Brochure:
NOVEL SURFACE FINISHES FOR PCBS AND ELECTRONIC ASSEMBLIES

Approved in SAP by Workflow/Freigabe mit SAP-WF	**CM Release/Freigabe**
Prepared by/Ersteller Ralf Bölter	
Engineering Susanne Kownatzki	
Quality Tobias Baisch	
Configuration Management Iris Rock	
	TESAT This document has been configured electronically and is valid without handsignature. The TESAT configuration management department certifies, that this document has been approved by the responsible people/functions in accordance with the TESAT configuration management process. Iris Rock 2024.09.12 15:11:56 +02'00'

CHANGE RECORD/ÄNDERUNGSBESCHREIBUNG

Issue	Details of Change/Änderungsdetails	Date
A	Initial issue	2024-09-11

ESA ITT AO/1-9899/19/NL/AR
NOVEL SURFACE FINISHES FOR PCBS AND ELECTRONIC ASSEMBLIES

by Tesat-Spacecom GmbH & Co. KG, Airbus SAS and Crisa

Space electronics is developing to higher frequencies and smaller pitches. Todays fused tin-lead surface of printed circuit boards (PCBs) is not ideal for such applications. Novel PCB surfaces offer a better performance for RF applications. These new lead-free surfaces also meet the European legislation directives as RoHS and allow lead-free soldering.

In this project, the market for Novel PCB surfaces was reviewed and the different surfaces were compared based on literature data. Two surfaces were chosen for detailed tests on PCB level based on ECSS-Q-ST-70-60C and for assembly based on ECSS-Q-ST-70-61C. The most promising surfaces after the technology review were ENIPIG and ISIG. Both surfaces are suitable for lead-free soldering and gold wire ultrasonic bonding.

In order to evaluate the suitability of the preselected surface finishes various tests on the unpopulated boards have been carried out. These tests contained several tests of Group 1 to Group 3 and Group 5 to Group 6 according to ECSS-Q-ST-70-60C. All the tests were passed with good to excellent results. Especially those that represent reliability in the high-frequency range such as the impedance testing and tests on a ring-resonator and the tendency of electrochemical migration. In addition to that, the tests representing the overall reliability of the workmanship and production quality of the PCB such as Group 2 and Group 6 were passed to overall satisfaction. Furthermore the results of the tests concerning the quality and workability of the surface itself for example the solder bath float or the corrosion rating, showed a general reliability of the examined surfaces.

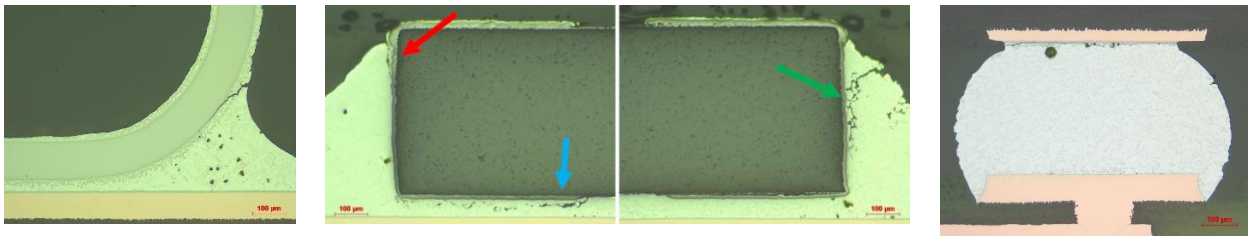
Key processes on these PCBs are lead free soldering and gold wire ultrasonic (US) bonding. Wetting tests and soldering tests as well gold wire US bonding with pull- and shear tests demonstrated that ENIPIG, ISIG and EPIG are well suitable for these processes.

Due to an obsolescence of the ISIG surface in Europe, assembly tests were performed with the surfaces ENIPIG and EPIG. Ball grid arrays (BGAs) with 484 balls, flatpacks with 16 leads and R2512 resistors have been soldered with SAC305 solder to PCBs made of Megtron7. Vapour phase soldering as well as hand soldering by solder iron and hot air gas repair soldering of the BGAs was performed. Some solder joints have been reworked several times.

These test boards went to vibration testing and 1500 temperature cycles according to ECSS-Q-ST-70-61C. All solder joints have been electrically online monitored during the temperature cycles.

BGA484 and Flatpack16 showed no electrical failures after the temperature cycles. First electrical failures of the R2512 were found after 300 temperature cycles (as expected).

The temperature cycles were followed by microsectioning of several solder joints. The BGAs only had beginning cracks in the balls at the corners of the package on top of the balls at the connection to the package. The solder joints to the PCB surfaces had no cracks. The flatpacks had some beginning cracks in the heel area of the leads at the corners looking similar to flatpacks with tin lead soldering. The cracks in the resistors occurred in the critical zone of the solder joints between package and PCB running in the solder material and due to the size starting at the top of the package. This is similar to cracks in solder joints of resistors soldered by tin lead soldering.



Microsections of FP16, R2512 and BGA484

ENIPIG and EPIG can also be used for ultrasonic gold wire bonding on the PCB. A good welding connection to both surfaces was demonstrated with pull tests of the gold wires and shear tests of the balls.

ENIPIG and ISIG successfully passed all PCB tests and in the assembly tests. It was demonstrated that ENIPIG and EPIG are suitable for lead free soldering and gold wire US bonding. The reliability of the solder joints is comparable to tin lead soldering.