



VNB35NV04 VNV35NV04 / VNP35NV04

“OMNIFET II”:
FULLY AUTOPROTECTED POWER MOSFET

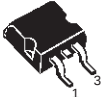
PRELIMINARY DATA

TYPE	$R_{DS(on)}$	I_{lim}	V_{clamp}
VNB35NV04 VNV35NV04 VNP35NV04	10 mΩ	30 A	40 V

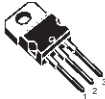
- ▢ LINEAR CURRENT LIMITATION
- ▢ THERMAL SHUT DOWN
- ▢ SHORT CIRCUIT PROTECTION
- ▢ INTEGRATED CLAMP
- ▢ LOW CURRENT DRAWN FROM INPUT PIN
- ▢ DIAGNOSTIC FEEDBACK THROUGH INPUT PIN
- ▢ ESD PROTECTION
- ▢ DIRECT ACCESS TO THE GATE OF THE POWER MOSFET (ANALOG DRIVING)
- ▢ COMPATIBLE WITH STANDARD POWER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

DESCRIPTION

The VNB35NV04, VNV35NV04, VNP35NV04, are monolithic devices designed in STMicroelectronics VIPower M0-3 Technology, intended for replacement of standard Power



D²PAK



TO-220



PowerSO-10™

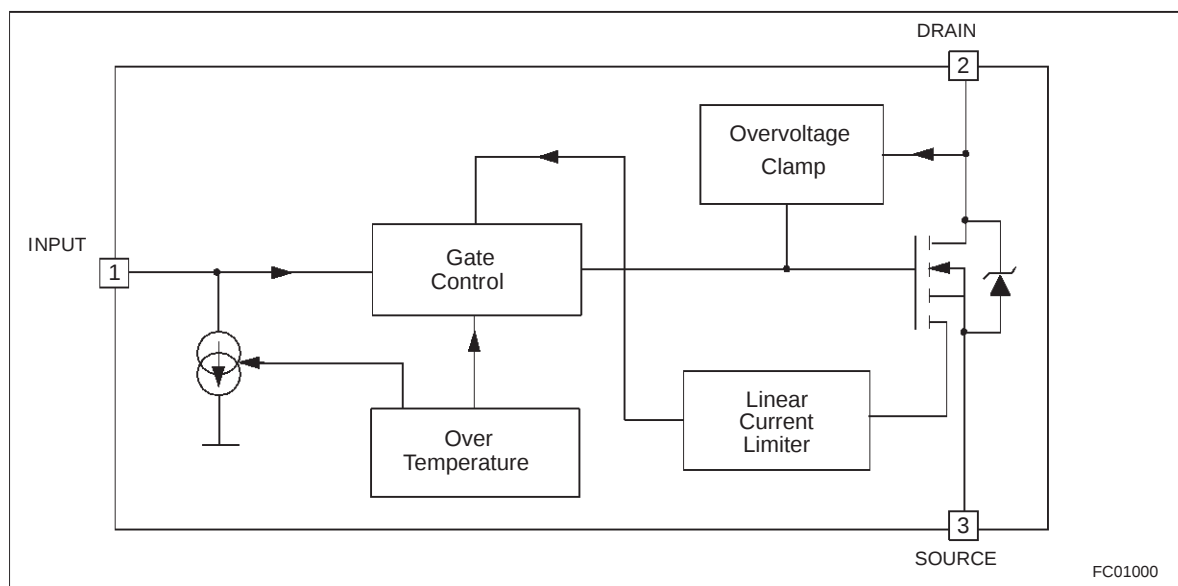
ORDER CODES:

D ² PAK	VNB35NV04
TO-220	VNP35NV04
PowerSO-10™	VNV35NV04

MOSFETS from DC up to 25KHz 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.

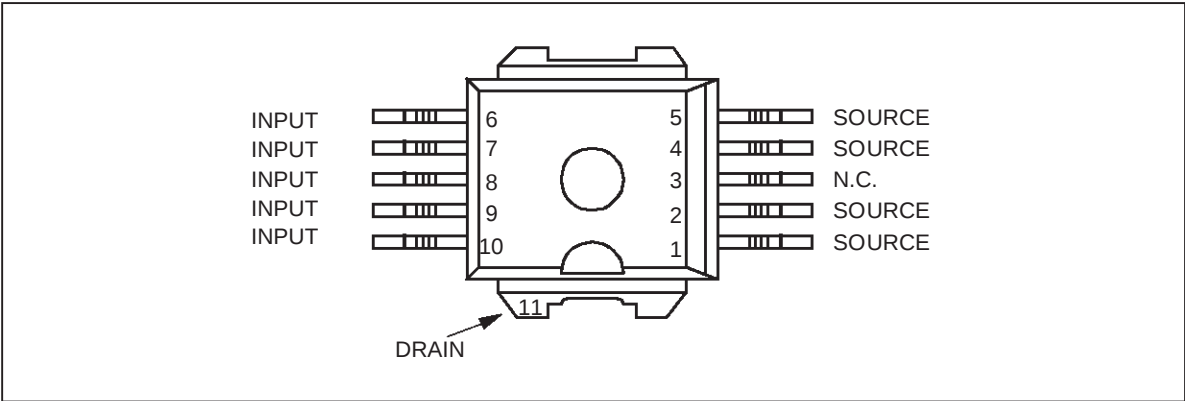
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

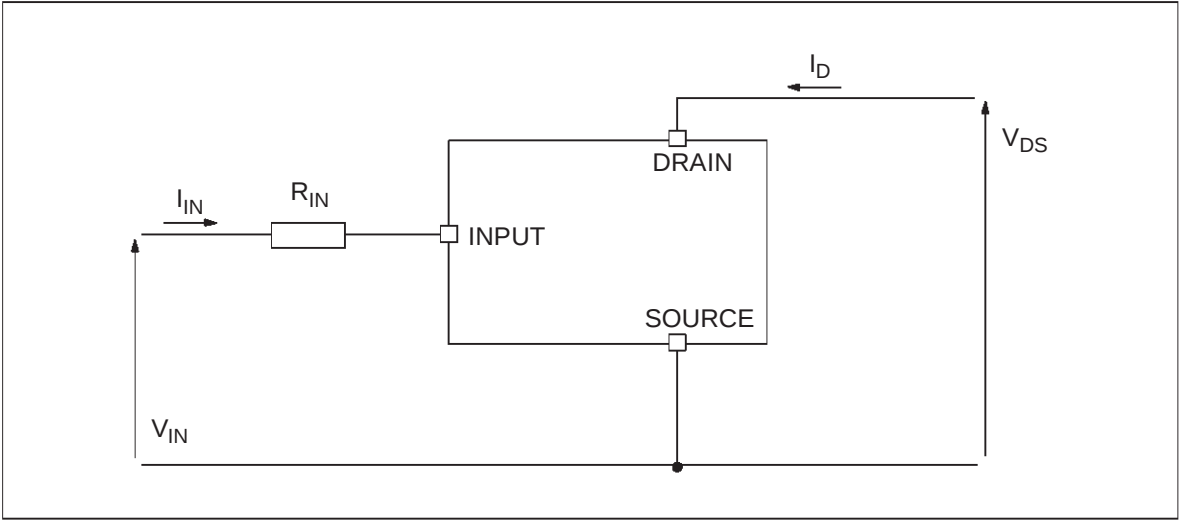
Symbol	Parameter	Value			Unit
		PowerSO-10™	D ² PAK	TO-220	
V _{DS}	Drain-source Voltage (V _{IN} =0V)	Internally Clamped			V
V _{IN}	Input Voltage	Internally Clamped			V
I _{IN}	Input Current	+/-20			mA
R _{IN MIN}	Minimum Input Series Impedance	4.7			Ω
I _D	Drain Current	Internally Limited			A
I _R	Reverse DC Output Current	-30			A
V _{ESD1}	Electrostatic Discharge (R=1.5KΩ, C=100pF)	4000			V
V _{ESD2}	Electrostatic Discharge on output pin only (R=330Ω, C=150pF)	16500			V
P _{tot}	Total Dissipation at T _c =25°C	125	125	125	W
T _j	Operating Junction Temperature	Internally limited			°C
T _c	Case Operating Temperature	Internally limited			°C
T _{stg}	Storage Temperature	-55 to 150			°C

CONNECTION DIAGRAM (TOP VIEW)



(*) For the pins configuration related to TO-220, D²PAK, see outlines at page 1.

CURRENT AND VOLTAGE CONVENTIONS



THERMAL DATA

Symbol	Parameter		Value			Unit
			PowerSO-10™	D2PAK	TO-220	
R _{thj-case}	Thermal Resistance Junction-case	MAX	1	1	1	°C/W
R _{thj-amb}	Thermal Resistance Junction-ambient	MAX	50(*)	50(*)	50	°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 =15A	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°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 =15A; T _j =25°C V _{IN} =5V; I _D =15A			10 20	mΩ

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	$V_{DD}=13\text{V}; I_D=15\text{A}$		35		S
C_{OSS}	Output Capacitance	$V_{DS}=13\text{V}; f=1\text{MHz}; V_{IN}=0\text{V}$		1300		pF

SWITCHING

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=15\text{V}; I_D=15\text{A}$ $V_{gen}=5\text{V}; R_{gen}=R_{IN\text{ MIN}}=4.7\Omega$ (see figure 1)		150	500	ns
t_r	Rise Time			750	2500	ns
$t_{d(off)}$	Turn-off Delay Time			900	3000	ns
t_f	Fall Time			500	1500	ns
$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=15\text{V}; I_D=15\text{A}$ $V_{gen}=5\text{V}; R_{gen}=2.2\text{K}\Omega$ (see figure 1)		4	12	μs
t_r	Rise Time			32	100	μs
$t_{d(off)}$	Turn-off Delay Time			50	150	μs
t_f	Fall Time			40	120	μs
$(di/dt)_{on}$	Turn-on Current Slope	$V_{DD}=15\text{V}; I_D=15\text{A}$ $V_{gen}=5\text{V}; R_{gen}=R_{IN\text{ MIN}}=4.7\Omega$		18		A/ μs
Q_i	Total Input Charge	$V_{DD}=12\text{V}; I_D=15\text{A}; V_{IN}=5\text{V}$ $I_{gen}=2.13\text{mA}$ (see figure 5)		60		nC

SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{SD} (*)	Forward On Voltage	$I_{SD}=15\text{A}; V_{IN}=0\text{V}$		0.8		V
t_{rr}	Reverse Recovery Time	$I_{SD}=15\text{A}; di/dt=100\text{A}/\mu\text{s}$ $V_{DD}=30\text{V}; L=200\mu\text{H}$ (see test circuit, figure 2)		400		ns
Q_{rr}	Reverse Recovery Charge			1.4		μC
I_{RRM}	Reverse Recovery Current			7		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	$V_{IN}=6\text{V}; V_{DS}=13\text{V}$	30	45	60	A
t_{dlim}	Step Response Current Limit	$V_{IN}=6\text{V}; V_{DS}=13\text{V}$		50		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 $T_j=25^\circ\text{C}; V_{DD}=24\text{V}$ $V_{IN}=5\text{V}; R_{gen}=R_{IN\text{ MIN}}=4.7\Omega; L=24\text{mH}$ (see figures 3 & 4)	1.7			J

 (*) 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 25KHz. 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 is. 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

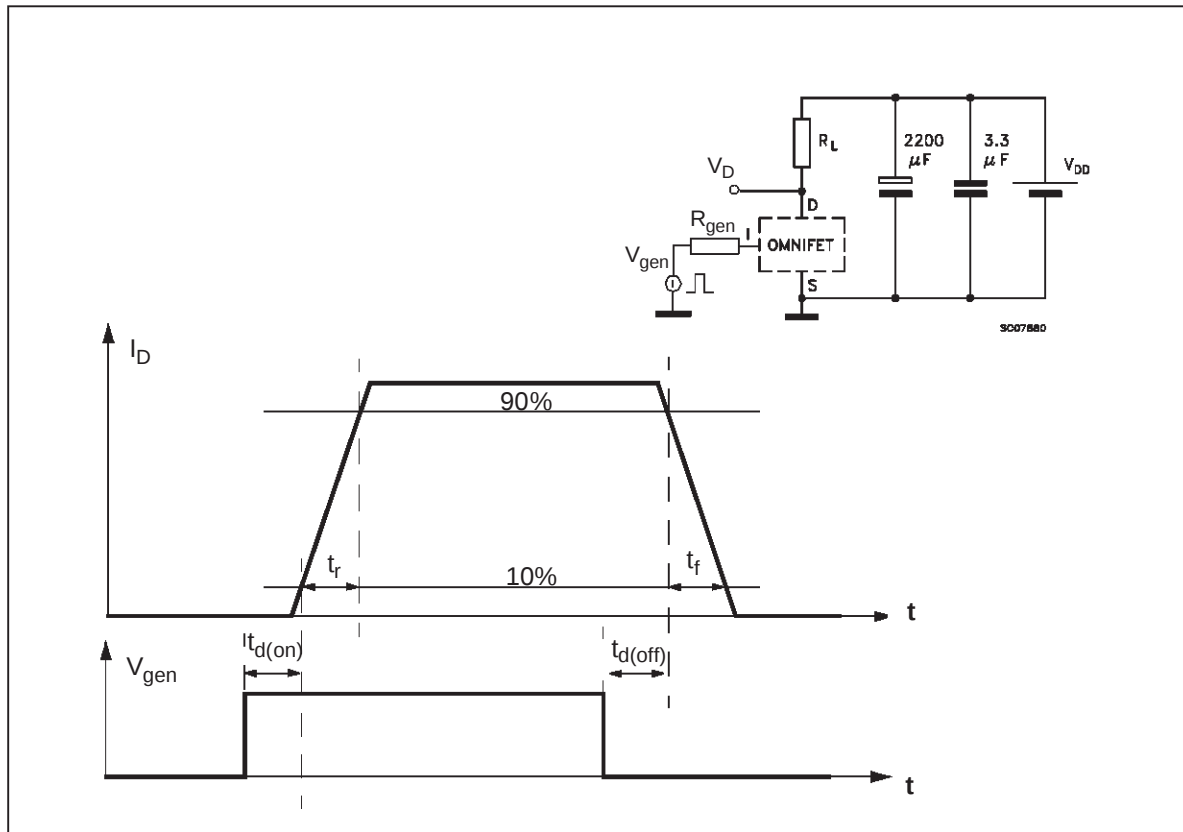


Fig.2: Test Circuit for Diode Recovery Times

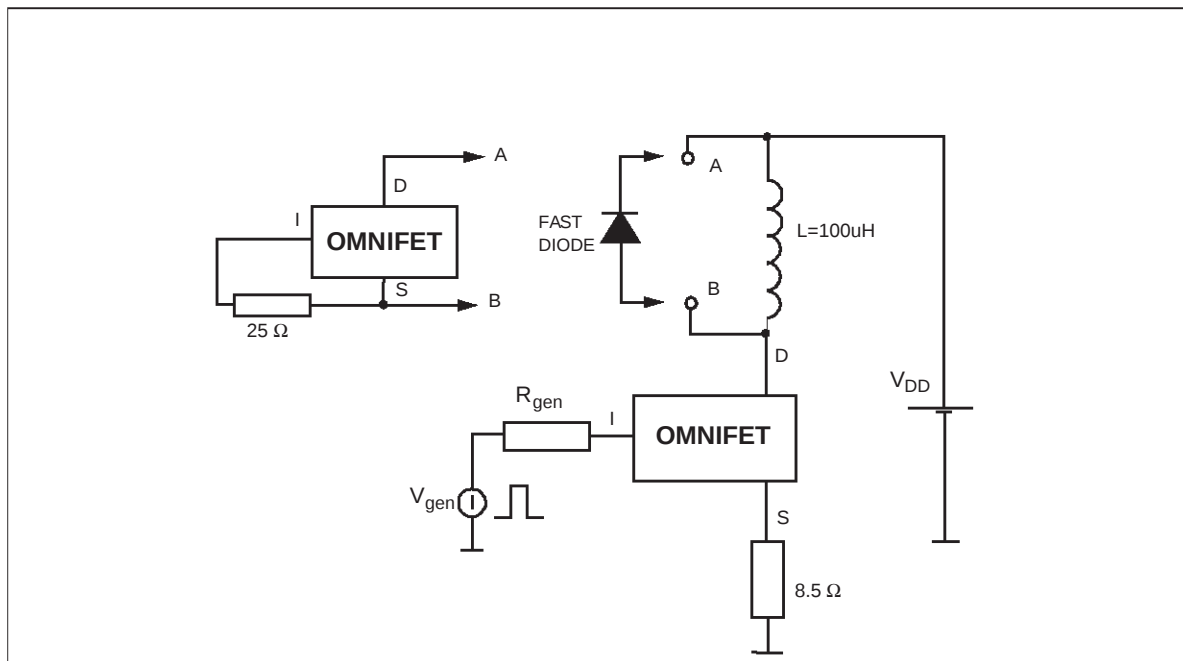
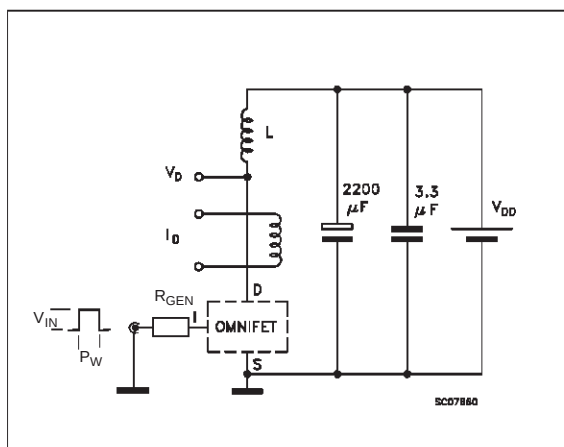
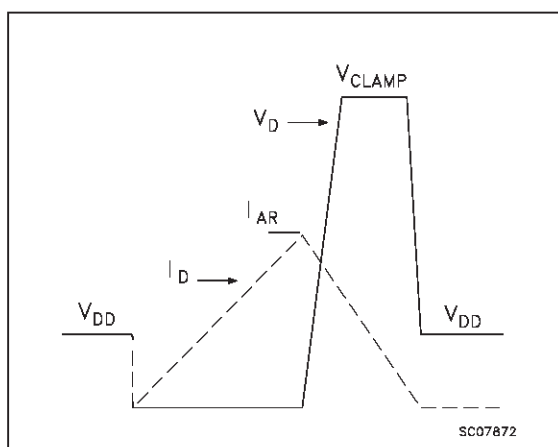
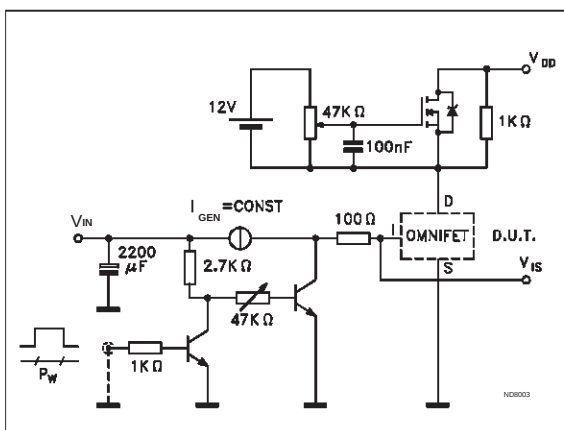
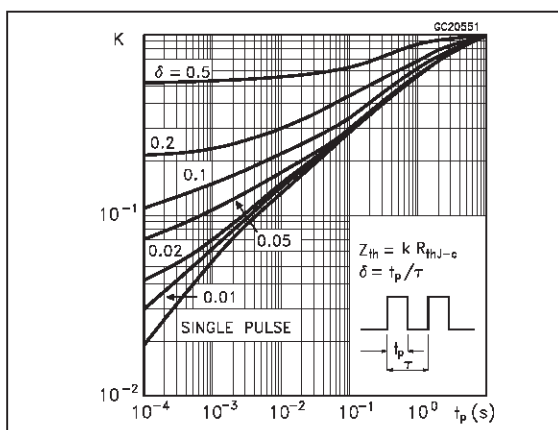
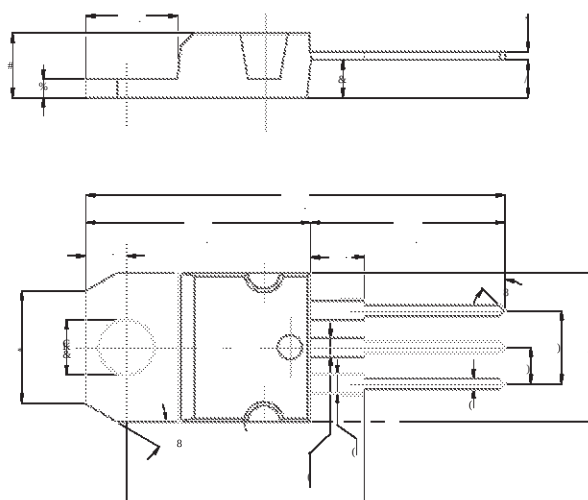


Fig. 3: Unclamped Inductive Load Test Circuits

Fig. 4: Unclamped Inductive Waveforms

Fig. 5: Input Charge Test Circuit

Fig 6 : Thermal Impedance for TO-220


TO-220 MECHANICAL DATA

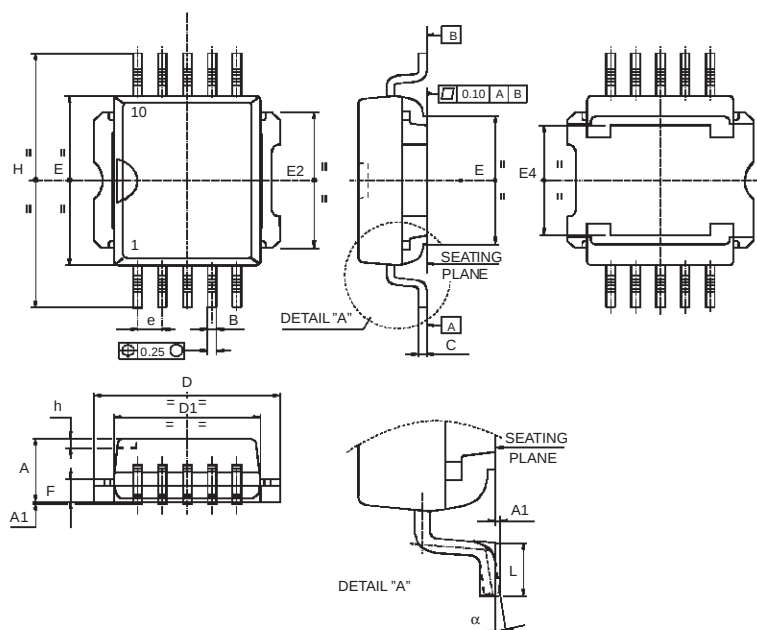
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		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



PowerSO-10™ MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	3.35		3.65	0.132		0.144
A (*)	3.4		3.6	0.134		0.142
A1	0.00		0.10	0.000		0.004
B	0.40		0.60	0.016		0.024
B (*)	0.37		0.53	0.014		0.021
C	0.35		0.55	0.013		0.022
C (*)	0.23		0.32	0.009		0.0126
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.300
E	9.30		9.50	0.366		0.374
E2	7.20		7.60	0.283		300
E2 (*)	7.30		7.50	0.287		0.295
E4	5.90		6.10	0.232		0.240
E4 (*)	5.90		6.30	0.232		0.248
e		1.27			0.050	
F	1.25		1.35	0.049		0.053
F (*)	1.20		1.40	0.047		0.055
H	13.80		14.40	0.543		0.567
H (*)	13.85		14.35	0.545		0.565
h		0.50			0.002	
L	1.20		1.80	0.047		0.070
L (*)	0.80		1.10	0.031		0.043
α	0°		8°	0°		8°
α (*)	2°		8°	2°		8°

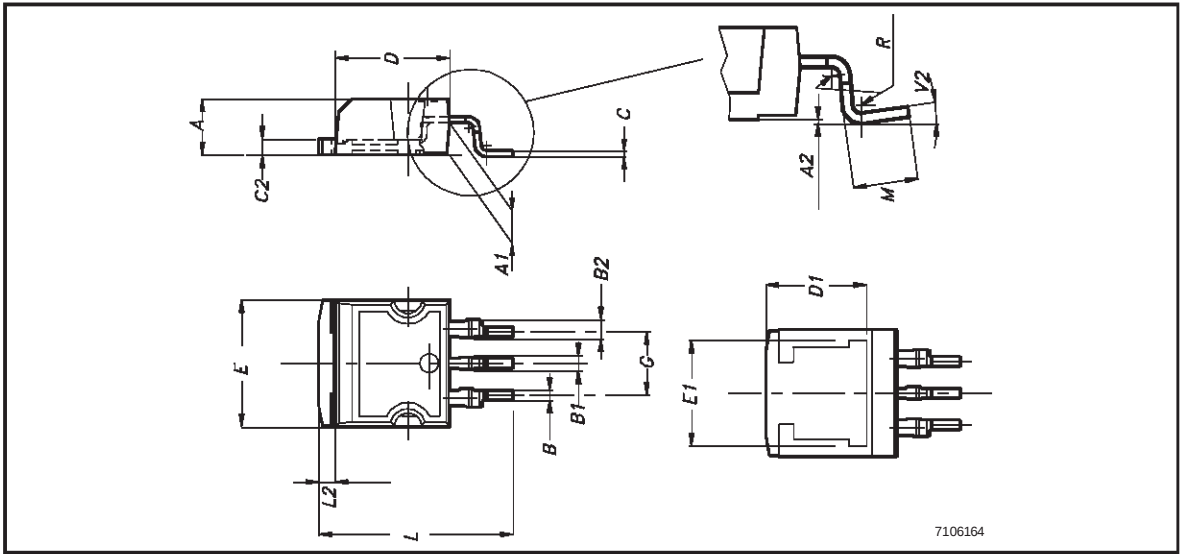
(*) Muar only POA P013P



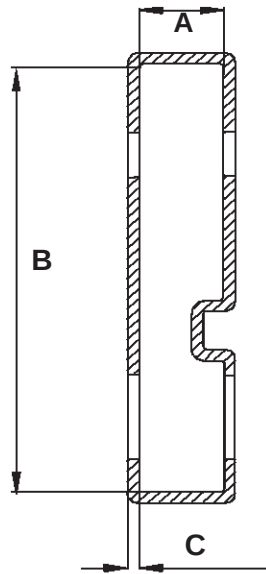
P095A

D²PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B1	0.8		1.3	0.031		0.051
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		8°			



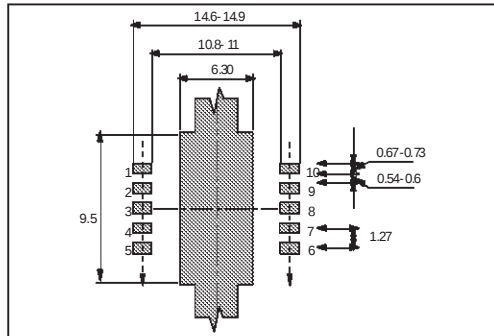
TO-220 TUBE SHIPMENT (no suffix)



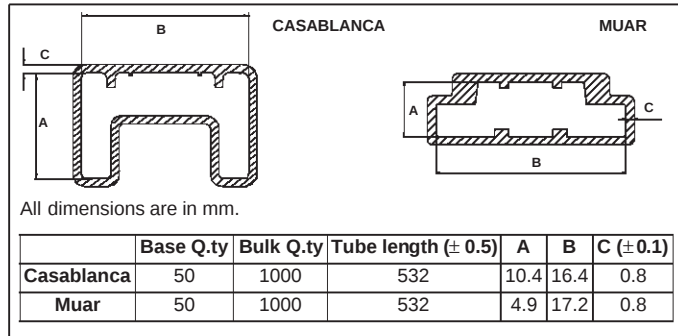
Base Q.ty	50
Bulk Q.ty	1000
Tube length (± 0.5)	532
A	5.5
B	31.4
C (± 0.1)	0.75

All dimensions are in mm.

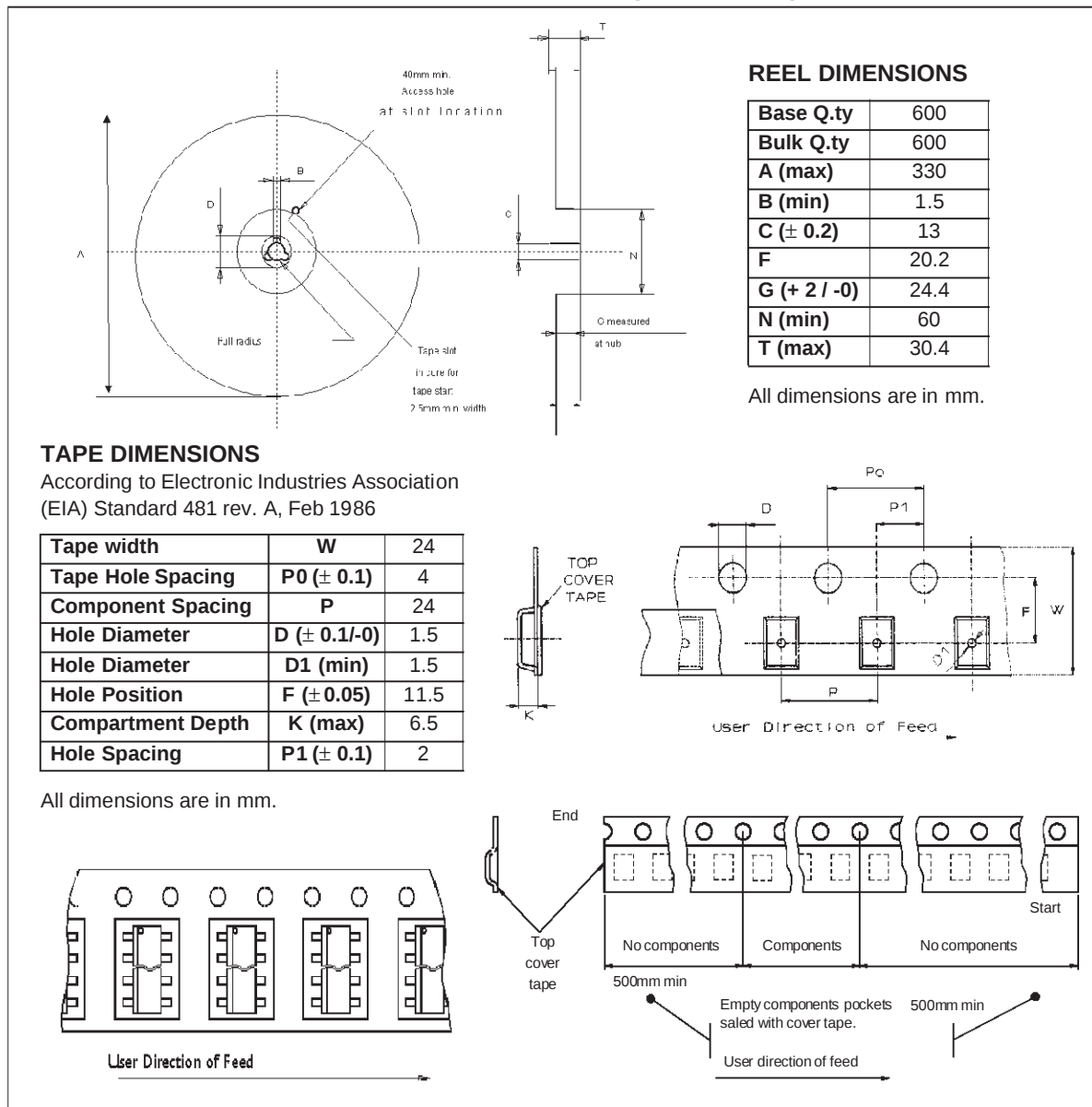
PowerSO-10™ SUGGESTED PAD LAYOUT



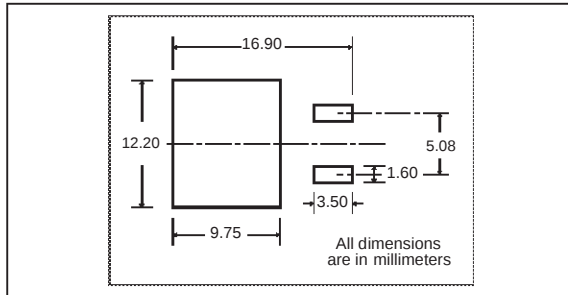
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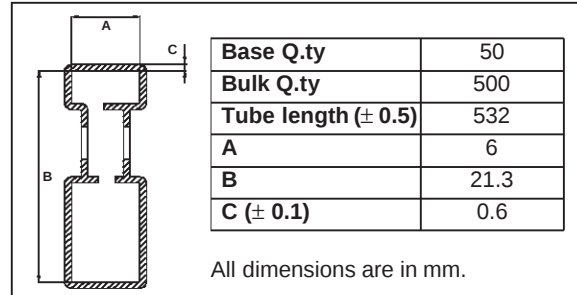
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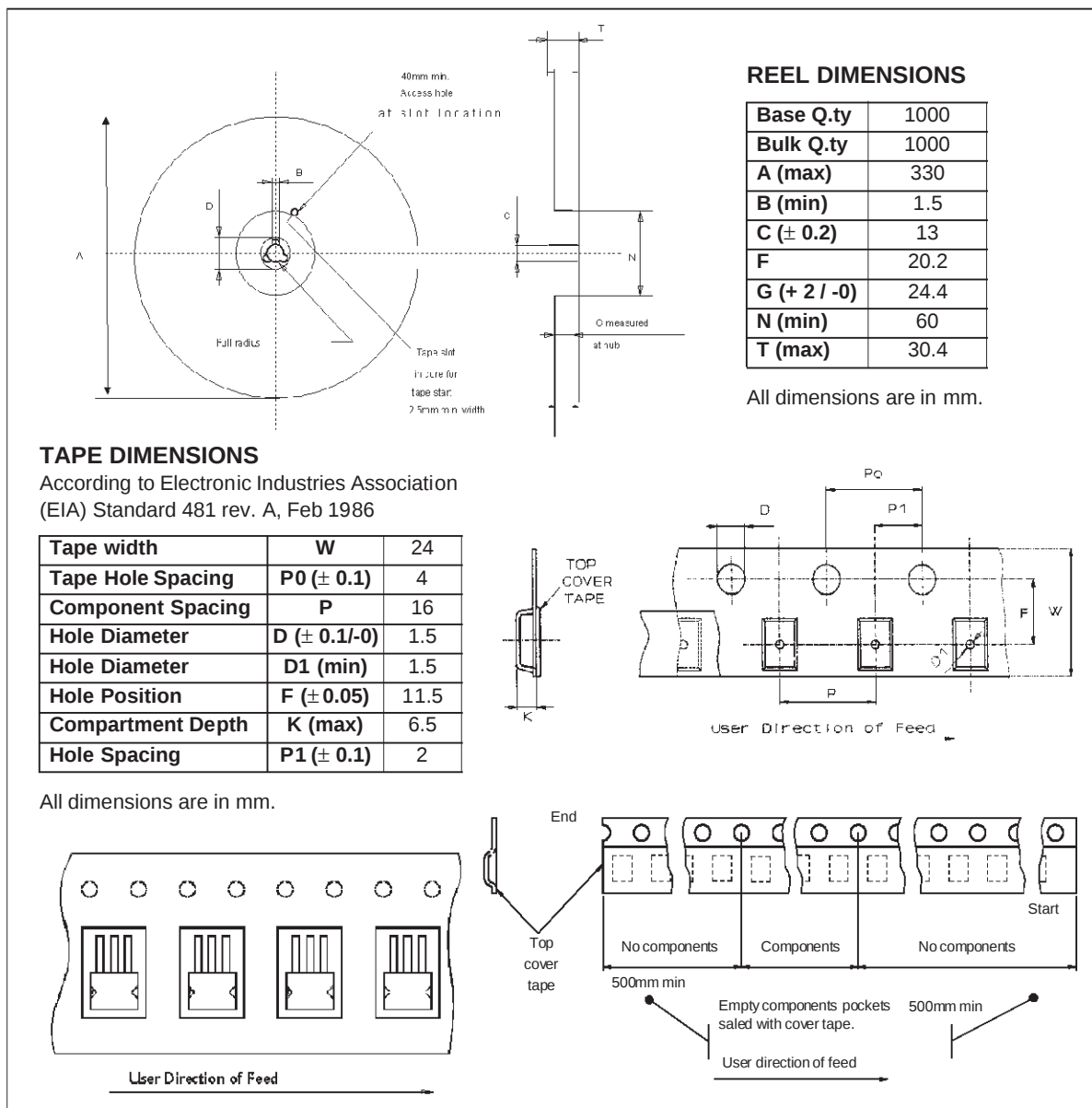
D²PAK FOOTPRINT



TUBE SHIPMENT (no suffix)



TAPE AND REEL SHIPMENT (suffix "13TR")



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