TN22

Fluorescent tube lamp starter SCR

Features

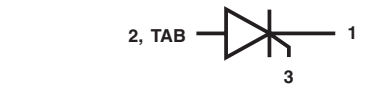
- High clamping voltage structure (1200 to 1500 V)
- Low gate triggering current for direct drive from line (< 1.5 mA)
- High holding current (> 175 mA), ensuring high striking energy

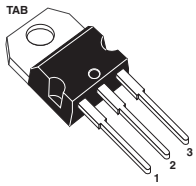
Description

The TN22 has been specifically developed for use in tube lamp electronic starter circuits.

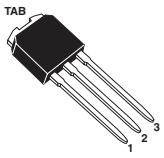
Used in conjunction with a sensitive SCR, it provides high energy striking characteristics with low triggering power.

Thanks to the optimized characteristics of the TN22, starters based on this device can offer high reliability levels and extended life time of the fluorescent tube lamps.

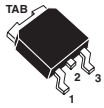




TO-220AB
TN22-1500T



IPAK
TN22-1500H



DPAK
TN22-1500B-TR

1 Characteristics

Table 1. Absolute ratings (limiting values)

Symbol	Parameter		Value	Unit
V_{RRM}	Repetitive peak off-state voltage	T_j = 110 °C	400	V
$I_{T(RMS)}$	On-state rms current full sine wave (180° conduction angle)	T_c = 95 °C	2	A
$I_{T(AV)}$	Mean on-state current Full sinewave (180° conduction angle)	T_c = 95 °C	1.8	A
I_{TSM}	Non repetitive surge peak on-state current (T_j initial = 25 °C)	t_p = 8.3 ms	22	A
		t_p = 10 ms	20	
I^2t	I^2t Value for fusing	t_p = 10 ms	2	A^2s
dI/dt	Critical rate of rise of on-state current I_G = 5 mA dI_G/dt = 70 mA/µs		50	A/µs
$P_{G(AV)}$	Average gate power dissipation		300	mW
P_{GM}	Peak gate power dissipation	t_p = 20 µs	2	W
I_{GM}	Peak gate current	t_p = 20 µs	1	A
V_{RGM}	Maximum peak reverse gate voltage		6	V
T_{stg} T_j	Storage and operating junction temperature range		-40 to +150 -40 to +110	°C
T_L	Maximum lead temperature for soldering during 10 s at 4.5 mm from case		260	°C

Table 2. Electrical characteristics (T_j = 25 °C unless otherwise stated)

Symbol	Test conditions		Value	Unit
I_{GT}	V_D=12 V (DC), R_L= 33 Ω	MAX	1.5	mA
V_{GT}	V_D=12 V (DC), R_L= 33 Ω, R_{GK} = 1 KΩ	MAX	3	V
I_H	V_{GK} = 0 V	MIN	175	mA
dV/dt	Linear slope up to V_D = 67% V_{DRM}, V_{GK} = 0 V, T_j = 110 °C	MIN	500	V/µs
V_{BR}	I_D = 5 mA, V_{GK} = 0 V	MIN	1200	V
		MAX	1500	

Table 3. Static electrical characteristics (Tj = 25 °C unless otherwise stated)

Symbol	Test conditions		Value	Unit
V_{TM}	I_{TM} = 2 A t_p = 380 µs	MAX	3.1	V
I_{DRM}	V_{DRM} rated	MAX	0.1	mA

Table 4. Thermal resistance

Symbol	Parameter		Value	Unit
$R_{th(j-a)}$	Junction to ambient	DPAK / IPAK	100	°C/W
		TO-220AB	60	
$R_{th(j-c)}$	Junction to case		3	°C/W

Figure 1. Maximum average power dissipation versus average on-state current (rectified sine wave)

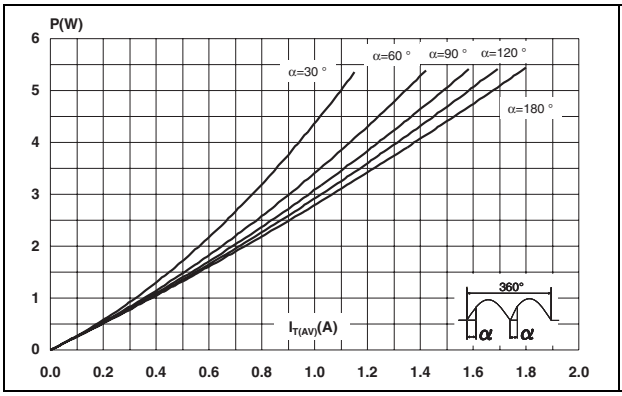


Figure 2. Average on-state current versus case temperature (rectified full sine wave)

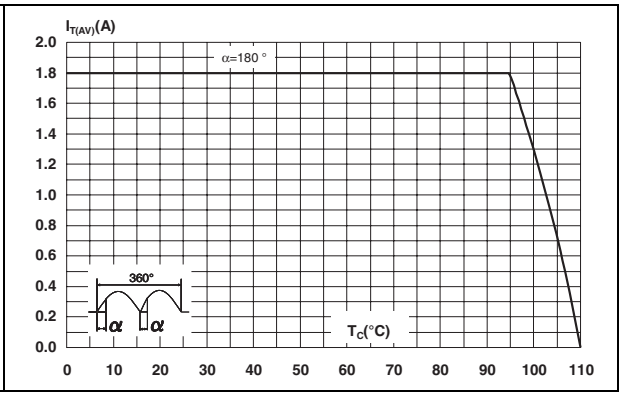


Figure 3. Average on-state current versus ambient temperature, free air convection (rectified full sine wave)

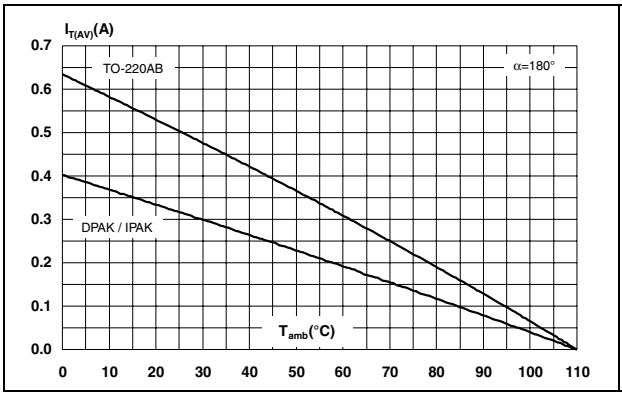


Figure 4. Variation of thermal impedance junction to ambient versus pulse duration

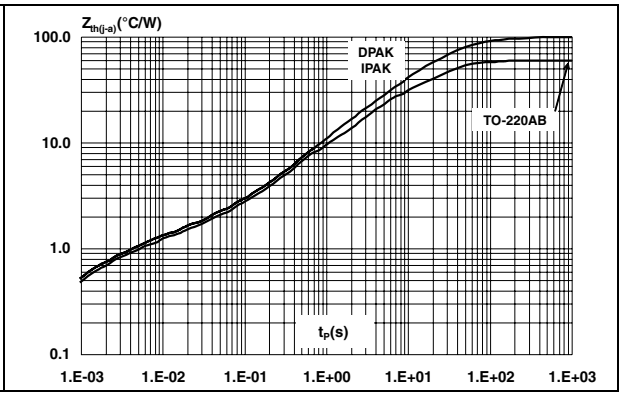


Figure 5. Relative variation of gate trigger current and holding current versus junction temperature

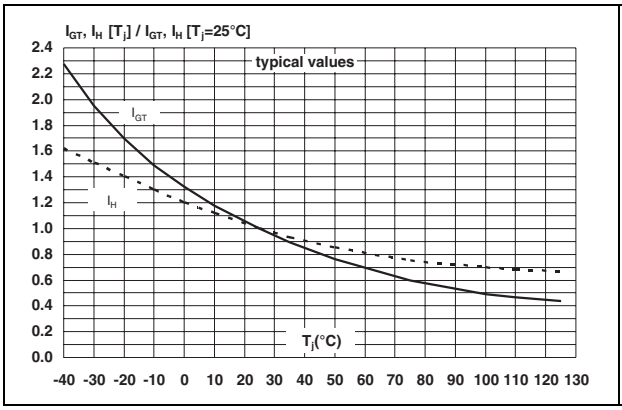


Figure 6. Surge peak on-state current versus number of cycles

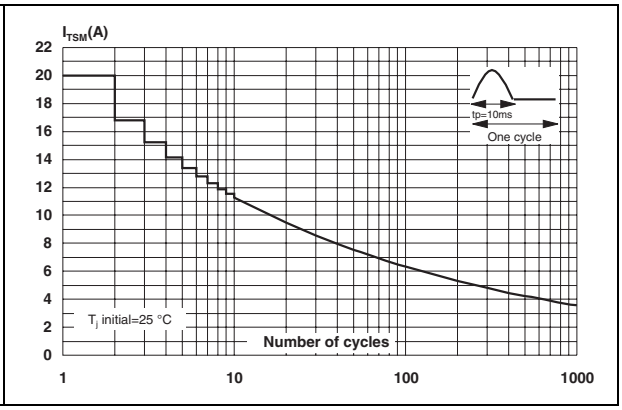


Figure 7. Non-repetitive surge peak on-state current for a sinusoidal pulse

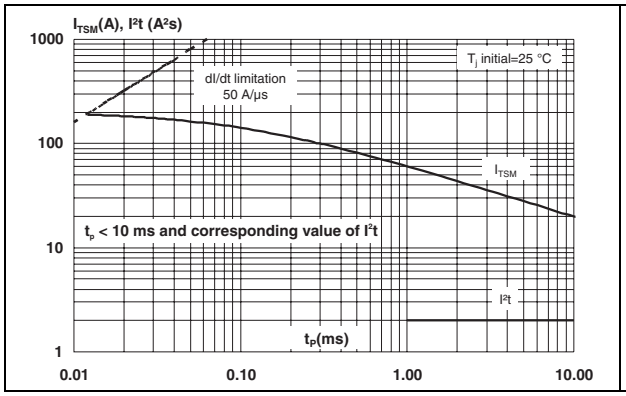


Figure 8. On-state characteristics (maximum values)

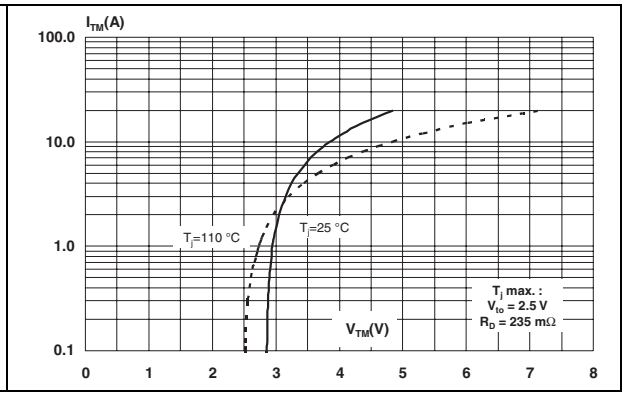


Figure 9. Maximum allowable rms current versus time conduction and initial case temperature

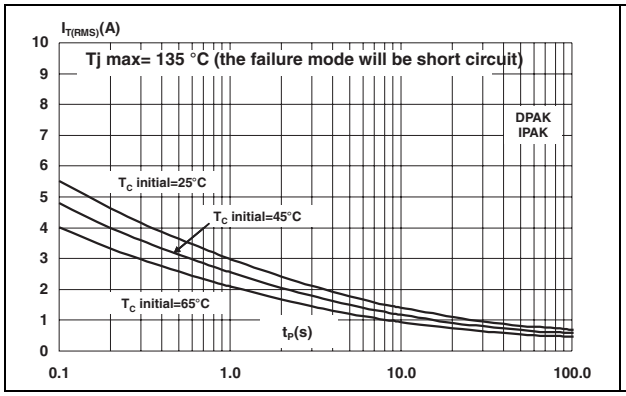


Figure 10. Maximum allowable rms current versus time conduction and initial case temperature

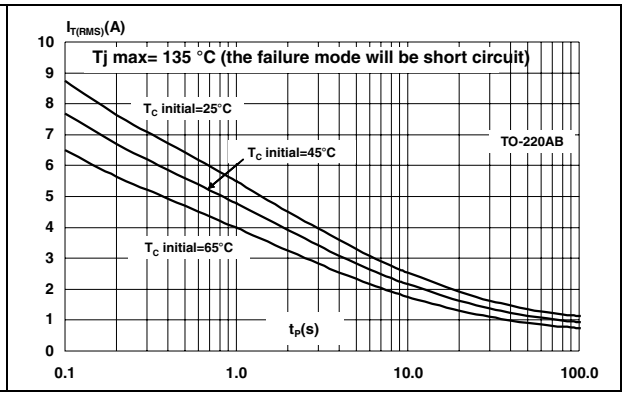
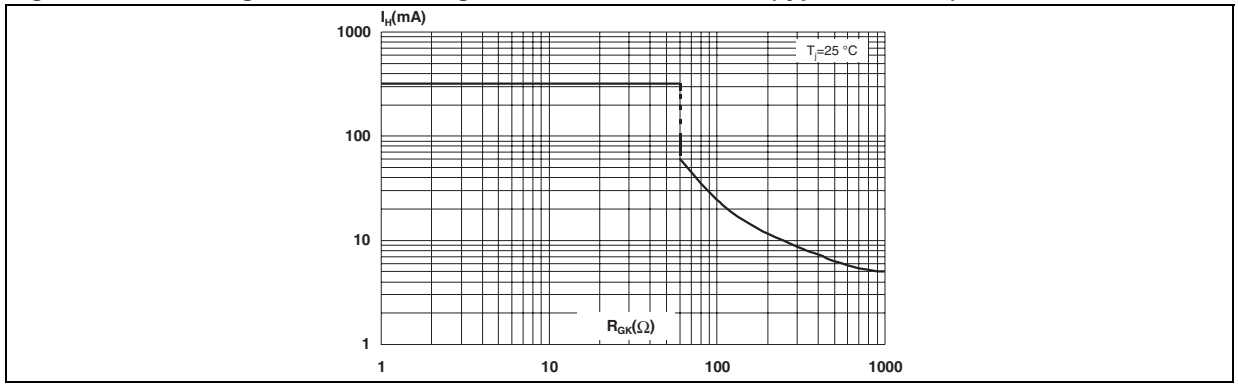


Figure 11. Holding current versus gate-cathode resistance (typical values)



2 Application information

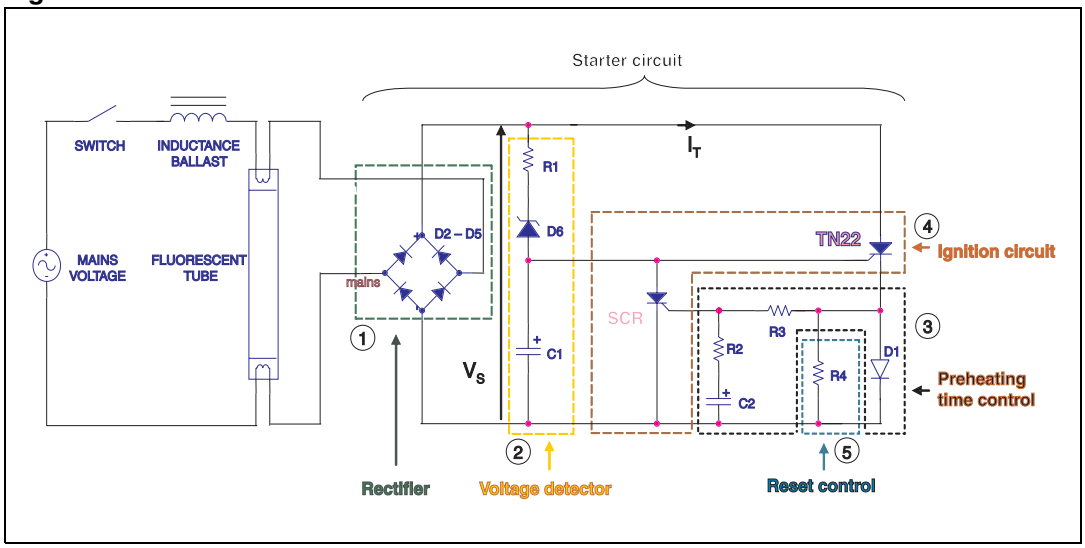
2.1 Overview

The TN22 has been designed for use as a fluorescent tube starter switch.

As shown in *Figure 12*, the starter circuit is divided in five parts:

1. **Rectifier bridge**: to rectify mains voltage.
2. **Voltage detector**: RCD circuit used to switch on the TN22.
3. **Preheating time control**: RC circuit used to switch on the SCR, so turn off the TN22.
4. **Ignition circuit**: made of sensitive SCR and TN22 devices.
5. **Reset control**: resistor used to discharge the C2 capacitor and to reset the circuit.

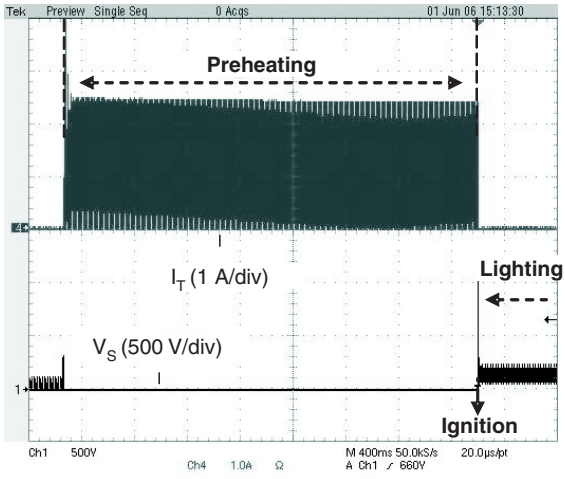
Figure 12. Electronic starter schematic



Three steps are necessary to ignite a fluorescent tube (see *Figure 13*):

- preheating of the filament
- ignition of the tube
- "lighting" mode

Figure 13. The three operating steps of the electronic starter: preheating, ignition and lighting



2.2 Filament and tube preheating

The mains voltage is applied across the circuit and when it reaches a higher level than the zener clamping voltage (V_{CL}), a current flows through the resistor R1 and the capacitor C1. The TN22 switches on when the voltage across its gate to cathode junction reaches the triggering gate level (V_{GT}).

As the TN22 is in on-state, a full sinusoidal current flows through the filaments (primary of the rectifier bridge) that are warmed up. This current is limited by the input ballast. The TN22 remains on at each current zero crossing point because the gate is still powered by the C1 capacitor.

The preheating time duration is set with the RC circuit made of R3, R2 and C2, and according to the voltage polarization fixed by the D1 drop voltage.

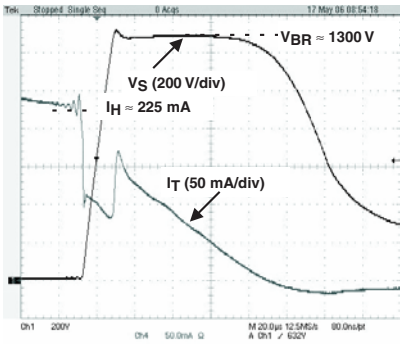
The preheating time is typically in the range of 2 to 3 seconds depending on the tube characteristics.

2.3 Ignition step

When C2 is charged above the SCR triggering gate voltage (V_{GT}), the SCR switches on. The voltage across the TN22 gate to cathode junction is fixed to a negative value, which allows a proper TN22 switch-off, with a high holding current (I_H) level.

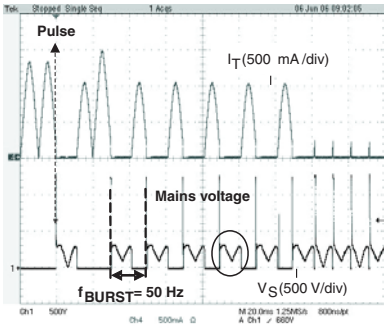
When the current reaches I_H, the TN22 switches off and the ballast inductor generates a high voltage pulse across the tube (see *Figure 14*). This over-voltage is clamped by the TN22 to a value fixed by the breakdown voltage (V_{BR}). A 1200 V to 1500 V level is necessary to ensure a correct ignition of the fluorescent tubes.

Figure 14. Typical high voltage pulse of an electronic starter circuit (P0130AA SCR, TN22)



If the lamp is not ignited after the first pulse, the starter circuit starts a new ignition sequence. The pulse is regenerated until ignition of the tube lamp. If the lamp is not ignited after several attempts, the starter circuit can automatically stop the ignition sequence.

Figure 15. Repetitive ignitions sequence

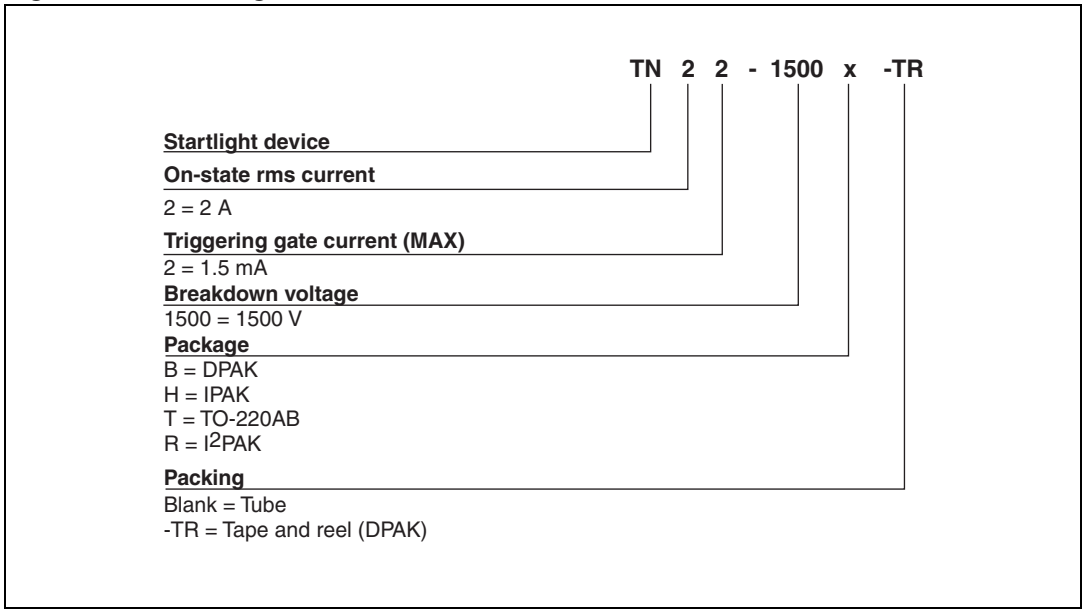


2.4 Lighting state

When the lamp is ignited, the capacitor C2 is discharged through the resistors R2, R3 and R4. The voltage across the lamp remains lower than the D6 clamping voltage (V_{CL}), avoiding the triggering of the TN22. The starter circuit remains in stand-by mode.

3 Ordering information scheme

Figure 16. Ordering information scheme

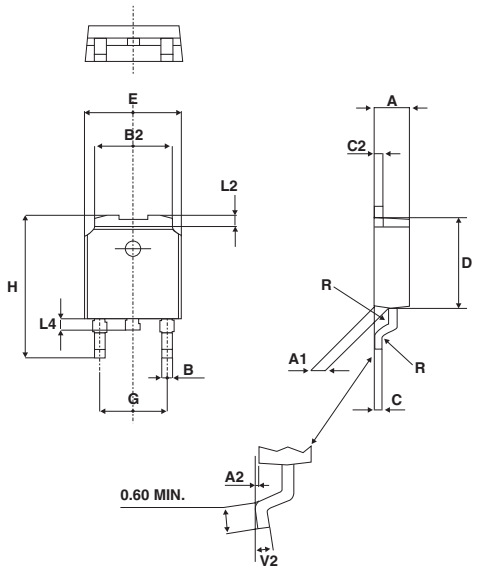


4 Package information

- Epoxy meets UL94,V0
- Cooling method: by convection
- Recommended torque value: 0.4 to 0.6 N·m (TO-220AB)

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

Table 5. DPAK dimensions



Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.40	0.086	0.094
A1	0.90	1.10	0.035	0.043
A2	0.03	0.23	0.001	0.009
B	0.64	0.90	0.025	0.035
B2	5.20	5.40	0.204	0.212
C	0.45	0.60	0.017	0.023
C2	0.48	0.60	0.018	0.023
D	6.00	6.20	0.236	0.244
E	6.40	6.60	0.251	0.259
G	4.40	4.60	0.173	0.181
H	9.35	10.10	0.368	0.397
L2	0.80 typ.		0.031 typ.	
L4	0.60	1.00	0.023	0.039
V2	0°	8°	0°	8°

Figure 17. Footprint (dimensions in mm)

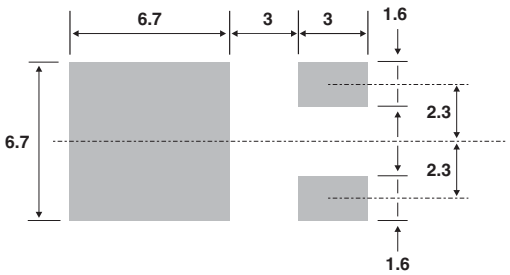
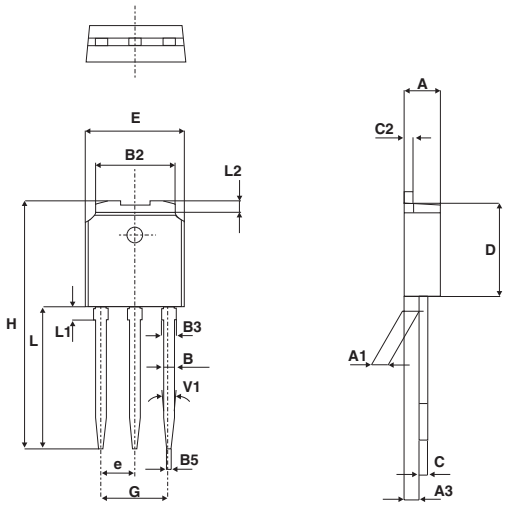
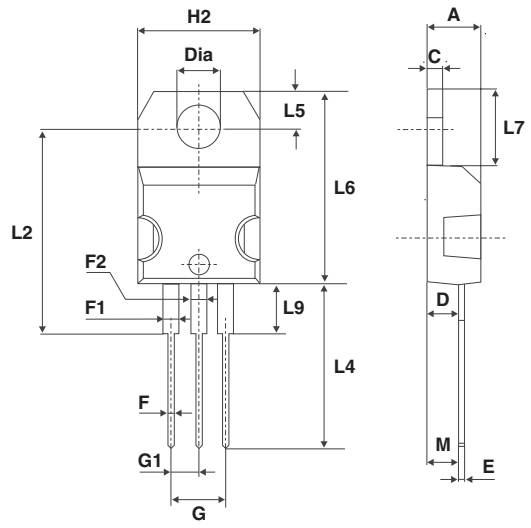


Table 6. IPAK dimensions



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.20	-	2.40	0.086	-	0.094
A1	0.90	-	1.10	0.035	-	0.043
A3	0.70	-	1.30	0.027	-	0.051
B	0.64	-	0.90	0.025	-	0.035
B2	5.20	-	5.40	0.204	-	0.212
B3	-	-	0.95	-	-	0.037
B5	-	0.30	-	-	0.035	-
C	0.45	-	0.60	0.017	-	0.023
C2	0.48	-	0.60	0.019	-	0.023
D	6	-	6.20	0.236	-	0.244
E	6.40	-	6.60	0.252	-	0.260
e	-	2.28	-	-	0.090	-
G	4.40	-	4.60	0.173	-	0.181
H	-	16.10	-	-	0.634	-
L	9	-	9.40	0.354	-	0.370
L1	0.8	-	1.20	0.031	-	0.047
L2	-	0.80	1	-	0.031	0.039
V1	-	10°	-	-	10°	-

Table 7. TO-220AB dimensions



Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	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	0.066
F2	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
G1	2.40	2.70	0.094	0.106
H2	10	10.40	0.393	0.409
L2	16.4 typ.		0.645 typ.	
L4	13	14	0.511	0.551
L5	2.65	2.95	0.104	0.116
L6	15.25	15.75	0.600	0.620
L7	6.20	6.60	0.244	0.259
L9	3.50	3.93	0.137	0.154
M	2.6 typ.		0.102 typ.	
Diam.	3.75	3.85	0.147	0.151

5 Ordering information

Table 8. Ordering information

Order code	Marking	Package	Weight	Base qty	Delivery mode
TN22-1500B	TN22-1500	DPAK	0.3 g	75	Tube
TN22-1500B-TR	TN22-1500	DPAK	0.3 g	2500	Tape and reel
TN22-1500H	TN22-1500	IPAK	0.4 g	75	Tube
TN22-1500T	TN22-1500	TO-220AB	2.0 g	50	Tube

6 Revision history

Table 9. Document revision history

Date	Revision	Changes
Oct-2000	1	First release.
17-Sep-2005	2	TO-220AB package added.
13-Aug-2009	3	Updated *Figure 4*. Added *Figure 9* and *10*.