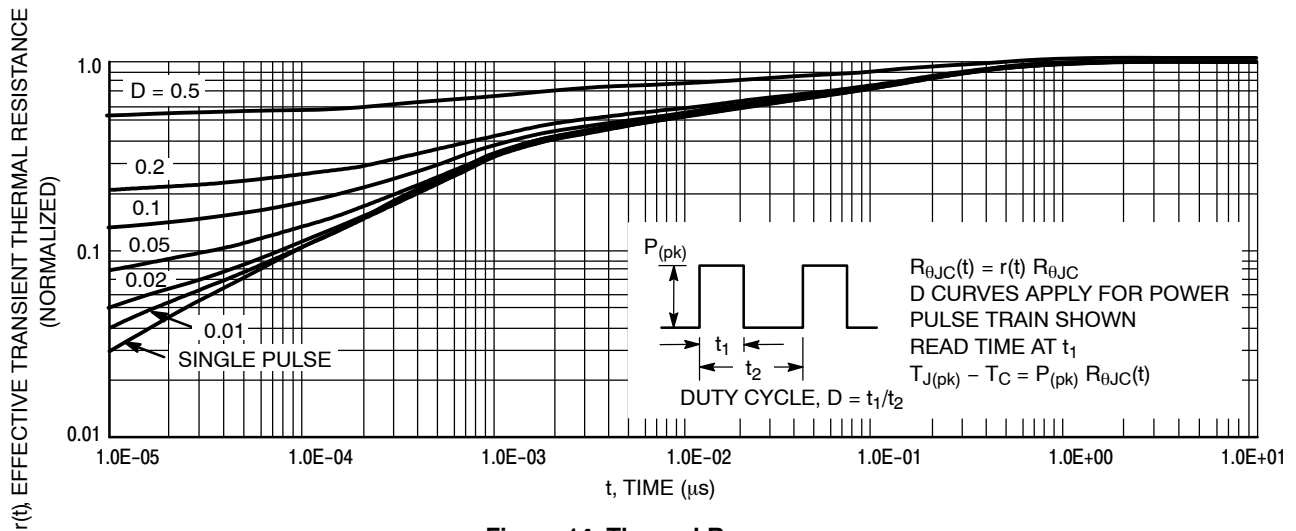


Figure 14. Thermal Response

## ORDERING INFORMATION

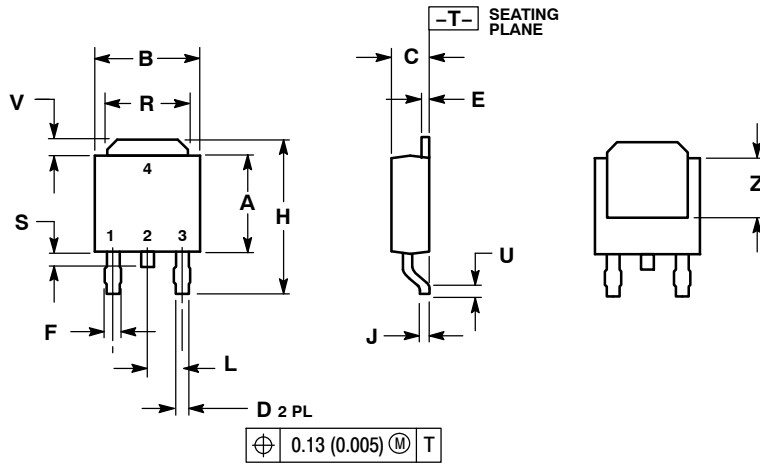
Device	Package	Shipping†
NTD4959NHT4G	DPAK (Pb-Free)	2500 / Tape & Reel
NTD4959NH-1G	IPAK (Pb-Free)	75 Units / Rail
NTD4959NH-35G	IPAK Trimmed Lead (3.5 ± 0.15 mm) (Pb-Free)	75 Units / Rail

†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.

# NTD4959NH

## PACKAGE DIMENSIONS

DPAK (SINGLE GAUGE)  
CASE 369AA-01  
ISSUE A

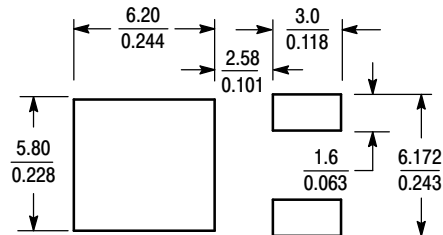


NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.025	0.035	0.63	0.89
E	0.018	0.024	0.46	0.61
F	0.030	0.045	0.77	1.14
H	0.386	0.410	9.80	10.40
J	0.018	0.023	0.46	0.58
L	0.090 BSC		2.29 BSC	
R	0.180	0.215	4.57	5.45
S	0.024	0.040	0.60	1.01
U	0.020	---	0.51	---
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

## SOLDERING FOOTPRINT\*



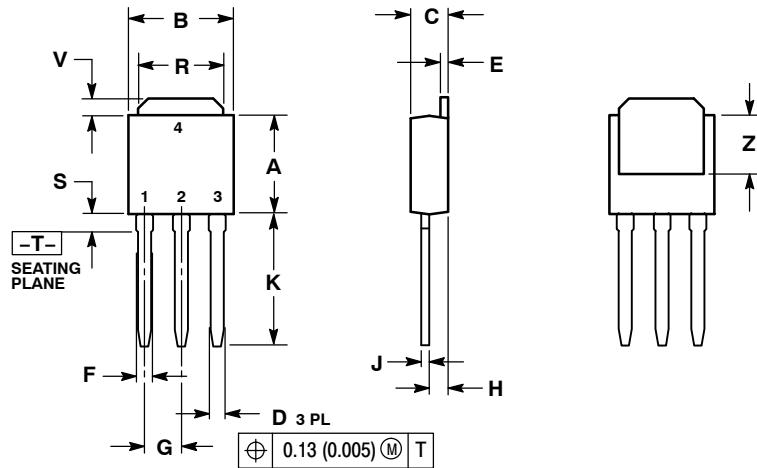
SCALE 3:1  $\left( \frac{\text{mm}}{\text{inches}} \right)$

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

# NTD4959NH

## PACKAGE DIMENSIONS

### IPAK (STRAIGHT LEAD DPAK) CASE 369D-01 ISSUE B

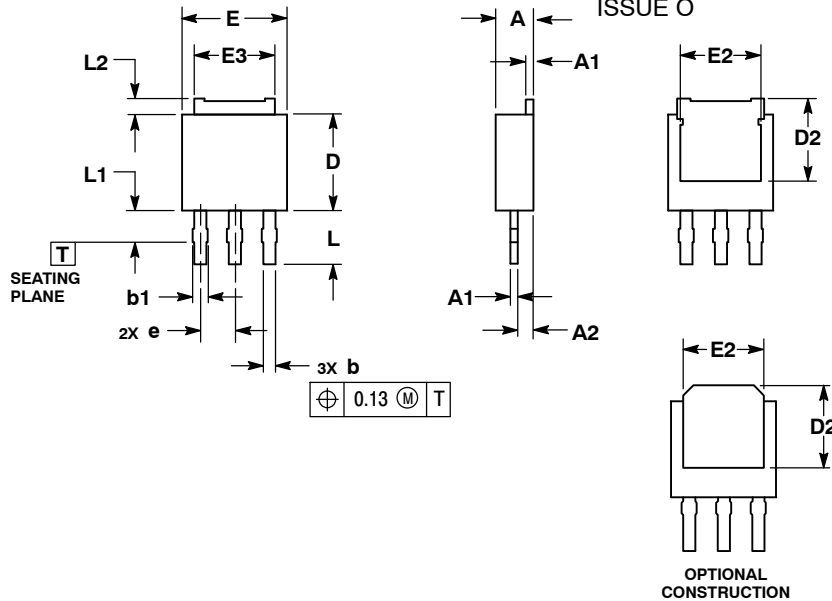


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

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
L	0.180	0.215	4.45	5.45
M	0.025	0.040	0.63	1.01
N	0.035	0.050	0.89	1.27
O	0.155	---	3.93	---

- STYLE 2:
1. GATE
  2. DRAIN
  3. SOURCE
  4. DRAIN

### 3.5 MM IPAK, STRAIGHT LEAD CASE 369AD-01 ISSUE O



- 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	4.70	---
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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