

NTD60N02R

Power MOSFET 60 Amps, 24 Volts

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

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	$R_{\theta JC}$	2.6	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	P_D	48	W
Drain Current			
Continuous @ $T_A = 25^\circ\text{C}$, Chip	I_D	60	A
Continuous @ $T_A = 25^\circ\text{C}$, Limited by Package	I_D	50	A
Continuous @ $T_A = 25^\circ\text{C}$, Limited by Wires	I_D	32	A
Thermal Resistance Junction-to-Ambient (Note 1)	$R_{\theta JA}$	80	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	P_D	1.56	W
Drain Current - Continuous @ $T_A = 25^\circ\text{C}$	I_D	9.3	A
Thermal Resistance Junction-to-Ambient (Note 2)	$R_{\theta JA}$	120	$^\circ\text{C/W}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	P_D	1.04	W
Drain Current - Continuous @ $T_A = 25^\circ\text{C}$	I_D	7.6	A
Operating and Storage Temperature	T_J , and T_{stg}	- 55 to 150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy - Starting $T_J = 25^\circ\text{C}$ ($V_{DD} = 50\text{ Vdc}$, $V_{GS} = 10.0\text{ Vdc}$, $I_L = 11\text{ Apk}$, $L = 1.0\text{ mH}$, $R_G = 25\ \Omega$)	E_{AS}	60	mJ
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds	T_L	260	$^\circ\text{C}$

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

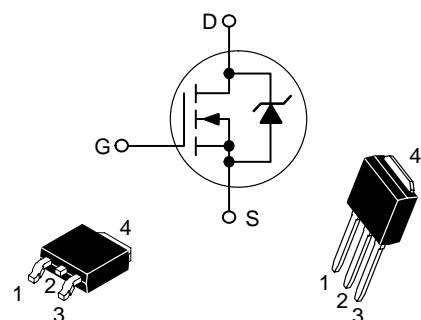


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$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	I_D MAX
24 V	8.0 m Ω @ 4.5 V	60 A

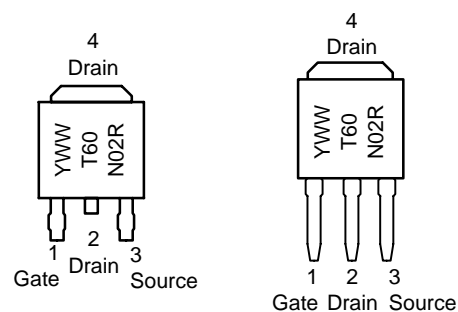
N-Channel



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

Device	Package	Shipping
NTD60N02R	DPAK	75 Units/Rail
NTD60N02RT4	DPAK	2500 Tape & Reel
NTD60N02R-1	DPAK Straight Lead	75 Units/Rail

NTD60N02R

ELECTRICAL CHARACTERISTICS (T_J = 25°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 Vdc, I _D = 250 μAdc) Temperature Coefficient (Positive)	V _{(BR)DSS}	24 -	27.5 25.5	- -	Vdc mV/°C
Zero Gate Voltage Drain Current (V _{DS} = 20 Vdc, V _{GS} = 0 Vdc) (V _{DS} = 20 Vdc, V _{GS} = 0 Vdc, T _J = 150°C)	I _{DSS}	- -	- -	1.5 10	μAdc
Gate-Body Leakage Current (V _{GS} = ±20 Vdc, V _{DS} = 0 Vdc)	I _{GSS}	-	-	±100	nAdc

ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage (Note 3) (V _{DS} = V _{GS} , I _D = 250 μAdc) Threshold Temperature Coefficient (Negative)	V _{GS(th)}	1.0 -	1.5 4.1	2.0 -	Vdc mV/°C
Static Drain-to-Source On-Resistance (Note 3) (V _{GS} = 4.5 Vdc, I _D = 15 Adc) (V _{GS} = 10 Vdc, I _D = 20 Adc) (V _{GS} = 10 Vdc, I _D = 30 Adc)	R _{DS(on)}	- - -	11.2 8.0 8.2	12.5 10.5 -	mΩ
Forward Transconductance (V _{DS} = 10 Vdc, I _D = 15 Adc) (Note 3)	g _{FS}	-	27	-	Mhos

DYNAMIC CHARACTERISTICS

Input Capacitance	(V _{DS} = 20 Vdc, V _{GS} = 0 Vdc, f = 1.0 MHz)	C _{iss}	-	948	1330	pF
Output Capacitance		C _{oss}	-	456	640	
Transfer Capacitance		C _{rss}	-	160	225	

SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	(V _{GS} = 10.0 Vdc, V _{DD} = 10 Vdc, I _D = 30 Adc, R _G = 3.0 Ω)	t _{d(on)}	-	7.0	-	ns
Rise Time		t _r	-	53	-	
Turn-Off Delay Time		t _{d(off)}	-	14	-	
Fall Time		t _f	-	10	-	
Gate Charge	(V _{GS} = 4.5 Vdc, I _D = 30 Adc, V _{DS} = 10 Vdc) (Note 3)	Q _T	-	8.4	-	nC
		Q ₁	-	3.7	-	
		Q ₂	-	4.04	-	

SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	(I _S = 20 Adc, V _{GS} = 0 Vdc) (Note 3) (I _S = 30 Adc, V _{GS} = 0 Vdc) (I _S = 15 Adc, V _{GS} = 0 Vdc, T _J = 125°C)	V _{SD}	- - -	0.88 1.10 0.80	1.2 - -	Vdc
Reverse Recovery Time	(I _S = 30 Adc, V _{GS} = 0 Vdc, di _S /dt = 100 A/μs) (Note 3)	t _{rr}	-	15.5	-	ns
		t _a	-	12.6	-	
		t _b	-	2.6	-	
Reverse Recovery Stored Charge		Q _{rr}	-	0.005	-	μC

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

4. Switching characteristics are independent of operating junction temperatures.

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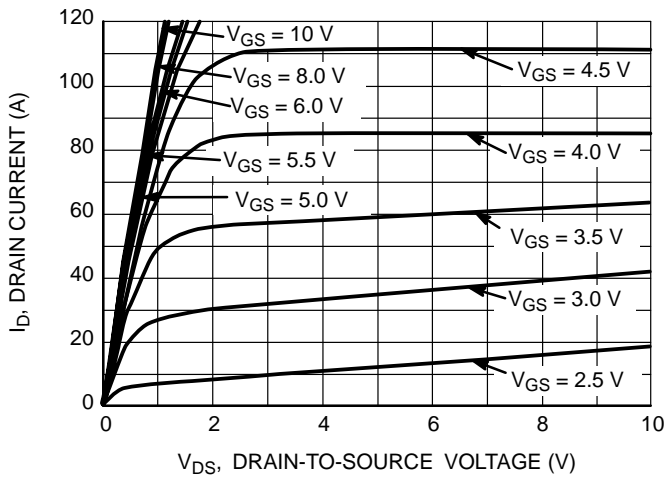


Figure 1. On-Region Characteristics

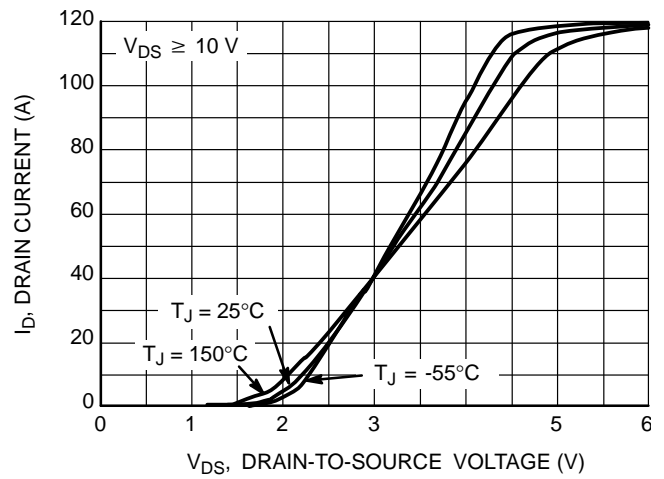


Figure 2. Transfer Characteristics

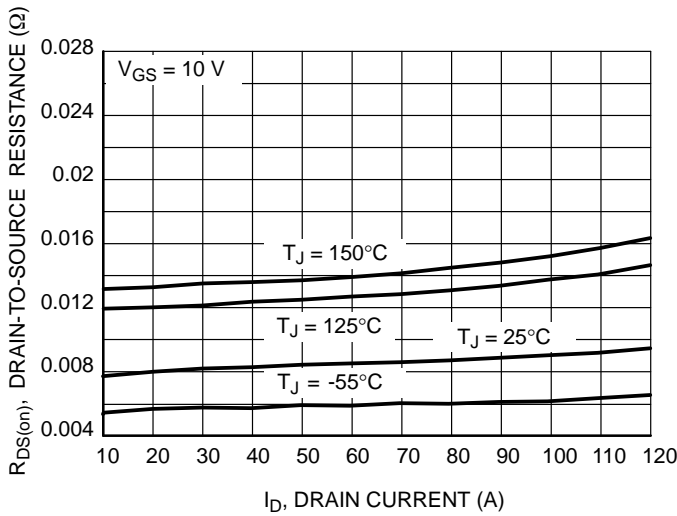


Figure 3. On-Resistance versus Drain Current and Temperature

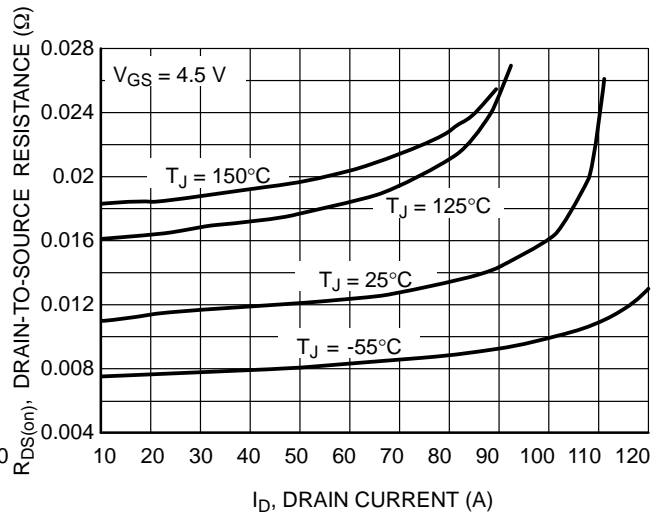


Figure 4. On-Resistance versus Drain Current and Temperature

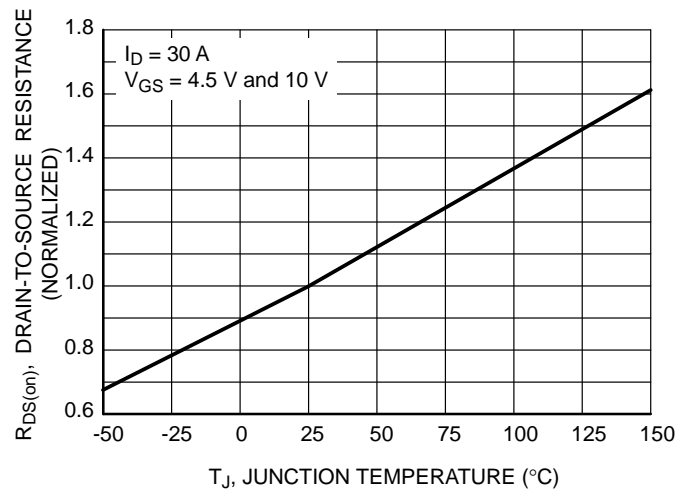


Figure 5. On-Resistance Variation with Temperature

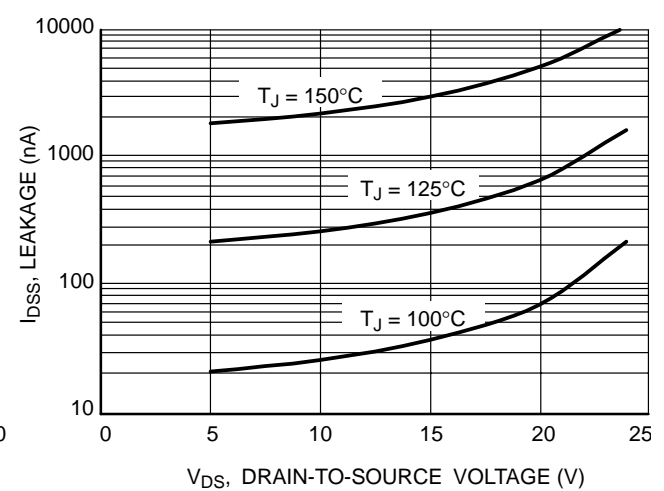
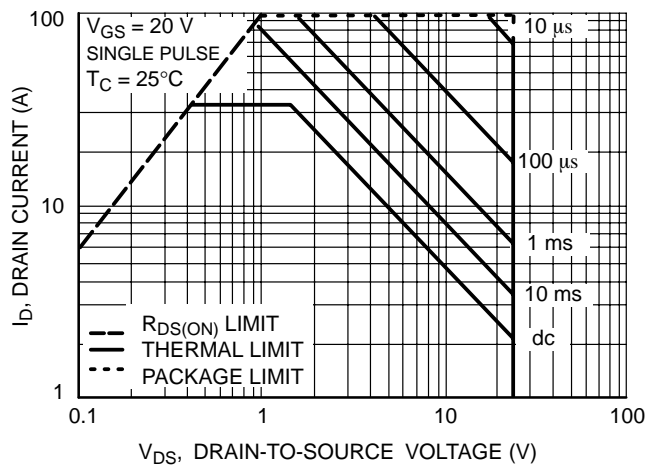
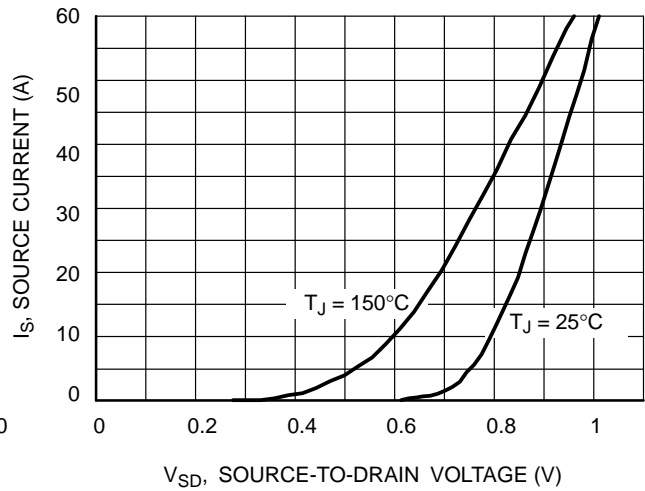
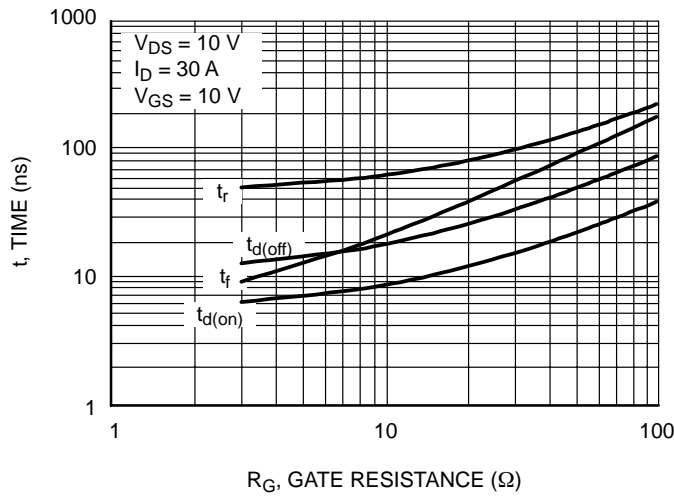
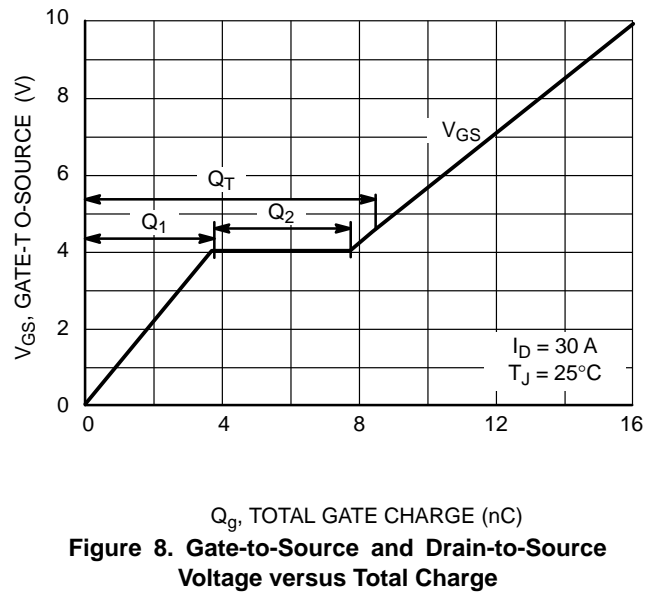
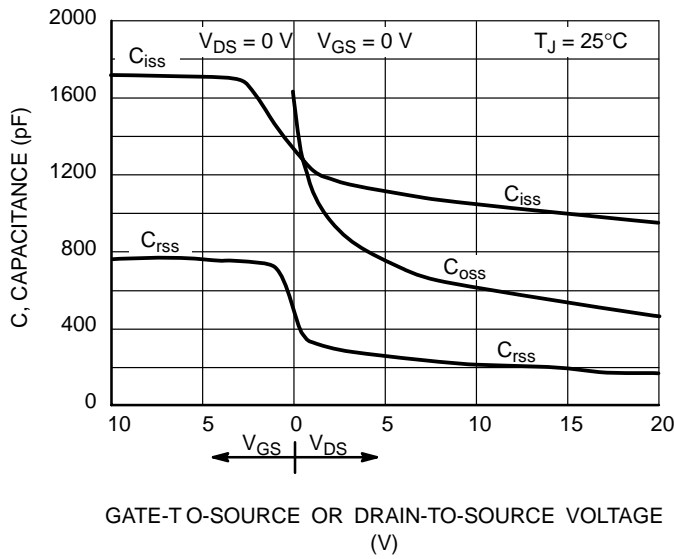


Figure 6. Drain-to-Source Leakage Current versus Voltage

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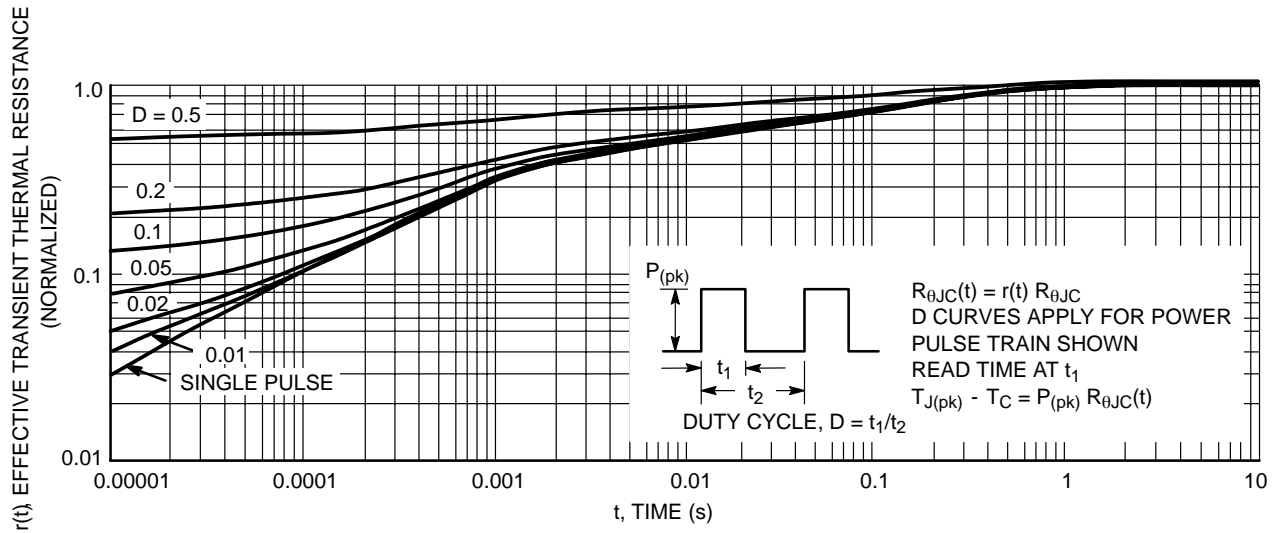


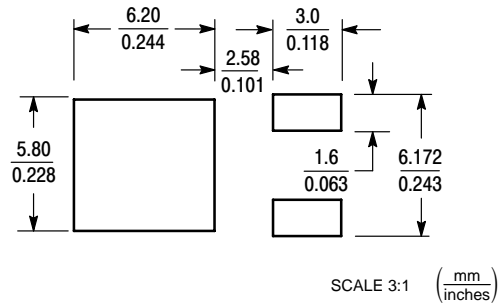
Figure 12. Thermal Response

INFORMATION FOR USING THE DPAK SURFACE MOUNT PACKAGE

RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to ensure proper solder connection

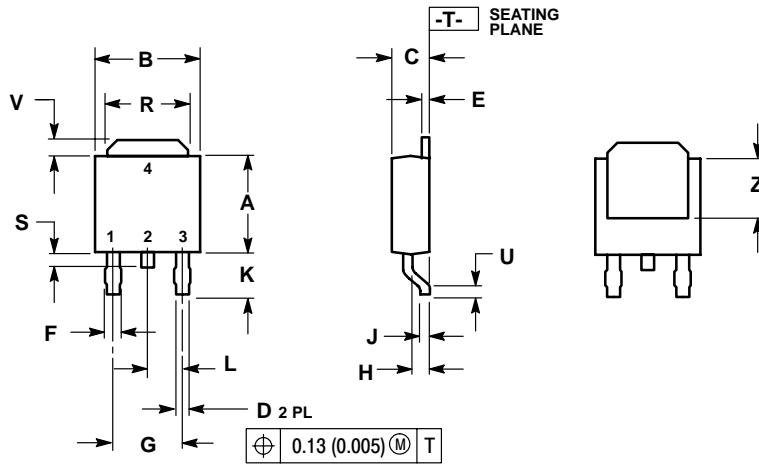
interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



NTD60N02R

PACKAGE DIMENSIONS

DPAK
CASE 369C-01
ISSUE O



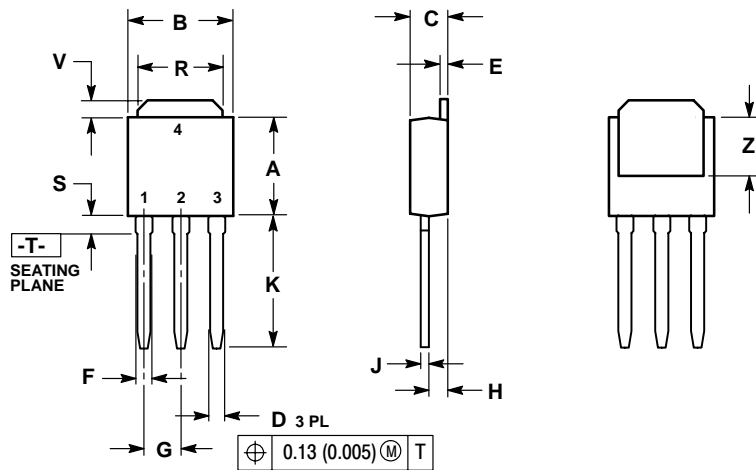
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.180 BSC		4.58 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090 BSC		2.29 BSC	
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

NTD60N02R

PACKAGE DIMENSIONS

DPAK
CASE 369D-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	6.35
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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