

**SNUBBERLESS TRIACS**

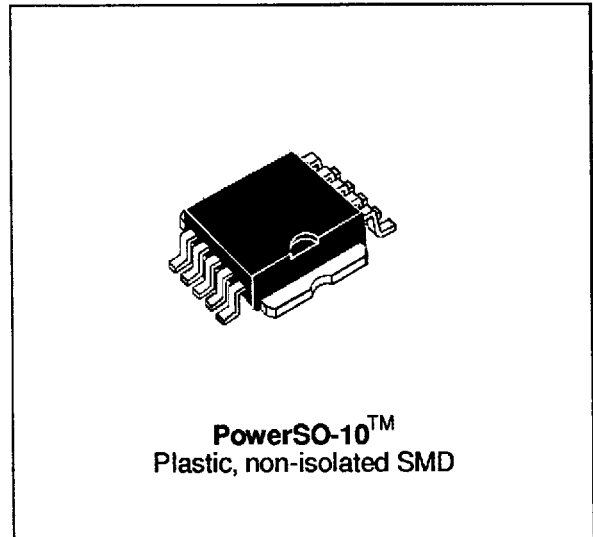
**FEATURES**

- HIGH COMMUTATION (di/dt): 22 A/ms without snubber
- HIGH STATIC dV/dt : 500V/μs
- HIGH DISSIPATION MINIATURE PACKAGE
- SURFACE MOUNT TECHNOLOGY COMPATIBLE

**DESCRIPTION**

The T2035 triac use high performance snubberless technology.

Packaged in PowerSO-10, this product is suitable for application such as phase control and static switching on inductive or resistive load.



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter		Value	Unit
V <sub>DRM</sub> V <sub>RRM</sub>	Repetitive peak off-state voltage	T <sub>j</sub> = 125°C	600	V
I <sub>T(RMS)</sub>	RMS on-state current (360° conduction angle)	T <sub>c</sub> = 90°C	20	A
I <sub>TSM</sub>	Non repetitive surge peak on-state current (T <sub>j</sub> initial = 25°C )	tp = 8.3 ms	170	A
		tp = 10 ms	160	
I <sup>2</sup> t	I <sup>2</sup> t Value	tp = 10 ms	128	A <sup>2</sup> s
di/dt	Critical rate of rise of on-state current Gate supply : I <sub>G</sub> = 500 mA     dI <sub>G</sub> /dt = 1 A/μs.	Repetitive F = 50 Hz	20	A/μs
		Non Repetitive	100	
T <sub>stg</sub> T <sub>j</sub>	Storage and operating junction temperature range		- 40 to + 150 - 40 to + 125	°C
TI	Maximum lead temperature for soldering during 10s			

**THERMAL RESISTANCES**

Symbol	Parameter	Value	Unit
Rth(j-c)	Junction to case for DC	1.7	°C/W
Rth(j-c)	Junction to case for A.C 360° conduction angle (F=50Hz)	1.3	°C/W

**GATE CHARACTERISTICS** (maximum values)

$P_{G(AV)} = 1\text{ W}$   $P_{GM} = 10\text{ W}$  ( $t_p = 20\ \mu\text{s}$ )  $I_{GM} = 4\text{ A}$  ( $t_p = 20\ \mu\text{s}$ )  $V_{GM} = 16\text{ V}$  ( $t_p = 20\ \mu\text{s}$ )

**ELECTRICAL CHARACTERISTICS**

Symbol	Test Conditions	Quadrant		Value	Unit
$I_{GT}$	$V_D = 12\text{V (DC)}$ $R_L = 33\Omega$	I-II-III	MIN	1	mA
			MAX	35	
$V_{GT}$	$V_D = 12\text{V (DC)}$ $R_L = 33\Omega$	I-II-III	MAX	1.5	V
$V_{GD}$	$V_D = V_{DRM}$ $R_L = 3.3\text{k}\Omega$	I-II-III	MIN	0.2	V
tgt	$V_D = V_{DRM}$ $I_G = 500\text{mA}$ $di_G/dt = 3\text{ A}/\mu\text{s}$	I-II-III	TYP	2	$\mu\text{s}$
$I_L$	$I_G = 1.2 I_{GT}$	I-III	MAX	80	mA
		II	MAX	80	
$I_H^*$	$I_T = 250\text{mA}$ Gate open		MAX	50	mA
$V_{TM}^*$	$I_{TM} = 28\text{A}$ $t_p = 380\mu\text{s}$		MAX	1.7	V
$I_{DRM}$ $I_{RRM}$	$V_{DRM}$ rated $V_{RRM}$ rated		MAX	0.01	mA
			MAX	3	
dV/dt *	Linear slope up to $V_D = 67\%V_{DRM}$ Gate open		MIN	250	V/ $\mu\text{s}$
			TYP	500	
(di/dt)c *	Without snubber		MIN	11	A/ms
			TYP	22	

\* For either polarity of electrode A2 voltage with reference to electrode A1.

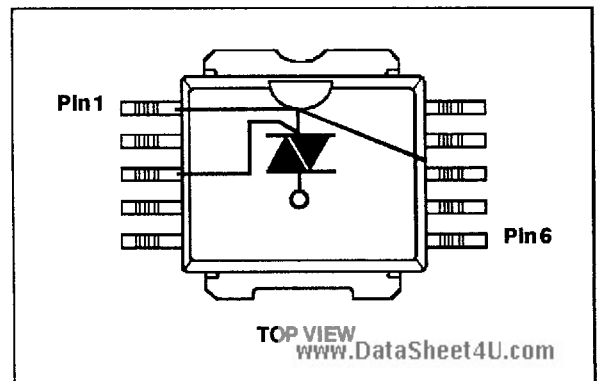
**PIN OUT configuration in PowerSO-10:**

A1 = Pin1, Pin 6 to 10

A2 = Connected to base tab

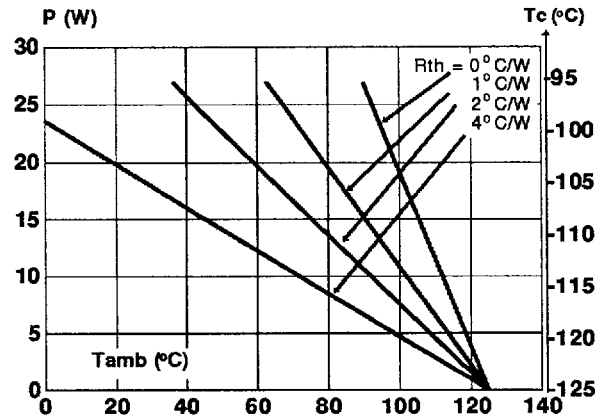
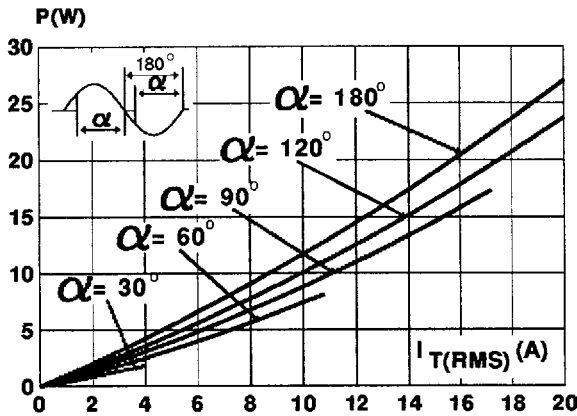
G = Pin 3

Note : Pin 2-4-5 are not connected.



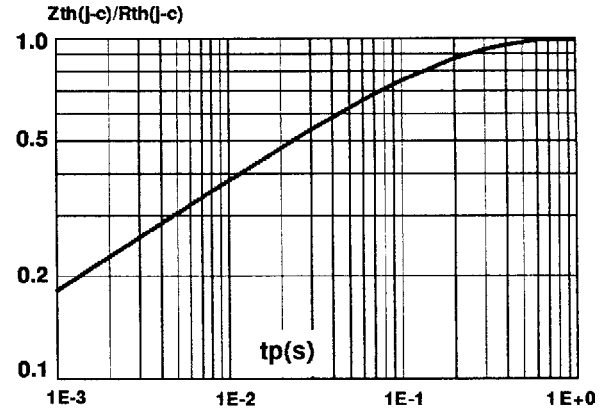
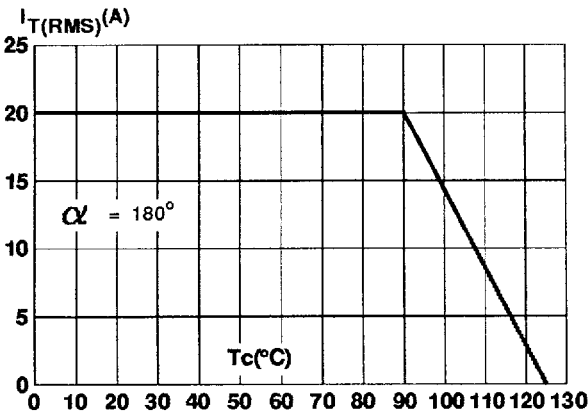
**Fig.1 :** Maximum power dissipation versus RMS on-state current.

**Fig.2 :** Correlation between maximum RMS power dissipation and maximum allowable temperature ( $T_{amb}$  and  $T_c$ ).



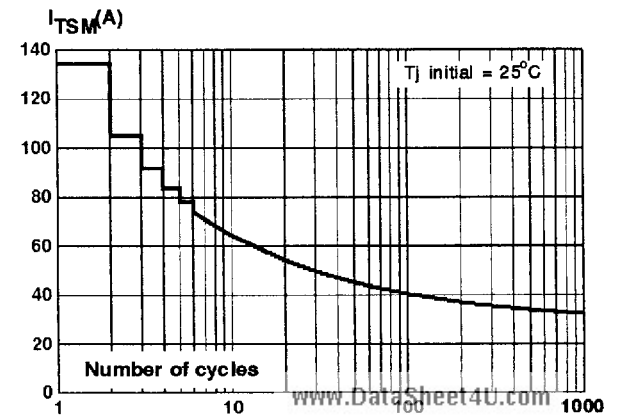
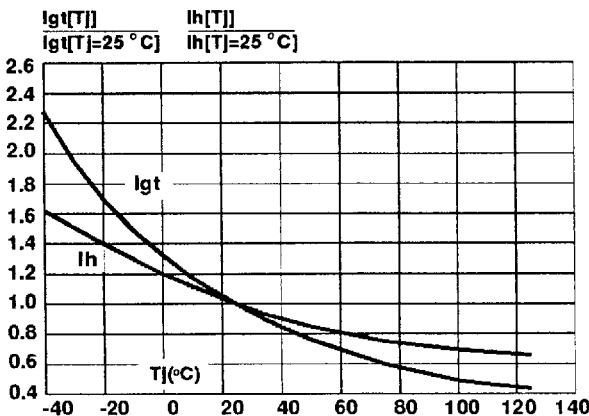
**Fig.3 :** RMS on-state current versus case temperature.

**Fig.4 :** Relative variation of thermal impedance versus pulse duration.



**Fig.5 :** Relative variation of gate trigger current and holding current versus junction temperature.

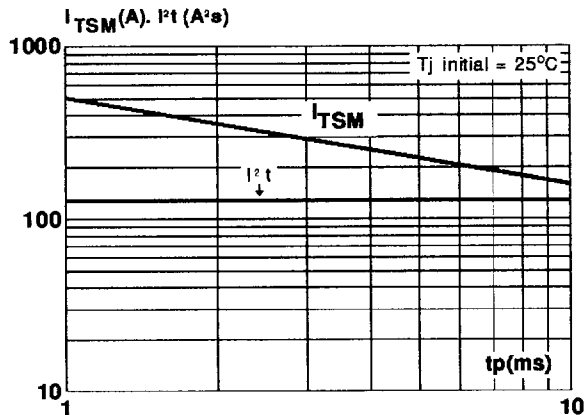
**Fig.6 :** Non repetitive surge peak on-state current versus number of cycles.



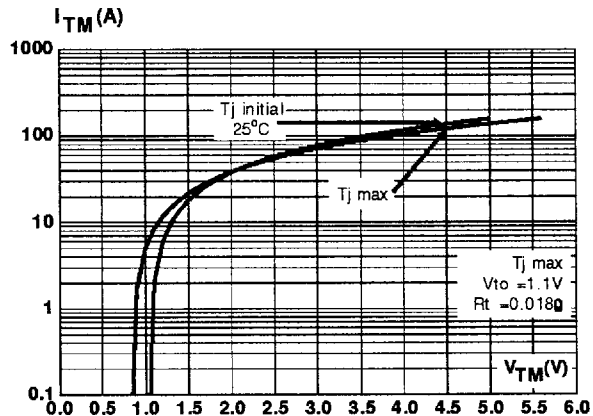
## T2035-600M

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**Fig.7 :** Non repetitive surge peak on-state current for a sinusoidal pulse with width :  $t_p \leq 10\text{ms}$ , and corresponding value of  $I^2t$ .



**Fig.8 :** On-state characteristics (maximum values).



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## SOLDERING RECOMMENDATION

The soldering process causes considerable thermal stress to a semiconductor component. This has to be minimized to assure a reliable and extended lifetime of the device. The PowerSO-10 package can be exposed to a maximum temperature of 260°C for 10 seconds. However a proper soldering of the package could be done at 215°C for 3 seconds. Any solder temperature profile should be within these limits. As reflow techniques are most common in surface mounting, typical heating profiles are given in Figure 1, either for mounting on FR4 or on metal-backed boards. For each particular board, the appropriate heat profile has to be adjusted experimentally. The present proposal is just a starting point. In any case, the following precautions have to be considered :

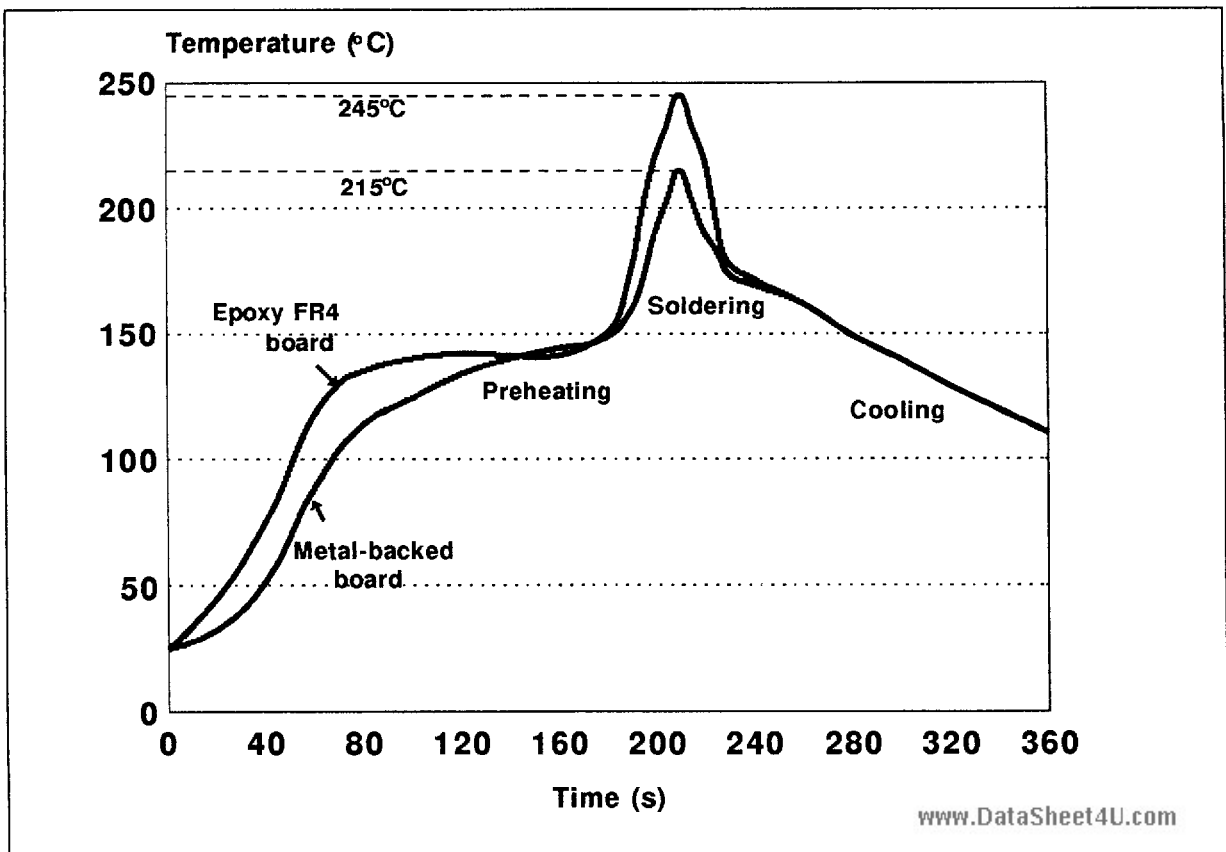
- always preheat the device
- peak temperature should be at least 30 °C higher than the melting point of the solder alloy chosen
- thermal capacity of the base substrate

Voids pose a difficult reliability problem for large surface mount devices. Such voids under the package result in poor thermal contact and the high thermal resistance leads to component fail-

ures. The PowerSO-10 is designed from scratch to be solely a surface mount package, hence symmetry in the x- and y-axis gives the package excellent weight balance. Moreover, the PowerSO-10 offers the unique possibility to control easily the flatness and quality of the soldering process. Both the top and the bottom soldered edges of the package are accessible for visual inspection (soldering meniscus).

Coplanarity between the substrate and the package can be easily verified. The quality of the solder joints is very important for two reasons : (I) poor quality solder joints result directly in poor reliability and (II) solder thickness affects the thermal resistance significantly. Thus a tight control of this parameter results in thermally efficient and reliable solder joints.

Fig 1 : Typical reflow soldering heat profile



**SUBSTRATES AND MOUNTING INFORMATION**

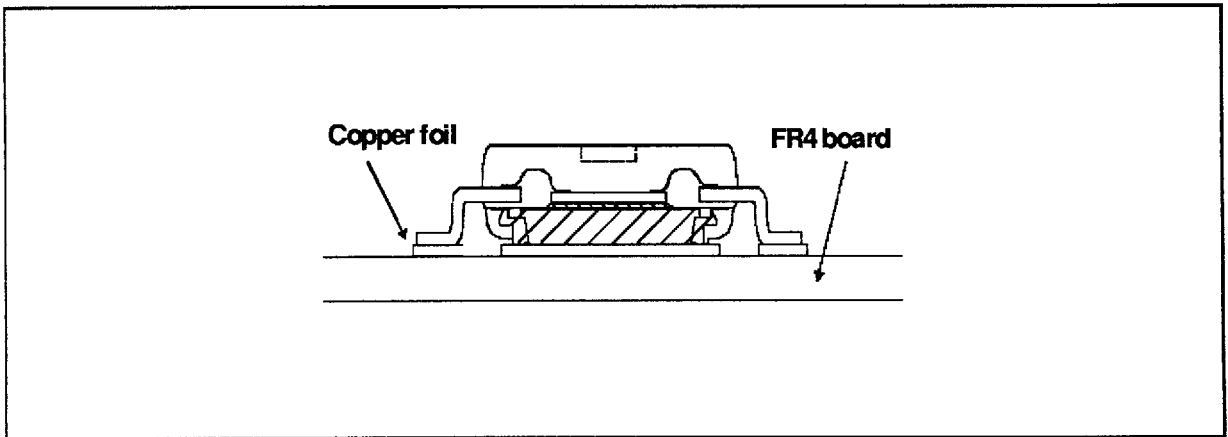
The use of epoxy FR4 boards is quite common for surface mounting techniques, however, their poor thermal conduction compromises the otherwise outstanding thermal performance of the PowerSO-10. Some methods to overcome this limitation are discussed below.

One possibility to improve the thermal conduction is the use of large heat spreader areas at the copper layer of the PC board. This leads to a reduction of thermal resistance to 35 °C for 6 cm<sup>2</sup> of the board heatsink (see fig. 2).

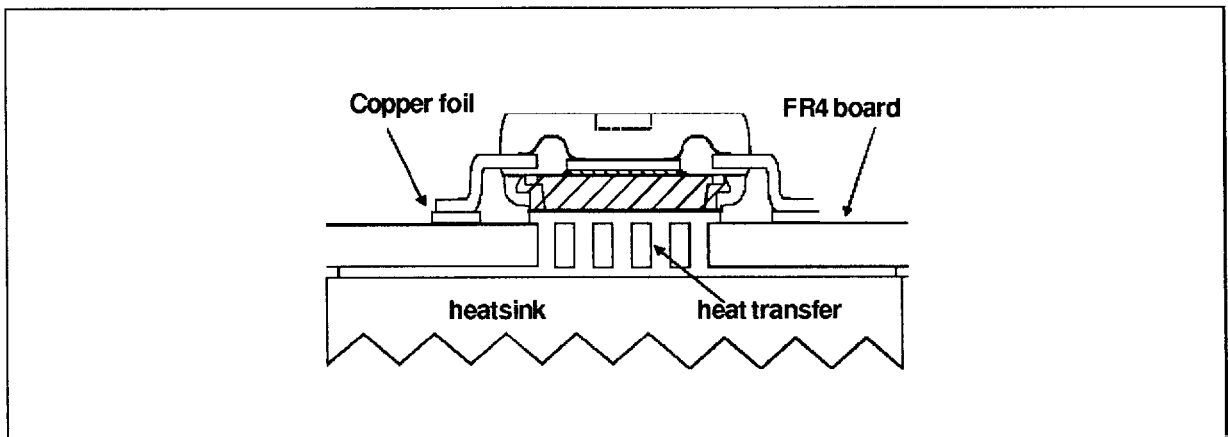
Use of copper-filled through holes on conventional FR4 techniques will increase the metallization and

decrease thermal resistance accordingly. Using a configuration with 16 holes under the spreader of the package with a pitch of 1.8 mm and a diameter of 0.7 mm, the thermal resistance (junction - heatsink) can be reduced to 12°C/W (see fig. 3). Beside the thermal advantage, this solution allows multi-layer boards to be used. However, a drawback of this traditional material prevent its use in very high power, high current circuits. For instance, it is not advisable to surface mount devices with currents greater than 10 A on FR4 boards. A Power Mosfet or Schottky diode in a surface mount power package can handle up to around 50 A if better substrates are used.

**Fig 2 :** Mounting on epoxy FR4 head dissipation by extending the area of the copper layer



**Fig 3 :** Mounting on epoxy FR4 by using copper-filled through holes for heat transfer



A new technology available today is IMS - an Insulated Metallic Substrate. This offers greatly enhanced thermal characteristics for surface mount components. IMS is a substrate consisting of three different layers, (I) the base material which is available as an aluminium or a copper plate, (II) a thermal conductive dielectrical layer and (III) a copper foil, which can be etched as a circuit layer. Using this material a thermal resistance of  $8^{\circ}\text{C}/\text{W}$  with  $40\text{ cm}^2$  of board floating in air is achievable (see fig. 4). If even higher power is to be dissipated an ex-

ternal heatsink could be applied which leads to an  $R_{\text{th(j-a)}}$  of  $3.5^{\circ}\text{C}/\text{W}$  (see Fig. 5), assuming that  $R_{\text{th}}$  (heatsink-air) is equal to  $R_{\text{th}}$  (junction-heatsink). This is commonly applied in practice, leading to reasonable heatsink dimensions. Often power devices are defined by considering the maximum junction temperature of the device. In practice, however, this is far from being exploited. A summary of various power management capabilities is made in table 1 based on a reasonable delta T of  $70^{\circ}\text{C}$  junction to air.

Fig 4 : Mounting on metal backed board

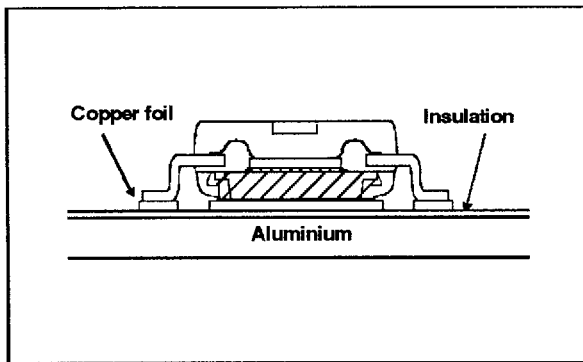
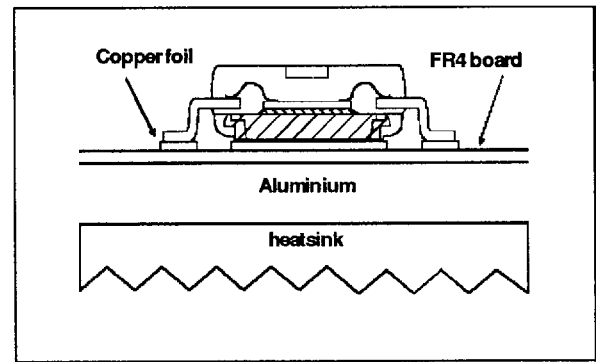


Fig 5 : Mounting on metal backed board with an external heatsink applied



## SUBSTRATES AND MOUNTING INFORMATION (cont'd)

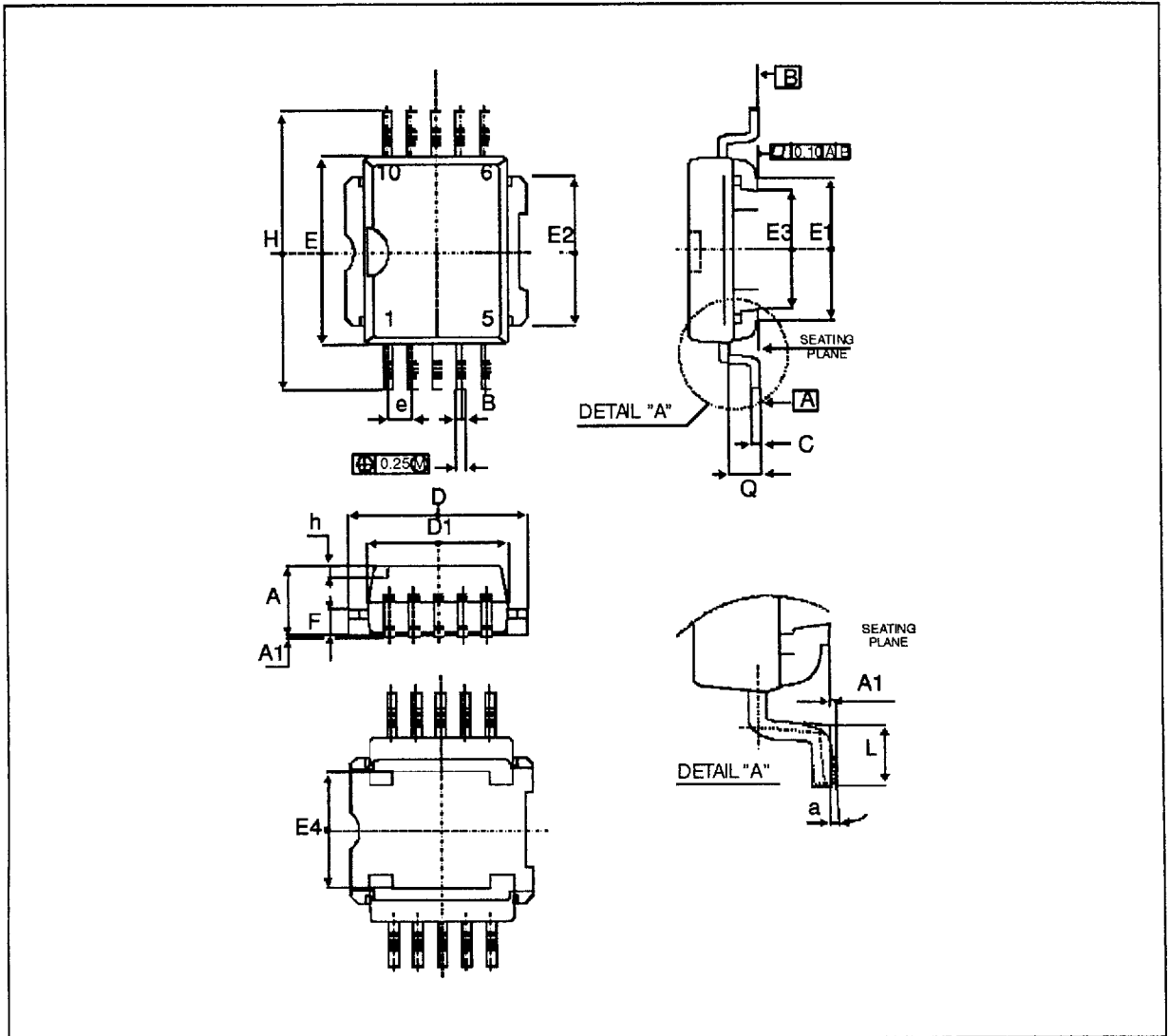
The PowerSO-10 concept also represents an attractive alternative to C.O.B. techniques. PowerSO-10 offers devices fully tested at low and high temperature. Mounting is simple - only

conventional SMT is required - enabling the users to get rid of bond wire problems and the problem to control the high temperature soft soldering as well. An optimized thermal management is guaranteed through PowerSO-10 as the power chips must in any case be mounted on heat spreaders before being mounted onto the substrate.

TABLE 1

PowerSo-10 package mounted on	$R_{\text{th}} (j-a)$	P Diss
1. FR4 using the recommended pad-layout	$50^{\circ}\text{C}/\text{W}$	1.5 W
2. FR4 with heatsink on board ( $6\text{ cm}^2$ )	$35^{\circ}\text{C}/\text{W}$	2.0 W
3. FR4 with copper-filled through holes and external heatsink applied	$12^{\circ}\text{C}/\text{W}$	5.8 W
4. IMS floating in air ( $40\text{ cm}^2$ )	$8^{\circ}\text{C}/\text{W}$	8.8 W
5. IMS with external heatsink applied	$3.5^{\circ}\text{C}/\text{W}$	20 W

PACKAGE MECHANICAL DATA

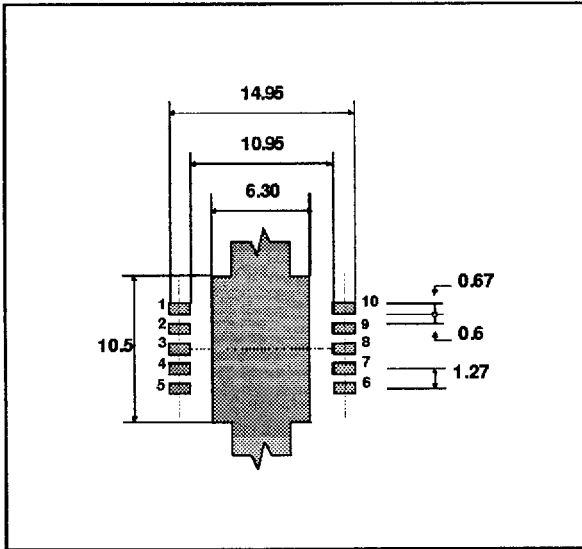


REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	3.35		3.65	0.131		0.143
A1	0.00		0.10	0.00		0.0039
B	0.40		0.60	0.0157		0.0236
C	0.35		0.55	0.0137		0.0217
D	9.40		9.60	0.370		0.378
D1	7.40		7.60	0.291		0.299
E	9.30		9.50	0.366		0.374
E1	7.20		7.40	0.283		0.291
E2	7.20		7.60	0.283		0.299

REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
E3	6.10		6.35	0.240		0.250
E4	5.90		6.10	0.232		0.240
e		1.27			0.05	
F	1.25		1.35	0.0492		0.0531
H	13.80		14.40	0.543		0.567
h		0.50			0.019	
L	1.20		1.80	0.0472		0.0708
Q		1.70			0.067	
a	0°		8°	0°		8°

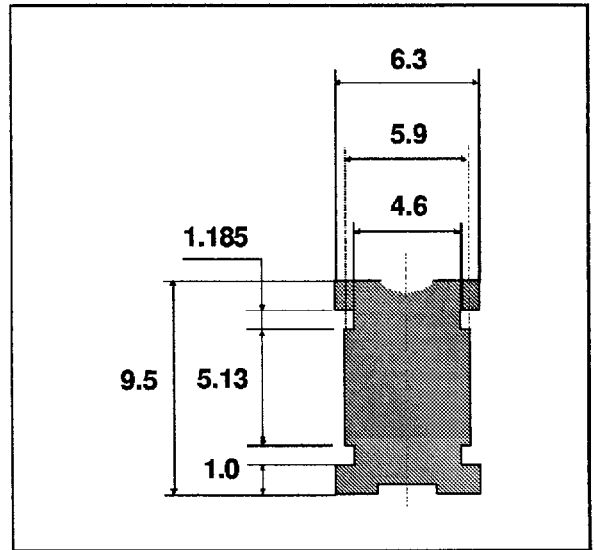


**FOOT PRINT  
MOUNTING PAD LAYOUT  
RECOMMENDED**



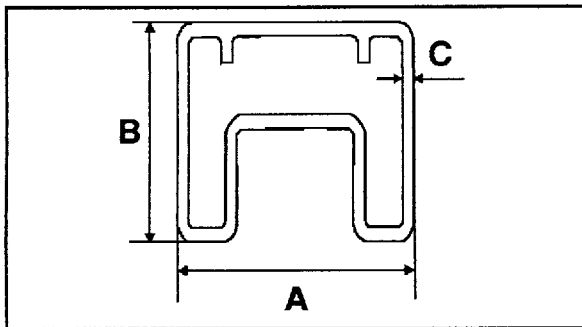
Dimensions in millimeters

**HEADER SHAPE**



Dimensions in millimeters

**SHIPPING TUBE**



Surface mount film taping : contact sales office

	DIMENSIONS (mm)	
	TYP	
A	18	
B	12	
C	0,8	
Length tube	532	
Quantity per tube	50	

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