

# NTD5865N

## N-Channel Power MOSFET 60 V, 38 A, 18 mΩ

### Features

- Low Gate Charge
- Fast Switching
- High Current Capability
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

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

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	V <sub>DSS</sub>	60	V	
Gate-to-Source Voltage – Continuous	V <sub>GS</sub>	±20	V	
Gate-to-Source Voltage – Non-Repetitive (t <sub>p</sub> < 10 μs)	V <sub>GS</sub>	±30	V	
Continuous Drain Current (R <sub>θJC</sub> )	Steady State	T <sub>C</sub> = 25°C	I <sub>D</sub> = 38	A
		T <sub>C</sub> = 100°C	24	
Power Dissipation (R <sub>θJC</sub> )		T <sub>C</sub> = 25°C	P <sub>D</sub> = 52	W
Pulsed Drain Current	t <sub>p</sub> = 10 μs	I <sub>DM</sub>	137	A
Operating Junction and Storage Temperature	T <sub>J</sub> , T <sub>stg</sub>	-55 to 150	°C	
Source Current (Body Diode)	I <sub>S</sub>	38	A	
Single Pulse Drain-to-Source Avalanche Energy	L = 0.1 mH	E <sub>AS</sub>	36	mJ
		I <sub>AS</sub>	27	A
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.

### THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	R <sub>θJC</sub>	2.4	°C/W
Junction-to-Ambient – Steady State (Note 1)	R <sub>θJA</sub>	42	

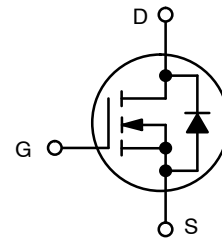
1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).



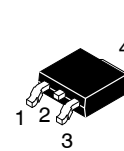
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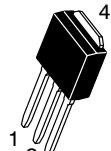
V <sub>(BR)DSS</sub>	R <sub>DS(on)</sub> MAX	I <sub>D</sub> MAX
60 V	18 mΩ @ 10 V	38 A



N-CHANNEL MOSFET

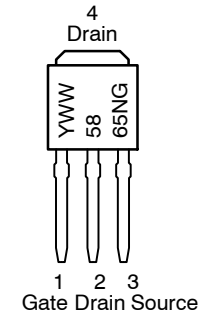
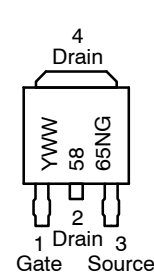


DPAK  
CASE 369C  
(Surface Mount)  
STYLE 2



IPAK  
CASE 369D  
(Straight Lead)  
STYLE 2

### MARKING DIAGRAMS & PIN ASSIGNMENT



- Y = Year
- WW = Work Week
- 5865N = Device Code
- G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

# NTD5865N

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	60			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>			59.2		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 60 V	T <sub>J</sub> = 25°C		1.0	μA
			T <sub>J</sub> = 150°C		100	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V			±100	nA

## ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA	2.0		4.0	V
Negative Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>			8.6		mV/°C
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A		14	18	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 20 A		6.9		S

## CHARGES, CAPACITANCES AND GATE RESISTANCES

Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = 25 V		1261		pF
Output Capacitance	C <sub>oss</sub>			136		
Reverse Transfer Capacitance	C <sub>rss</sub>			85		
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 48 V, I <sub>D</sub> = 38 A		23		nC
Threshold Gate Charge	Q <sub>G(TH)</sub>			1.5		
Gate-to-Source Charge	Q <sub>GS</sub>			6.7		
Gate-to-Drain Charge	Q <sub>GD</sub>			7.7		
Gate Resistance	R <sub>G</sub>			1.5		Ω

## SWITCHING CHARACTERISTICS (Note 3)

Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 48 V, I <sub>D</sub> = 38 A, R <sub>G</sub> = 2.5 Ω		10		ns
Rise Time	t <sub>r</sub>			17		
Turn-Off Delay Time	t <sub>d(off)</sub>			20		
Fall Time	t <sub>f</sub>			3.5		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 38 A	T <sub>J</sub> = 25°C		0.94	1.2	V
			T <sub>J</sub> = 125°C		0.85		
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> = 38 A		23		ns	
Charge Time	t <sub>a</sub>			17			
Discharge Time	t <sub>b</sub>			6			
Reverse Recovery Charge	Q <sub>RR</sub>			20			nC

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

3. Switching characteristics are independent of operating junction temperatures.

## ORDERING INFORMATION

Order Number	Package	Shipping†
NTD5865N-1G	DPAK (Straight Lead) (Pb-Free)	75 Units / Rail
NTD5865NT4G	DPAK (Pb-Free)	2500 / 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.

# NTD5865N

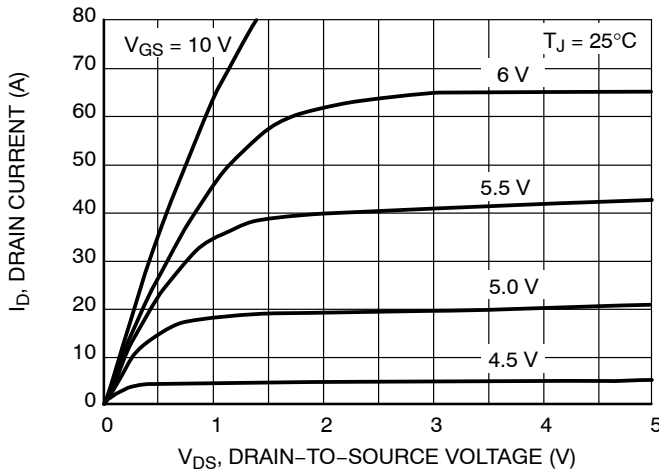


Figure 1. On-Region Characteristics

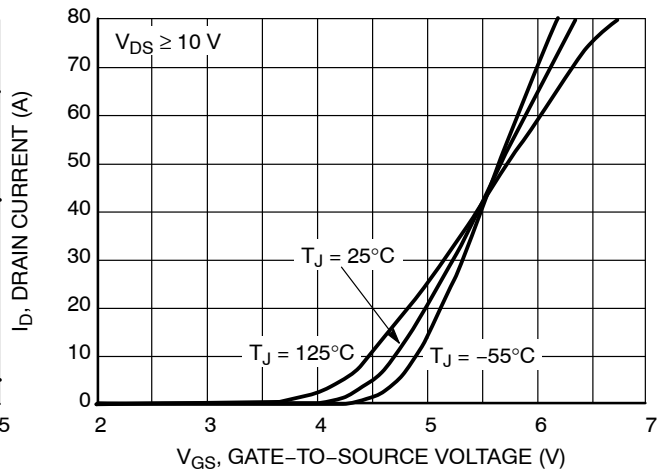


Figure 2. Transfer Characteristics

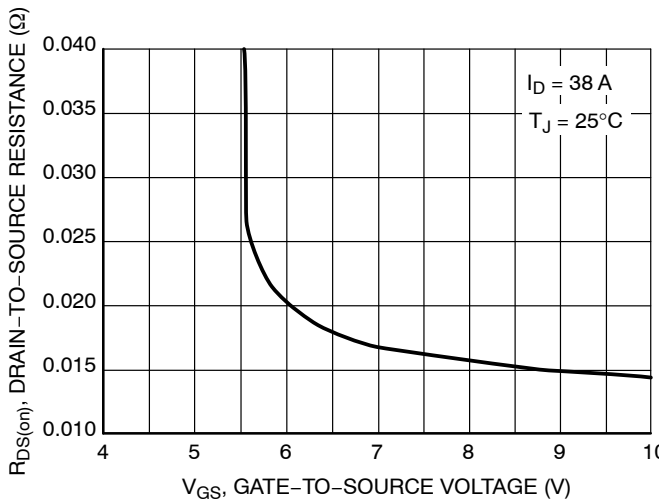


Figure 3. On-Resistance vs. Gate Voltage

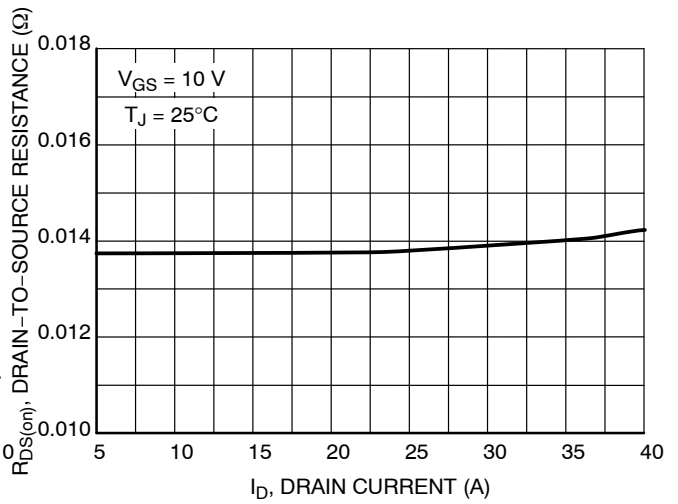


Figure 4. On-Resistance vs. Drain Current

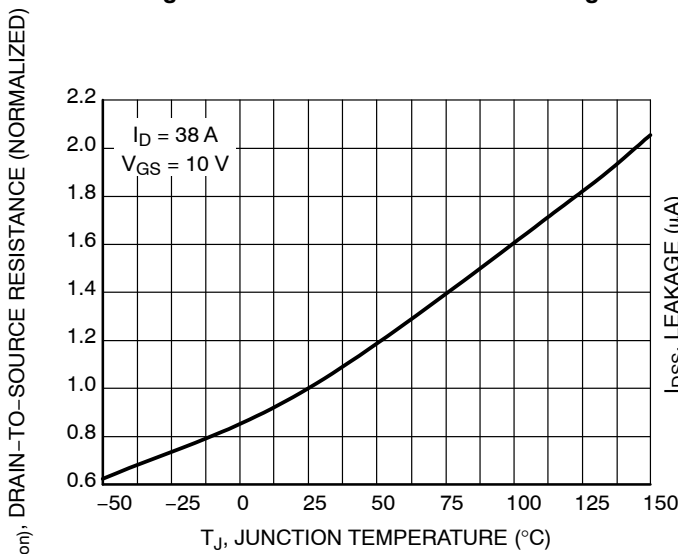


Figure 5. On-Resistance Variation with Temperature

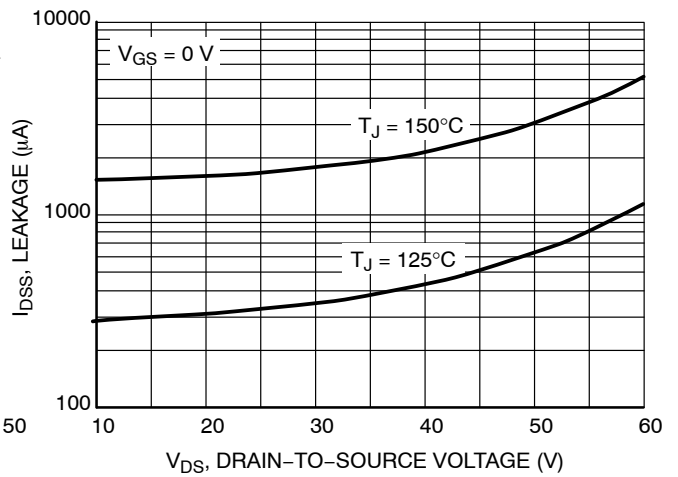
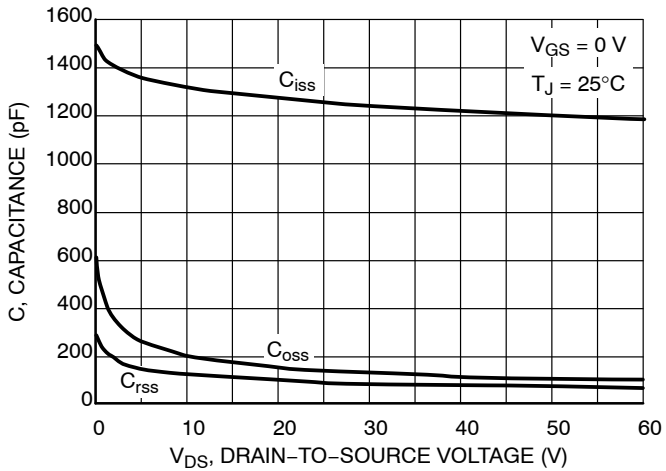
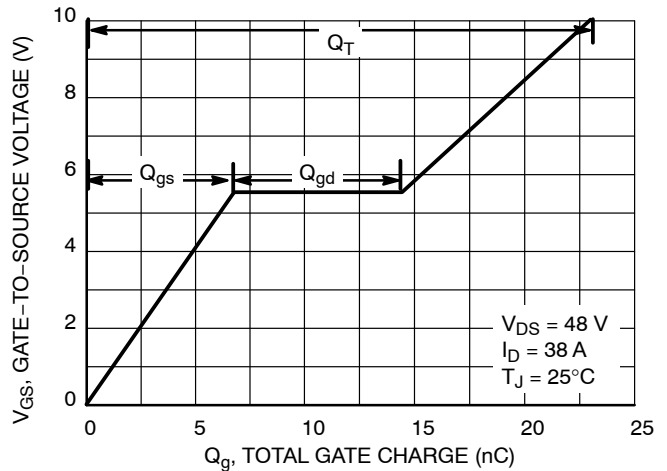


Figure 6. Drain-to-Source Leakage Current vs. Voltage

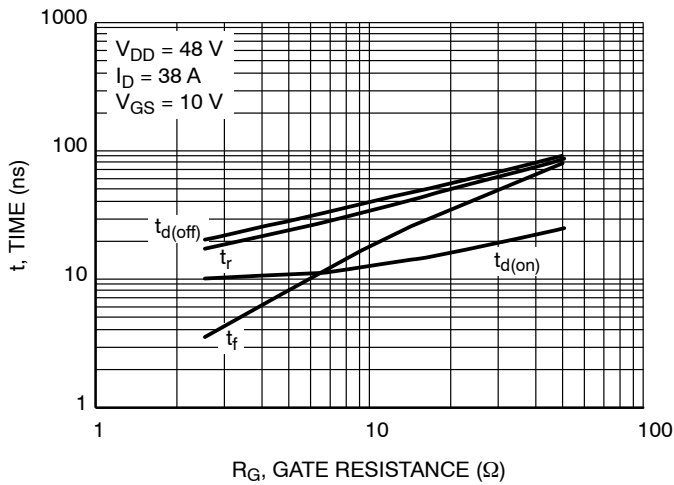
# NTD5865N



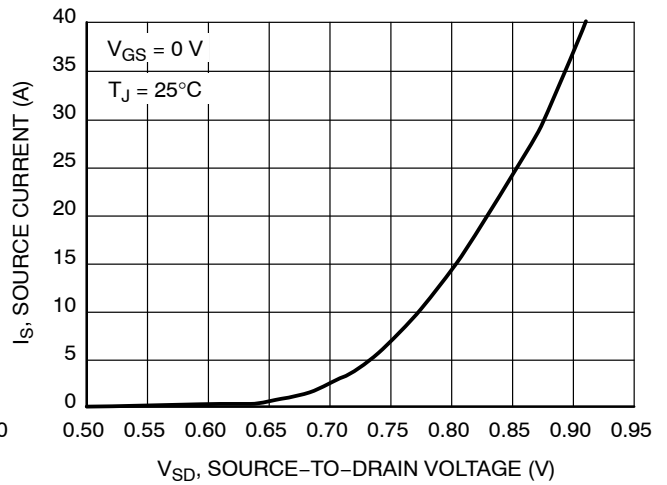
**Figure 7. Capacitance Variation**



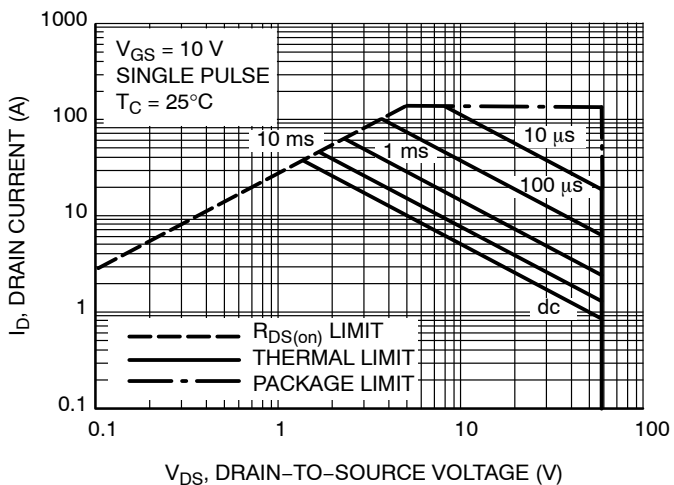
**Figure 8. Gate-to-Source vs. Total Charge**



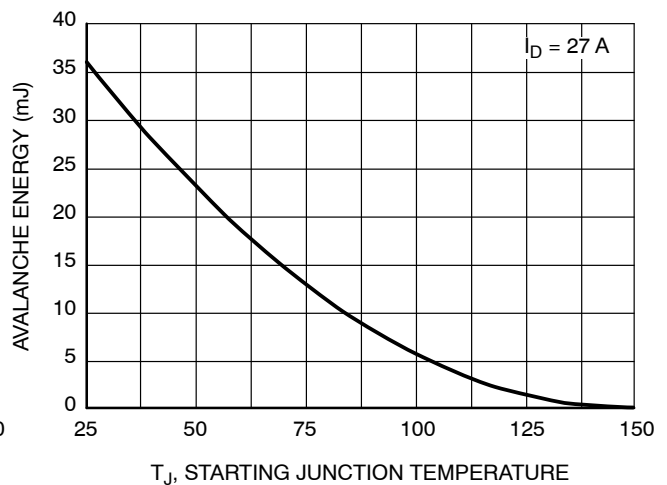
**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**



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



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



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

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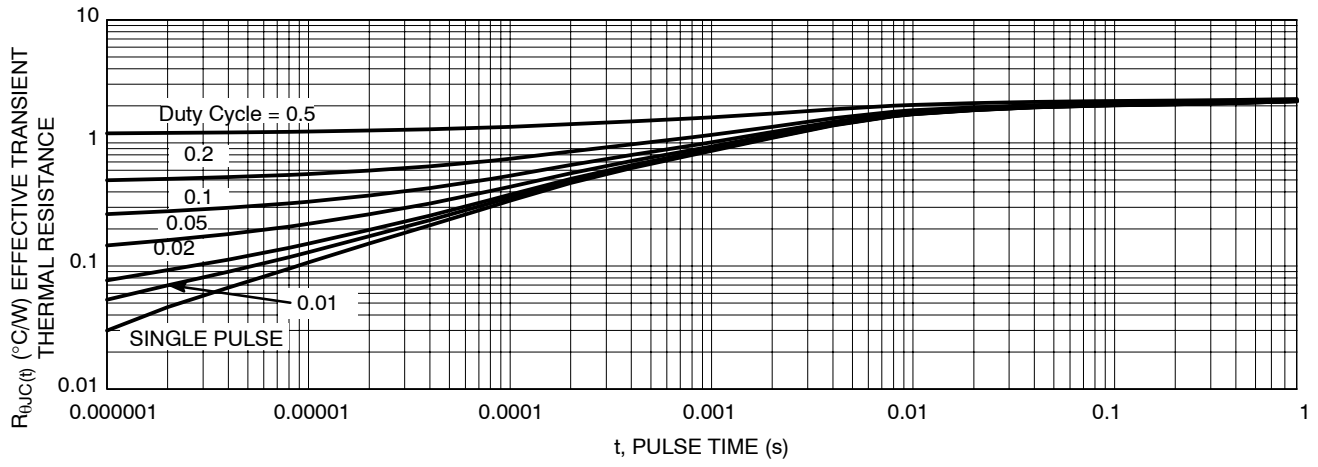
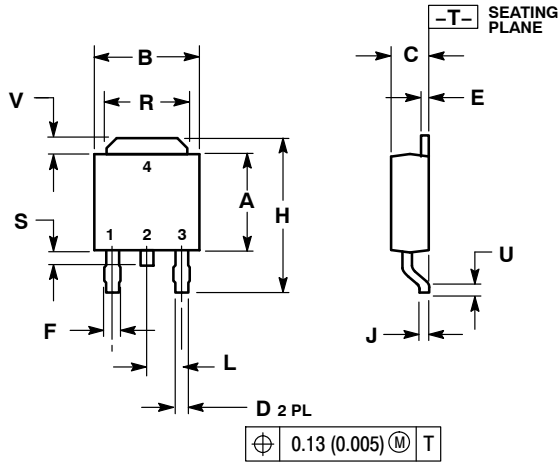


Figure 13. Thermal Response

# NTD5865N

## PACKAGE DIMENSIONS

### DPAK (SINGLE GUAGE) CASE 369AA-01 ISSUE A

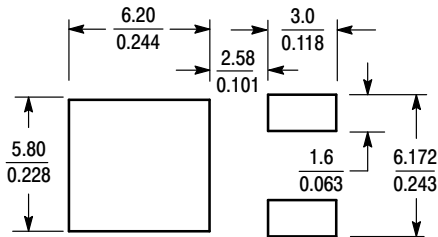


- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

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\*



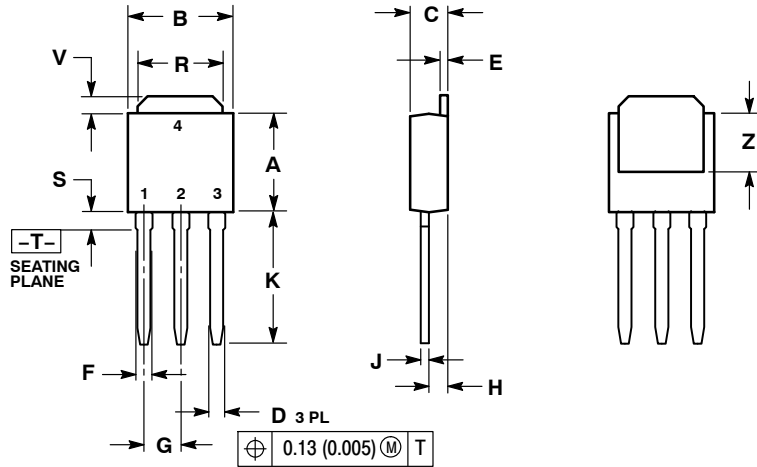
SCALE 3:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

# NTD5865N

## PACKAGE DIMENSIONS

### IPAK-3 (SINGLE GAUGE) 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
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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