Fachverband für Design,
Leiterplatten- & Elektronikfertigung

Die Elektroindustrie

Recommendations of the FED and ZVEI

on Multiple Solder Limits

1. Background

The German Electrical and Electronic Manufacturers' Association (ZVEI) and the Association for Design, Circuit Board and Electronics Manufacturing (FED) are leading industry associations of the German electronics industry. They represent an industry with a turnover of 193.5 billion euros and around 888,000 employees.

ZVEI and FED are consistently committed to the safety and reliability of industry products, both in standardization work and in many other committees. The associations have therefore always cooperated with organizations in the field of standardization and safety. Against this background, ZVEI and FED have taken up UL's demand for new specifications for multiple soldering: In several round table discussions and working group meetings of the two associations, representatives from the fields of base materials, solders, lacquers, printed circuit boards and assemblies developed the following recommendation.

2. Approach

Multiple soldering is common in many productions today. The variety of the assemblies and the resulting individual heat demand require an individual adaptation of solder profiling. This applies to both the flow process and the reflow process. In the flow processes, the thermal loads for the printed circuit board are limited by the plant technology and also by the specification of the components (260°C for 10 s) and have been sufficiently covered for years by method 2.6.8 from TM 650.

In the reflow process, on the other hand, it is much more complicated: individual solder profiles must be created from the specifications of the solder paste manufacturers, the temperature restrictions of components (max. 245 °C) and the thermal mass of the printed circuit board, which meet all these requirements. The main differences in the individually created profiles are the peak temperatures and the duration of the soldering process.

For this reason, it is not possible to define a uniform maximum profile for the reflow process. In practice, reflow profiles that have a long duration often have a lower peak temperature, whereas short profiles have relatively high peak temperatures. The decisive factor (in the sense of a thermal stressor and thus as a reference value) is actually always the amount of heat introduced into the printed circuit board. This can be given with an equivalent in Ks (Kelvin seconds) and is simply the area under the curve of the solder profile.

3. Results

The following recommendations apply to rigid PCBs. In the case of special forms (flex, rigid-flex, IMS) and special materials (e.g. polymide), the soldering parameters must be agreed between the PCB manufacturer and the component manufacturer. The agreed profile and the number of temperature cycles are sent to UL for testing and approval.

A data query with assembly manufacturers has shown that there are three essential representations of soldering profiles which represent a temperature load on printed circuit boards:

a. Profile according to IPC-TM-650 method 6.2.27A
b. a profile similar to the J-STD-020 for modules in power electronics
c. a quantity of heat not exceeding 105,000 Ks at a start and end temperature of more than 30 °C

Details of the above profiles can be found in Appendix 1.

By observing the basic conditions from one of the above profile variants (a, b or c), it is possible for the assembly manufacturer to produce reliable assemblies. It also makes sense to divide printed circuit boards into two categories. The selection of the individual base materials is often based on the number of soldering processes and the subsequent use of the assembly.

- *Category 1*
  Printed circuit boards with few soldering processes. Here the qualification criteria should also be lower (e.g. only three reflow simulations) in line with the lower load during assembly production.

- *Category 2*
  Circuit boards with several soldering processes, e.g. 2x reflow, 2x flow processes. Here you can keep the number of simulations as described in TM-650 2.6.27A.

Appendix 1:

TM650 High Profile

Upper Limit

	Temp	Time
A	30	0
B	230	100
C	230	195
D	265	255
E	265	285
F	230	345
G	30	550

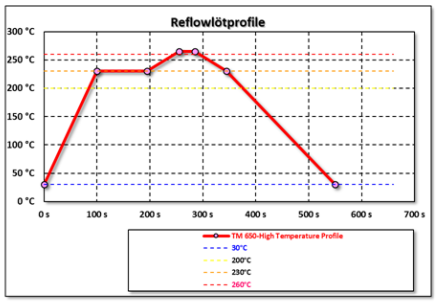


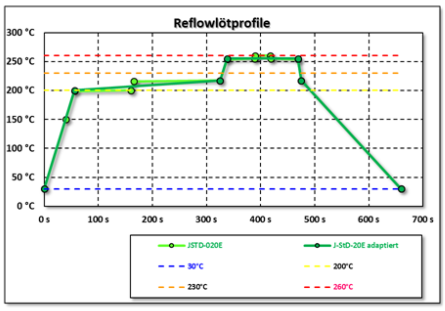
Table 5-1 260 °C Reflow Profile Specifications (Default)*

Value	Time (Seconds)	Temperature (°C)	Description
t1	210 ± 15	–	Target preheat time
t2	270 ± 10	–	Target peak reflow time
t3	330 ± 15	–	Target cool-down start time
t3 - t1	120 ± 30		Target time above T1
T1	–	230	Maximum preheat temperature
T2	–	260 ± 5	Target reflow temperature

J-STD 020E - adapted

Upper Limit

	Temp	Time
A	30	0
B	200	56
C	217	325
D	255	338
E	255	469
F	217	475
G	30	660



Adaption of the Profile according to J-STD020E

The measurement is carried out on the PCB surface; there must be no conductive tracks or soldering surfaces under the sensor.

Examples for the calculation of the introduced heat quantity (max. 105.000 Ks)