

NTD60N02R

Power MOSFET 62 A, 24 V, N-Channel, DPAK

Features

- Planar HD3e Process for Fast Switching Performance
- Low $R_{DS(on)}$ to Minimize Conduction Loss
- Low C_{iss} to Minimize Driver Loss
- Low Gate Charge
- Optimized for High Side Switching Requirements in High-Efficiency DC-DC Converters
- Pb-Free Packages are Available

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	V_{DS}	24	Vdc
Gate-to-Source Voltage – Continuous	V_{GS}	± 20	Vdc
Thermal Resistance Junction-to-Case Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Drain Current	$R_{\theta JC}$ P_D I_D	2.6 58 62	$^\circ\text{C/W}$ W A
Continuous @ $T_C = 25^\circ\text{C}$, Chip Continuous @ $T_C = 25^\circ\text{C}$, Limited by Package Continuous @ $T_A = 25^\circ\text{C}$, Limited by Wires	I_D I_D I_D	50 32	A A A
Thermal Resistance Junction-to-Ambient (Note 1) Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Drain Current – Continuous @ $T_A = 25^\circ\text{C}$	$R_{\theta JA}$ P_D I_D	80 1.87 10.5	C/W W A
Thermal Resistance Junction-to-Ambient (Note 2) Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Drain Current – Continuous @ $T_A = 25^\circ\text{C}$	$R_{\theta JA}$ P_D I_D	120 1.25 8.5	$^\circ\text{C/W}$ W A
Operating and Storage Temperature	T_J , and T_{stg}	-55 to 175	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ ($V_{DD} = 50$ Vdc, $V_{GS} = 10.0$ Vdc, $I_L = 11$ Apk, $L = 1.0$ mH, $R_G = 25$ Ω)	E_{AS}	60	mJ
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	T_L	260	$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

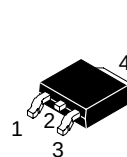
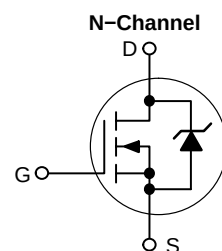
1. When surface mounted to an FR4 board using 0.5 in sq drain pad size.
2. When surface mounted to an FR4 board using the minimum recommended pad size.



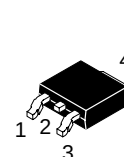
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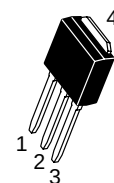
$V_{(BR)DS}$	$R_{DS(on)}$ TYP	I_D MAX
24 V	8.4 m Ω @ 10 V	62 A



CASE 369AA
DPAK
(Surface Mount)
STYLE 2

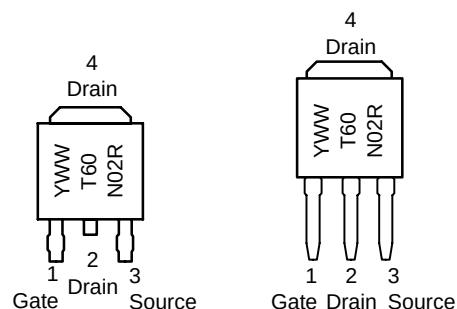


CASE 369C
DPAK
(Surface Mount)
STYLE 2



CASE 369D
DPAK
(Straight Lead)
STYLE 2

MARKING DIAGRAM & PIN ASSIGNMENTS



Y = Year
WW = Work Week
60N02R = Device Code

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

NTD60N02R

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 3) ($V_{GS} = 0\text{ Vdc}$, $I_D = 250\text{ }\mu\text{Adc}$) Temperature Coefficient (Positive)	$V_{(BR)DSS}$	24 –	27.5 25.5	– –	Vdc mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current ($V_{DS} = 20\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$) ($V_{DS} = 20\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$, $T_J = 150^\circ\text{C}$)	I_{DSS}	– –	– –	1.5 10	μAdc
Gate-Body Leakage Current ($V_{GS} = \pm 20\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$)	I_{GSS}	–	–	± 100	nAdc

ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage (Note 3) ($V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{Adc}$) Threshold Temperature Coefficient (Negative)	$V_{GS(th)}$	1.0 –	1.5 4.1	2.0 –	Vdc mV/ $^\circ\text{C}$
Static Drain-to-Source On-Resistance (Note 3) ($V_{GS} = 4.5\text{ Vdc}$, $I_D = 15\text{ Adc}$) ($V_{GS} = 10\text{ Vdc}$, $I_D = 20\text{ Adc}$) ($V_{GS} = 10\text{ Vdc}$, $I_D = 31\text{ Adc}$)	$R_{DS(on)}$	– – –	11.2 8.4 8.2	12.5 10.5 –	m Ω
Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 15\text{ Adc}$) (Note 3)	g_{FS}	–	27	–	Mhos

DYNAMIC CHARACTERISTICS

Input Capacitance	$(V_{DS} = 20\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$, $f = 1.0\text{ MHz}$)	C_{iss}	–	1000	1330	pF
Output Capacitance		C_{oss}	–	480	640	
Transfer Capacitance		C_{rss}	–	180	225	

SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$(V_{GS} = 10\text{ Vdc}$, $V_{DD} = 10\text{ Vdc}$, $I_D = 31\text{ Adc}$, $R_G = 3.0\text{ }\Omega$)	$t_{d(on)}$	–	7.0	–	ns
Rise Time		t_r	–	33	–	
Turn-Off Delay Time		$t_{d(off)}$	–	19	–	
Fall Time		t_f	–	9.0	–	
Gate Charge	$(V_{GS} = 4.5\text{ Vdc}$, $I_D = 31\text{ Adc}$, $V_{DS} = 10\text{ Vdc}$) (Note 3)	Q_T	–	9.5	–	nC
		Q_{GS}	–	2.2	–	
		Q_{GD}	–	5.0	–	

SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	$(I_S = 20\text{ Adc}$, $V_{GS} = 0\text{ Vdc}$) (Note 3) $(I_S = 31\text{ Adc}$, $V_{GS} = 0\text{ Vdc}$) $(I_S = 15\text{ Adc}$, $V_{GS} = 0\text{ Vdc}$, $T_J = 125^\circ\text{C}$)	V_{SD}	– – –	0.88 1.15 0.80	1.2 – –	Vdc
Reverse Recovery Time	$(I_S = 31\text{ Adc}$, $V_{GS} = 0\text{ Vdc}$, $di_S/dt = 100\text{ A}/\mu\text{s}$) (Note 3)	t_{rr}	–	29.1	–	ns
		t_a	–	13.6	–	
		t_b	–	15.5	–	
Reverse Recovery Stored Charge		Q_{rr}	–	0.02	–	μC

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

4. Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

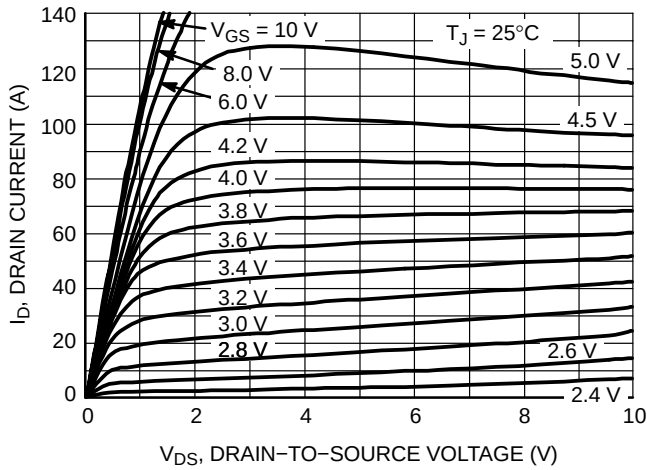


Figure 1. On-Region Characteristics

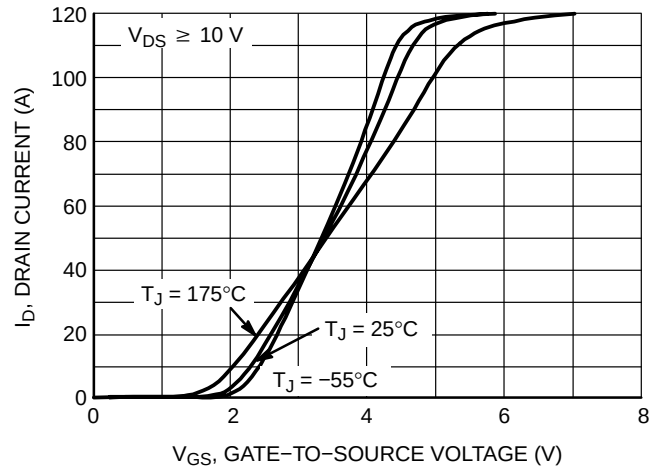


Figure 2. Transfer Characteristics

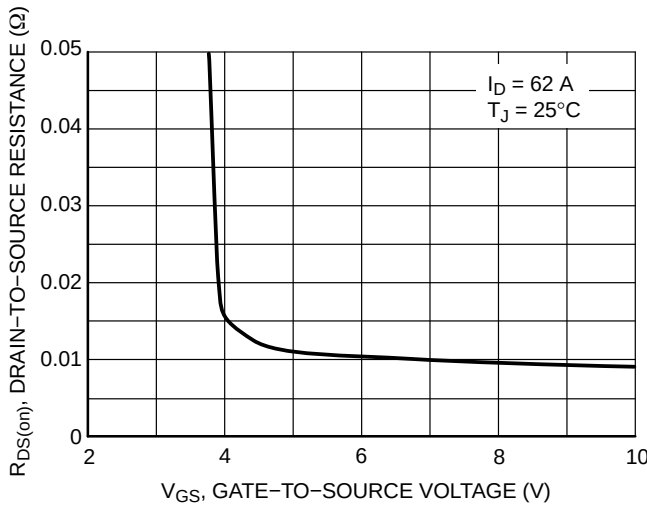


Figure 3. On-Resistance versus Gate-to-Source Voltage

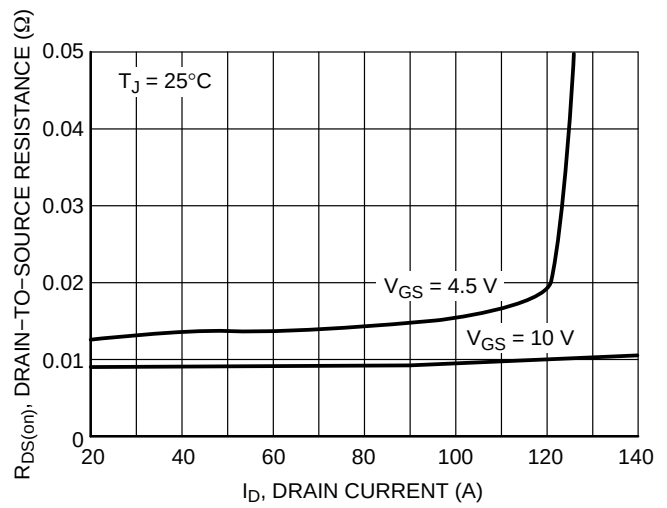


Figure 4. On-Resistance versus Drain Current and Gate Voltage

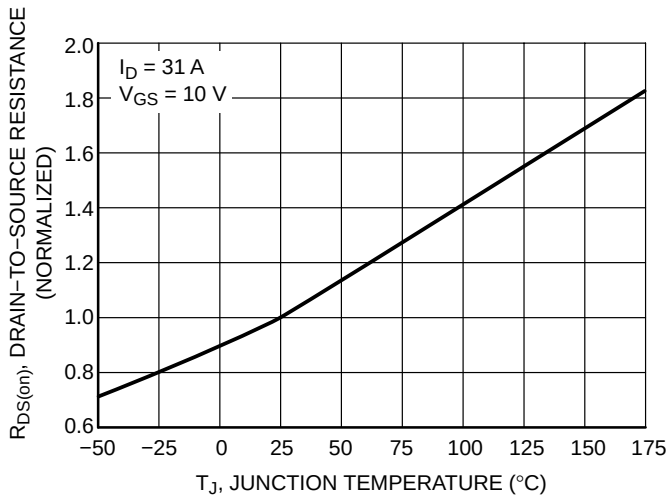


Figure 5. On-Resistance Variation with Temperature

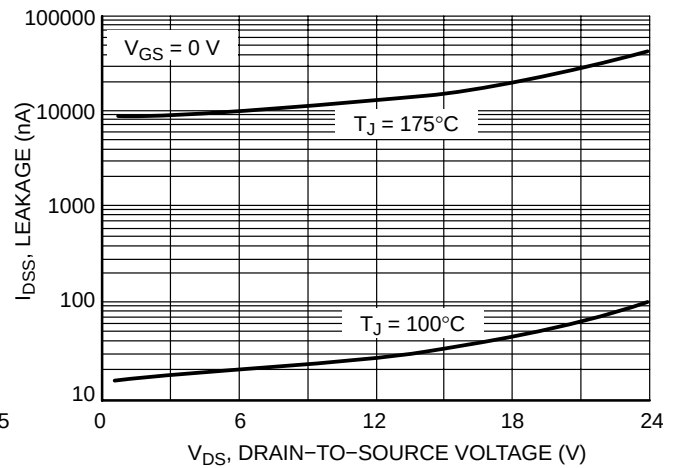


Figure 6. Drain-to-Source Leakage Current versus Voltage

NTD60N02R

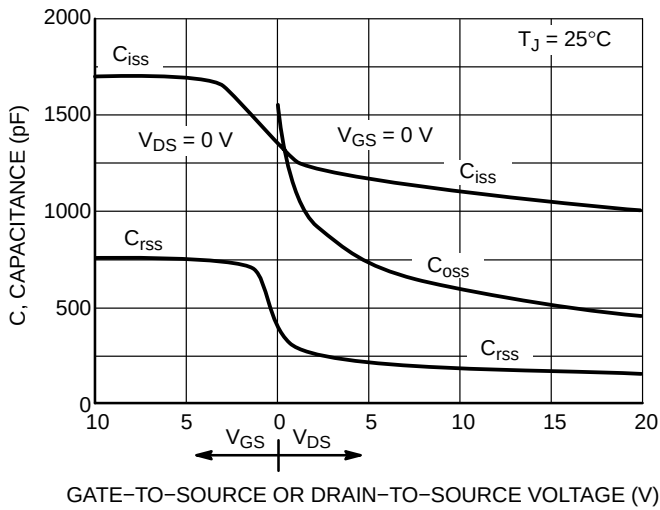


Figure 7. Capacitance Variation

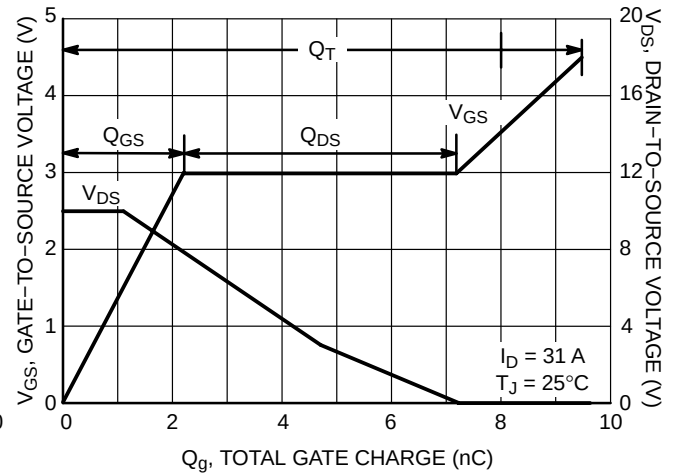


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

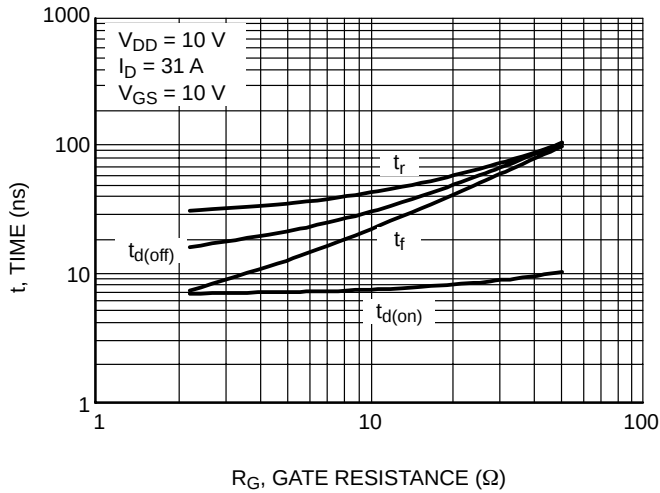


Figure 9. Resistive Switching Time Variation versus Gate Resistance

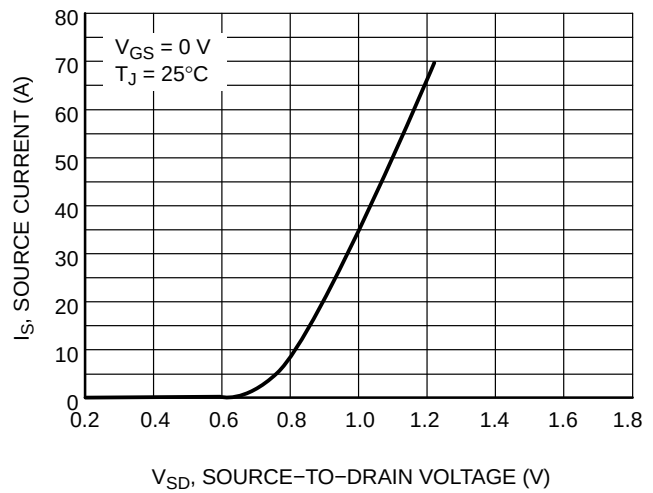


Figure 10. Diode Forward Voltage versus Current

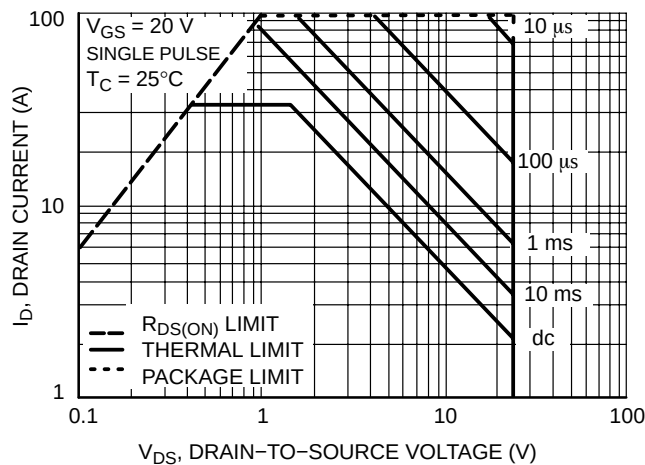


Figure 11. Maximum Rated Forward Biased Safe Operating Area

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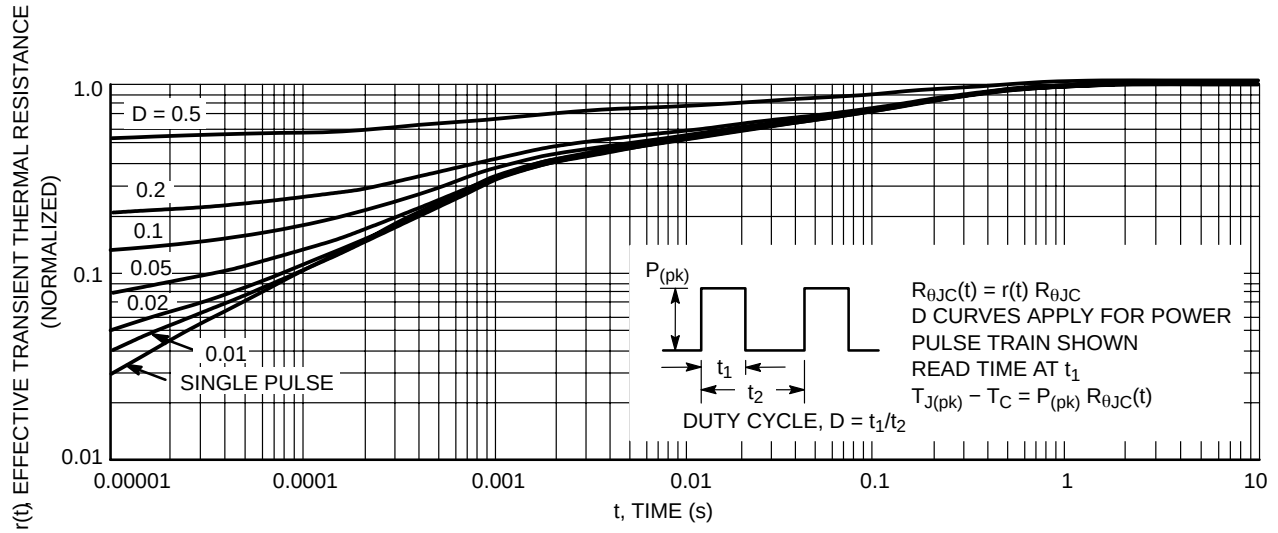


Figure 12. Thermal Response

ORDERING INFORMATION

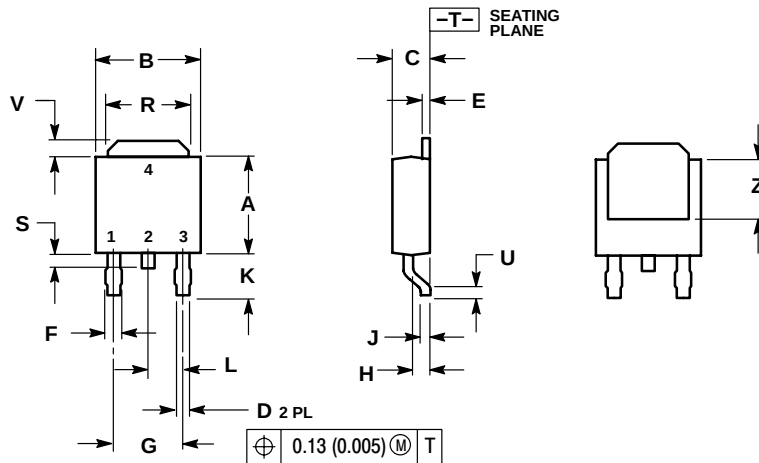
Order Number	Package	Shipping [†]
NTD60N02R	DPAK-3	75 Units / Rail
NTD60N02RG	DPAK-3 (Pb-Free)	75 Units / Rail
NTD60N02RT4	DPAK-3	2500 / Tape & Reel
NTD60N02RT4G	DPAK-3 (Pb-Free)	2500 / Tape & Reel
NTD60N02R-001	DPAK-3 Straight Lead	75 Units / Rail
NTD60N02R-1G	DPAK-3 Straight Lead (Pb-Free)	75 Units / Rail
NTD60N02R-032	DPAK-3 Straight Lead (3.2 ± 0.5 mm)	75 Units / Rail
NTD60N02R-032G	DPAK-3 Straight Lead (3.2 ± 0.5 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.

NTD60N02R

PACKAGE DIMENSIONS

DPAK
CASE 369C-01
ISSUE O

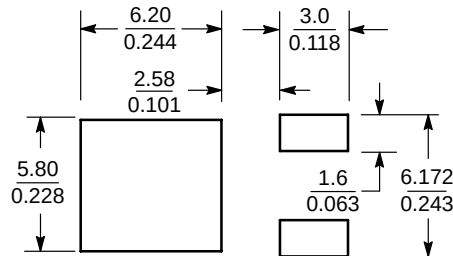


NOTES:
1. DIMENSIONING AND TOLERANCING
PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

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	0.027	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	0.180 BSC		4.58 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090 BSC		2.29 BSC	
R	0.180	0.215	4.57	5.45
S	0.025	0.040	0.63	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*



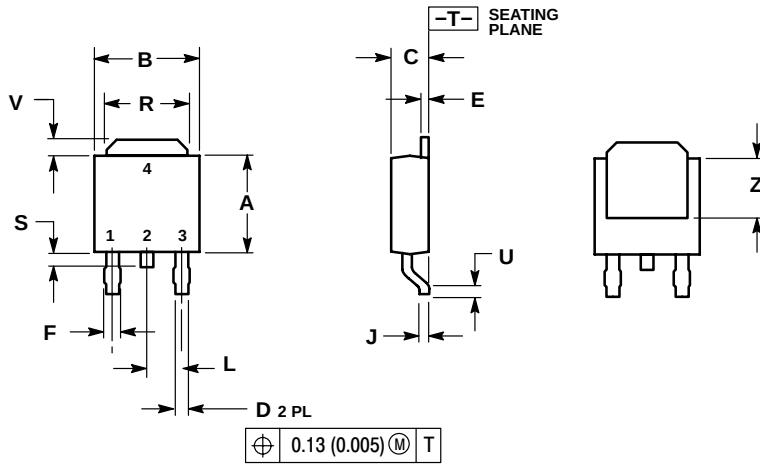
SCALE 3:1 (mm inches)

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

NTD60N02R

PACKAGE DIMENSIONS

DPAK
CASE 369AA-01
ISSUE O

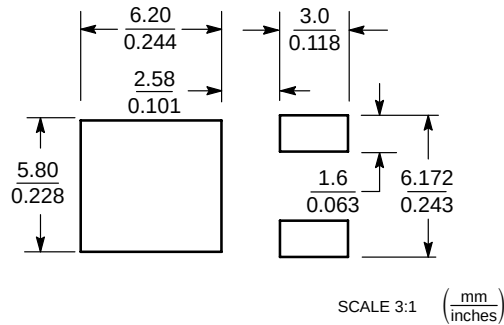


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

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	0.88
E	0.018	0.024	0.46	0.61
F	0.033	0.045	0.83	1.14
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	0.025	0.040	0.63	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
 - DRAIN
 - SOURCE
 - DRAIN

SOLDERING FOOTPRINT*

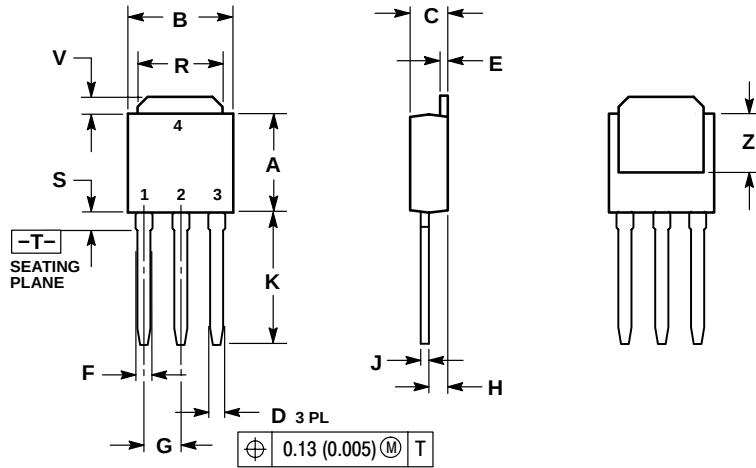


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NTD60N02R

PACKAGE DIMENSIONS

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
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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