

# NDF60N360U1, NDD60N360U1

## Product Preview

# N-Channel Power MOSFET 600 V, 360 mΩ

### Features

- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

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

Parameter			Symbol	NDF	NDD	Unit
Drain-to-Source Voltage			V <sub>DSS</sub>	600		V
Gate-to-Source Voltage			V <sub>GS</sub>	±25		V
Continuous Drain Current R <sub>θJC</sub> (Note 1)	Steady State	T <sub>C</sub> = 25°C	I <sub>D</sub>	13	11	A
		T <sub>C</sub> = 100°C		8.1	7.3	
Power Dissipation – R <sub>θJC</sub>	Steady State	T <sub>C</sub> = 25°C	P <sub>D</sub>	30	114	W
Pulsed Drain Current	t <sub>p</sub> = 10 μs		I <sub>DM</sub>	51	46	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>	13	11	A
Single Pulse Drain-to-Source Avalanche Energy			EAS	TBD		mJ
Lead Temperature for Soldering Leads			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.

1. Limited by maximum junction temperature

### THERMAL RESISTANCE

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain) NDF60N360U1 NDD60N360U1	$R_{\theta JC}$	4.1 1.1	$^\circ\text{C}/\text{W}$
Junction-to-Ambient Steady State NDF60N360U1 NDD60N360U1 NDD60N360U1-1	$R_{\theta JA}$	50 31 96	$^\circ\text{C}/\text{W}$

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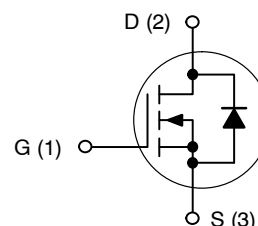


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$V_{(BR)DSS}$	$R_{DS(ON) MAX}$
600 V	360 mΩ @ 10 V

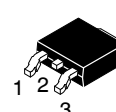
### N-Channel MOSFET



**TO-220FP  
CASE 221AH**



**IPAK  
CASE 369D**



**DPAK  
CASE 369AA**

### MARKING AND ORDERING INFORMATION

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

# NDF60N360U1, NDD60N360U1

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

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	600			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			TBD		mV/ $^\circ\text{C}$
Drain-to-Source Leakage Current	$I_{DSS}$	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	$T_J = 25^\circ\text{C}$		1	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		50	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 50\text{ }\mu\text{A}$	2	TBD	4	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	Reference to $25^\circ\text{C}, I_D = 50\text{ }\mu\text{A}$		TBD		mV/ $^\circ\text{C}$
Static Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 6.5\text{ A}$		280	360	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = 15\text{ V}, I_D = 6.5\text{ A}$		TBD		S

### DYNAMIC CHARACTERISTICS

Input Capacitance	$C_{iss}$	$V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		800		pF
Output Capacitance	$C_{oss}$			55		
Reverse Transfer Capacitance	$C_{rss}$			3.5		
Total Gate Charge	$Q_g$	$V_{DS} = 300\text{ V}, I_D = 13\text{ A}, V_{GS} = 10\text{ V}$		29		nC
Gate-to-Source Charge	$Q_{gs}$			TBD		
Gate-to-Drain Charge	$Q_{gd}$			TBD		
Plateau Voltage	$V_{GP}$			TBD		V
Gate Resistance	$R_g$			TBD		$\Omega$

### RESISTIVE SWITCHING CHARACTERISTICS (Note 3)

Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 300\text{ V}, I_D = 13\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 0\text{ }\Omega$		TBD		ns
Rise Time	$t_r$			TBD		
Turn-off Delay Time	$t_{d(off)}$			TBD		
Fall Time	$t_f$			TBD		

### SOURCE-DRAIN DIODE CHARACTERISTICS

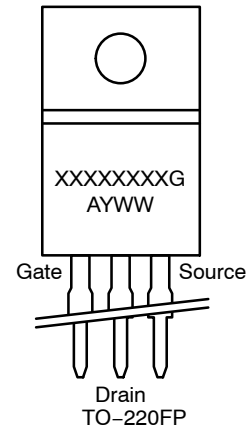
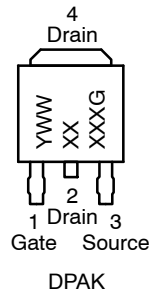
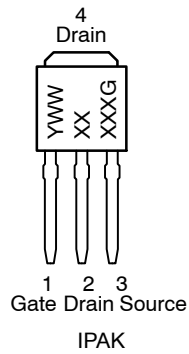
Diode Forward Voltage	$V_{SD}$	$I_S = 13\text{ A}, V_{GS} = 0\text{ V}$	$T_J = 25^\circ\text{C}$		TBD	1.6	V
			$T_J = 100^\circ\text{C}$		TBD		
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0\text{ V}, V_{DD} = 30\text{ V}$ $I_S = 13\text{ A}, d_i/d_t = 100\text{ A}/\mu\text{s}$			TBD		ns
Charge Time	$t_a$				TBD		
Discharge Time	$t_b$				TBD		
Reverse Recovery Charge	$Q_{rr}$				TBD		nC

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

3. Switching characteristics are independent of operating junction temperatures.

# NDF60N360U1, NDD60N360U1

## MARKING DIAGRAMS



A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

## ORDERING INFORMATION

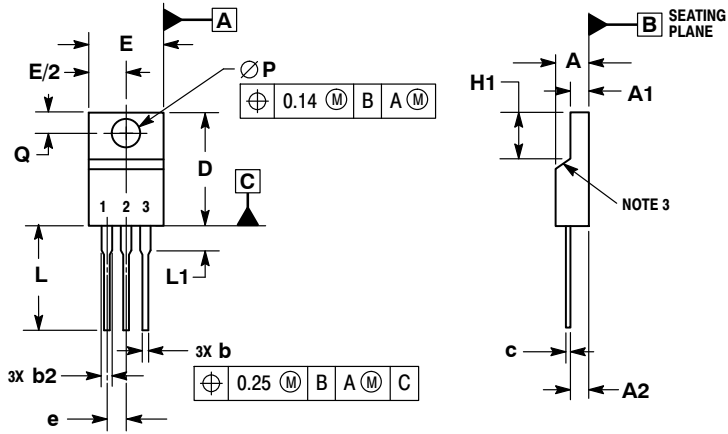
Device	Package	Shipping <sup>†</sup>
NDF60N360U1G	TO-220FP (Pb-Free, Halogen-Free)	50 Units / Rail
NDD60N360U1-1G	IPAK (Pb-Free, Halogen-Free)	75 Units / Rail
NDD60N360U1T4G	DPAK (Pb-Free, Halogen-Free)	2500 / Tape & Reel

<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.

# NDF60N360U1, NDD60N360U1

## PACKAGE DIMENSIONS

### TO-220 FULLPACK, 3-LEAD CASE 221AH ISSUE C



#### NOTES:

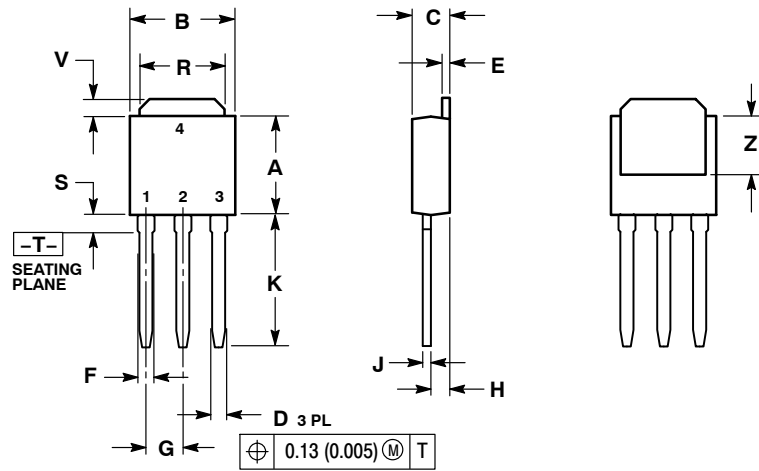
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR UNCONTROLLED IN THIS AREA.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH AND GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE TO BE MEASURED AT OUTERMOST EXTREME OF THE PLASTIC BODY.
5. DIMENSION b2 DOES NOT INCLUDE DAMBAR PROTRUSION. LEAD WIDTH INCLUDING PROTRUSION SHALL NOT EXCEED 2.00.

MILLIMETERS		
DIM	MIN	MAX
A	4.30	4.70
A1	2.50	2.90
A2	2.50	2.70
b	0.54	0.84
b2	1.10	1.40
c	0.49	0.79
D	14.70	15.30
E	9.70	10.30
e	2.54 BSC	
H1	6.70	7.10
L	12.70	14.73
L1	---	2.80
P	3.00	3.40
Q	2.80	3.20

# NDF60N360U1, NDD60N360U1

## PACKAGE DIMENSIONS

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	---

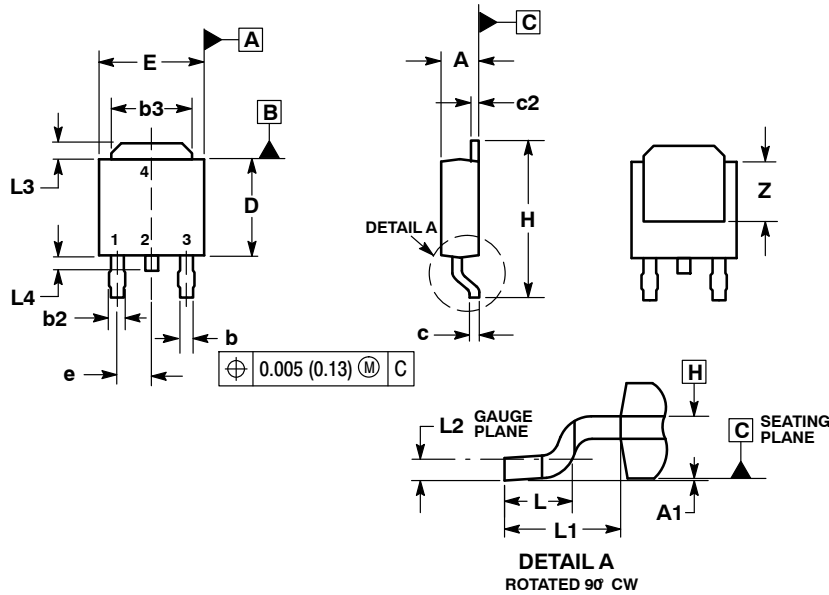
### STYLE 2:

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

# NDF60N360U1, NDD60N360U1

## PACKAGE DIMENSIONS

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

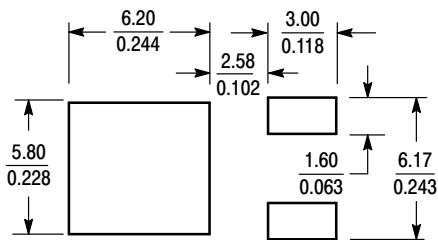


#### NOTES:

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 (mm/inches)

#### STYLE 2:

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