

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 1" pad size, (Cu Area 1.127 in²).
2. When surface mounted to an FR4 board using the minimum recommended pad size, (Cu Area 0.412 in²).



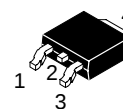
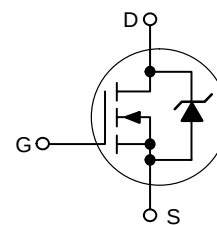
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**60 AMPERES
24 VOLTS**

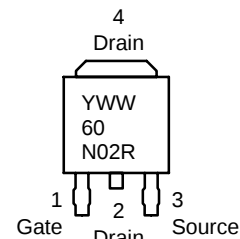
$R_{DS(on)} = 8.0\text{ m}\Omega$ (Typ.)

N-Channel



**CASE 369A
DPAK
(Bend 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
NTD60N02R1	DPAK	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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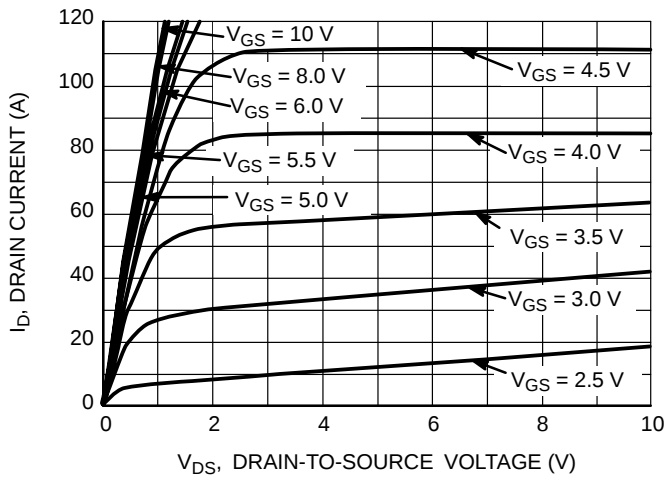


Figure 1. On-Region Characteristics

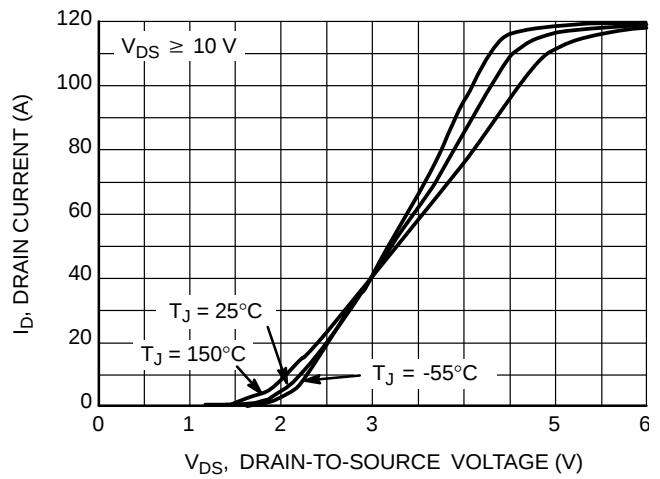


Figure 2. Transfer Characteristics

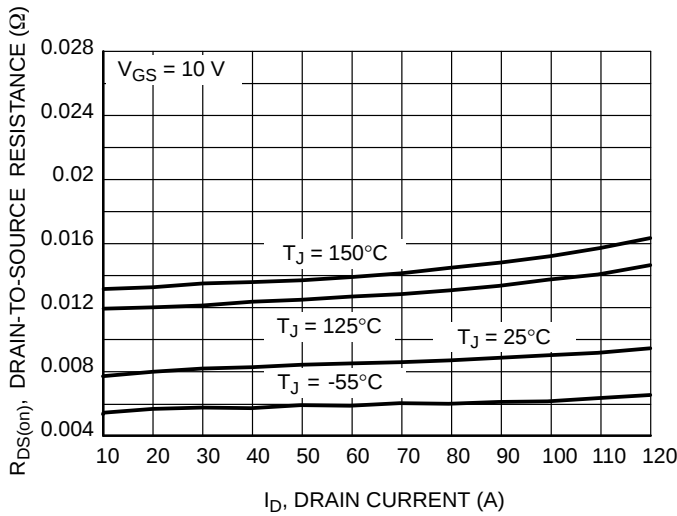


Figure 3. On-Resistance versus Drain Current and Temperature

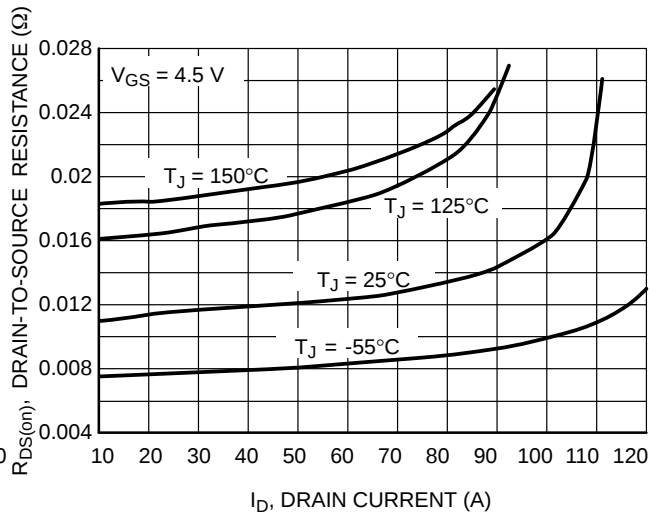


Figure 4. On-Resistance versus Drain Current and Temperature

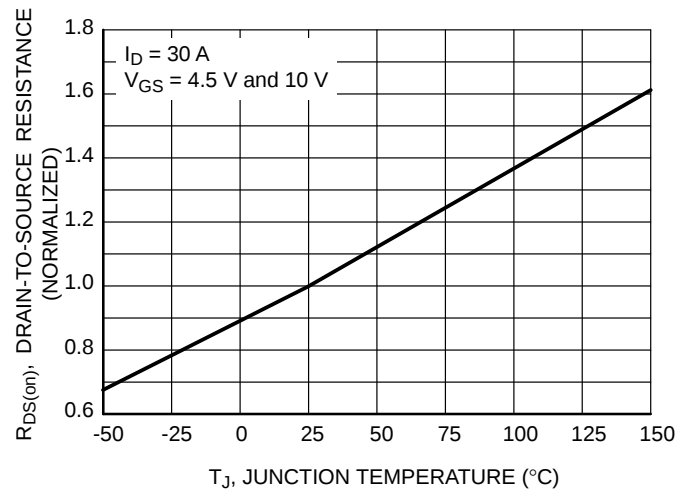


Figure 5. On-Resistance Variation with Temperature

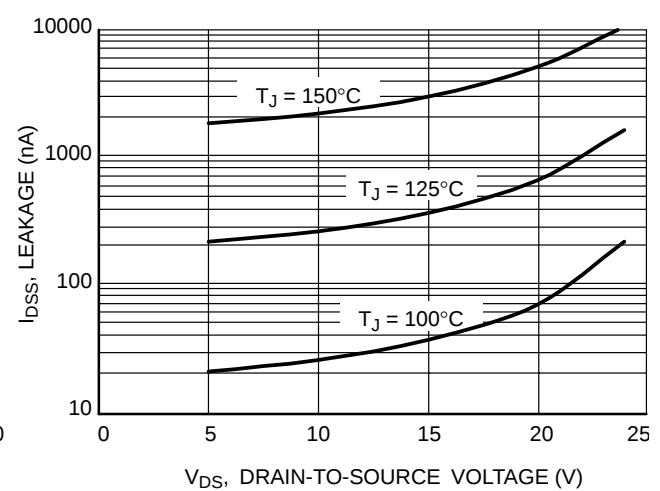


Figure 6. Drain-to-Source Leakage Current versus Voltage

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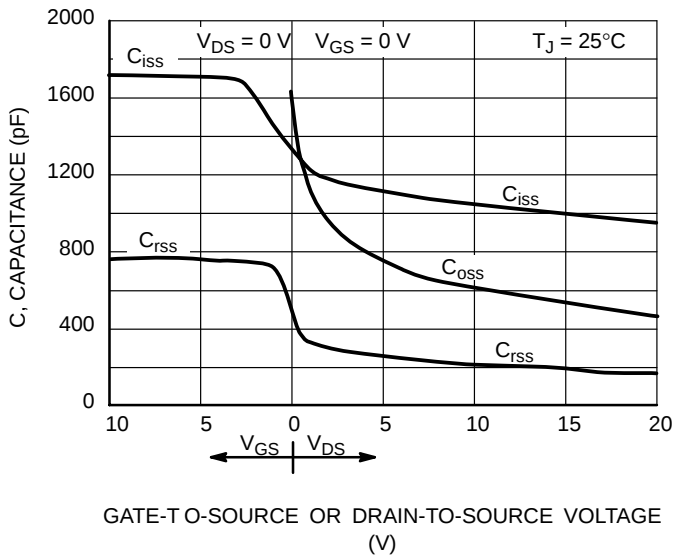


Figure 7. Capacitance Variation

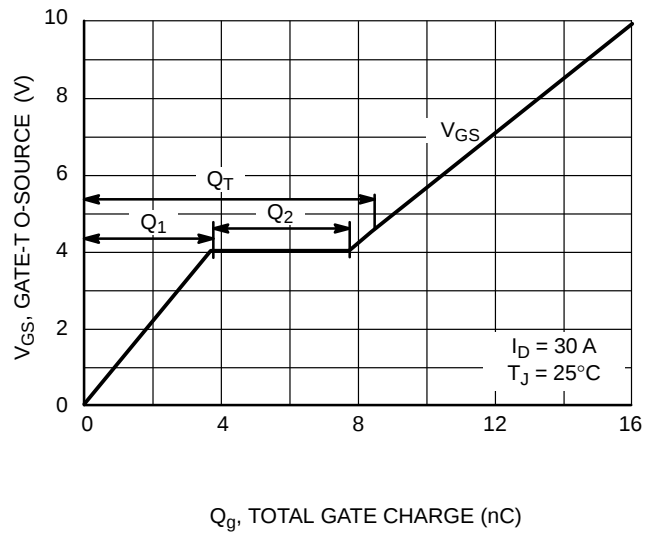


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

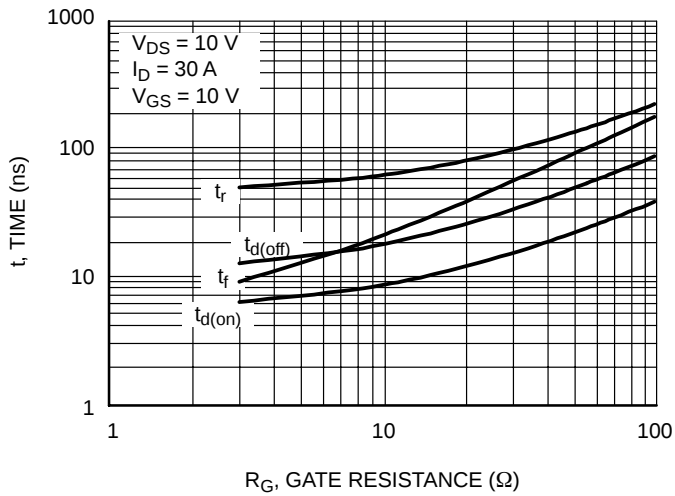


Figure 9. Resistive Switching Time Variation versus Gate Resistance

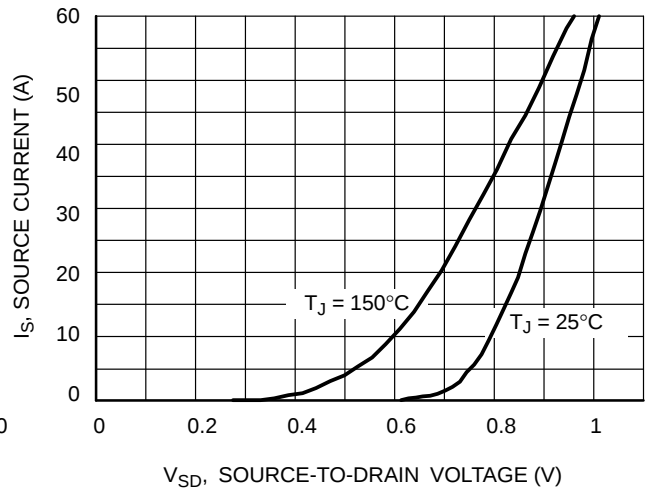


Figure 10. Diode Forward Voltage versus Current

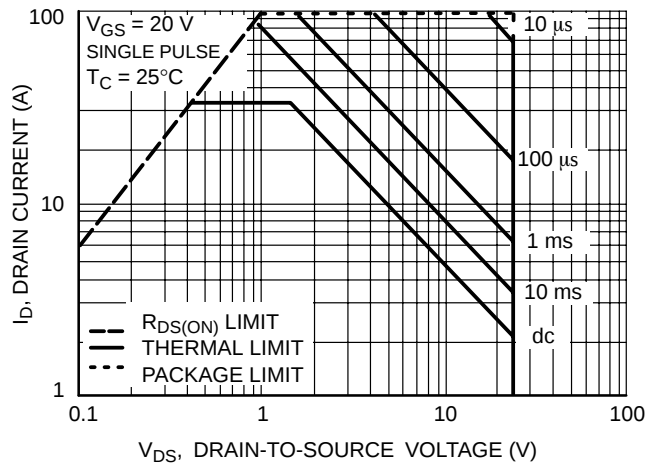


Figure 11. Maximum Rated Forward Biased Safe Operating Area

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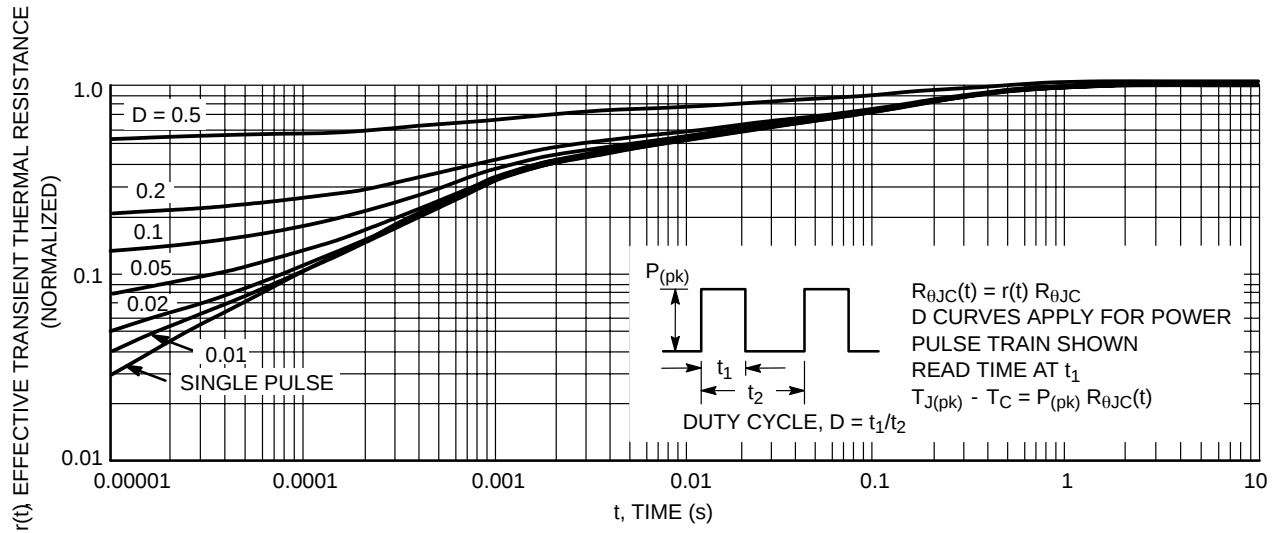
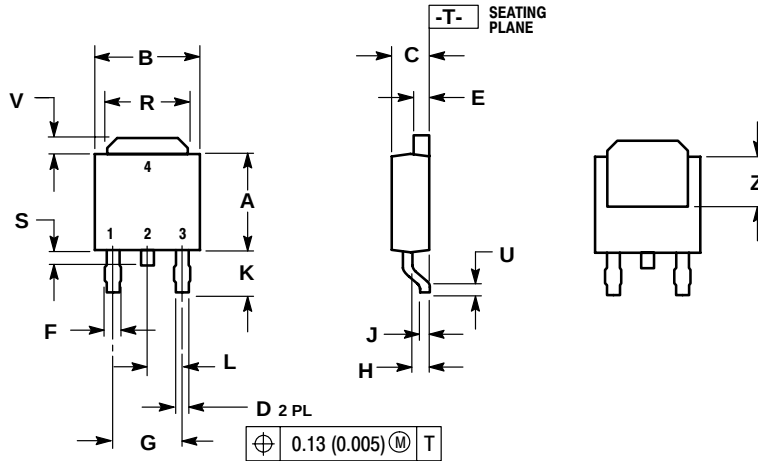


Figure 12. Thermal Response

NTD60N02R

PACKAGE DIMENSIONS

DPAK
CASE 369A-13
ISSUE AB



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.250	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	0.033	0.040	0.84	1.01
F	0.037	0.047	0.94	1.19
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	0.175	0.215	4.45	5.46
S	0.020	0.050	0.51	1.27
U	0.020	---	0.51	---
V	0.030	0.050	0.77	1.27
Z	0.138	---	3.51	---

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

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