



VNS14NV04 / VND14NV04 VND14NV04-1 / VNP14NV04

“OMNIFET II”: FULLY AUTOPROTECTED POWER MOSFET

PRELIMINARY DATA

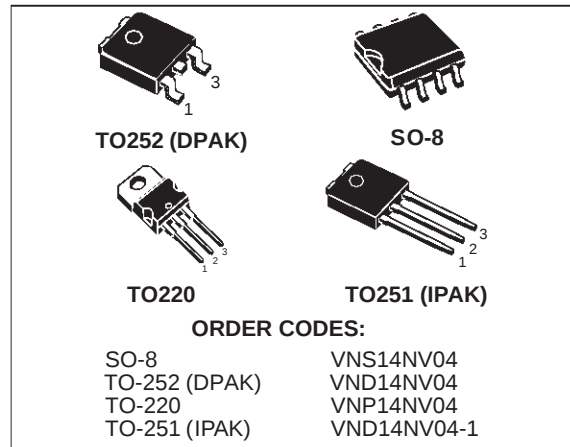
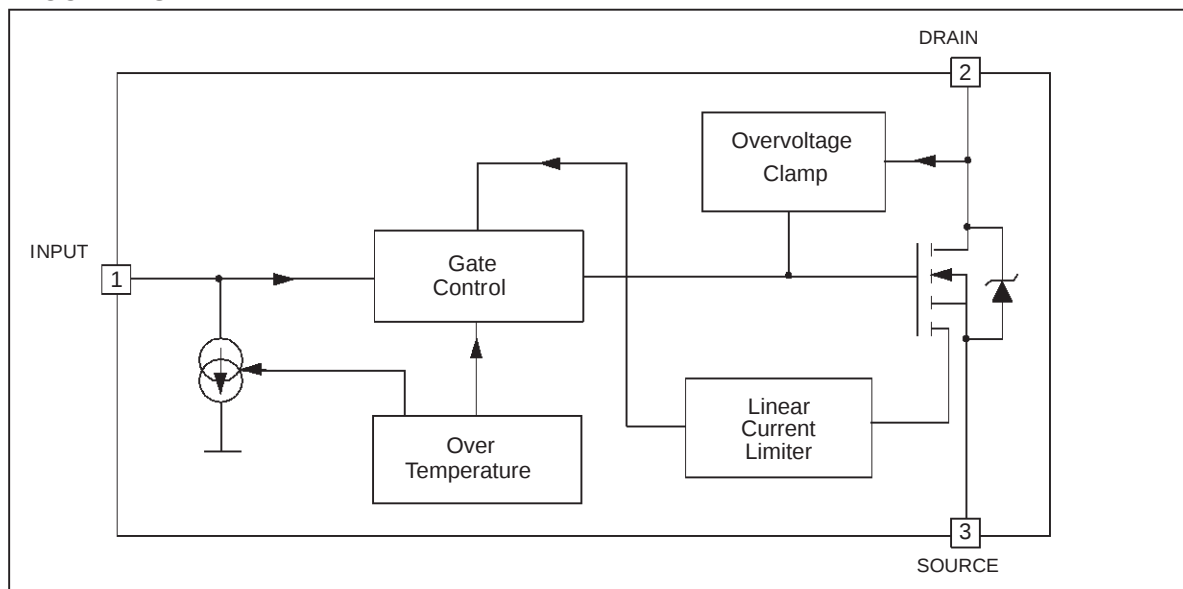
TYPE	$R_{DS(on)}$	I_{lim}	V_{clamp}
VNS14NV04 VND14NV04 VND14NV04-1 VNP14NV04	35 mΩ	12 A	40 V

- LINEAR CURRENT LIMITATION
- THERMAL SHUT DOWN
- SHORT CIRCUIT PROTECTION
- INTEGRATED CLAMP
- LOW CURRENT DRAWN FROM INPUT PIN
- DIAGNOSTIC FEEDBACK THROUGH INPUT PIN
- ESD PROTECTION
- DIRECT ACCESS TO THE GATE OF THE POWER MOSFET (ANALOG DRIVING)
- COMPATIBLE WITH STANDARD POWER MOSFET

DESCRIPTION

The VNS14NV04, VND14NV04, VNP14NV04, VND14NV04-1, are monolithic devices designed in STMicroelectronics VIPower M0-3 Technology,

BLOCK DIAGRAM



intended for replacement of standard Power MOSFETS from DC up to 50KHz applications. Built in thermal shutdown, linear current limitation and overvoltage clamp protect the chip in harsh environments.

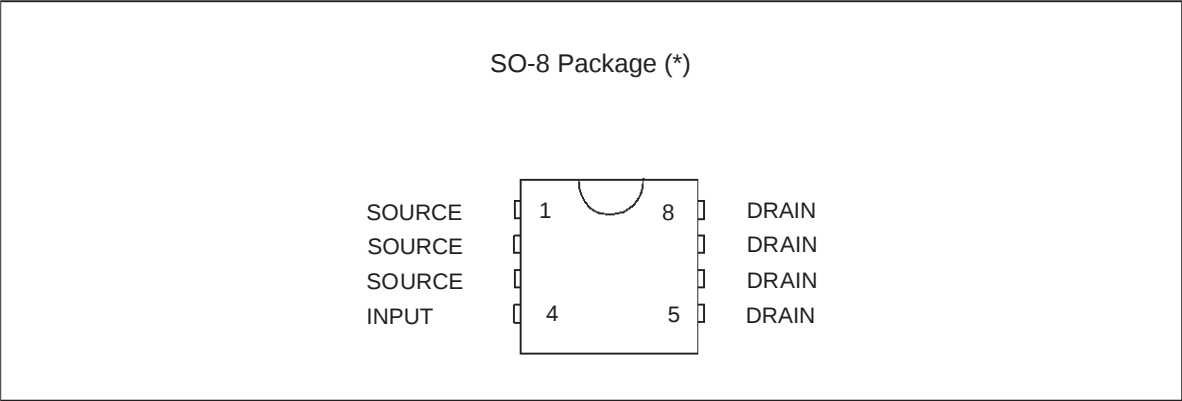
Fault feedback can be detected by monitoring the voltage at the input pin.

VNS14NV04 / VND14NV04 / VND14NV04-1 / VNP14NV04

ABSOLUTE MAXIMUM RATING

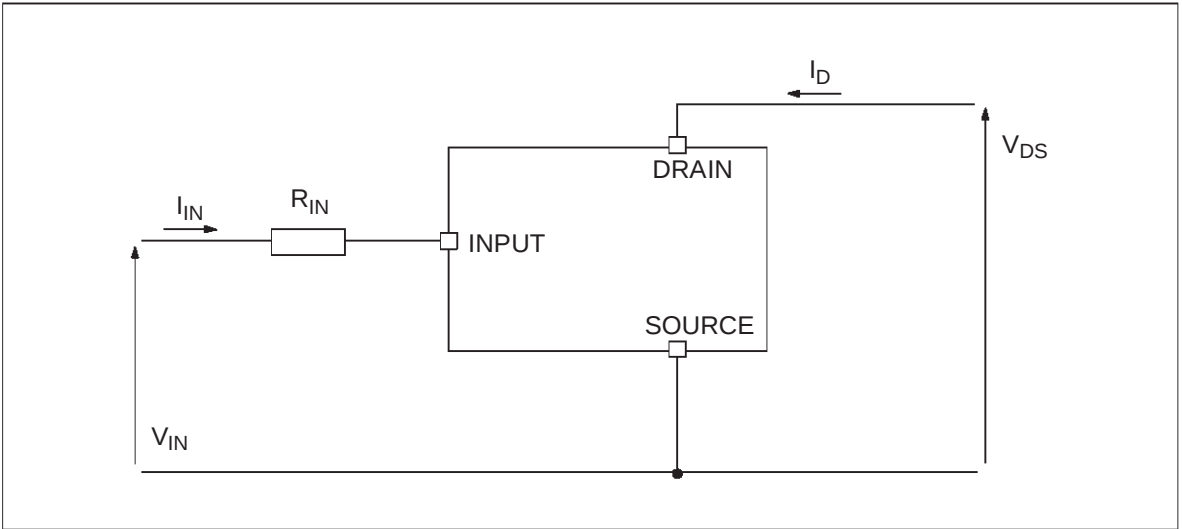
Symbol	Parameter	Value				Unit
		SO-8	DPAK	TO-220	IPAK	
V_{DS}	Drain-source Voltage ($V_{IN}=0V$)	Internally Clamped				V
V_{IN}	Input Voltage	Internally Clamped				V
I_{IN}	Input Current	+/-20				mA
$R_{IN\ MIN}$	Minimum Input Series Impedance	10				Ω
I_D	Drain Current	Internally Limited				A
I_R	Reverse DC Output Current	-15				A
V_{ESD1}	Electrostatic Discharge ($R=1.5K\Omega$, $C=100pF$)	4000				V
V_{ESD2}	Electrostatic Discharge on output pin only ($R=330\Omega$, $C=150pF$)	16500				V
P_{tot}	Total Dissipation at $T_c=25^\circ C$	8.3	50	70	50	W
T_j	Operating Junction Temperature	Internally limited				$^\circ C$
T_c	Case Operating Temperature	Internally limited				$^\circ C$
T_{stg}	Storage Temperature	-55 to 150				$^\circ C$

CONNECTION DIAGRAM (TOP VIEW)



(*) For the pins configuration related to DPAK, IPAK, TO-220 see outlines at page 1.

CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

Symbol	Parameter		Value				Unit
			SO-8	DPAK	TO-220	IPAK	
$R_{thj-case}$	Thermal Resistance Junction-case	MAX		2.5	1.8	2.5	°C/W
$R_{thj-lead}$	Thermal Resistance Junction-lead	MAX	15				°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	MAX	65(*)	52.5(*)	50	100	°C/W

(*) When mounted on a standard single-sided FR4 board with 50mm² of Cu (at least 35 µm thick) connected to all DRAIN pins.

ELECTRICAL CHARACTERISTICS (-40°C < T_j < 150°C, unless otherwise specified)**OFF**

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{CLAMP}	Drain-source Clamp Voltage	$V_{IN}=0V$; $I_D=7A$	40	45	55	V
V_{CLTH}	Drain-source Clamp Threshold Voltage	$V_{IN}=0V$; $I_D=2mA$	36			V
V_{INTH}	Input Threshold Voltage	$V_{DS}=V_{IN}$; $I_D=1mA$	0.5		2.5	V
I_{ISS}	Supply Current from Input Pin	$V_{DS}=0V$; $V_{IN}=5V$		100	150	µA
V_{INCL}	Input-Source Clamp Voltage	$I_{IN}=1mA$ $I_{IN}=-1mA$	6 -1.0	6.8	8 -0.3	V
I_{DSS}	Zero Input Voltage Drain Current ($V_{IN}=0V$)	$V_{DS}=13V$; $V_{IN}=0V$; $T_j=25^\circ C$ $V_{DS}=25V$; $V_{IN}=0V$			30 75	µA

ON

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{IN}=5V$; $I_D=7A$; $T_j=25^\circ C$ $V_{IN}=5V$; $I_D=7A$			35 70	mΩ

VNS14NV04 / VND14NV04 / VND14NV04-1 / VNP14NV04

ELECTRICAL CHARACTERISTICS (continued) ($T_j=25^\circ\text{C}$, unless otherwise specified)

DYNAMIC

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$g_{fs} (*)$	Forward Transconductance	$V_{DD}=13\text{V}; I_D=7\text{A}$		19		S
C_{OSS}	Output Capacitance	$V_{DS}=13\text{V}; f=1\text{MHz}; V_{IN}=0\text{V}$		400		pF

SWITCHING

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=15\text{V}; I_D=7\text{A}$ $V_{gen}=5\text{V}; R_{gen}=R_{IN\ MIN}=10\Omega$ (see figure 1)		50	150	ns
t_r	Rise Time			250	750	ns
$t_{d(off)}$	Turn-off Delay Time			320	1000	ns
t_f	Fall Time			200	600	ns
$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=15\text{V}; I_D=7\text{A}$ $V_{gen}=5\text{V}; R_{gen}=2.2\text{K}\Omega$ (see figure 1)		1.2	3.6	μs
t_r	Rise Time			7.5	22.5	μs
$t_{d(off)}$	Turn-off Delay Time			13	40	μs
t_f	Fall Time			10	30	μs
$(di/dt)_{on}$	Turn-on Current Slope	$V_{DD}=15\text{V}; I_D=7\text{A}$ $V_{gen}=5\text{V}; R_{gen}=R_{IN\ MIN}=10\Omega$		25		A/ μs
Q_i	Total Input Charge	$V_{DD}=12\text{V}; I_D=7\text{A}; V_{IN}=5\text{V}; I_{gen}=2.13\text{mA}$ (see figure 5)		20		nC

SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{SD} (*)$	Forward On Voltage	$I_{SD}=7\text{A}; V_{IN}=0\text{V}$		-0.8		V
t_{rr}	Reverse Recovery Time	$I_{SD}=7\text{A}; di/dt=40\text{A}/\mu\text{s}$		300		ns
Q_{rr}	Reverse Recovery Charge	$V_{DD}=30\text{V}; L=200\mu\text{H}$		0.8		μC
I_{RRM}	Reverse Recovery Current	(see test circuit, figure 2)		5		A

PROTECTIONS ($-40^\circ\text{C} < T_j < 150^\circ\text{C}$, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{lim}	Drain Current Limit	$V_{IN}=6\text{V}; V_{DS}=13\text{V}$	12	18	24	A
t_{dlim}	Step Response Current Limit	$V_{IN}=6\text{V}; V_{DS}=13\text{V}$		40		μs
T_{jsh}	Overtemperature Shutdown		150	175		$^\circ\text{C}$
T_{jrs}	Overtemperature Reset		135			$^\circ\text{C}$
I_{gf}	Fault Sink Current	$V_{IN}=5\text{V}; V_{DS}=13\text{V}; T_j=T_{jsh}$	10	15	20	mA
E_{as}	Single Pulse Avalanche Energy	starting $T_j=25^\circ\text{C}; V_{DD}=24\text{V}$ $V_{IN}=5\text{V}; R_{gen}=R_{IN\ MIN}=10\Omega; L=24\text{mH}$ (see figures 3 & 4)	400			mJ

(*) Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

PROTECTION FEATURES

During normal operation, the INPUT pin is electrically connected to the gate of the internal power MOSFET through a low impedance path.

The device then behaves like a standard power MOSFET and can be used as a switch from DC up to 50KHz. The only difference from the user's standpoint is that a small DC current I_{SS} (typ. 100 μ A) flows into the INPUT pin in order to supply the internal circuitry.

The device integrates:

- OVERVOLTAGE CLAMP PROTECTION:

internally set at 45V, along with the rugged avalanche characteristics of the Power MOSFET stage give this device unrivalled ruggedness and energy handling capability. This feature is mainly important when driving inductive loads.

- LINEAR CURRENT LIMITER CIRCUIT:

limits the drain current I_D to I_{lim} whatever the INPUT pin voltages. When the current limiter is active, the device operates in the linear region, so power dissipation may exceed the capability of the heatsink. Both case and junction temperatures increase, and if this phase lasts long enough, junction temperature may reach the overtemperature threshold T_{jsh} .

- OVERTEMPERATURE AND SHORT CIRCUIT PROTECTION:

these are based on sensing the chip temperature and are not dependent on the input voltage. The location of the sensing element on the chip in the power stage area ensures fast, accurate detection of the junction temperature. Overtemperature cutout occurs in the range 150 to 190 °C, a typical value being 170 °C. The device is automatically restarted when the chip temperature falls of about 15°C below shut-down temperature.

- STATUS FEEDBACK:

in the case of an overtemperature fault condition ($T_j > T_{jsh}$), the device tries to sink a diagnostic current I_{gf} through the INPUT pin in order to indicate fault condition. If driven from a low impedance source, this current may be used in order to warn the control circuit of a device shutdown. If the drive impedance is high enough so that the INPUT pin driver is not able to supply the current I_{gf} , the INPUT pin will fall to 0V. **This will not however affect the device operation: no requirement is put on the current capability of the INPUT pin driver except to be able to supply the normal operation drive current I_{SS} .**

Additional features of this device are ESD protection according to the Human Body model and the ability to be driven from a TTL Logic circuit.

Fig.1: Switching Time Test Circuit for Resistive Load

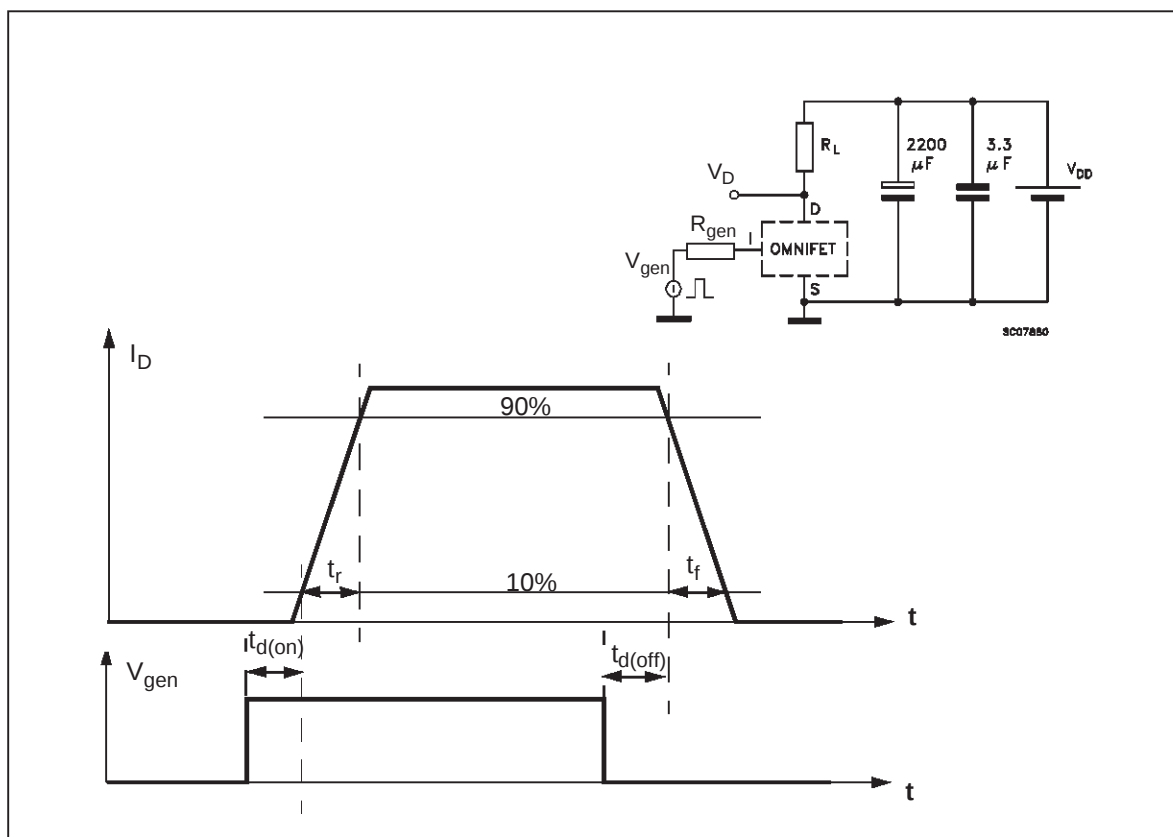


Fig.2: Test Circuit for Diode Recovery Times

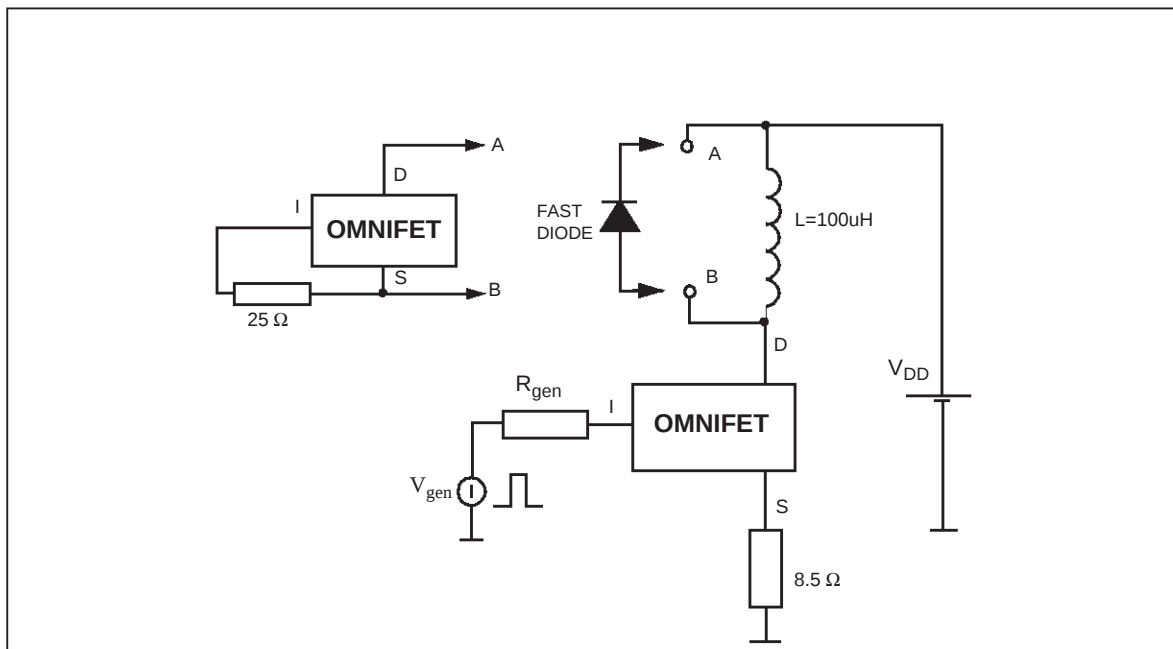


Fig. 3: Unclamped Inductive Load Test Circuits

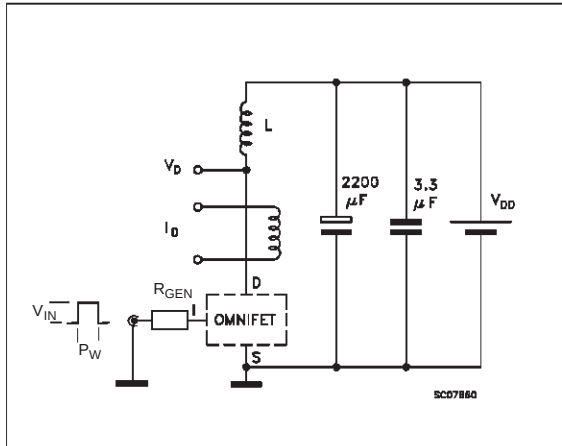


Fig. 4: Unclamped Inductive Waveforms

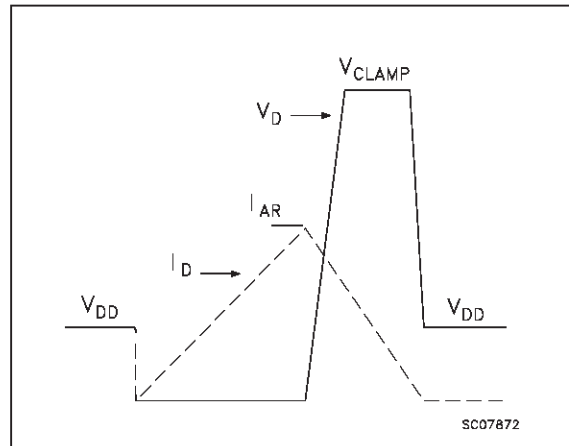
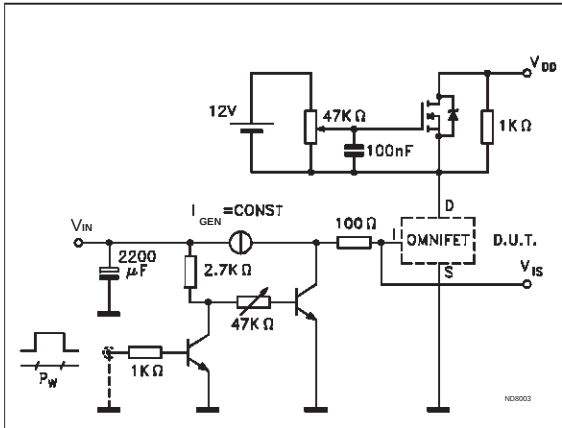
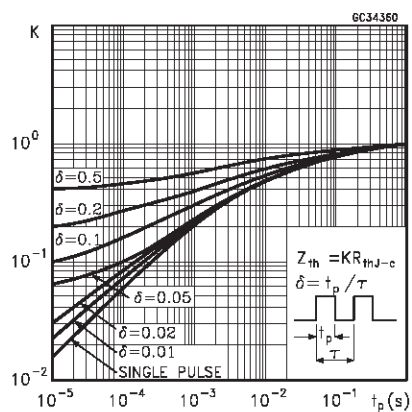


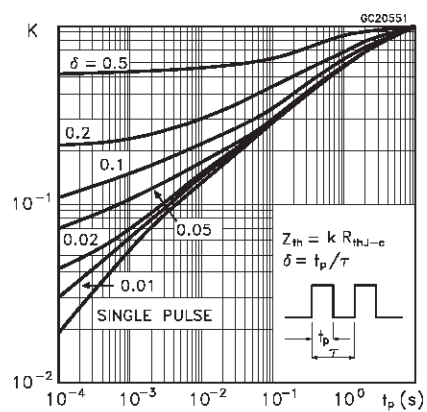
Fig. 5: Input Charge Test Circuit



Thermal Impedance for DPAK/IPAK

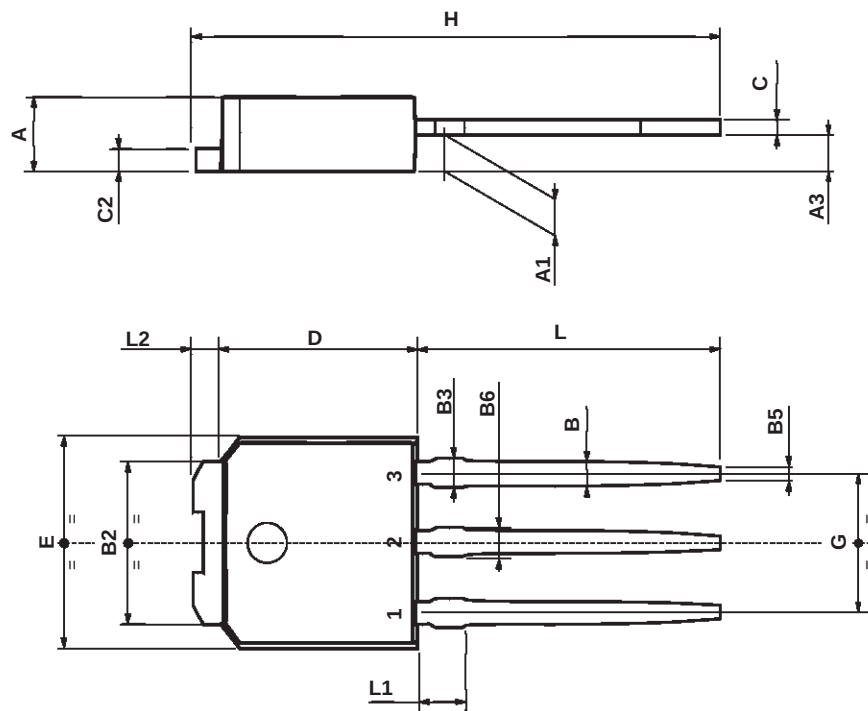


Thermal Impedance for TO-220



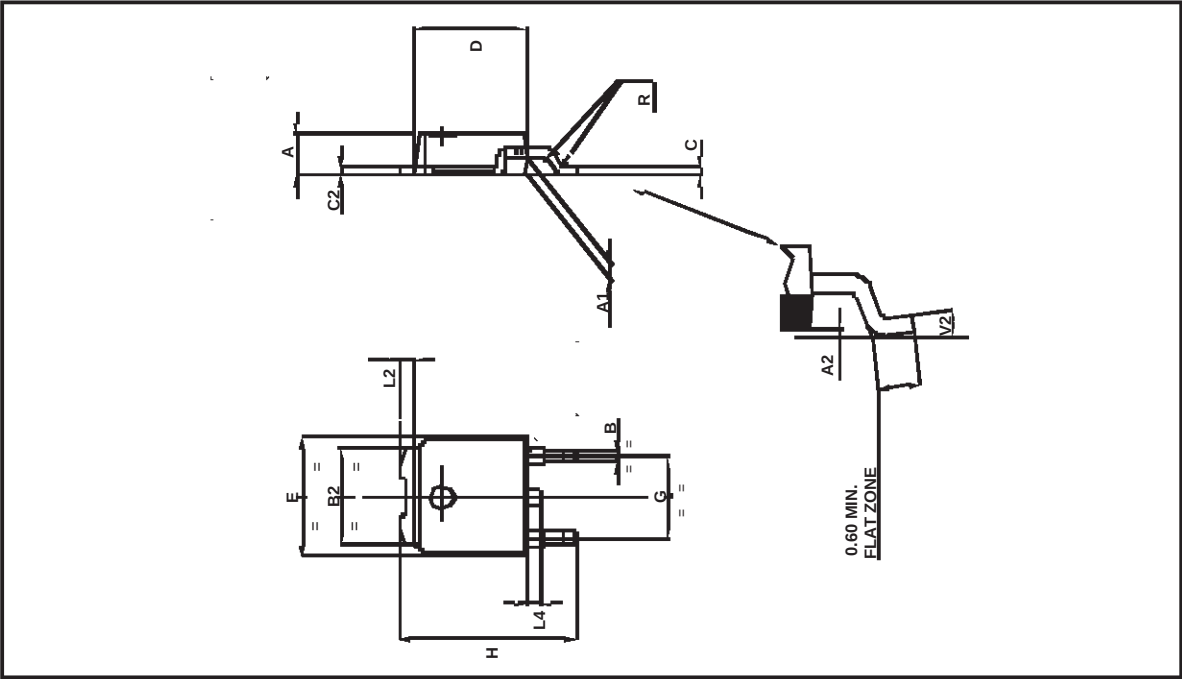
TO-251 (IPAK) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



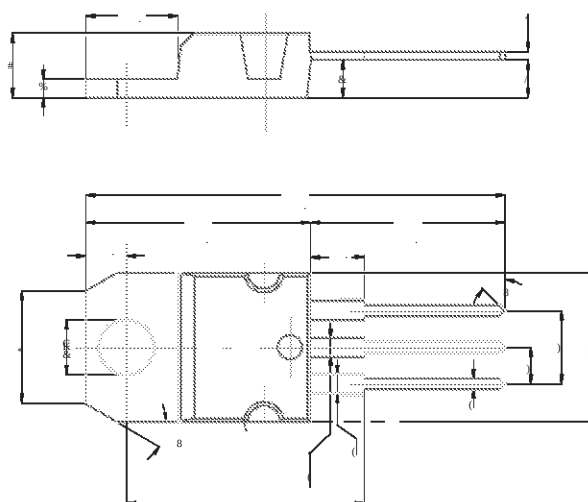
TO-252 (DPAK) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
B2	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°	8°		0°	8°	



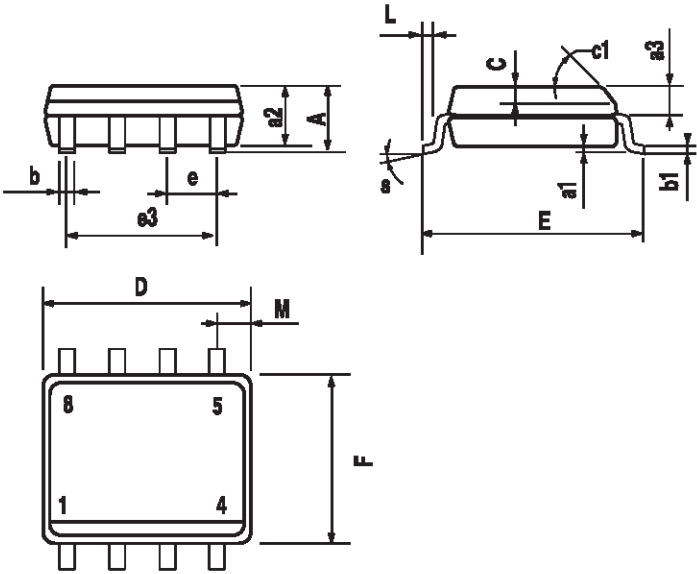
TO-220 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137	0.154	
M		2.6			0.102	
DIA.	3.75		3.85	0.147		0.151

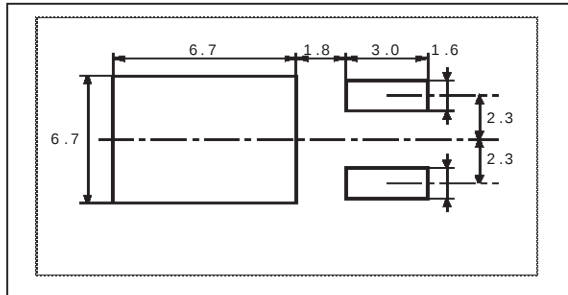


SO-8 MECHANICAL DATA

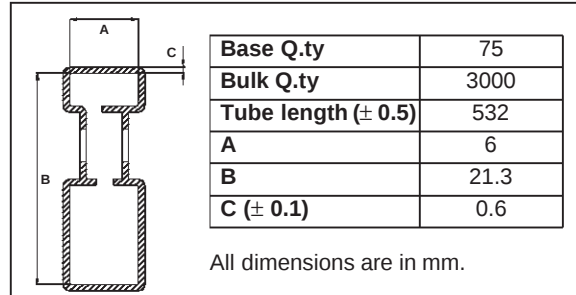
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.25	0.003		0.009
a2			1.65			0.064
a3	0.65		0.85	0.025		0.033
b	0.35		0.48	0.013		0.018
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.019
c1	45 (typ.)					
D	4.8		5.0	0.188		0.196
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.14		0.157
L	0.4		1.27	0.015		0.050
M			0.6			0.023
F	8 (max.)					



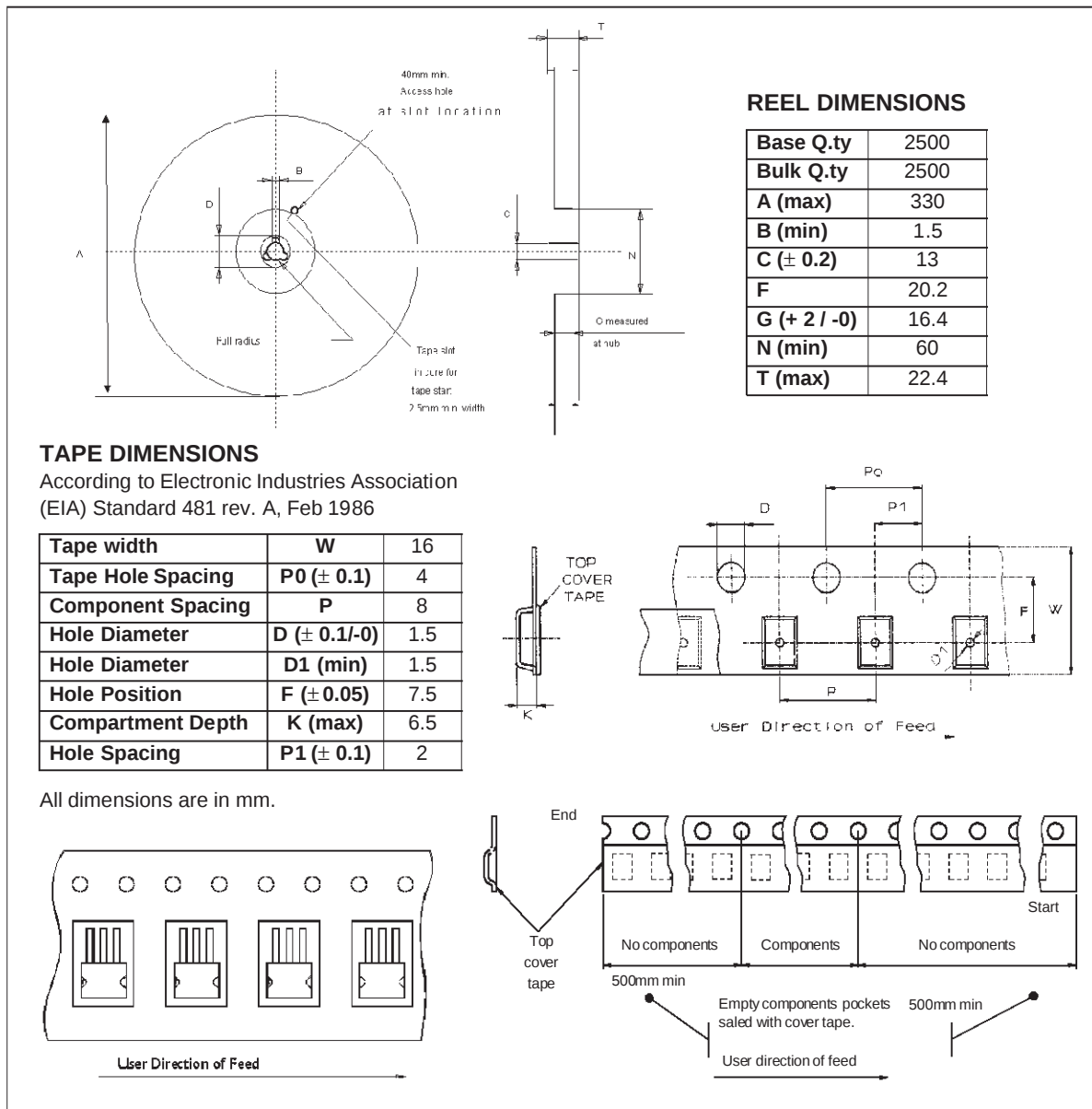
DPAK FOOTPRINT



TUBE SHIPMENT (no suffix)

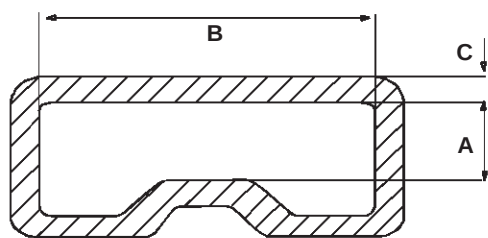


TAPE AND REEL SHIPMENT (suffix "13TR")



VNS14NV04 / VND14NV04 / VND14NV04-1 / VNP14NV04

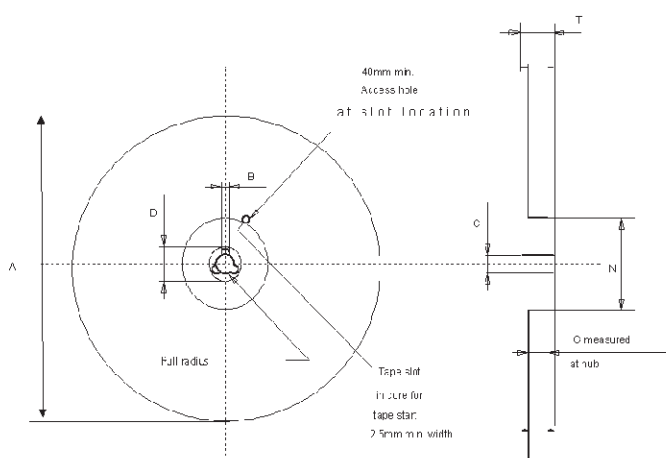
SO-8 TUBE SHIPMENT (no suffix)



Base Q.ty	100
Bulk Q.ty	2000
Tube length (± 0.5)	532
A	3.2
B	6
C (± 0.1)	0.6

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix "13TR")



REEL DIMENSIONS

Base Q.ty	2500
Bulk Q.ty	2500
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / - 0)	12.4
N (min)	60
T (max)	18.4

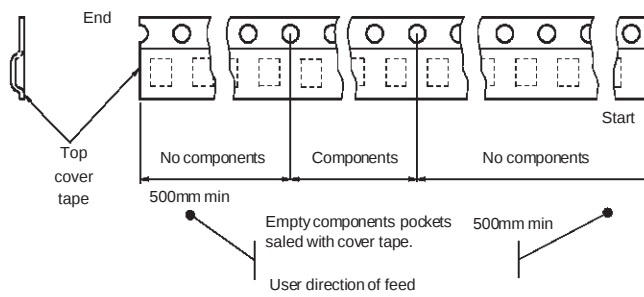
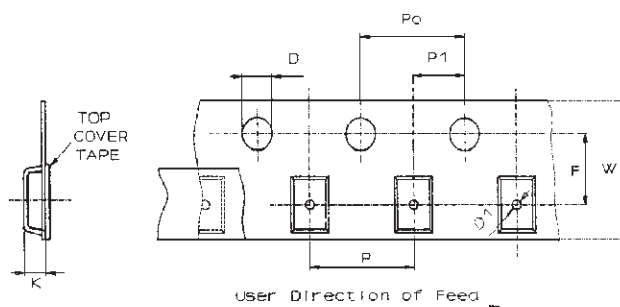
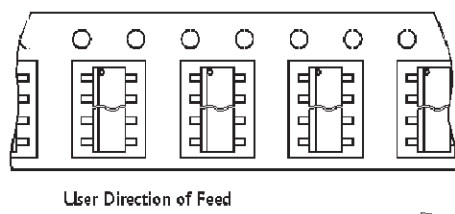
All dimensions are in mm.

TAPE DIMENSIONS

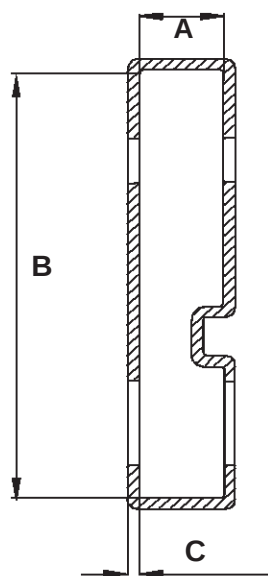
According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	W	12
Tape Hole Spacing	P0 (± 0.1)	4
Component Spacing	P	8
Hole Diameter	D ($\pm 0.1/-0$)	1.5
Hole Diameter	D1 (min)	1.5
Hole Position	F (± 0.05)	5.5
Compartment Depth	K (max)	4.5
Hole Spacing	P1 (± 0.1)	2

All dimensions are in mm.



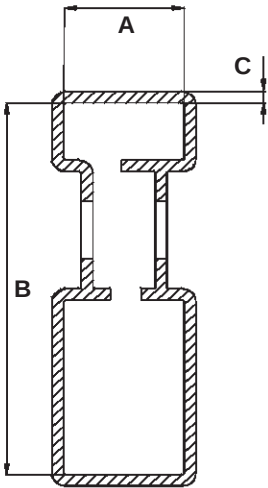
TO-220 TUBE SHIPMENT (no suffix)



Base Q.ty	50
Bulk Q.ty	1000
Tube length (± 0.5)	532
A	5.5
B	31.4
C (± 0.1)	0.75

All dimensions are in mm.

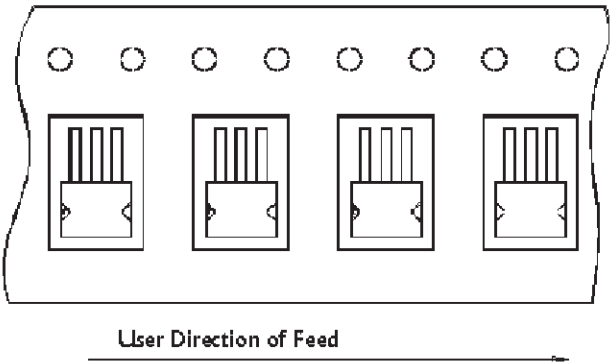
IPAK TUBE SHIPMENT (no suffix)



Base Q.ty	75
Bulk Q.ty	3000
Tube length (± 0.5)	532
A	6
B	21.3
C (± 0.1)	0.6

All dimensions are in mm.

MECHANICAL POLARIZATION



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