

Soldering of EconoPACK™, EconoPIM™, EconoBRIDGE™, EconoPACK™+, EconoDUAL™, EasyPACK and EasyPIM™ modules

About this document

Scope and purpose

This application note was designed to provide engineers information and advice on soldering of EconoPACK™, EconoPIM™, EconoBRIDGE™, EconoPACK™+, EconoDUAL™, EasyPACK and EasyPIM™ modules.

Intended audience

The intended audiences for this document are design engineers, technicians, developers of electronic systems and Electronic Manufacturing Services.

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Introduction

1 Introduction

The soldering processes have been established, developed and improved over decades. This means that all components used, such as devices, circuit boards and auxiliary materials were initially designed for lead-based soldering and later adapted for lead-free soldering. In soldering, a distinction is made between soft and hard soldering.

For soft soldering, maximum operating temperatures of approximately 450°C are applied. For hard soldering the operating temperature is higher.

The solder is usually an alloy of two or more metals that bonds the metals under the influence of the applied temperature. The temperature melts the solder, however, not the metals to be joined.

A good solder should easily flow onto the metals at the given temperatures, moisten the metal and bond with the metal surface to form an alloy with it.

The degree of rigidity should be as high as possible without the bond becoming brittle.

The EU-Directive 2002/95/EG requires that from 1 July 2006 onward electric and electronic equipment newly released in the market may not contain lead, mercury, cadmium, hexavalent chromium, polybromide biphenyl (PBB) or polybromide diphenyl ether (PBDE).

Circuit board manufacturers produce epoxy FR4 PCBs with halogen-free base materials also suitable for the process (with the necessary T_g -values)

Generally, the soldering temperature impacts the selection of the flux, the pre-heat profile setting, the oxidation behavior and of course, the selection of suitable SMD components. When increasing the process temperature is increased, the specification of the components must be observed in terms of maximum heat gradients and maximum temperature. The maximum temperature limit of the flux should not be exceeded. The aim is to keep the solder temperature as low as possible. In leadfree solder processes, however, higher solder temperatures are often used.

Lead-based solders were used at temperatures around 210°C in the past. To achieve decent soldering results with lead-free solders, these solders must be processed with a minimum temperature of 245°C.

The modules with lead-free tinned pins (nickel-plated base) were tested according to the specification IEC 60068-2-20 with positive results. As mentioned this specification defines test conditions with a solder temperature of 260°C and a process time of 10s. Further, tests have shown that alternatively, solder temperatures up to 280°C and a process time of 5s are also permissible. Given these maximum conditions, the maximum heat deflection temperature (HDT) of the case material of 220°C must not be exceeded.

Solder process

2 Solder process

Common soldering is a way to join electrically conducting metals. In the most simple and conventional soldering process, a soldering iron, solder and flux are needed. Flux is applied to the metals to be joined, the soldering iron heats up the parts to be soldered, the solder is applied and thus the soldering is achieved. (Fig 1)

In an optimized process, the metals to be joined are heated up with the soldering iron. The melting point of the solder is around 180°C to 217°C. Resin and colophony are used as flux in these cored solders. The purpose of the flux is to dissolve oxides and to prevent further oxidization during the solder process.

Temperature: 350°C

Duration: (5)s or (10)s

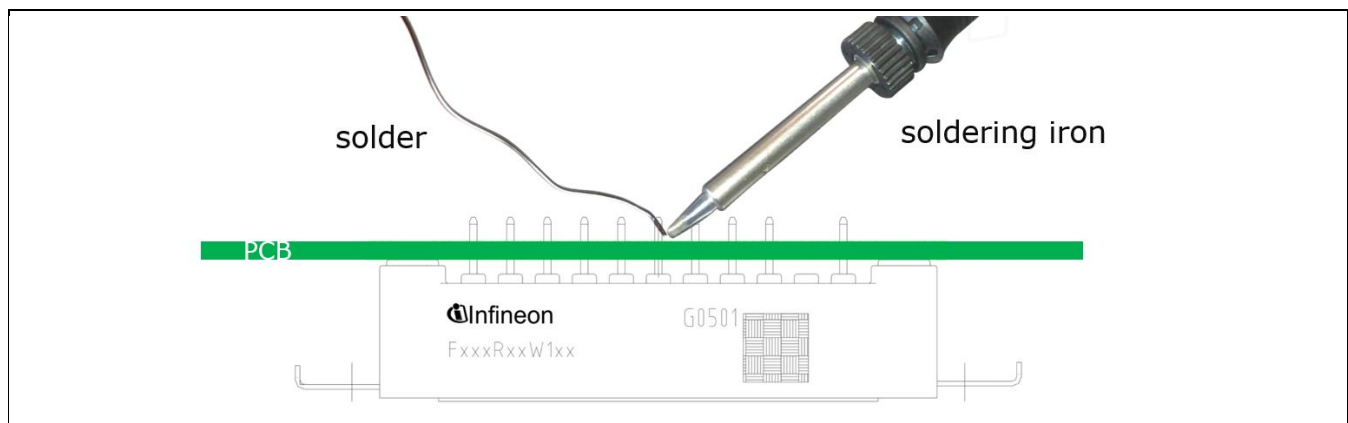


Figure 1 Manual soldering

One of the most common solder process used is the wave soldering. In wave soldering first dissolved flux is applied, then the solvent is evaporated and the preheating started. After this process the points of contact are driven over a pumped up standing wave. (Fig 2)

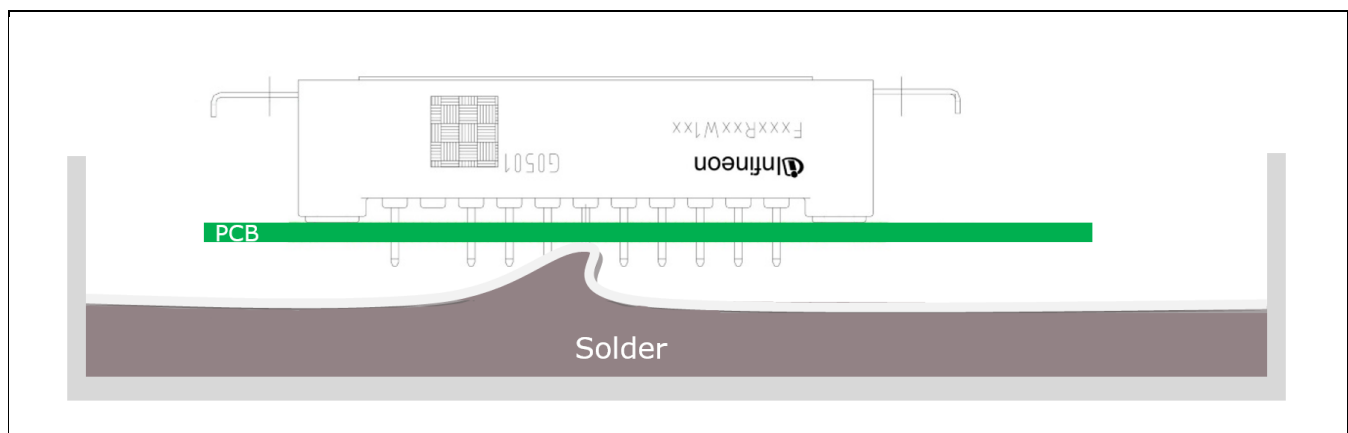


Figure 2 Concept of wave soldering

Solder process

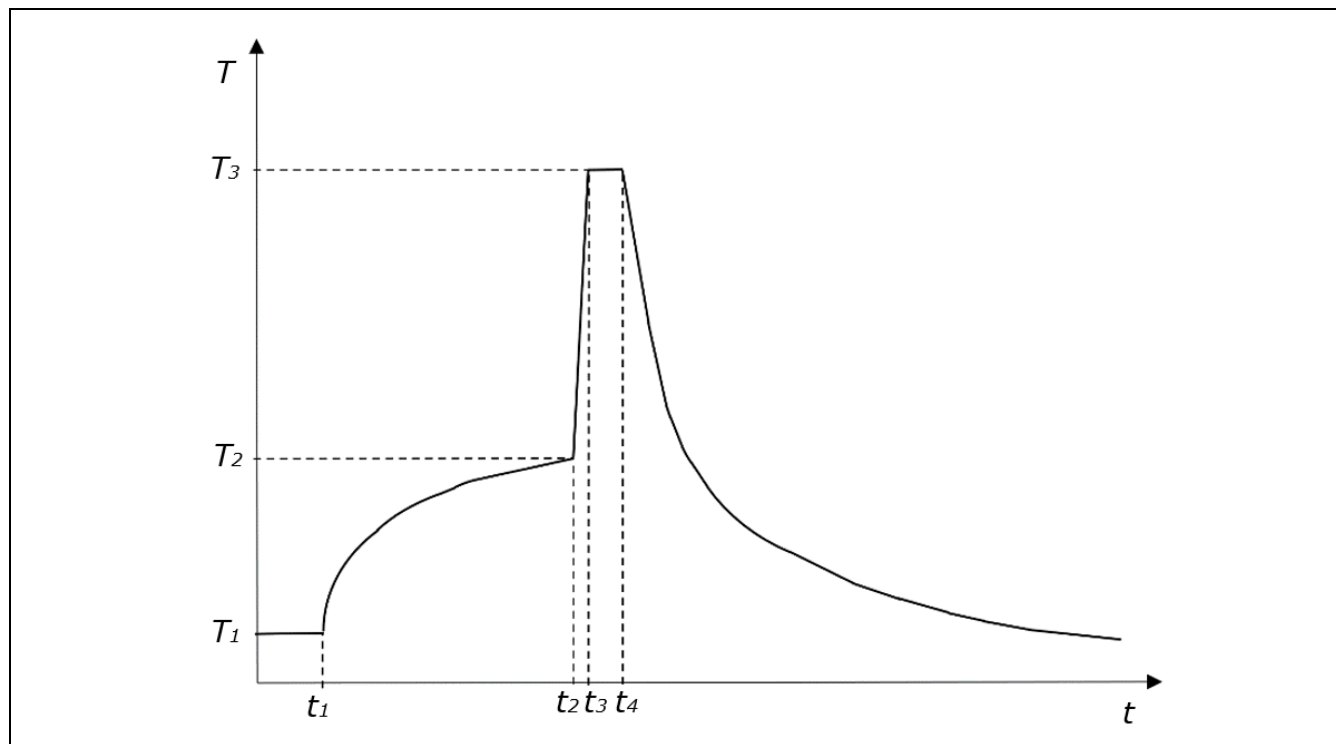


Figure 3 Temperature at the soldering joint

$$250^{\circ}\text{C} < T_3 < 260^{\circ}$$

$$T_3 - T_2 < 150^{\circ}\text{C}$$

$$2 \frac{\text{K}}{\text{s}} < \frac{T_2 - T_1}{t_2 - t_1} < 3 \frac{\text{K}}{\text{s}}$$

$$2\text{s} < t_4 - t_3 < 10\text{s}$$

Wave soldering is a mass solder process. The operating temperature for soldering electronic assemblies is approximately between 200°C and 260°C, (depending on the heat sensitivity of the components used).

committees	Wave solder alloys
USA	SnAg0.3Cu0.7
Europe	SnAg3.8Cu0.7Sb0.25
Japan	SnAg3.0Cu0.5

This listing shows that currently alloys of the SnAgCu family are considered the best option worldwide.

Solder process

A further process is selective soldering. In this soldering process, the joints are heated locally by taking care of heat-sensitive components.

This selective solder process too is based on melting onto the contact. Here too the operation involves solder paste, solder wire or a solder bath.

Selective soldering is hence separated into:

- automatised soldering iron

The heat is applied by a solder tip (soldering iron) to the connection point, where solder and flux (flux cored solder wire) is then fed to. (Fig 4)

According to need the contact point can be pre-heated.

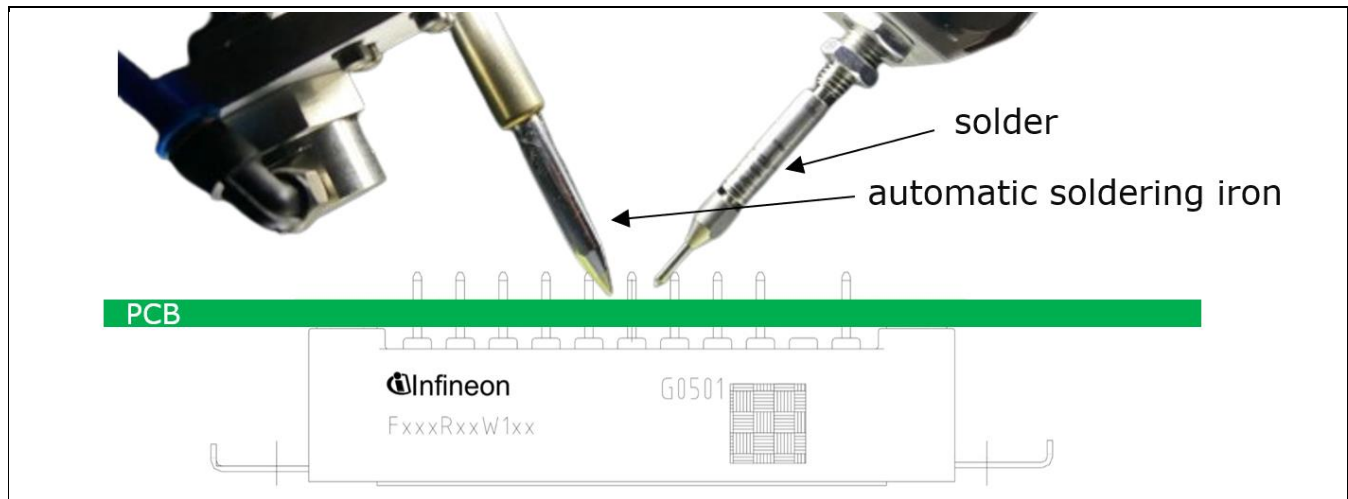


Figure 4 Concept of automatised iron soldering

- Use of pointed wave

With this concept the already molten solder is applied to the connection point. Here dedicated points are aimed at, where metallic contacts are still to be bonded. (Fig 5)

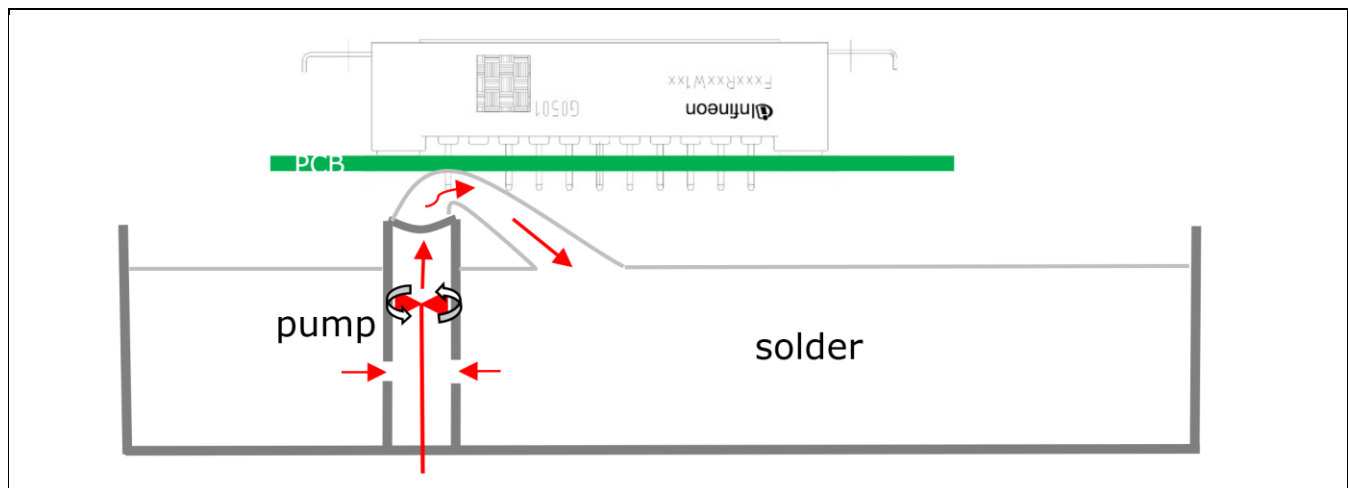


Figure 5 Concept of a pointed or mini wave

Solder process

- Dip soldering

When dip soldering the points of contact are submerged into the molten and temperate solder. (Fig 6)

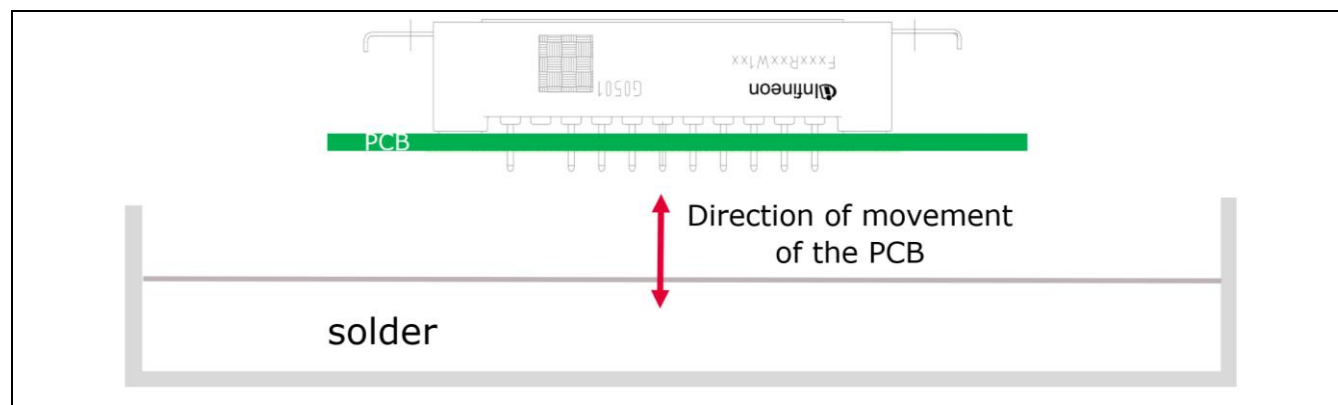


Figure 6 Concept of dip soldering

Solder temperature

3 Solder temperature

The international Standard IEC 60068-2-20 (260°C ≤ 10s) is to be observed with all these soldering examples. This specifies a soldering temperature of 260°C and a solder time of 10s max. for the module. During the described soldering process, the maximum heat deflection temperature (HDT) of the case material of 220°C must not be exceeded.

To assure and control the quality of the solder joint the following techniques may be used:

- Visual inspection by the operator
- automatic optical inspection by an inspection system which scans images of the assembly and evaluates them.
- X-ray inspection

According to the Interconnecting and Packaging Electronic Circuits Standard IPC-A-610G for Evaluation of good or faulty solder joints can only be made through the build-up of the joint (bulge or reflection), with x-ray inspection via the spatial distribution of the solder.

The build-up of the joint and hence its evaluation depends mostly on the properties of the solder and the adjoining surfaces. (Distribution of the solder, wetting and surface oxidization).

Repair

4 Repair

The heat transfer to the solder joint is always the critical factor when de-soldering. Most important is to create an optimal contact region for the heat transfer by using a tip appropriate to a solder job.

The energy requirement for heating up is difficult to estimate as the energy flow from the tip to the solder joint is hard to determine.

The required heat to be supplied is influenced by the joint itself which dissipated heat to its surround. The gauge and the number of the circuit board tracks as well as the metallization especially for multi-layer boards are important factors of influence.

Once the solder is molten it may be removed from the joint with a pump.

This procedure has to be carried out on all pins.

Once the module is no longer mechanically connected to the PCB, it may easily be removed from the contact holes.

When a new module is inserted into the same PCB it is quite logical to use the same solder for the process with which the previous module was soldered in before.

When repairing by manually soldering, de-solder wick, suction pump and de-soldering iron may be used.

When using de-solder wick the solder and the wick are heated. The capillary action of the wick sucks up the solder.

The disadvantage of this process is that de-solder wick can only be used once and is expensive too.

A more cost effective and widely used solution to de-solder is the use of suction pumps. The de-soldering suction pump sucks up the heated and molten solder by means of a vacuum. (Fig 7)

Another improved version is the de-soldering iron. This is a combination of soldering iron and suction pump. Here the soldering iron is equipped with a hollow canal in the tip. The hollow tip is placed onto the solder to be removed. Once the solder is molten, it is sucked up into a storage compartment by a motorized pump.

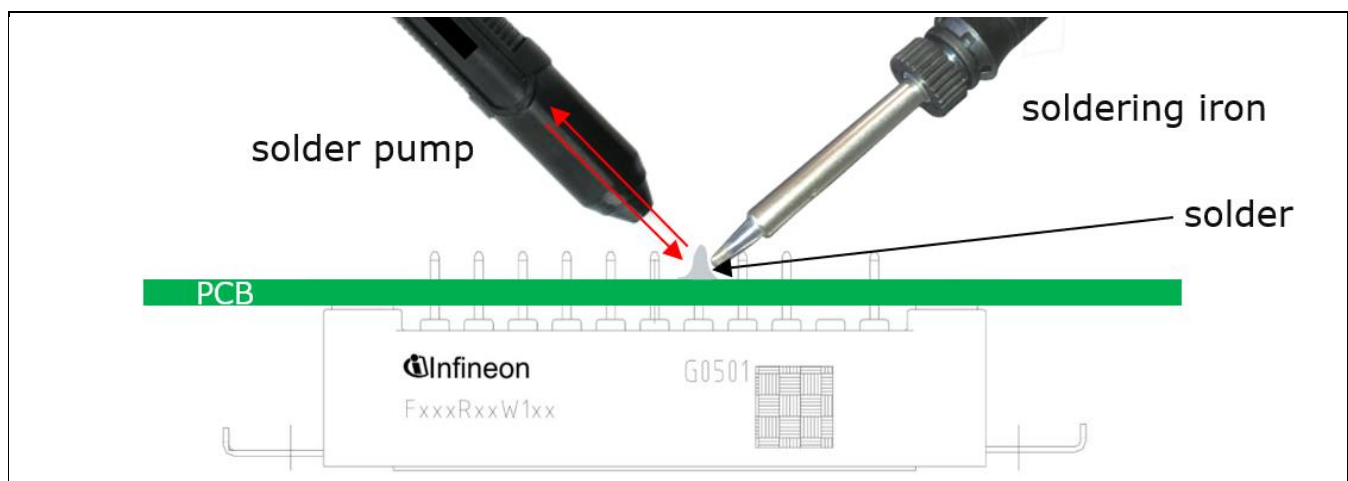


Figure 7 concept of a soldering suction pump

References

References

- [1] IEC 60068-2-20:2021 © IEC 2021 Environmental testing – Part 2-20: Tests – Tests Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads; Edition 6.0 2021-03

Revision history

Revision history

Document revision	Date	Description of changes
Revision 1.0	2005-07-18	Initial Version
Revision 1.1	2024-10-29	Document update

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