

NTD78N03

Power MOSFET

25 V, 78 A, Single N-Channel, DPAK

Features

- Low $R_{DS(on)}$
- Optimized Gate Charge
- Pb-Free Packages are Available

Applications

- Desktop VCORE
- DC-DC Converters
- Low Side Switch

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

Parameter		Symbol	Value	Unit
Drain-to-Source Voltage		V_{DS}	25	V
Gate-to-Source Voltage		V_{GS}	± 20	V
Continuous Drain Current (Note 1)	$T_A = 25^\circ\text{C}$	I_D	14.8	A
	$T_A = 85^\circ\text{C}$		11.5	
Power Dissipation (Note 1)	$T_A = 25^\circ\text{C}$	P_D	2.3	W
Continuous Drain Current (Note 2)	$T_A = 25^\circ\text{C}$	I_D	11.4	A
	$T_A = 85^\circ\text{C}$		8.8	
Power Dissipation (Note 2)	$T_A = 25^\circ\text{C}$	P_D	1.4	W
Continuous Drain Current ($R_{\theta JC}$)	$T_C = 25^\circ\text{C}$	I_D	78	A
	$T_C = 85^\circ\text{C}$		56	
Power Dissipation ($R_{\theta JC}$)	$T_C = 25^\circ\text{C}$	P_D	64	W
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	I_{DM}	88	A
Current Limited by Package	$T_A = 25^\circ\text{C}$	$I_{DmaxPkg}$	32	A
Drain to Source dV/dt		dV/dt	2.0	V/ns
Operating Junction and Storage Temperature		T_J, T_{stg}	-55 to 175	$^\circ\text{C}$
Source Current (Body Diode)		I_S	78	A
Single Pulse Drain-to-Source Avalanche Energy ($V_{DD} = 24 \text{ V}$, $V_{GS} = 10 \text{ V}$, $L = 5.0 \text{ mH}$, $I_L(pk) = 17 \text{ A}$, $R_G = 25 \Omega$)		E_{AS}	722.5	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		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.

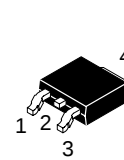
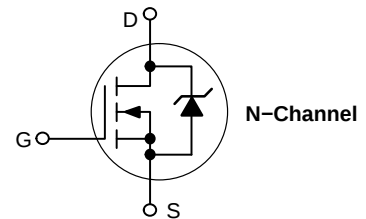
1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
2. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = TBD in sq).



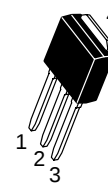
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$V_{(BR)DS}$	$R_{DS(on)}$ TYP	I_D MAX
25 V	4.6 @ 10 V	78 A
	6.5 @ 4.5 V	



CASE 369C
DPAK
(Bend Lead)
STYLE 2

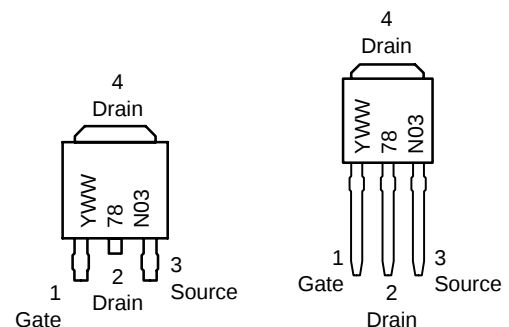


CASE 369D
DPAK
(Straight Lead)
STYLE 2



CASE 369AC
3 IPAK
(Straight Lead)

MARKING DIAGRAMS & PIN ASSIGNMENTS



Y = Year
WW = Work Week
78N03 = Device Code

ORDERING INFORMATION

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

THERMAL RESISTANCE MAXIMUM RATINGS

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Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	1.95	°C/W
Junction-to-Ambient – Steady State (Note 3)	$R_{\theta JA}$	65	
Junction-to-Ambient – Steady State (Note 4)	$R_{\theta JA}$	110	

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	25			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			24		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$	$T_J = 25^\circ\text{C}$		1.5	μA
			$T_J = 125^\circ\text{C}$		10	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			± 100	nA

ON CHARACTERISTICS (Note 5)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	1.0	1.6	3.0	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			-5.0		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 78\text{ A}$		4.6	6.0	m Ω
		$V_{GS} = 4.5\text{ V}, I_D = 36\text{ A}$		6.5	7.8	
Forward Transconductance	g_{FS}	$V_{DS} = 10\text{ V}, I_D = 15\text{ A}$		22		S

CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 12\text{ V}$		1920		pF
Output Capacitance	C_{oss}			960		
Reverse Transfer Capacitance	C_{rss}			420		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}, I_D = 20\text{ A}$		25.5	35	nC
Threshold Gate Charge	$Q_{G(TH)}$			2.4		
Gate-to-Source Charge	Q_{GS}			5.3		
Gate-to-Drain Charge	Q_{GD}			18.2		

SWITCHING CHARACTERISTICS (Note 6)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 4.5\text{ V}, V_{DS} = 20\text{ V}, I_D = 20\text{ A}, R_G = 3.0\text{ }\Omega$		11		ns
Rise Time	t_r			68		
Turn-Off Delay Time	$t_{d(off)}$			23		
Fall Time	t_f			42		

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V}, I_S = 20\text{ A}$	$T_J = 25^\circ\text{C}$		0.83	1.0	V
			$T_J = 125^\circ\text{C}$		0.7		
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = 20\text{ A}$			39		ns
Charge Time	t_a				17.8		
Discharge Time	t_b				21		
Reverse Recovery Time	Q_{RR}				33		nC

- Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
- Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = TBD in sq).
- Pulse Test: Pulse Width $\leq 300\text{ }\mu\text{s}$, Duty Cycle $\leq 2\%$.
- Switching characteristics are independent of operating junction temperatures.

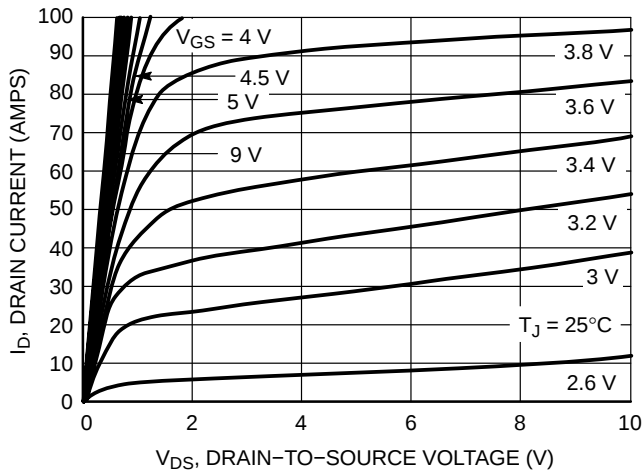


Figure 1. On-Region Characteristics

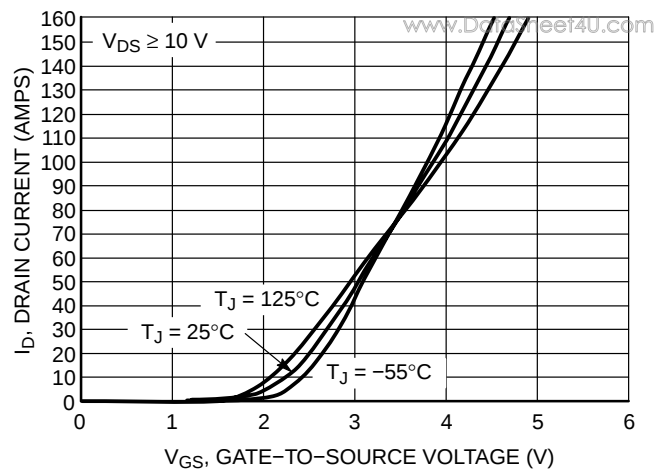


Figure 2. Transfer Characteristics

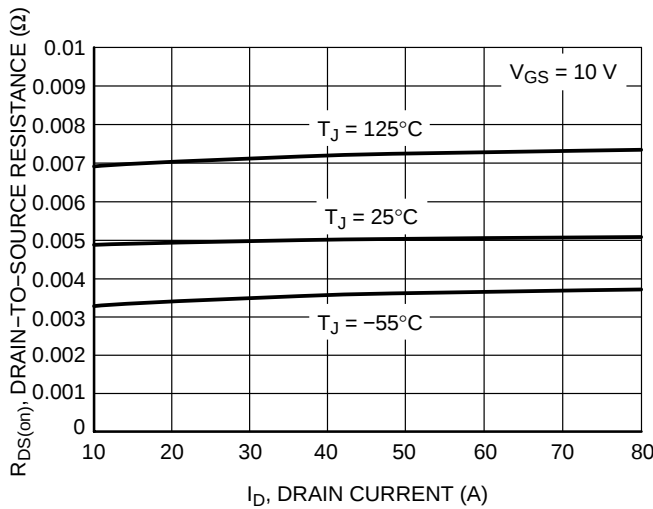


Figure 3. On-Resistance versus Drain Current and Temperature

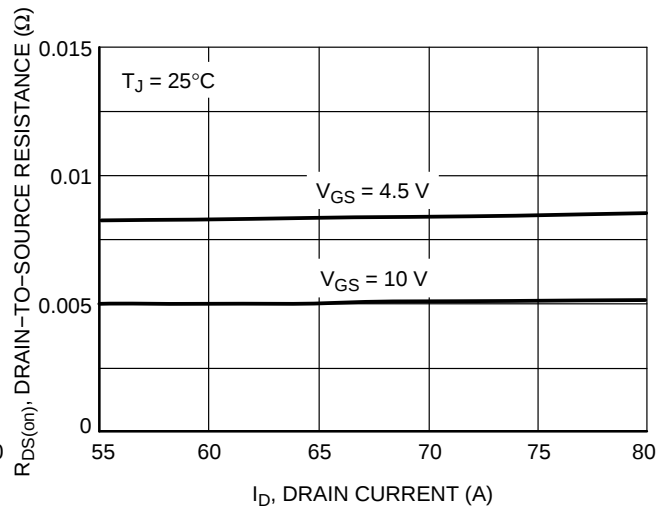


Figure 4. On-Resistance versus Drain Current and Gate Voltage

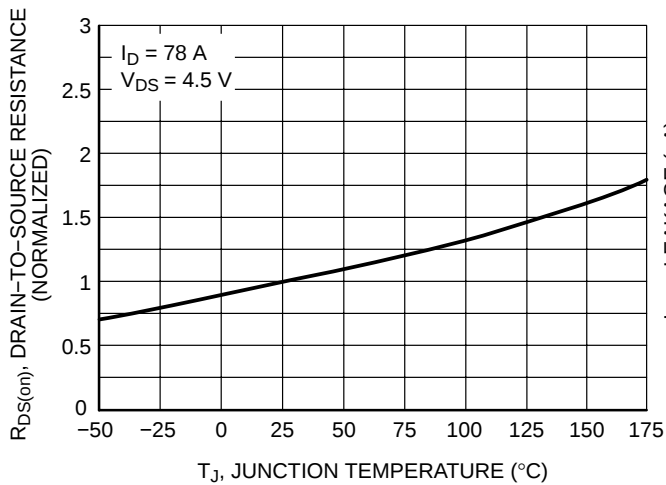


Figure 5. On-Resistance Variation with Temperature

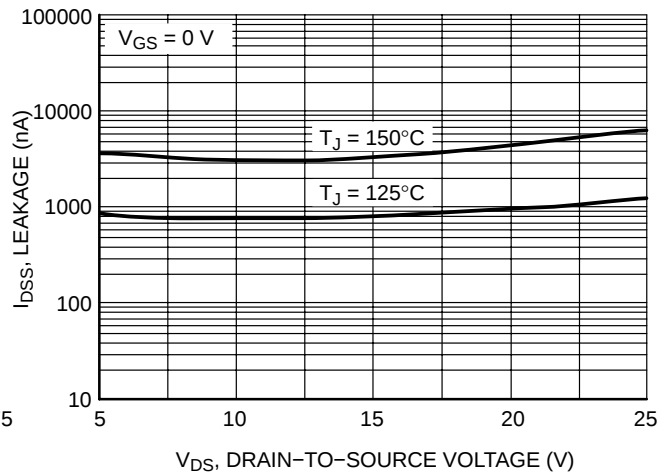


Figure 6. Drain-To-Source Leakage Current versus Voltage

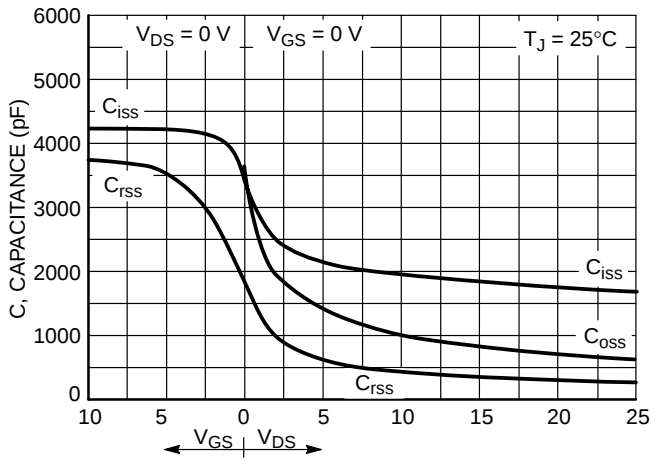


Figure 7. Capacitance Variation

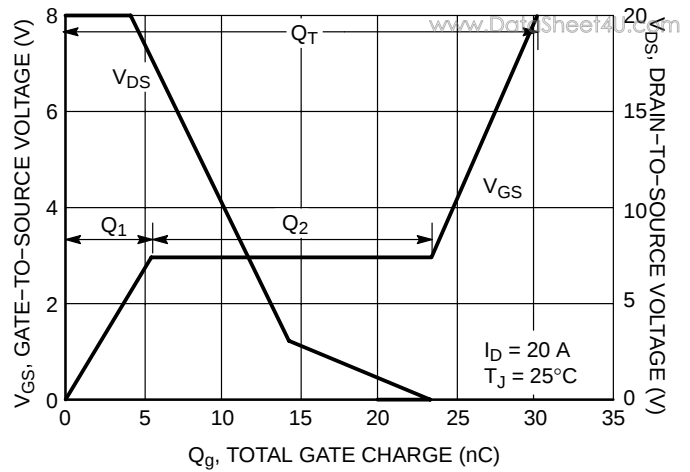


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

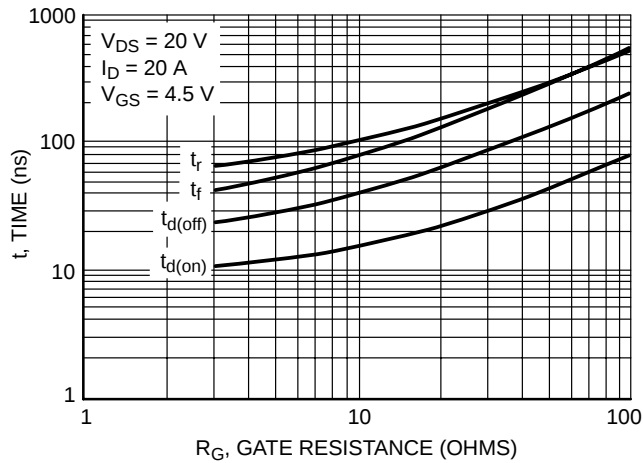


Figure 9. Resistive Switching Time Variation versus Gate Resistance

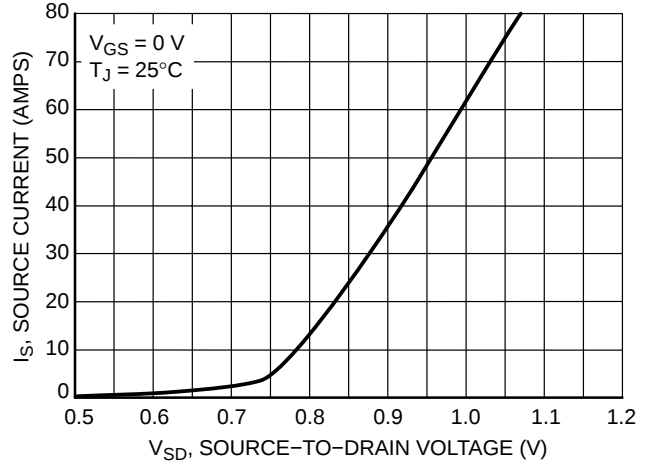


Figure 10. Diode Forward Voltage versus Current

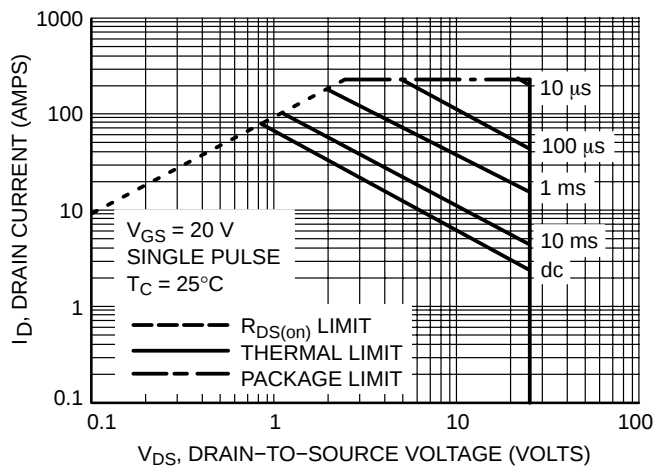


Figure 11. Maximum Rated Forward Biased Safe Operating Area

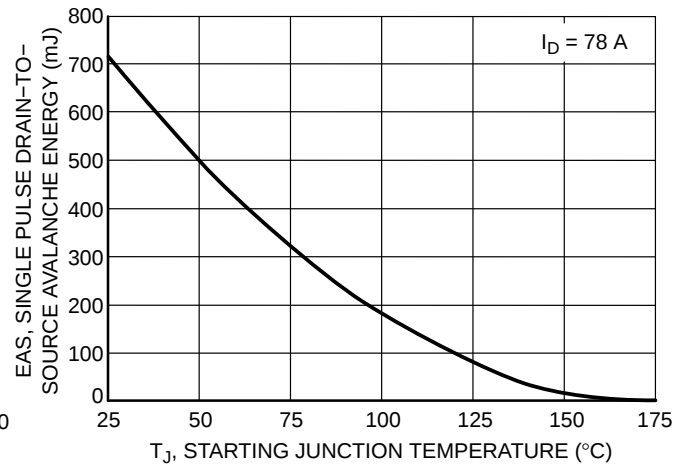


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

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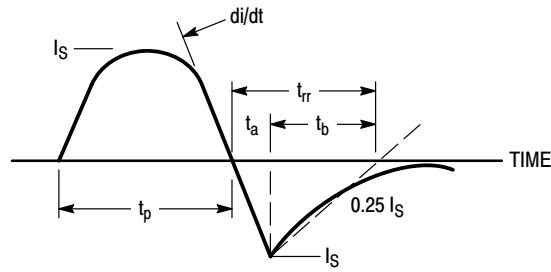


Figure 13. Diode Reverse Recovery Waveform

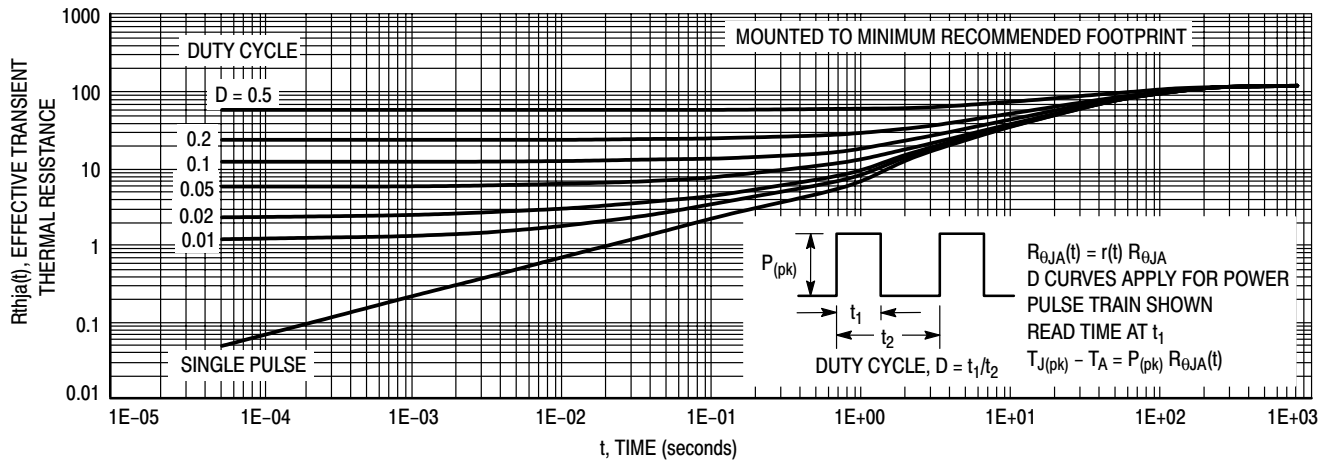


Figure 14. Thermal Response – Various Duty Cycles

ORDERING INFORMATION

Order Number	Package	Shipping [†]
NTD78N03	DPAK	75 Units/Rail
NTD78N03T4	DPAK	2500 Tape & Reel
NTD78N03T4G	DPAK (Pb-Free)	2500 Tape & Reel
NTD78N03-1	DPAK Straight Lead	75 Units/Rail
NTD78N03-1G	DPAK Straight Lead (Pb-Free)	75 Units/Rail
NTD78N03-35	DPAK-3 Straight Lead (3.5 ± 0.15 mm)	75 Units/Rail
NTD78N03-35G	DPAK-3 Straight Lead (3.5 ± 0.15 mm) (Pb-Free)	75 Units/Rail

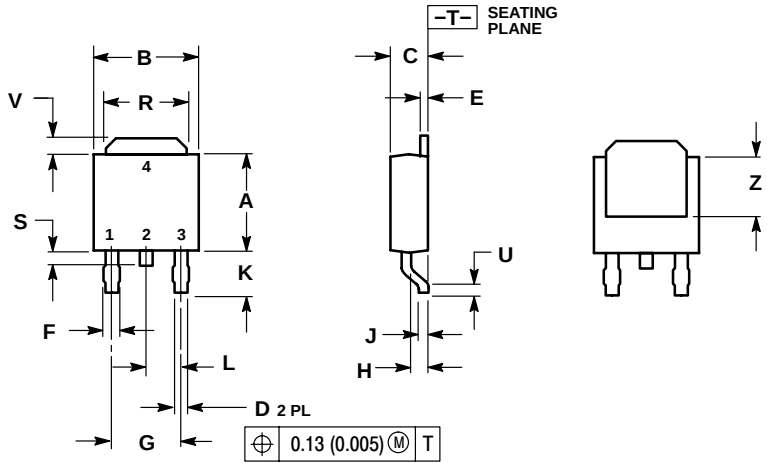
[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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PACKAGE DIMENSIONS

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DPAK CASE 369C-01 ISSUE O

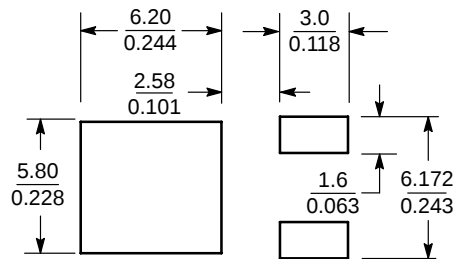


NOTES:

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	---

SOLDERING FOOTPRINT*



SCALE 3:1 (mm/inches)

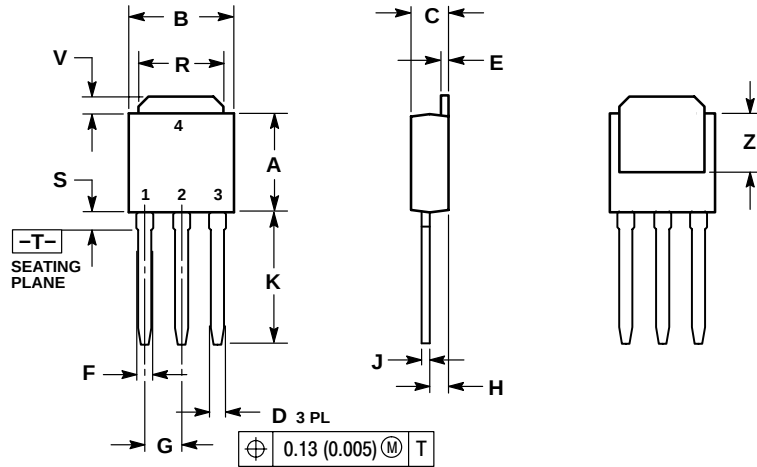
*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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PACKAGE DIMENSIONS

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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	---

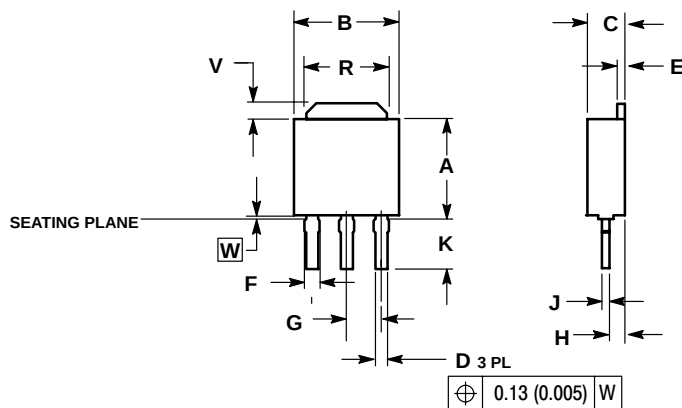
STYLE 2:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

NTD78N03

PACKAGE DIMENSIONS

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3 IPAK, STRAIGHT LEAD CASE 369AC-01 ISSUE O



NOTES:

- 1.. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2.. CONTROLLING DIMENSION: INCH.
3. SEATING PLANE IS ON TOP OF DAMBAR POSITION.
4. DIMENSION A DOES NOT INCLUDE DAMBAR POSITION OR MOLD GATE.

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	0.043	0.94	1.09
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	0.134	0.142	3.40	3.60
R	0.180	0.215	4.57	5.46
V	0.035	0.050	0.89	1.27
W	0.000	0.010	0.00	0.25

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