

VN0600A,D ■ VN0601A,D
VN0400A,D ■ VN0401A,D

60V N-Channel Enhancement Mode MOSPOWER

This power FET is designed especially for switching regulators, converters, solenoid and relay drivers, and audio amplifiers.

FEATURES

- Low $r_{DS(on)}$
- No Second Breakdown
- High Input Impedance
- Internal Drain-Source Diode
- Very Rugged: Excellent SOA
- Extremely Fast Switching

BENEFITS

- Reduced Component Count
- Improved Performance
- Simpler Designs
- Improved Reliability

Product Summary

Part Number	BV_{DSS}	$R_{DS(on)}$	I_D	Package
VN0600A	60V	0.12 Ω	18A	TO-3
VN0400A	40V		18A	
VN0601A	60V	0.15 Ω	16A	TO-220AB
VN0401A	40V		16A	
VN0600D	60V	0.12 Ω	18A	TO-220AB
VN0400D	40V		18A	
VN0601D	60V	0.15 Ω	16A	TO-220AB
VN0401D	40V		16A	



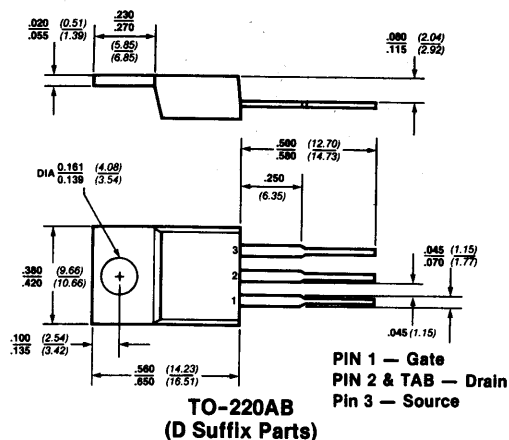
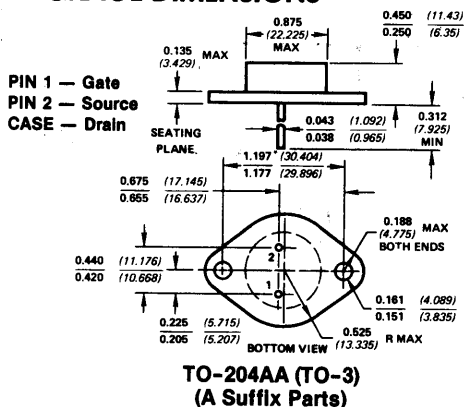
ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Drain-Source Voltage	
VN0600A,D; VN0601A,D	60V
VN0400A,D; VN0401A,D	40V
Drain-Gate Voltage	
VN0600A,D; VN0601A,D	60V
VN0400A,D; VN0401A,D	40V
Drain Current Continuous	
VN0400A,D; VN0600A,D	$\pm 18\text{A}$
VN0401A,D; VN0601A,D	$\pm 16\text{A}$
Drain Current Pulsed ¹	$\pm 60\text{A}$

Gate Current (Peak)	$\pm 3\text{A}$
Gate-Source Voltage	$\pm 40\text{V}$
Power Dissipation	
TO-3	100W
TO-220AB	75W
Linear Derating Factor	0.60W/ $^\circ\text{C}$
Operating and Storage Temperature	
TO-3	-55°C to $+175^\circ\text{C}$
TO-220AB	-55°C to $+150^\circ\text{C}$

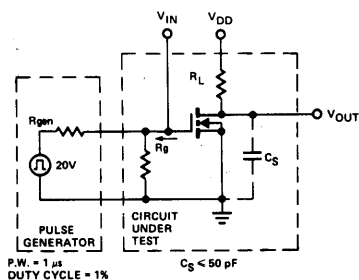
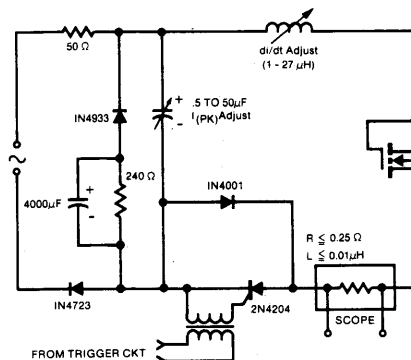
Note 1: Pulse test — 80 μs to 300 μs , 1% duty cycle.

PACKAGE DIMENSIONS



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

Parameter	Part Number	Min	Max	Unit	Test Conditions
Static					
BV _{DSS} Drain-Source Breakdown	VN0600A	60		V	V _{GS} = 0, I _D = 1 mA
	VN0601A	60			
	VN0400A	40			
	VN0401A	40			
	VN0600D	60			
	VN0601D	60			
	VN0400D	40			
	VN0401D	40			
V _{GS(th)} Gate Threshold Voltage	All	2	4.5	V	V _{DS} = V _{GS} , I _D = 1 mA
I _{GSS} Gate Body Leakage	All		100	nA	V _{GS} = 30 V, V _{DS} = 0
I _{DSS} Zero Gate Voltage Drain Current	All		1	mA	V _{GS} = 0, V _{DS} = Rated V _{DS}
			4		V _{GS} = 0, V _{DS} = Rated V _{DS} , T _C = 150°C
V _{DS(on)} Drain-Source Saturation Voltage ¹	VN0600A,D		1.44	V	V _{GS} = 10 V, I _D = 12 A
	VN0400A,D				
	VN0601A,D		1.8		
	VN0401A,D				
r _{DS(on)} Drain-Source On Resistance ¹	VN0600A,D		0.12	Ω	V _{GS} = 10 V, I _D = 12 A
	VN0400A,D				
	VN0601A,D		0.15		
	VN0401A,D				
I _{D(on)} On-State Drain Current ¹	All	18		A	V _{GS} = 10 V, V _{DS} = 25 V
Dynamic					
g _{fs} Forward Transconductance ¹	All	3		mS	V _{DS} = 25 V, I _D = 12 A (Note 1)
C _{iss} Input Capacitance	All		1200	pF	V _{DS} = 25 V, V _{GS} = 0, f = 1 MHz
C _{rss} Reverse Transfer Capacitance	All		200		
C _{oss} Common-Source Output Capacitance	All		500		
t _{d(on)} Turn-on Time	All		30	ns	V _{DD} = 30 V, I _D ≈ 12 A, R _L = 2.4 Ω, R _g = 10 Ω (Figure 1)
t _r Rise Time	All		150		
t _{d(off)} Turn-off Time	All		100		
t _f Fall Time	All		100		
Drain-Source Diode Characteristics					
V _{SD} Forward ON Voltage ¹	All	-1.5		V	I _S = -12 A, V _{GS} = 0
t _{rr} Reverse Recovery Time	All	300		ns	I _F = 40 A, V _{GS} = 0, di/dt = 100 A/μS (Figure 2)

Note 1: Pulse test — 80 μs to 300 μs , 1% duty cycle**TEST CIRCUITS****FIGURE 1. Switching Test Circuit****FIGURE 2. Reverse Recovery Test Circuit**

VN0800A ■ VN0801A ■ VN1000A ■ VN1001A
 VN1200A ■ VN1201A
 VN0800D ■ VN0801D ■ VN1000D ■ VN1001D
 VN1200D ■ VN1201D

120V^N-Channel Enhancement Mode MOSPOWER

These power FETs are designed especially for audio amplifiers, power converters, and drivers for motors, solenoids and relays.

FEATURES

- No Second Breakdown
- High Input Impedance
- Internal Drain-Source Diode
- Very Rugged: Excellent SOA
- Extremely Fast Switching

BENEFITS

- Reduced Component Count
- Improved Performance
- Simpler Designs
- Improved Reliability



Product Summary

Part Number	BV _{DSS}	R _{DS(on)}	I _D	Package
VN0800A	80 V	0.18 Ω	14 A	TO-3
VN0800D				TO-220
VN0801A		0.25 Ω	12 A	TO-3
VN0801D				TO-220
VN1000A	100 V	0.18 Ω	14 A	TO-3
VN1000D				TO-220
VN1001A		0.25 Ω	12 A	TO-3
VN1001D				TO-220
VN1200A	120 V	0.18 Ω	14 A	TO-3
VN1200D				TO-220
VN1201A		0.25 Ω	12 A	TO-3
VN1201D				TO-220

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

Drain-Source Voltage

VN0800A,D; VN0801A,D	80 V
VN1000A,D; VN1001A,D	100 V
VN1200A,D; VN1201A,D	120 V

Drain-Gate Voltage

VN0800A,D; VN0801A,D	80 V
VN1000A,D; VN1001A,D	100 V
VN1200A,D; VN1201A,D	120 V

Drain Current Continuous

VN0800A,D; VN1000A,D; VN1200A,D	± 14 A
VN0801A,D; VN1001A,D; VN1201A,D	± 12 A

Drain Current

Pulsed (80 μs to 300 μs, 1% duty cycle) ± 56 A

Gate Current (Peak) ± 3 A

Gate-Source Voltage ± 40 V

Power Dissipation

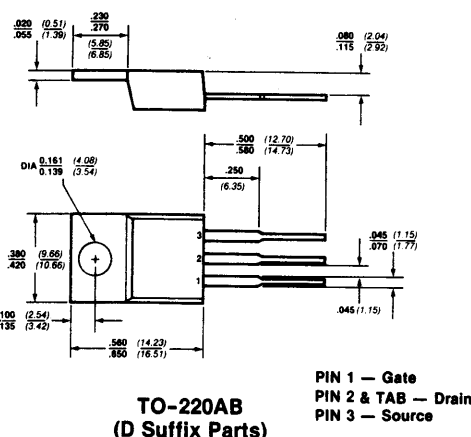
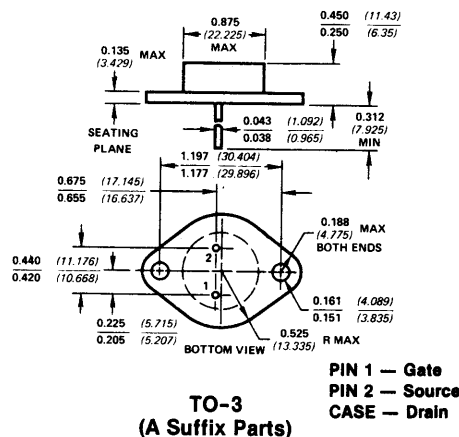
TO-3	100 W
TO-220AB	75 W

Linear Derating Factor 0.60 W/°C

Operating and Storage Temperature

TO-3	-55°C to +175°C
TO-220AB	-55°C to +150°C

PACKAGE DIMENSIONS



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

Parameter	Part Number	Min	Max	Unit	Test Conditions
Static					
BV_{DSS} Drain-Source Breakdown Voltage	VN0800A.D VN0801A.D	80		V	$V_{GS} = 0, I_D = 1 \text{ mA}$
	VN1000A.D VN1001A.D	100			
	VN1200A.D VN1201A.D	120			
$V_{GS(th)}$ Gate Threshold Voltage	All	2.0	4.5	V	$V_{GS} = V_{DS}, I_D = 1 \text{ mA}$
I_{GSS} Gate-Body Leakage	All		100	nA	$V_{GS} = 30\text{V}, V_{DS} = 0$
I_{DSS} Zero Gate Voltage Drain Current	All		1.0	mA	$V_{DS} = \text{Rated } V_{DS}, V_{GS} = 0$
			4.0		$V_{DS} = \text{Rated } V_{DS}, V_{GS} = 0, T_C = 150^\circ\text{C}$
$V_{DS(on)}$ Drain-Source ON-State Voltage ¹	VN0800A.D VN1000A.D VN1200A.D		2.16	V	$V_{GS} = 10\text{V}, I_D = 12\text{A}$
	VN0801A.D VN1001A.D VN1201A.D		3.0		
$r_{DS(on)}$ Drain-Source On Resistance ¹	VN0800A.D VN1000A.D VN1200A.D		0.18	Ω	$V_{GS} = 10\text{V}, I_D = 12\text{A}$
	VN0801A.D VN1001A.D VN1201A.D		0.25		
$I_{D(on)}$ On-State Drain Current ¹	All	14		A	$V_{DS} = 25\text{V}, V_{GS} = 10\text{V}$

Dynamic

g_{fs} Forward Transconductance ¹	All	3.0		S	$V_{DS} = 25\text{V}, I_D = 6\text{A}$
C_{iss} Input Capacitance	All		1200	pF	$V_{GS} = 0, V_{DS} = 25\text{V}, f = 1 \text{ MHz}$
C_{rss} Reverse Transfer Capacitance	All		200		
C_{oss} Output Capacitance	All		600		
$t_{d(on)}$ Turn-On Delay Time	All		30	ns	$V_{DD} = 60\text{V}, I_D \approx 12\text{A}, R_L = 5\Omega, R_g = 10\Omega$ (Figure 1)
t_r Rise Time	All		150		
$t_{d(off)}$ Turn-Off Delay Time	All		100		
t_f Fall Time	All		100		

Drain-Source Diode Characteristics

	Typ	Unit	
V_{SD} Forward On Voltage ¹	-1.5	V	$I_S = -30\text{A}, V_{GS} = 0$
t_{rr} Reverse Recovery Time	300	ns	$I_F = 30\text{A}, V_{GS} = 0, di/dt = 100\text{A}/\mu\text{s}$ (Figure 2)

Note 1: Pulse test — 80 μs to 300 μs , 1% duty cycle

Refer to VNDA12 Design Curves (See Section 4)

TEST CIRCUITS

FIGURE 1 Switching Test Circuit

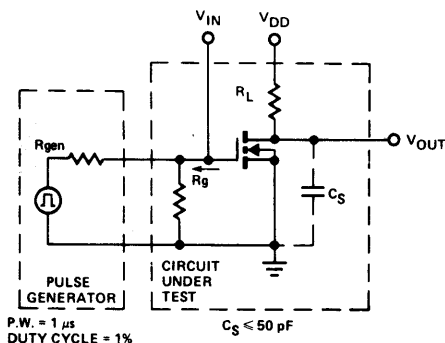
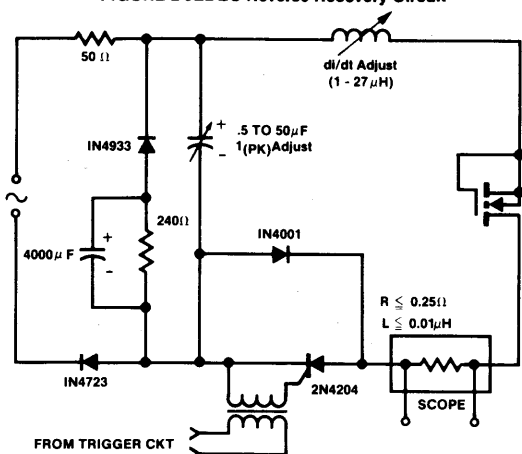


FIGURE 2 JEDEC Reverse Recovery Circuit



VN3500A ■ VN3501A ■ VN4000A ■ VN4001A
VN3500D ■ VN3501D ■ VN4000D ■ VN4001D



400V N-Channel Enhancement Mode MOSPOWER

These power FETs are designed especially for offline switching regulators, converters, solenoid and relay drivers.

FEATURES

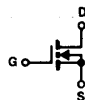
- High Voltage
- No Second Breakdown
- High Input Impedance
- Internal Drain-Source Diode
- High Threshold for Noise Immunity
- Very Rugged: Excellent SOA
- Extremely Fast Switching

BENEFITS

- Reduced Component Count
- Improved Performance
- Simpler Designs
- Improved Reliability

Product Summary

Part Number	PRO ELECTRON Part Number	BV _{DSS}	R _{DS(on)}	I _D	Package
VN3500A	BUP60	350V	1Ω	6A	TO-3
VN3500D					TO-220
VN3501A	BUP61		1.5Ω	5A	TO-3
VN3501D					TO-220
VN4000A	BUP62	400V	1.0Ω	6A	TO-3
VN4000D					TO-229
VN4001A	BUP63		1.5Ω	5A	TO-3
VN4001D					TO-220



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

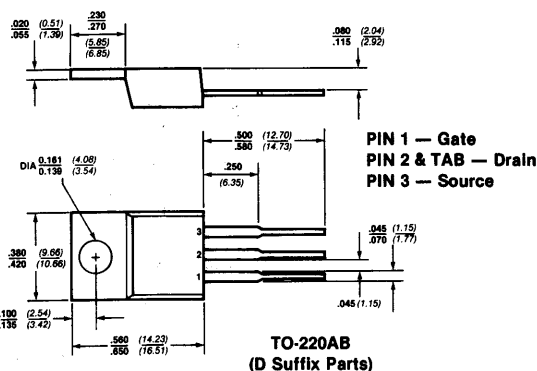
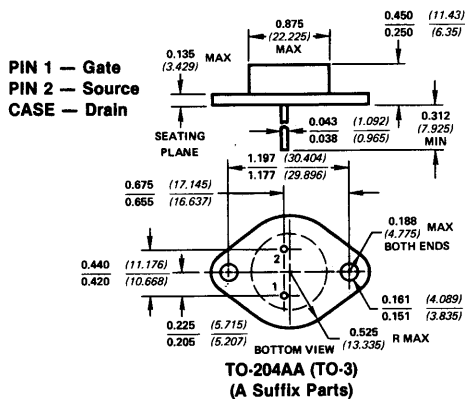
Drain-Source Voltage	
VN3500A, D; VN3501A, D	350V
VN4000A, D; VN4001A, D	400V
Drain-Gate Voltage	
VN3500A, D; VN3501A, D	350V
VN4000A, D; VN4001A, D	400V
Drain Current	
Continuous ¹	
VN3500A, D; VN4000A, D	± 6A
VN3501A, D; VN4001A, D	± 5A
Pulsed ²	
A Suffix	± 16A
D Suffix	± 10A

Gate Current (Peak)	± 3A
Gate-Source Voltage	± 40V
Total Power Dissipation, A Suffix	125W
Linear Derating Factor	0.833W/°C
Total Power Dissipation, D Suffix	75W
Linear Derating Factor	0.6W/°C
Storage and Junction Temperature	
A Suffix	- 55°C to +175°C
D Suffix	- 55°C to +150°C

Notes:

- Limited by package dissipation.
- Pulse test — 80μs to 300μs, 1% duty cycle.

PACKAGE DIMENSIONS



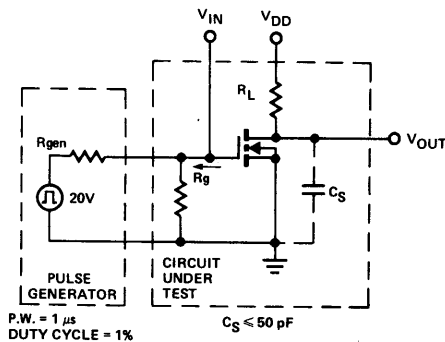
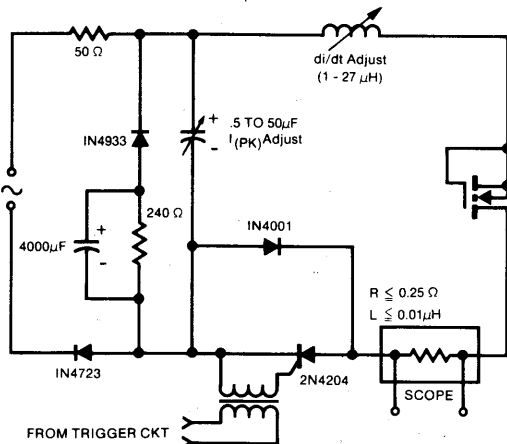
ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Part Number	Min	Max	Unit	Test Conditions
Static					
BV_{DSS} Drain-Source Breakdown	VN3500A, D VN3501A, D	350		V	$V_{GS} = 0, I_D = 1\text{ mA}$
	VN4000A, D VN4001A, D	400			
$V_{GS(th)}$ Gate Threshold Voltage	All	3	6	V	$V_{GS} = V_{DS}, I_D = 1\text{ mA}$
I_{GSS} Gate Body Leakage	All		100	nA	$V_{GS} = 30\text{V}, V_{DS} = 0$
I_{DSS} Zero Gate Voltage Drain Current	All		1	mA	$V_{DS} = \text{Rated } V_{DS}, V_{GS} = 0$
			2.5		$V_{DS} = \text{Rated } V_{DS}, V_{GS} = 0, T_C = 150^\circ\text{C}$
$V_{DS(on)}$ Drain-Source Saturation Voltage	VN3500A, D VN4000A, D		3	V	$V_{GS} = 10\text{V}, I_D = 3\text{A}$ (Note 1)
	VN3501A, D VN4001A, D		4.5		
$r_{DS(on)}$ Drain-Source On Resistance	VN3500A, D VN4000A, D		1	Ω	$V_{GS} = 10\text{V}, I_D = 3\text{A}$ (Note 1)
	VN3501A, D VN4001A, D		1.5		
$I_{D(on)}$ On-State Drain Current	All	8		A	$V_{DS} = 25\text{V}, V_{GS} = 10\text{V}$ (Note 1)
Dynamic					
g_{fs} Forward Transconductance	All	2.5		mS	$V_{DS} = 25\text{V}, I_D = 3\text{A}$ (Note 1)
C_{iss} Input Capacitance	All		1000	pF	$V_{GS} = 0, V_{DS} = 25\text{V}, f = 1\text{ MHz}$
C_{rss} Reverse Transfer Capacitance	All		40		
C_{oss} Common-Source Output Capacitance	All		220	ns	$V_{DD} = 200\text{V}, I_D \approx 1\text{A}, R_L = 67\Omega, R_g = 10\Omega$ (Figure 1)
$t_{d(on)}$ Turn-On Delay Time	All		50		
t_r Rise Time	All		50		
$t_{d(off)}$ Turn-Off Delay Time	All		100		
t_f Fall Time	All		80		
Drain-Source Diode Characteristics					
V_{SD} Forward ON Voltage	All	-1.2		V	$I_S = -4\text{A}, V_{GS} = 0$ (Note 1)
t_{rr} Reverse Recovery Time	All	400		ns	$I_F = I_R = 4\text{A}, V_{GS} = 0$ (Figure 2)

Note:

1. Pulse test: 80 μs to 300 μs , 1% duty cycle.

Refer to VNDA40 Design Curves (See Section 4)

TEST CIRCUITS**FIGURE 1 Switching Test Circuit****FIGURE 2 JEDEC Reverse Recovery Circuit**

500V N-Channel Enhancement Mode MOSPOWER

These power FETs are designed especially for offline switching regulators, converters, solenoid and relay drivers.

FEATURES

- **High Voltage**
- **No Second Breakdown**
- **High Input Impedance**
- **Internal Drain-Source Diode**
- **High Threshold for Noise Immunity**
- **Very Rugged: Excellent SOA**
- **Extremely Fast Switching**

BENEFITS

- Reduced Component Count
- Improved Performance
- Simpler Designs
- Improved Reliability

Product Summary

Part Number	PRO ELECTRON Part Number	V _{DSS}	R _{DS(on)}	I _D	Package
VN4501A	BUP64	450V	1.5Ω	4.5A	TO-3
VN4501D					TO-220
VN4502A	BUP65		2Ω	4A	TO-3
VN4502D					TO-220
VN5001A	BUP66	500V	1.5Ω	4.5A	TO-3
VN5001D					TO-220
VN5002A	BUP67		2Ω	4A	TO-3
VN5002D					TO-220



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

Drain-Source Voltage

VN4501, VN4502	450V
VN5001, VN5002	500V

Gate Current (Peak) $\pm 3A$

Gate-Source Voltage..... $\pm 40V$

Drain-Gate Voltage

VN4501, VN4502	450V
VN5001, VN5002	500V

	TO-3	TO-220AB
Maximum Power Dissipation	100W	75W
Linear Derating Factor	0.67W/°C	0.6W/°C

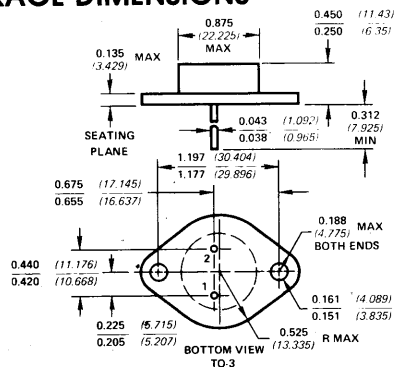
Drain Current Continuous

VN4501A,D; VN5001A,D	± 4.5 A
VN4502A,D; VN5001A,D	± 4 A

Operating and Storage Temperature	-55°C to +175°C	-40°C to +150°C
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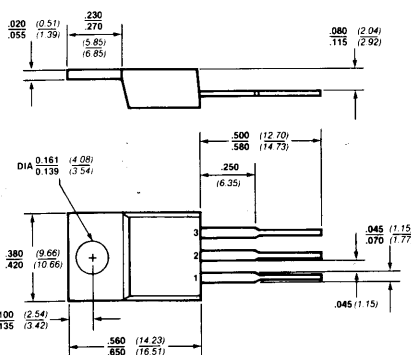
Pulsed (80 μ s–300 μ s, 1% duty cycle) ± 10 A

PACKAGE DIMENSIONS



PIN 1 — Gate
PIN 2 — Source
CASE — Drain

**TO-204AA (TO-3)
(A Suffix Parts)**



PIN 1 — Gate
PIN 2 & TAB — Drain
PIN 3 — Source

TO-220AB
(D Suffix Parts)

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

Parameter		Part Number	Min	Max	Unit	Test Conditions
Static						
BV _{DSS}	Drain-Source Breakdown	VN4501A, D VN4502A, D	450		V	V _{GS} = 0, I _D = 1.0 mA
		VN5001A, D VN5002A, D	500			
V _{GS(th)}	Gate Threshold Voltage	All	3.0	6.0		V _{DS} = V _{GS} , I _D = 1 mA
I _{GSS}	Gate-Body Leakage	All		100	nA	V _{GS} = 30 V, V _{DS} = 0
I _{DSS}	Zero Gate Voltage Drain Current	All		1.0	mA	V _{DS} = Rated V _{DS} , V _{GS} = 0
				4.0		V _{DS} = Rated V _{DS} , V _{GS} = 0, T _C = 150 °C
I _{D(on)}	On-State Drain Current ¹	All	6.0		A	V _{DS} = 25 V, V _{GS} = 10 V
V _{DS(on)}	Drain-Source Saturation Voltage ¹	VN4501A, D VN5001A, D		3.0	V	V _{GS} = 10 V, I _D = 2.0 A
		VN4502A, D VN5002A, D		4.0		
r _{DS(on)}	Static Drain-Source On-State Resistance ¹	VN4501A, D VN5001A, D		1.5	Ω	V _{GS} = 10 V, I _D = 2.0 A
		VN4502A, D VN5002A, D		2.0		
Dynamic						
g _{fs}	Forward Transconductance ¹	All	2.5		S	V _{DS} = 25 V, I _D = 2.0 A
C _{iss}	Input Capacitance	All		1000	pF	V _{GS} = 0, V _{DS} = 25 V, f = 1 MHz
C _{oss}	Output Capacitance			220		
C _{rss}	Reverse Transfer Capacitance			40		
t _{d(on)}	Turn-On Delay Time	All		50	ns	V _{DD} = 200 V, I _D ≈ 2 A, R _L = 100 Ω, R _g = 10 Ω (Fig 1)
t _r	Rise Time	All		50		
t _{d(off)}	Turn-Off Delay Time	All		100		
t _f	Fall Time	All		100		
Drain-Source Diode Characteristics						
			Typ			
V _{SD}	Forward On Voltage ¹	All	-1.2		V	I _S = -4 A, V _{GS} = 0
t _{rr}	Reverse Recovery Time	All	400		ns	I _F = I _R = 4 A, V _{GS} = 0 (Fig 2)

Note:

1. Pulse test: $80 \mu\text{s}$ – $300 \mu\text{s}$, 1% duty cycle.

Refer to VNDA50 Design Curves (See Section 4)

TEST CIRCUITS

FIGURE 1 Switching Test Circuit

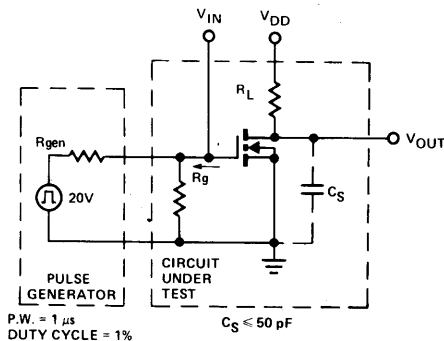


FIGURE 2 Reverse Recovery Test Circuit

