ROGERS CORPORATION

Fabrication Notes

A Study of Solder Temperature Effect on Copper Foil Adhesion to RT/duroid® 5870 Glass Microfiber PTFE Laminate

RT/duroid® copper clad laminates based on polytetrafluoroethylene (PTFE) are normally manufactured by directly fusing the PTFE components of the laminate to the surface of the metallic foil. The nodular bonding surface of the more popular ED foil made by an electrodeposition process develops a mechanically interlocked bond with the PTFE.

Because of the thermal stability of the RT/duroid laminate, there has been little concern for close control of the solder process, such as would be needed to lower temperature materials. There have been occasions when problems with bond during soldering have been encountered. This has been particularly true of cases where poorly controlled hand soldering tools have been used to apply shear of lifting forces during assembly or rework operations.

To determine the effect of temperture on the bond strength of copper foil to RT/duroid laminate, a laboratory study was performed with RT/duroid 5870 laminate 0.062 inch(1.59mm) thick, clad with 1 oz ft2 (34 mm thick) ED copper foil. This study involved exposure of specimens to a series of solder temperature ranging from 182C to 371 C (360F to 700F). The specimens consisted of 1/8 inch (3mm) wide copper lines with a 1/4 inch pad on one end etched onto 2 inch square coupons of the laminate.

Three measurements were made:

1. Cold peel strength was measured as the force at a 90° angle to peel the 1/8 inch (3.2mm) wide line form the base at ambient 21°C after the speciman was floated on solder for 30 seconds.
2. Hot peel strength was measured as the force at a 90° angle to peel the 1/8 inch wide line from the base while the specimen is immersed in solder at temperature, after stabilization of about 1 minute.
3. Shear force to destroy the bond was measured on the 1/4 inch square pad at the end of the 1/8 inch wide strip while the specimen is immersed in solder at temperature after stabilization of about minute. To determine this force the 1/8 inch strip was peeled away from the substrate up to the pad area. The force to separate the pad from the base was measured by pulling on the 1/8 inch strip parallel to the specimen surface.

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Average test results are shown in Table 1.

Solder Temperature °C (°F)	Cold Peel 30 sec. float lb/in. width	Hot Peel in solder lb/in. width	Hot Shear in solder lb/.25in. pad
182 (360)	14.8	5.4	16.0+
204 (400)	14.8	3.2	16.0+
232 (450)	14.8	1.6	16.0+
260 (500)	14.4	0.8	12.8
288 (550)	12.7	0.1	8.0
316 (600)	11.9	0.0	6.4
343 (650)	6.3	0.0	6.4
371 (700)	6.4	0.0	1.6

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The cold peel after solder exposure shows that bond is not destroyed until temperature about the 327°C crystalline melt point of the PTFE is approached. At this temperature the copper tends to oxidize on contact with air. The protection from air afforded by the PTFE bond to the foil surface probably is lost as the PTFE begins its phase change.

The hot peel and shear failure values show that the bond is susceptible to mechanical damage at elevated temperatures. Care must be exercised in hand soldering work to avoid extremes of force or temperature.

Notes:

1. Cold peel failure up to 288°C was into the substrate (cohesive). All other peel failures were between foil and substrate (adhesive).
2. The cold peel value for material not floated on solder was 16.0 lb/in. width with failure into the substrate (cohesive).
3. The 16.0+ hot shear failures were breakage of the 1/8 inch wide copper strip used to apply force to the pad.

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