NDD01N60, NDT01N60

N-Channel Power MOSFET 600 V, 8.5 Ω

Features

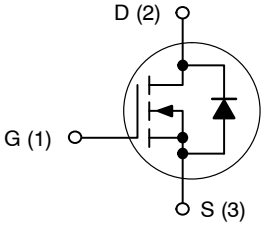
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

ON Semiconductor®

http://onsemi.com

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX
600 V	8.5 Ω @ 10 V

N−Channel MOSFET



ABSOLUTE MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameter	Symbol	NDD	NDT	Unit
Drain−to−Source Voltage	V_{DSS}	600		V
Continuous Drain Current $R_{\theta JC}$ Steady State, T_C = 25°C (Note 1)	I_D	1.5	0.4	A
Continuous Drain Current $R_{\theta JC}$ Steady State, T_C = 100°C (Note 1)	I_D	1.0	0.25	A
Pulsed Drain Current, t_p = 10 μs	I_{DM}	6.0	1.5	A
Power Dissipation − $R_{\theta JC}$ Steady State, T_C = 25°C	P_D	46	2.5	W
Gate−to−Source Voltage	V_{GS}	±30		V
Single Pulse Drain−to−Source Avalanche Energy (I_{PK} = 1.0 A)	EAS	13		mJ
Peak Diode Recovery (Note 2)	dv/dt	4.5		V/ns
Source Current (Body Diode)	I_S	1.5	0.4	A
Lead Temperature for Soldering Leads	T_L	260		°C
Operating Junction and Storage Temperature	T_J, T_{STG}	−55 to +150		°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.

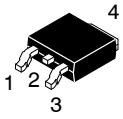
1. Limited by maximum junction temperature
2. I_S = 1.5 A, di/dt ≤ 100 A/μs, $V_{DD} \le BV_{DSS}$

THERMAL RESISTANCE

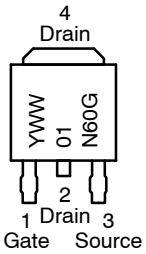
Parameter		Symbol	Value	Unit
Junction−to−Case (Drain)	NDD01N60	$R_{\theta JC}$	2.7	°C/W
Junction−to−Ambient	(Note 4) NDD01N60	$R_{\theta JA}$	38	°C/W
	(Note 3) NDD01N60−1		96	
	(Note 4) NDT01N60		58	
	(Note 5) NDT01N60		141	

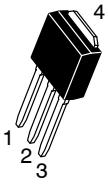
3. Insertion mounted.
4. Surface−mounted on FR4 board using 1" sq. pad size (Cu area = 1.127" sq. [2 oz] including traces).
5. Surface−mounted on FR4 board using minimum recommended pad size (Cu area = 0.026" sq. [2 oz]).

MARKING DIAGRAMS

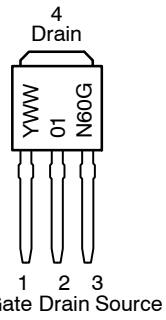


DPAK
CASE 369C
STYLE 2

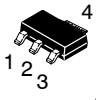




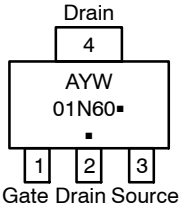
IPAK
CASE 369D
STYLE 2



Y = Year
WW = Work Week
G = Pb−Free Package



SOT−223
CASE 318E
STYLE 3



A = Assembly Location
Y = Year
W = Work Week
01N60 = Specific Device Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

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

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic	Symbol	Test Conditions		Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 1 mA		600			V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	Reference to 25°C, I_D = 1 mA			660		mV/°C
Drain−to−Source Leakage Current	I_{DSS}	V_{DS} = 600 V, V_{GS} = 0 V	T_J = 25°C			1	μA
			T_J = 125°C			50	
Gate−to−Source Leakage Current	I_{GSS}	V_{GS} = ±20 V				±100	nA
ON CHARACTERISTICS (Note 6)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{DS} = V_{GS}, I_D = 50 μA		2.2	3.3	3.7	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$				7.0		mV/°C
Static Drain-to-Source On Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 0.2 A			8.0	8.5	Ω
Forward Transconductance	g_{FS}	V_{DS} = 15 V, I_D = 0.2 A			0.9		S
CHARGES, CAPACITANCES & GATE RESISTANCES							
Input Capacitance (Note 7)	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz			160		pF
Output Capacitance (Note 7)	C_{oss}				22		
Reverse Transfer Capacitance (Note 7)	C_{rss}				4.0		
Total Gate Charge (Note 7)	Q_g	V_{DS} = 300 V, I_D = 0.4 A, V_{GS} = 10 V			7.2		nC
Gate-to-Source Charge (Note 7)	Q_{gs}				1.2		
Gate-to-Drain Charge (Note 7)	Q_{gd}				3.1		
Plateau Voltage	V_{GP}				4.5		V
Gate Resistance	R_g				6.7		Ω
SWITCHING CHARACTERISTICS (Note 8)							
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 300 V, I_D = 0.4 A, V_{GS} = 10 V, R_G = 0 Ω			8.0		ns
Rise Time	t_r				5.1		
Turn-off Delay Time	$t_{d(off)}$				16.5		
Fall Time	t_f				21.3		
DRAIN−SOURCE DIODE CHARACTERISTICS							
Diode Forward Voltage	V_{SD}	I_S = 0.4 A, V_{GS} = 0 V	T_J = 25°C		0.78	1.6	V
			T_J = 125°C		0.63		
Reverse Recovery Time	t_{rr}	V_{GS} = 0 V, V_{DD} = 30 V, I_S = 1.0 A, d_i/d_t = 100 A/μs			179		ns
Charge Time	t_a				37		
Discharge Time	t_b				141		
Reverse Recovery Charge	Q_{rr}				288		nC

6. Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
7. Guaranteed by design.
8. Switching characteristics are independent of operating junction temperatures.

ORDERING INFORMATION

Device	Package	Shipping†
NDD01N60−1G	IPAK (Pb-Free, Halogen-Free)	75 Units / Rail
NDD01N60T4G	DPAK (Pb-Free, Halogen-Free)	2500 / Tape & Reel
NDT01N60T1G	SOT−223 (Pb-Free, Halogen-Free)	1000 / 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.

TYPICAL CHARACTERISTICS

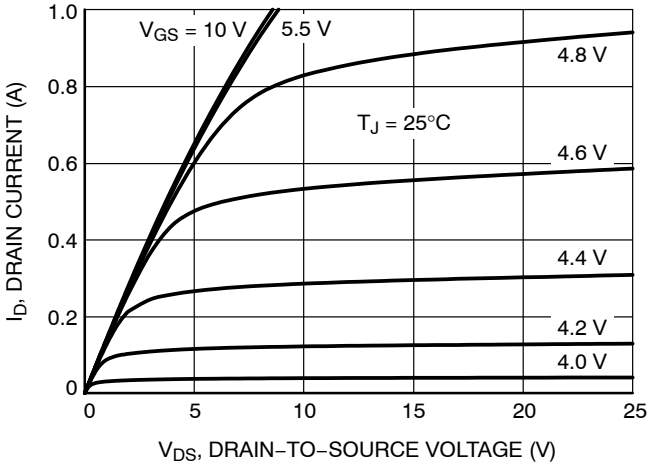


Figure 1. On−Region Characteristics

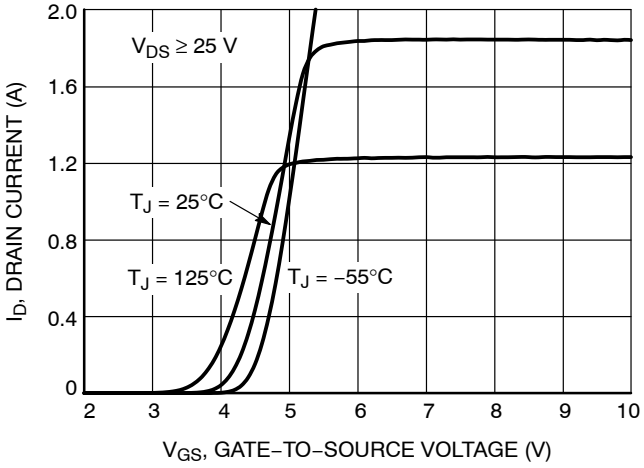


Figure 2. Transfer Characteristics

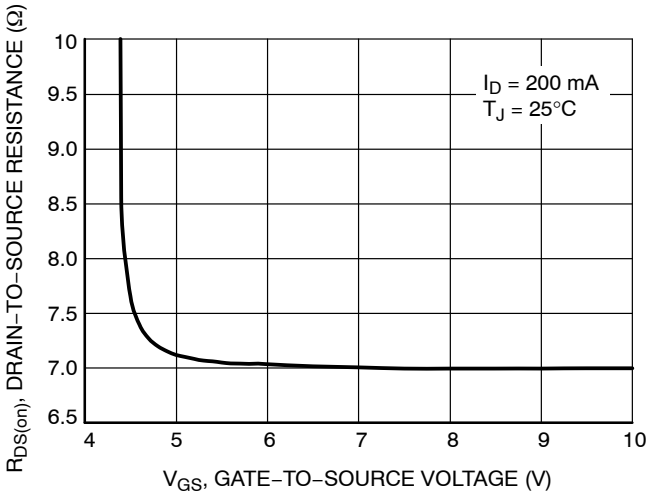


Figure 3. On−Resistance vs. Gate Voltage

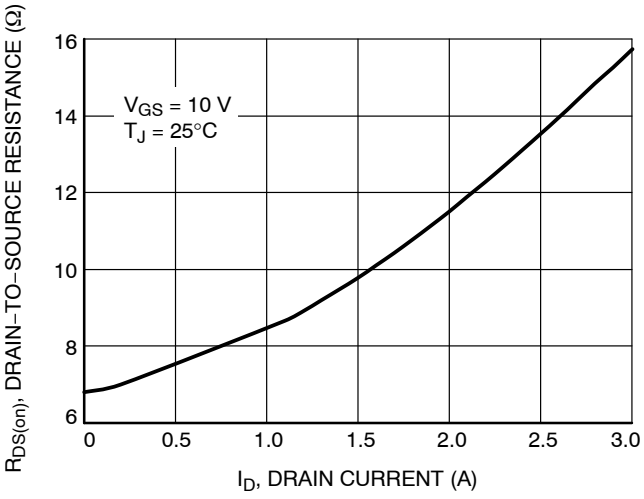


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

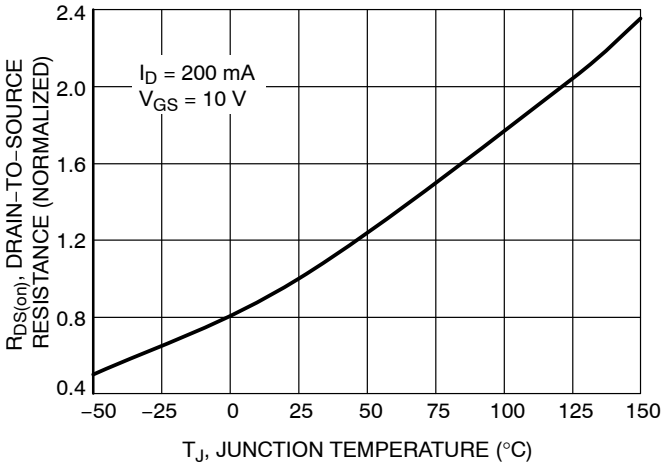


Figure 5. On−Resistance Variation with Temperature

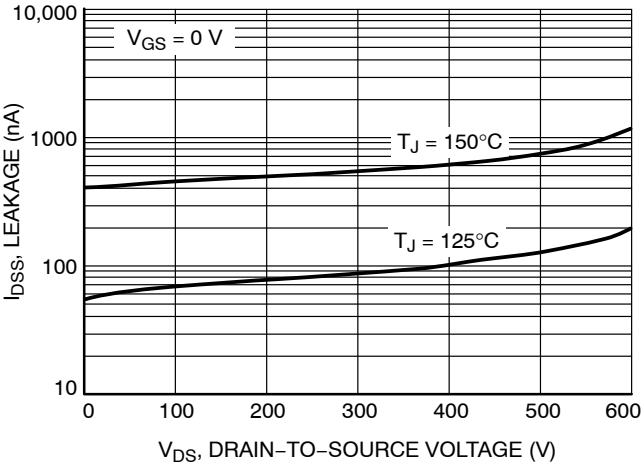


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

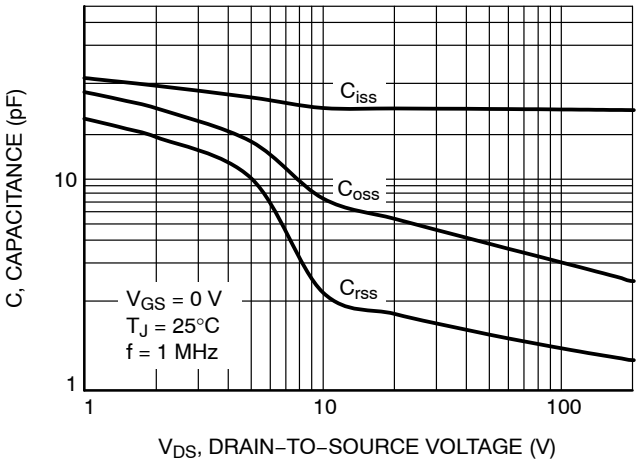


Figure 7. Capacitance Variation

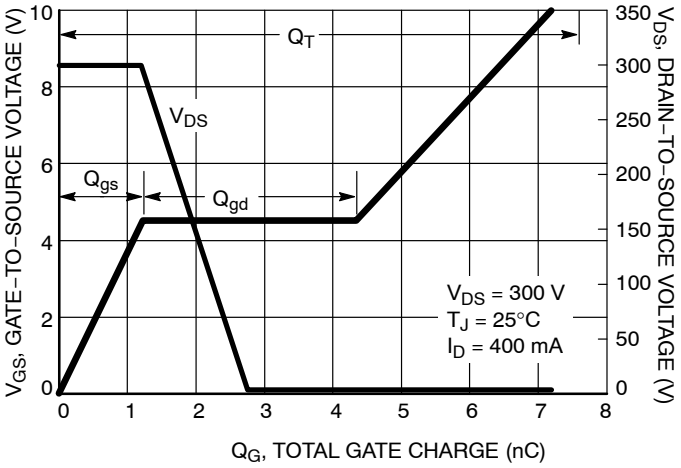


Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge

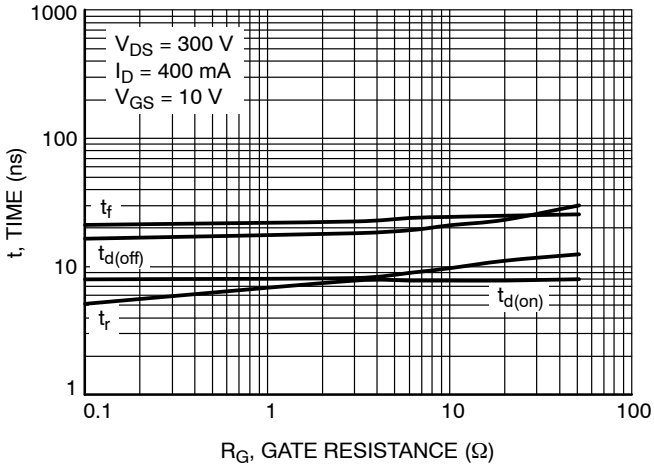


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

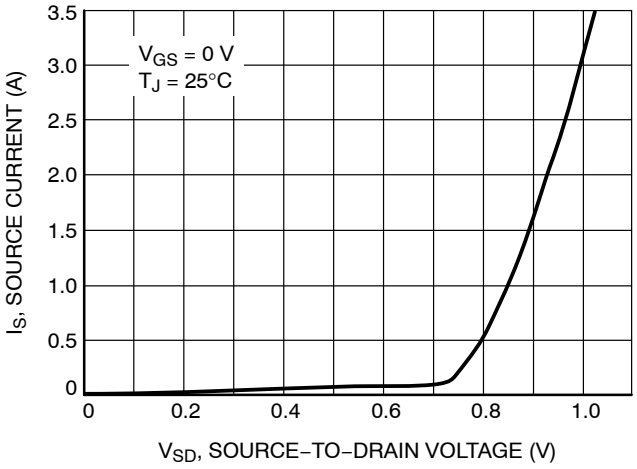


Figure 10. Diode Forward Voltage vs. Current

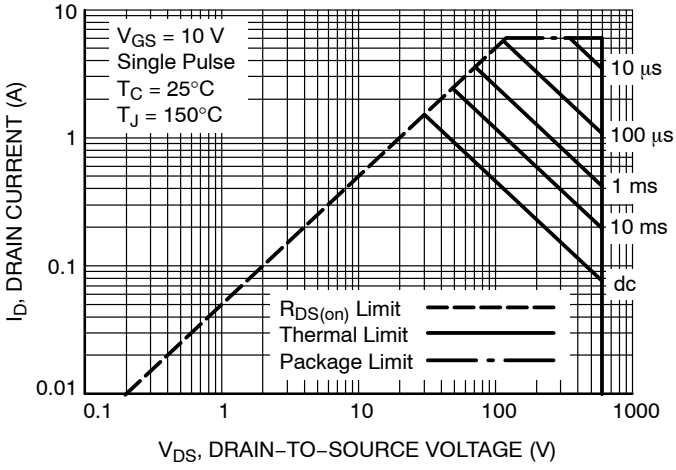


Figure 11. Maximum Rated Forward Biased Safe Operating Area NDD01N60

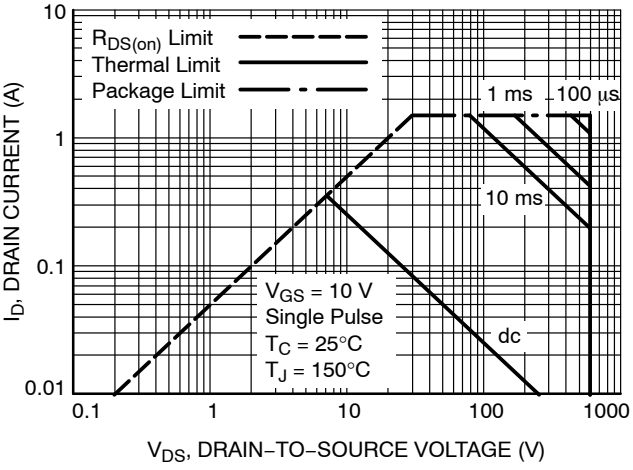


Figure 12. Maximum Rated Forward Biased Safe Operating Area NDT01N60

TYPICAL CHARACTERISTICS

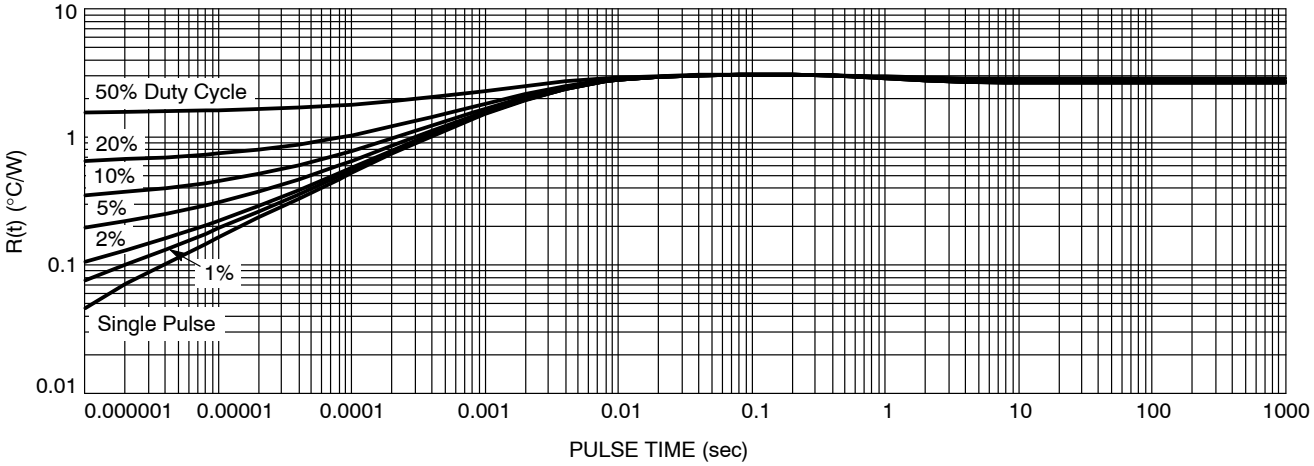


Figure 13. Thermal Impedance (Junction−to−Case) for NDD01N60

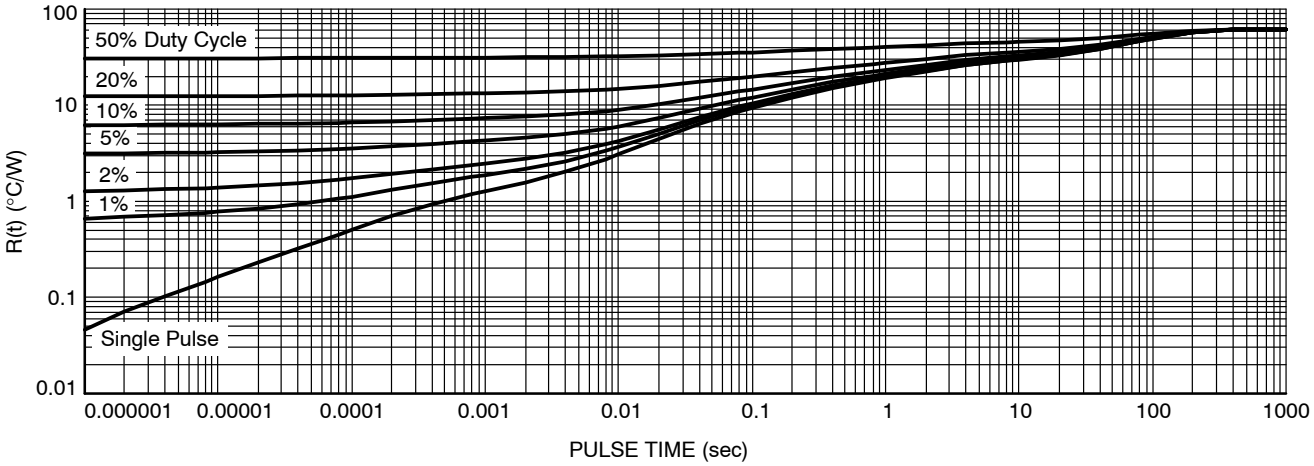
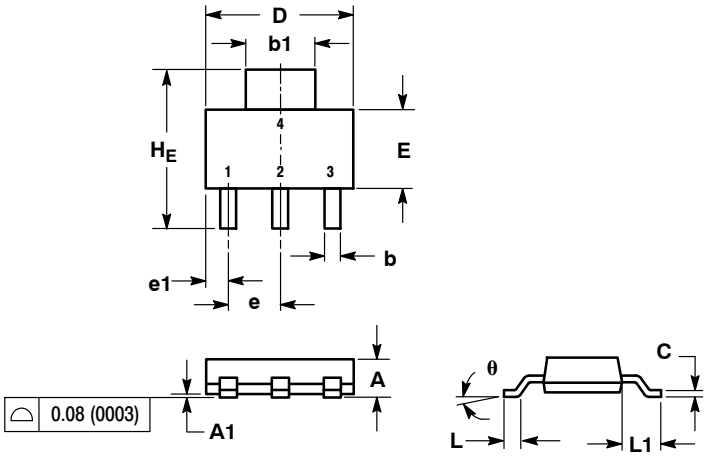


Figure 14. Thermal Impedance (Junction−to−Ambient) for NDT01N60

PACKAGE DIMENSIONS

SOT−223 (TO−261)
CASE 318E−04
ISSUE N

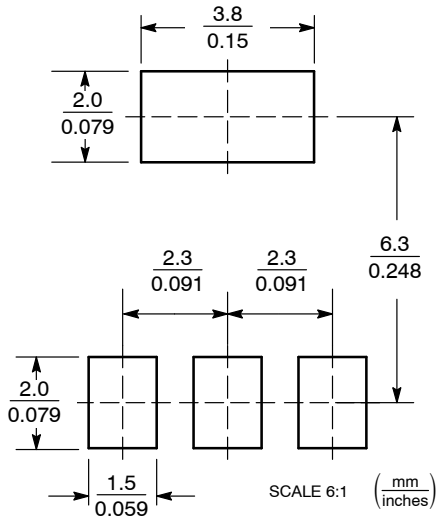


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	1.50	1.63	1.75	0.060	0.064	0.068
A1	0.02	0.06	0.10	0.001	0.002	0.004
b	0.60	0.75	0.89	0.024	0.030	0.035
b1	2.90	3.06	3.20	0.115	0.121	0.126
c	0.24	0.29	0.35	0.009	0.012	0.014
D	6.30	6.50	6.70	0.249	0.256	0.263
E	3.30	3.50	3.70	0.130	0.138	0.145
e	2.20	2.30	2.40	0.087	0.091	0.094
e1	0.85	0.94	1.05	0.033	0.037	0.041
L	0.20	−−−	−−−	0.008	−−−	−−−
L1	1.50	1.75	2.00	0.060	0.069	0.078
H_E	6.70	7.00	7.30	0.264	0.276	0.287
θ	0°	–	10°	0°	–	10°

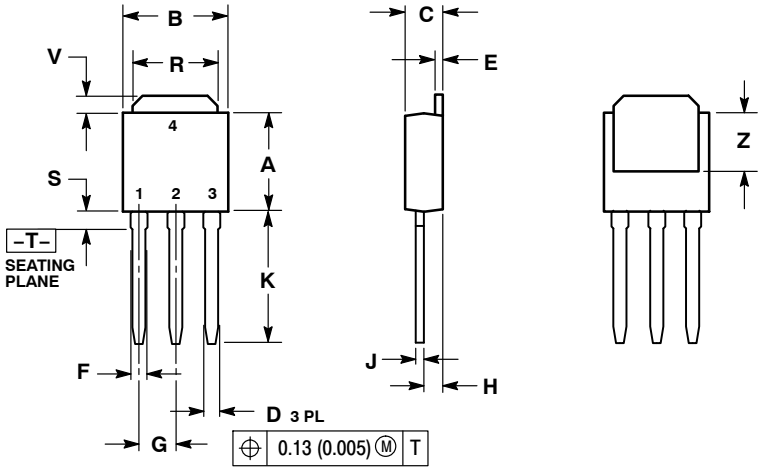
STYLE 3:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

SOLDERING FOOTPRINT



PACKAGE DIMENSIONS

IPAK
CASE 369D
ISSUE C



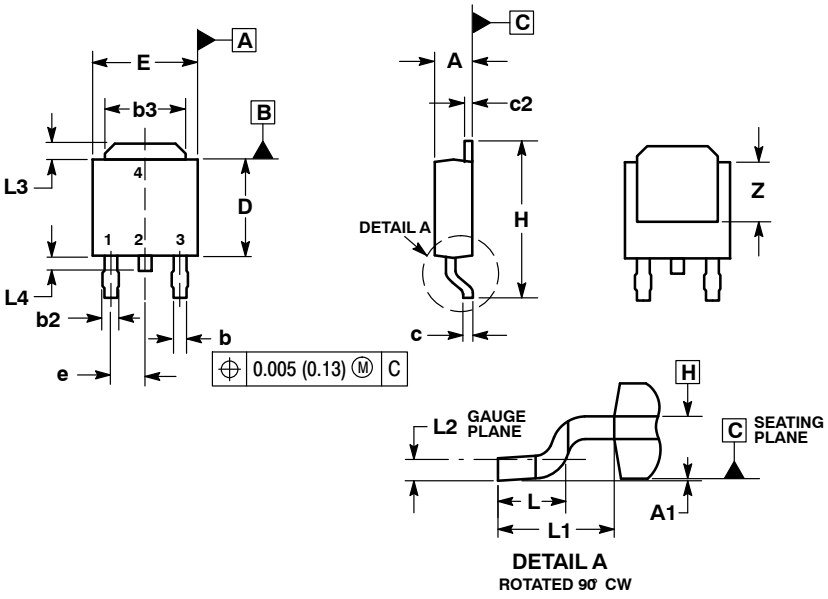
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	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

PACKAGE DIMENSIONS

DPAK (SINGLE GAUGE)
CASE 369C−01
ISSUE D

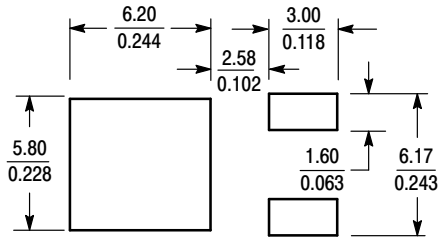


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES 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.

	INCHES		MILLIMETERS	
DIM	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	−−−

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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative