



Application Specific Discretes  
A.S.D.<sup>TM</sup>

# TLPxxM/G/G-1

## TRIPOLAR OVERVOLTAGE PROTECTION for TELECOM LINE

### MAIN APPLICATIONS

Any sensitive telecom equipment requiring protection against lightning :

- Analog and ISDN line cards
- Main Distribution Frames
- Terminal and transmission equipment
- Gas-tube replacement

### DESCRIPTION

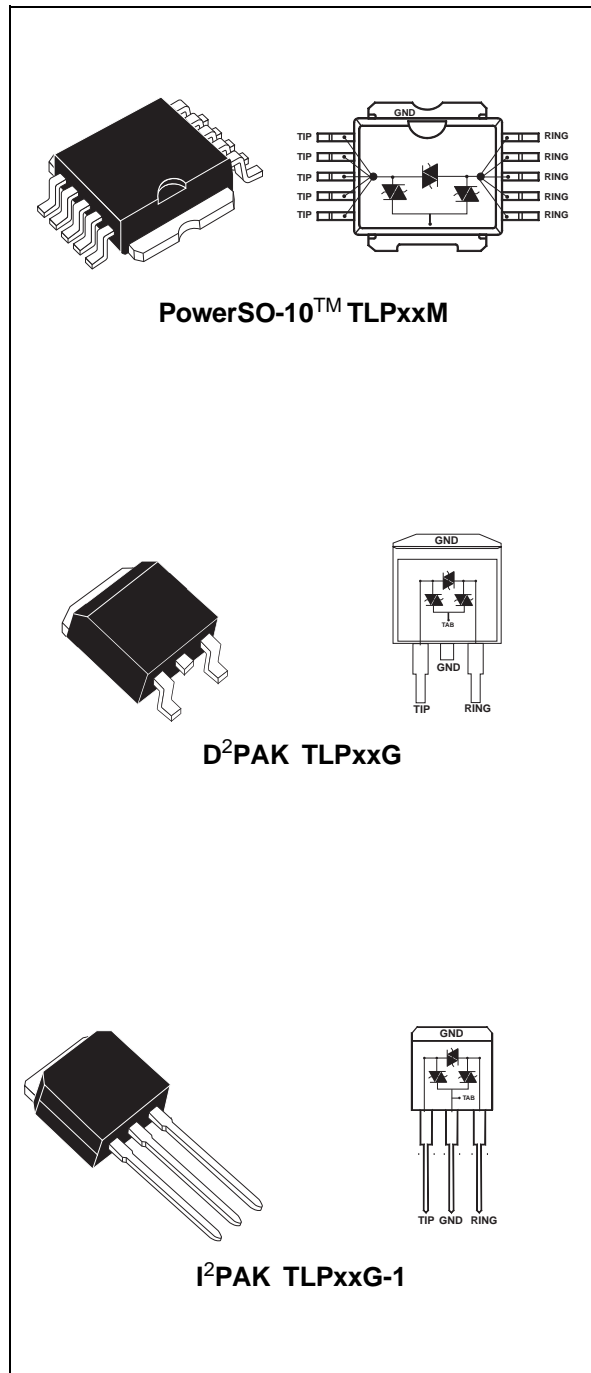
The TLPxxM/G/G-1 series are tripolar transient surge arrestors used for primary and secondary protection in sensitive telecom equipment.

### FEATURES

- TRIPOLAR CROWBAR PROTECTION
- VOLTAGE RANGE SELECTED FOR TELECOM APPLICATIONS
- REPETITIVE PEAK PULSE CURRENT :  
 $I_{PP} = 100 \text{ A (10 / 1000 } \mu\text{s)}$
- HOLDING CURRENT :  $I_H = 150 \text{ mA}$
- LOW CAPACITANCE :  $C = 110 \text{ pF typ.}$
- LOW LEAKAGE CURRENT :  $I_R = 5 \mu\text{A max}$

### BENEFITS

- No ageing and no noise.
- If destroyed, the TLPxxM/G/G-1 falls into short circuit, still ensuring protection.
- Access to Surface Mount applications thanks to the PowerSO-10<sup>TM</sup> and D<sup>2</sup>PAK package.



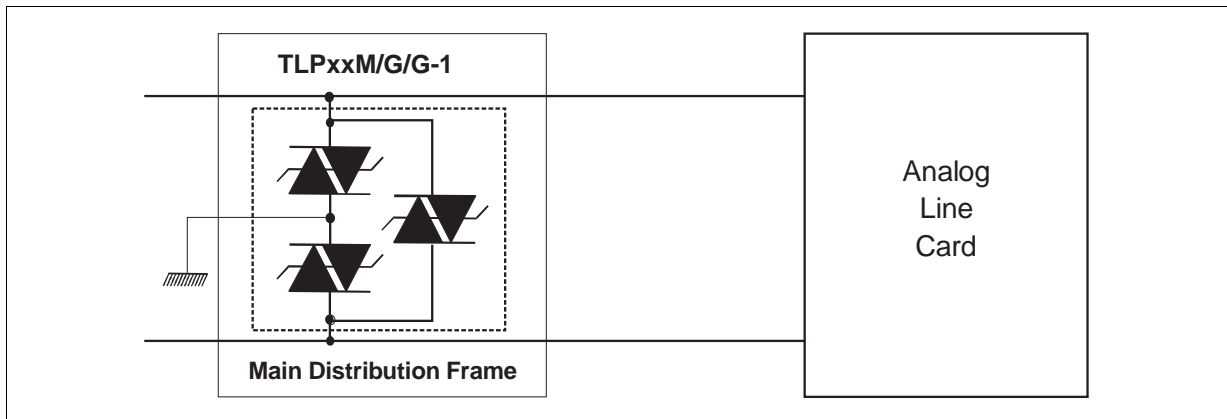
TM: ASD and PowerSO-10 are trademarks of ST Microelectronics.

September 1998 - Ed : 3C

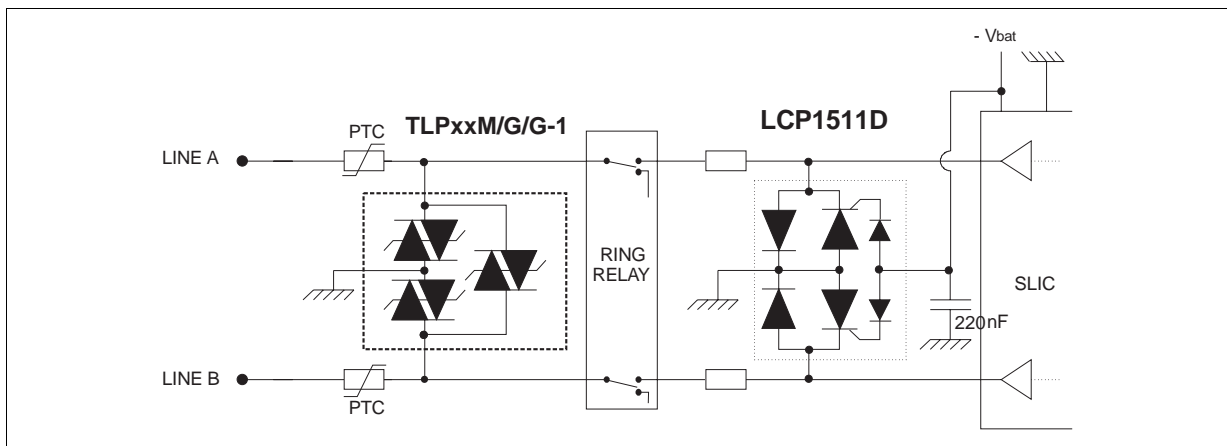
## TLPxxM/G/G-1

| COMPLIES WITH THE FOLLOWING STANDARDS: | Peak Surge Voltage (V) | Voltage Waveform ( $\mu$ s) | Current Waveform ( $\mu$ s) | Admissible Ipp (A) | Necessary Resistor ( $\Omega$ ) |
|--|------------------------|-----------------------------|-----------------------------|--------------------|---------------------------------|
| CCITT K20                              | 4000                   | 10/700                      | 5/310                       | 100                | -                               |
| VDE0433                                | 4000                   | 10/700                      | 5/310                       | 100                | -                               |
| VDE0878                                | 4000                   | 1.2/50                      | 1/20                        | 100                | -                               |
| IEC-1000-4-5                           | level 4<br>level 4     | 10/700<br>1.2/50            | 5/310<br>8/20               | 100<br>100         | -<br>-                          |
| FCC Part 68, lightning surge type A    | 1500<br>800            | 10/160<br>10/560            | 10/160<br>10/560            | 200<br>100         | -<br>-                          |
| FCC Part 68, lightning surge type B    | 1000                   | 5/320                       | 5/320                       | 25                 | -                               |
| BELLCORE TR-NWT-001089 FIRST LEVEL     | 2500<br>1000           | 2/10<br>10/1000             | 2/10<br>10/1000             | 500<br>100         | -<br>-                          |
| BELLCORE TR-NWT-001089 SECOND LEVEL    | 5000                   | 2/10                        | 2/10                        | 500                | -                               |
| CNET I31-24                            | 4000                   | 0.5/700                     | 0.8/310                     | 100                | -                               |

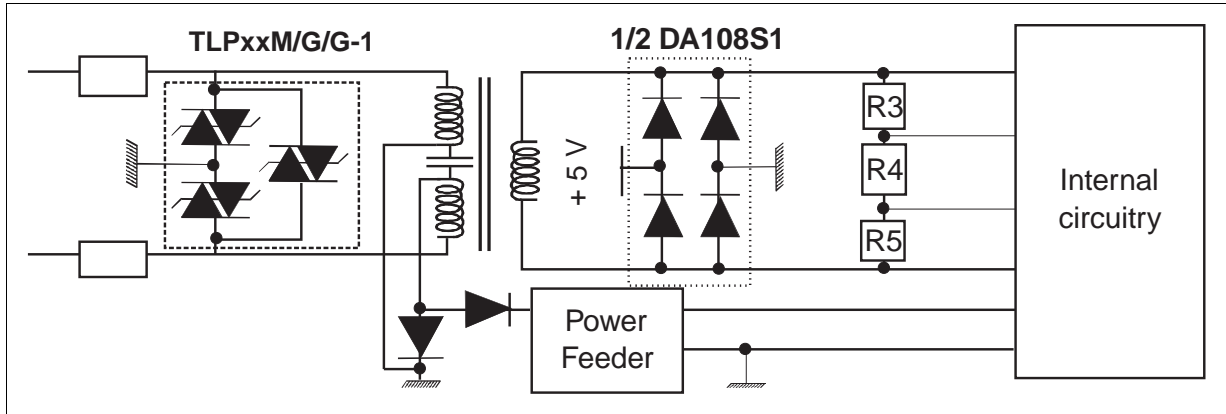
### TYPICAL APPLICATION Primary protection module



### Analog line card protection

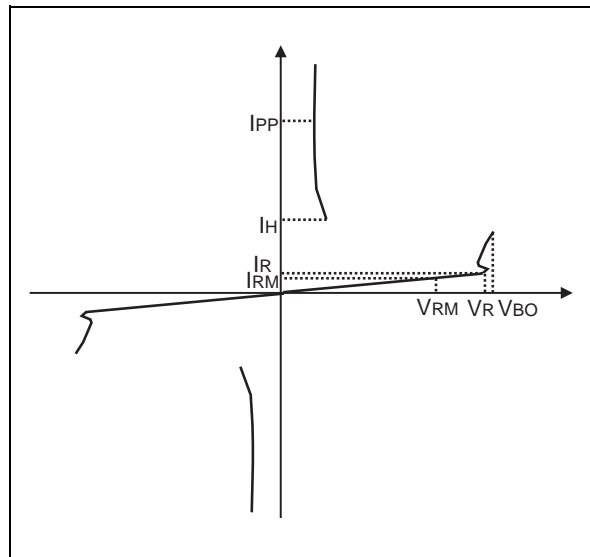


**TYPICAL APPLICATION**  
**ISDN: U interface protection**



**PARAMETER MEASUREMENT INFORMATION**

| Symbol           | Description                   |
|------------------|-------------------------------|
| I <sub>PP</sub>  | Peak pulse current            |
| I <sub>TSM</sub> | Maximum peak on-state current |
| I <sub>R</sub>   | Leakage current               |
| I <sub>RM</sub>  | Leakage current               |
| I <sub>H</sub>   | Holding current               |
| V <sub>BR</sub>  | Breakdown voltage             |
| V <sub>R</sub>   | Continuous reverse voltage    |
| V <sub>RM</sub>  | Maximum stand-off voltage     |
| V <sub>BO</sub>  | Breakover voltage             |
| C                | Capacitance                   |



**ABSOLUTE MAXIMUM RATINGS** (T<sub>amb</sub> = 25°C)

| Symbol           | Parameter   | Value         | Unit |   |
|------------------|---|---------------|------|---|
| I <sub>PP</sub>  | Peak pulse current (longitudinal & transversal mode) :                        |               |      |   |
|                  | 10/1000 μs (open circuit voltage waveform 1 kV 10/1000 μs)                    | 100           | A    |   |
|                  | 8/20 μs (open circuit voltage waveform 4 kV 1.2/50 μs)                        | 250           | A    |   |
|                  | 2/10 μs (open circuit voltage waveform 2.5kV 2/10 μs)                         | 500           | A    |   |
| I <sub>TSM</sub> | Mains power induction<br>V <sub>RMS</sub> = 300V, R = 600Ω                    | t = 200ms     | 0.7  | A |
|                  | Mains power contact<br>V <sub>RMS</sub> = 220V, R = 10Ω (Fail-Safe threshold) | t = 200 ms    | 31   | A |
|                  | V <sub>RMS</sub> = 220V, R = 600Ω   | t = 15 mn     | 0.42 | A |
| T <sub>stg</sub> | Storage temperature range   | - 55 to + 150 | °C   |   |
| T <sub>j</sub>   | Maximum operating junction temperature  | 150           | °C   |   |
| T <sub>L</sub>   | Maximum lead temperature for soldering during 10 s                            | 260           | °C   |   |
| T <sub>OP</sub>  | Operating temperature range   | - 40 to + 85  | °C   |   |

## TLPxxM/G/G-1

### THERMAL RESISTANCE

| Symbol    | Parameter           |                              | Value   | Unit |
|-----------|---------------------|------------------------------|---|------|
| Rth (j-c) | Junction to case    | TLPxxM                       | 1.0   | °C/W |
|           |                     | TLPxxG                       | 1.0   |      |
|           |                     | TLPxxG-1                     | 1.0   |      |
| Rth (j-a) | Junction to ambient | TLPxxM<br>TLPxxG<br>TLPxxG-1 | see table page 14<br>see table page 14<br>see table page 14 | °C/W |

### ELECTRICAL CHARACTERISTICS BETWEEN TIP AND RING ( $T_{amb} = 25^{\circ}\text{C}$ )

| Type          | $I_{RM} @ V_{RM}$<br>max. |     | $I_R @ V_R$<br>max. |     | C<br>typ.<br>note |
|---------------|---------------------------|-----|---------------------|-----|-------------------|
|               | $\mu\text{A}$             | V   | $\mu\text{A}$       | V   | pF                |
| TLP140M/G/G-1 | 5                         | 120 | 50                  | 140 | 35                |
| TLP200M/G/G-1 | 5                         | 180 | 50                  | 200 | 35                |
| TLP270M/G/G-1 | 5                         | 230 | 50                  | 270 | 35                |

Note :  $V_R = 50\text{ V}$  bias,  $V_{RMS} = 1\text{ V}$ ,  $F = 1\text{ MHz}$ .

### ELECTRICAL CHARACTERISTICS BETWEEN TIP AND GND, RING AND GND ( $T_{amb} = 25^{\circ}\text{C}$ )

| Type          | $I_{RM} @ V_{RM}$<br>max. |     | $I_R @ V_R$<br>max.<br>note 1 |     | $V_{BO} @ I_{BO}$<br>max. max.<br>note 2 |     | $I_H$<br>min.<br>note 3 | C @ $V_R$<br>typ.<br>note 4   note 5 |    |
|---------------|---------------------------|-----|-------------------------------|-----|--|-----|-------------------------|--------------------------------------|----|
|               | $\mu\text{A}$             | V   | $\mu\text{A}$                 | V   | V  | mA  | mA                      | pF                                   | pF |
| TLP140M/G/G-1 | 5                         | 120 | 50                            | 140 | 200                                      | 500 | 150                     | 110                                  | 40 |
| TLP200M/G/G-1 | 5                         | 180 | 50                            | 200 | 290                                      | 500 | 150                     | 110                                  | 40 |
| TLP270M/G/G-1 | 5                         | 230 | 50                            | 270 | 400                                      | 500 | 150                     | 110                                  | 40 |

Note 1:  $I_R$  measured at  $V_R$  guarantees  $V_{BR\ min} > V_R$ .

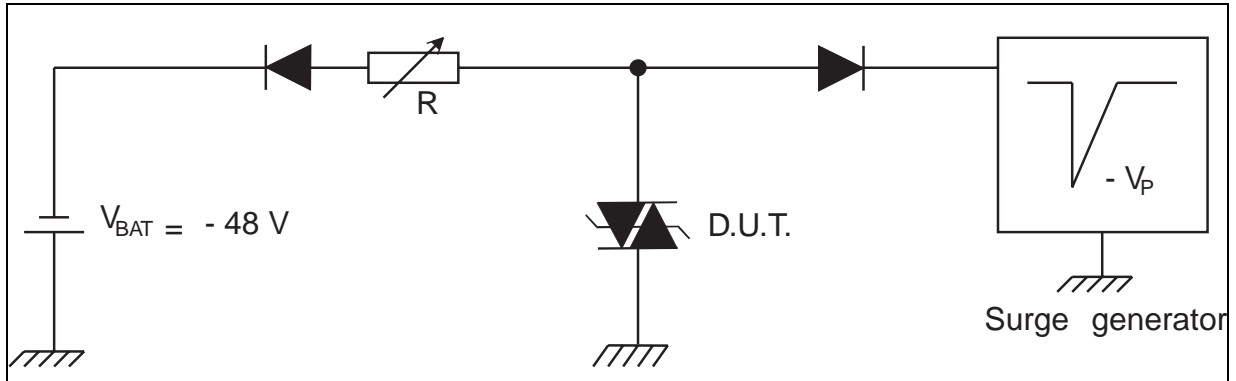
Note 2: Measured at 50 Hz.

Note 3: See functional holding current test circuit.

Note 4:  $V_R = 0\text{ V}$  bias,  $V_{RMS} = 1\text{ V}$ ,  $F = 1\text{ MHz}$ .

Note 5:  $V_R = 50\text{ V}$  bias,  $V_{RMS} = 1\text{ V}$ ,  $F = 1\text{ MHz}$  (TIP or RING (-) / GND (+)).

**FUNCTIONAL HOLDING CURRENT ( $I_H$ ) TEST CIRCUIT: GO-NO GO TEST**



This is a GO-NO GO test which allows to confirm the holding current ( $I_H$ ) level in a functional test circuit.

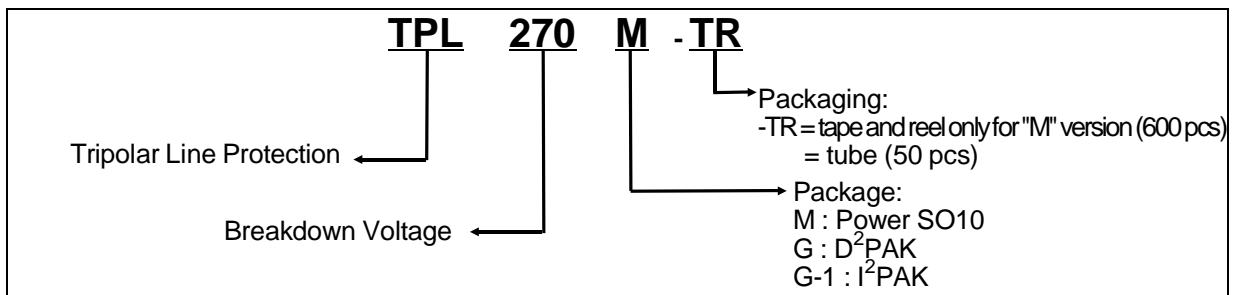
**TEST PROCEDURE :**

- Adjust the current level at the  $I_H$  value by short circuiting the D.U.T.
- Fire the D.U.T. with a surge current :  $I_{PP} = 10A, 10/1000\mu s$ .
- The D.U.T. will come back to the off-state within a duration of 50ms max.

**MARKING**

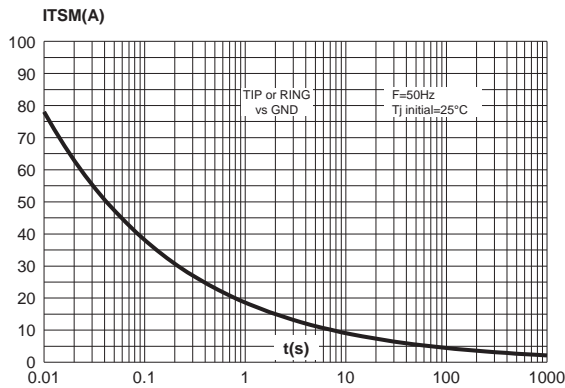
| Package            | Types                               | Marking                       |
|--------------------|-------------------------------------|-------------------------------|
| PowerSO-10         | TLP140M<br>TLP200M<br>TLP270M       | TLP140M<br>TLP200M<br>TLP270M |
| D <sup>2</sup> PAK | TLP140G<br>TLP200G<br>TLP270G       | TLP140G<br>TLP200G<br>TLP270G |
| I <sup>2</sup> PAK | TLP140G-1<br>TLP200G-1<br>TLP270G-1 | TLP140G<br>TLP200G<br>TLP270G |

**ORDER CODE**

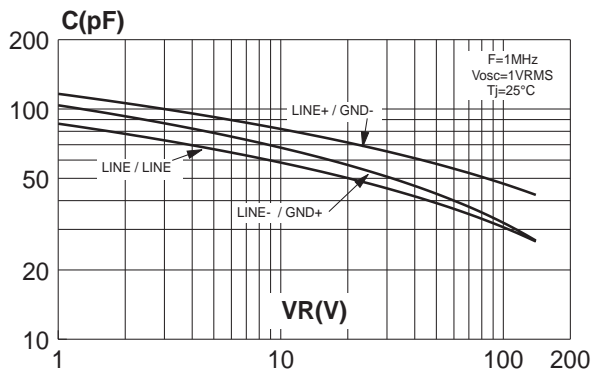


# TLPxxM/G/G-1

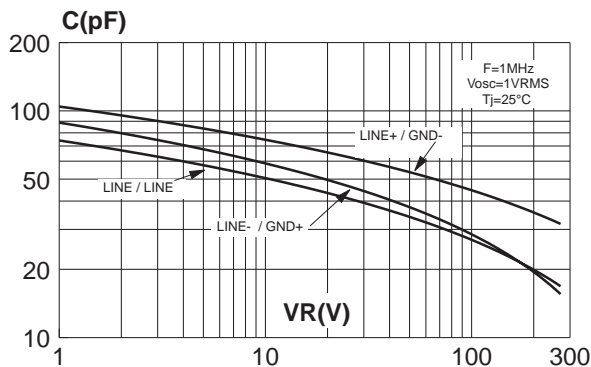
**Fig. 1:** Maximum peak on-state current versus pulse duration.



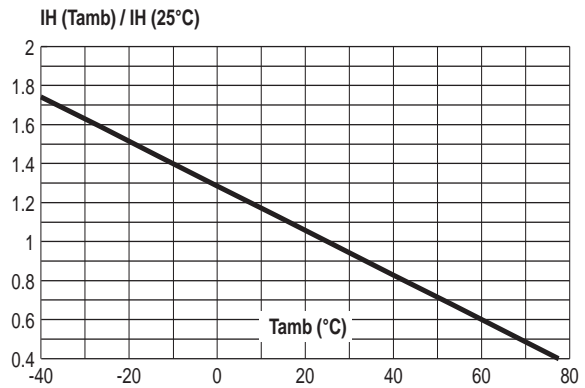
**Fig. 3-1:** junction capacitance versus applied reverse voltage (typical values) (TLP140M/G/G-1).



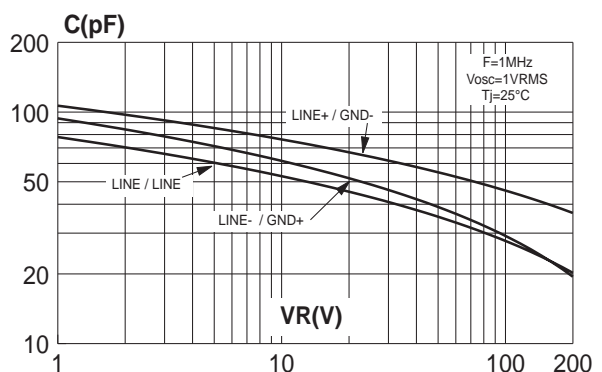
**Fig. 3-3:** junction capacitance versus applied reverse voltage (typical values) (TLP270M/G/G-1).



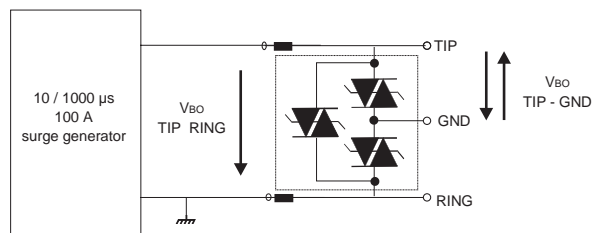
**Fig. 2:** Relative variation of  $I_H$  versus  $T_{amb}$ .



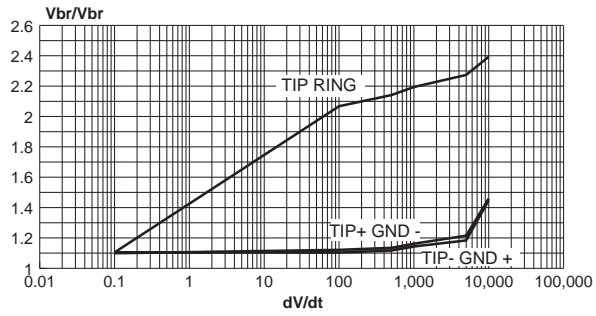
**Fig. 3-2:** junction capacitance versus applied reverse voltage (typical values) (TLP200M/G/G-1).



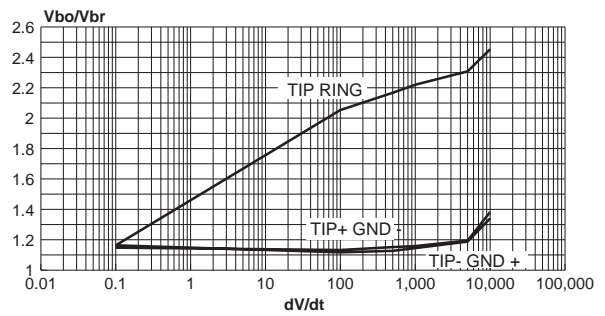
**Fig. 4:** Test diagram for breakover voltage measurement.



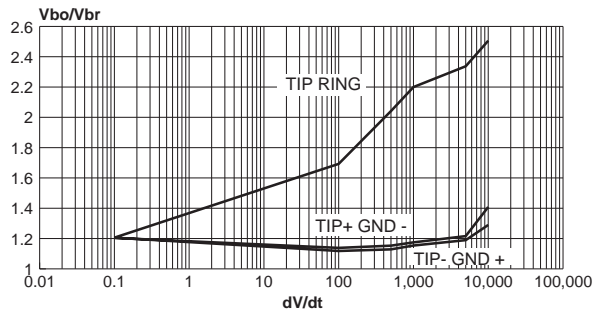
**Fig. 5-1 : Breakover voltage measurement (TLP140M/G/G-1).**



**Fig. 5-2 : Breakover voltage measurement (TLP200M/G/G-1).**

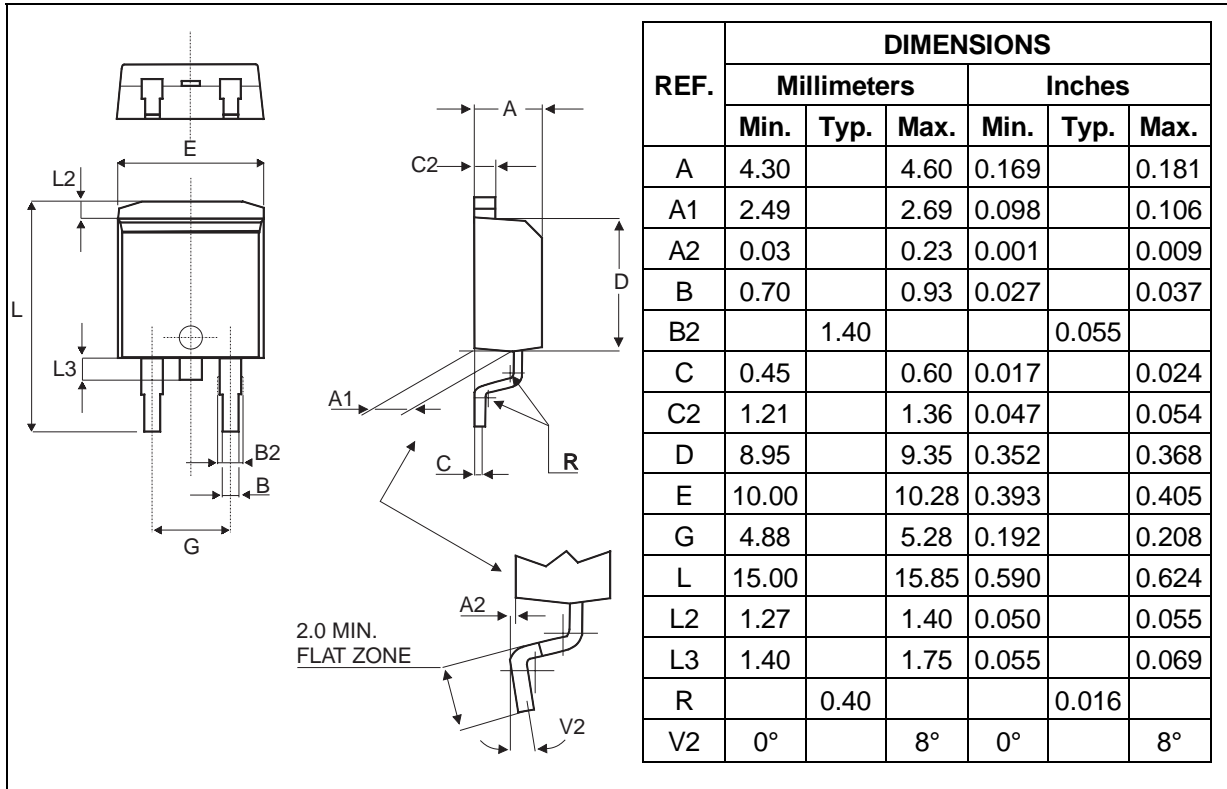


**Fig. 5-3 : Breakover voltage measurement (TLP270M/G/G-1).**

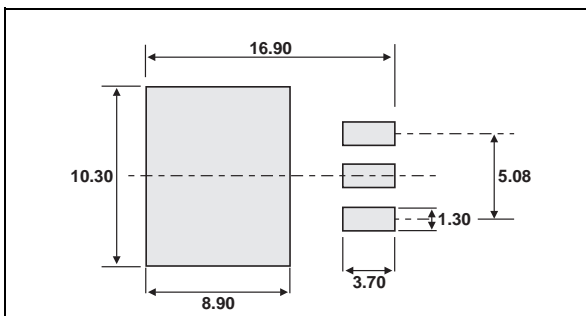


**TLPxxM/G/G-1**

**PACKAGE MECHANICAL DATA**  
D<sup>2</sup>PAK Plastic

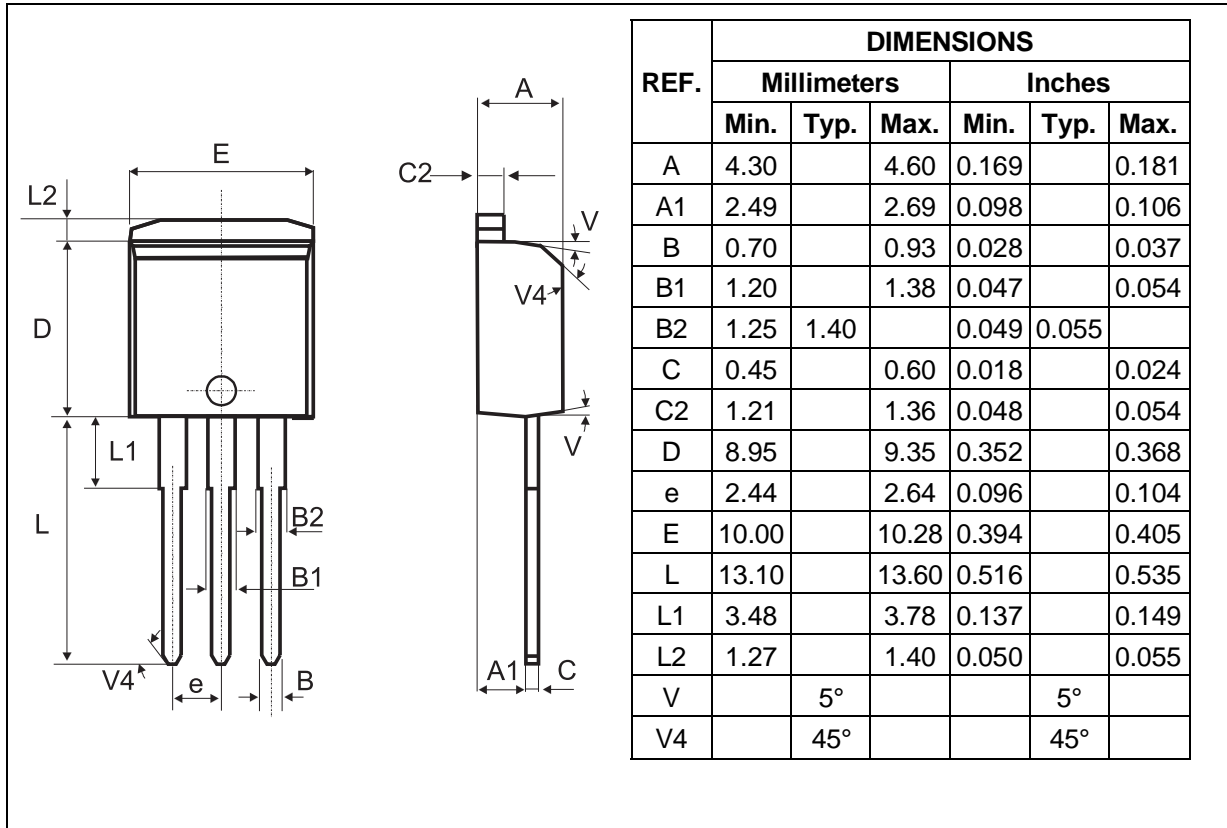


**FOOT-PRINT D<sup>2</sup>PAK**

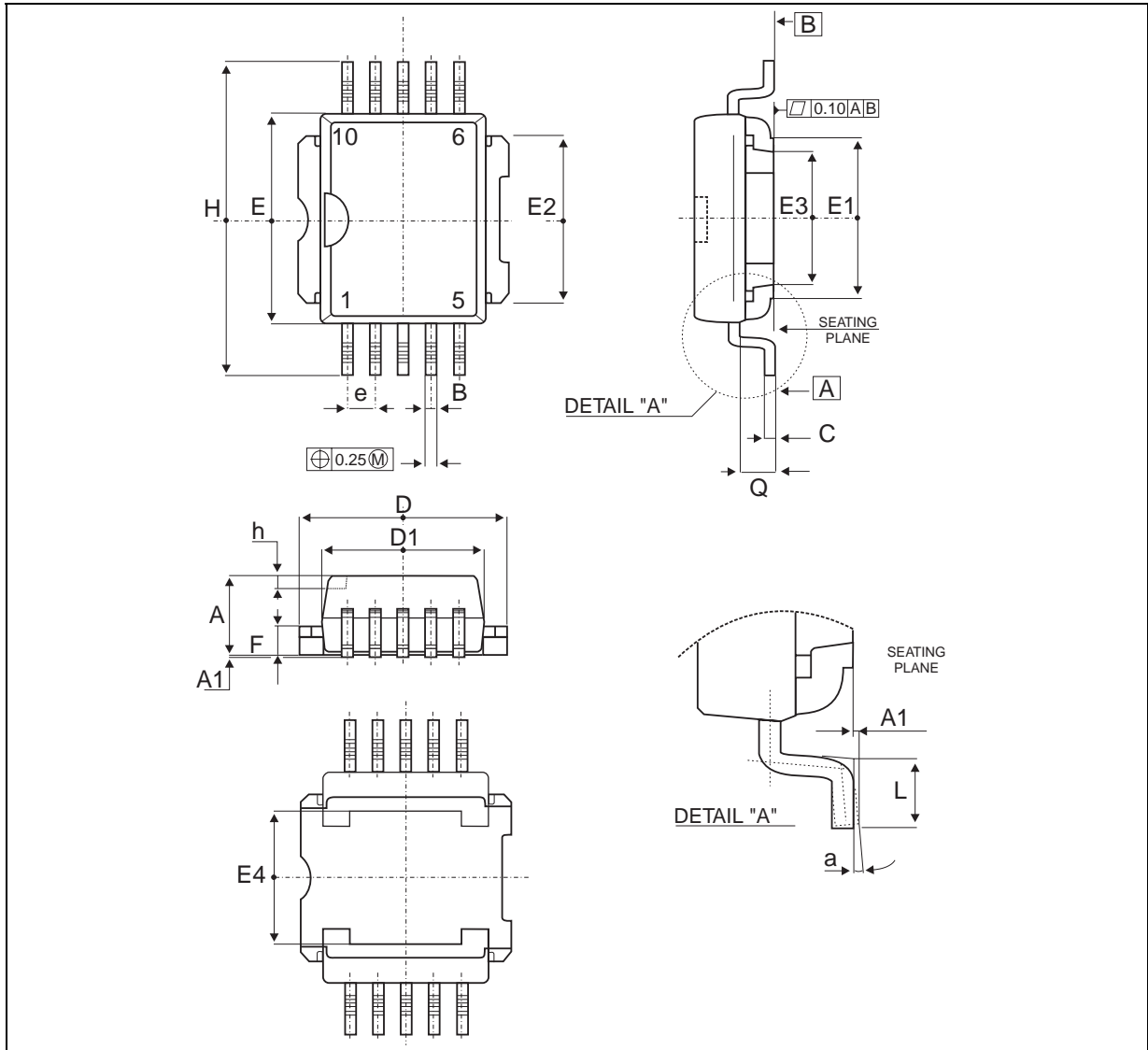




**PACKAGE MECHANICAL DATA**  
I<sup>2</sup>PAK Plastic



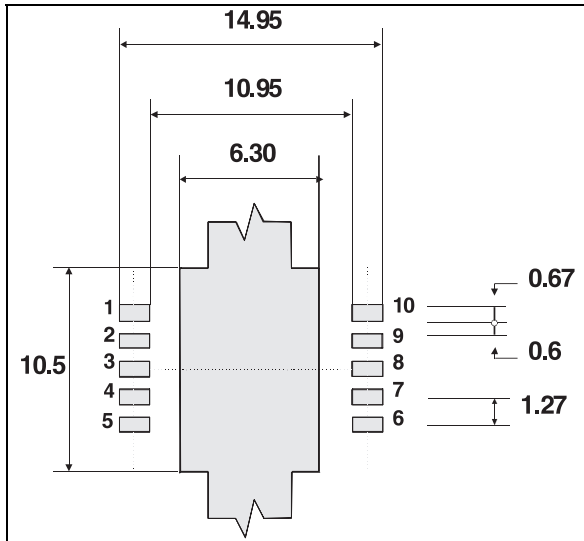
**PACKAGE MECHANICAL DATA**  
Power-SO10



| 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  |

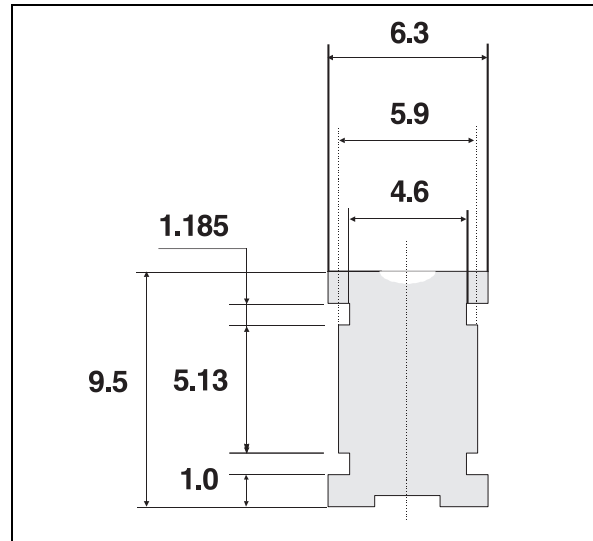
| REF. | DIMENSIONS  |      |       |        |       |        |
|------|-------------|------|-------|--------|-------|--------|
|      | Millimeters |      |       | Inches |       |        |
|      | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.   |
| E3   | 6.10        |      | 6.35  | 0.240  |       | 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 Power-SO10  
MOUNTING PAD LAYOUT  
RECOMMENDED**



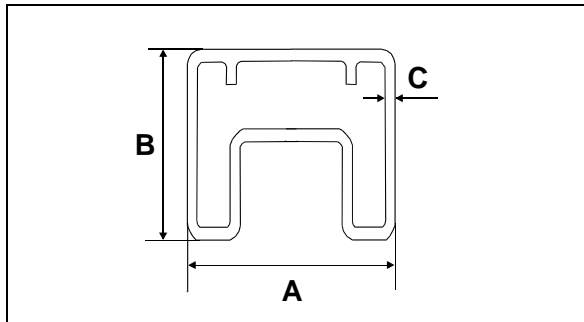
Dimensions in millimeters

**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              |

**SOLDERING RECOMMENDATION**

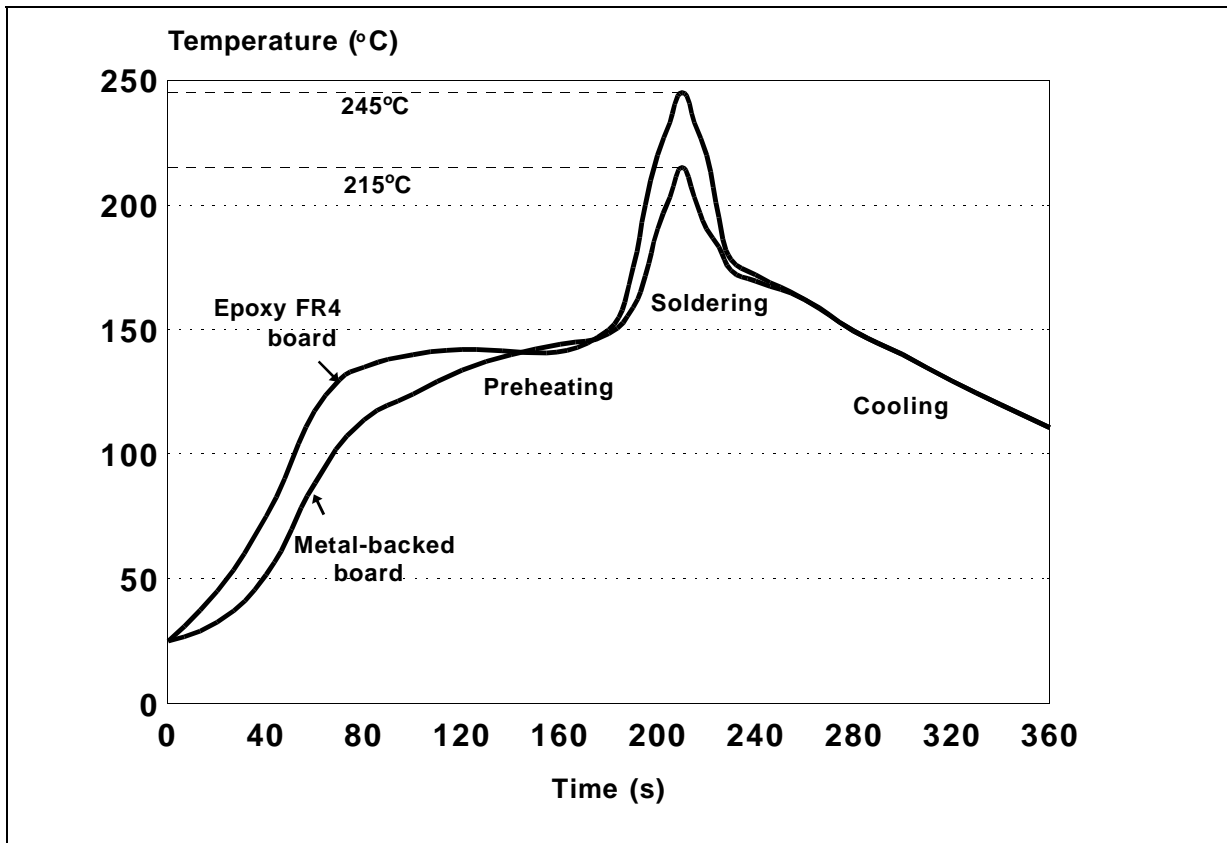
The soldering process causes considerable thermal stress to a semiconductor component. This has to be minimized to assure a reliable and extended lifetime of the device. The PowerSO-10 package can be exposed to a maximum temperature of 260°C for 10 seconds. However a proper soldering of the package could 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 failures. 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**

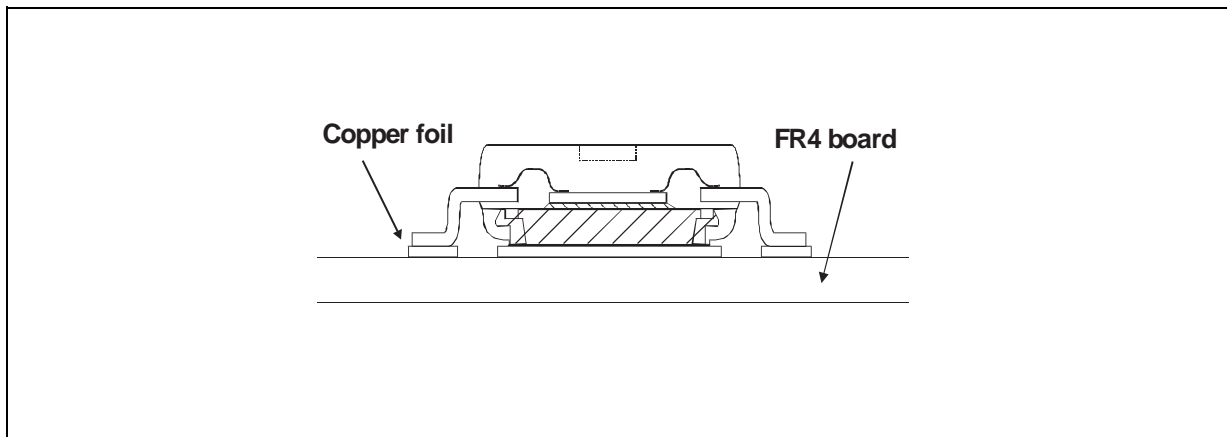
The use of epoxy FR4 boards is quite common for surface mounting techniques, however, their poor thermal conduction compromises the otherwise outstanding thermal performance of the PowerSO-10. Some methods to overcome this limitation are discussed below.

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).

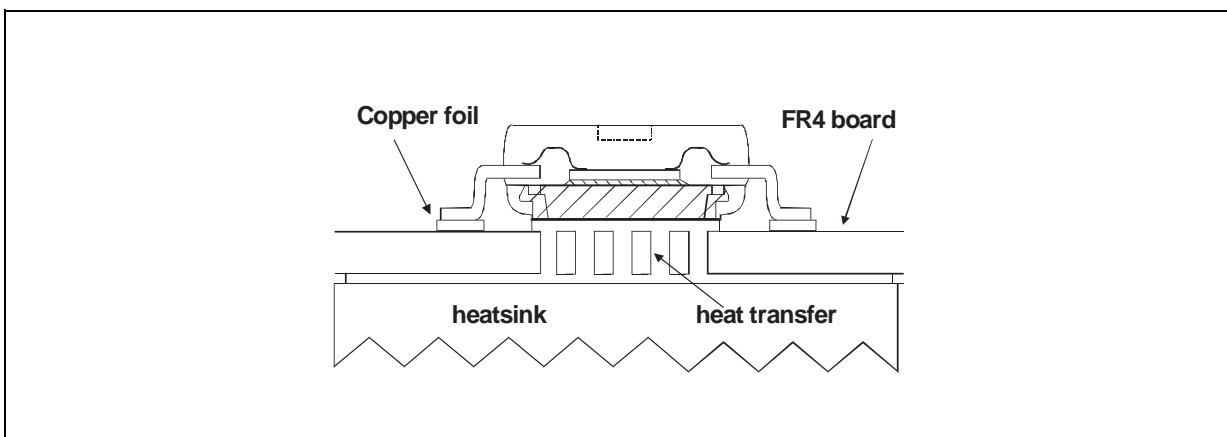
Use of copper-filled through holes on conventional FR4 techniques will increase the metallization and

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 prevents 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



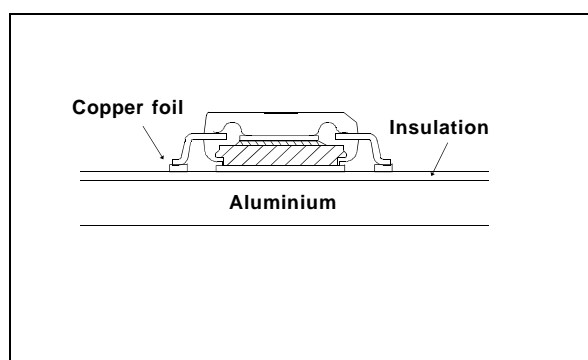
## TLPxxM/G/G-1

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°C/W with 40 cm<sup>2</sup> of board floating in air is achievable (see fig. 4). If even higher power is to be dissipated an external heatsink could be applied which leads to an R<sub>th(j-a)</sub> of 3.5°C/W (see Fig. 5), assuming that R<sub>th</sub> (heatsink-air) is equal to R<sub>th</sub> (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°C junction to air.

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.

**Fig. 4 :** Mounting on metal backed board



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

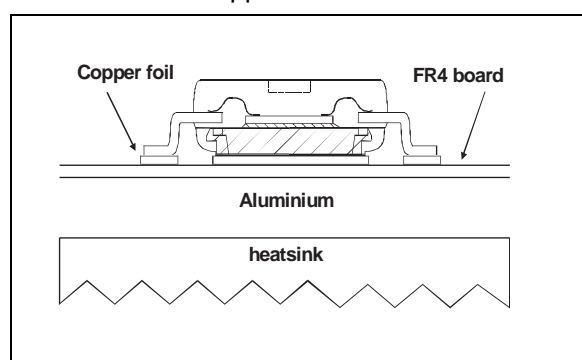


TABLE 1

| Printed circuit board material                                       | R <sub>th</sub> (j-a) | P Diss |
|--|-----------------------|--------|
| 1.FR4 using the recommended pad-layout                               | 50 °C/W               | 1.5 W  |
| 2.FR4 with heatsink on board (6cm <sup>2</sup> )                     | 35 °C/W               | 2.0 W  |
| 3.FR4 with copper-filled through holes and external heatsink applied | 12 °C/W               | 5.8 W  |
| 4. IMS floating in air (40 cm <sup>2</sup> )                         | 8 °C/W                | 8.8 W  |
| 5. IMS with external heatsink applied                                | 3.5 °C/W              | 20 W   |

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