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# SOLDER FOR FORMATION OF CONTACTS TO CONVERTERS OF OPTICAL AND X-RAY IMAGES INTO THE ELECTRICAL SIGNAL

The pasty solder is used in the technology of the installation of electro-radio elements. Such elements can be microcircuits and optical and X-ray images microelectronic sensors with a hard raster [1]. Tinning of such sensor contact surfaces and printed circuit boards, where such sensors are mounted and soldering of the sensors to the plate is a considerable problem due to the need to remove corrosive active paste radical. The advantage of the developed solder is low corrosion activity and high fluxing ability. After soldering, there is no need to clean the surface of the printed circuit board and the contact sensor from paste redicals and chemical reaction products.

Because of the high printing density of the optical and X-ray images sensors with a rigid raster, when the distance between the current circles, the width and thickness of the tracks can be less than 10 microns, the solder paste should have high fluxing activity and not cause corrosion, while providing satisfactory soldering.

The main disadvantages of known pasty solders:

1. Insufficient fluxing activity. The paste radicals after soldering are corrosively active.
2. When soldering due to the presence of rosin (up to 22%), there is the formation of a large number of resinification products on a surface that is soldered. Removal of these substances needs thorough washing with mixtures of various organic solvents, and in some cases, additional mechanical cleaning. This is associated with the significant technological difficulties, especially with the high compactness of the printed assembly and the presence on the printed circuit boards without hull and hinged elements.
3. High rosin corrosion activity (acid number 170-180) leads to the maturation and dissolution of the metal, which is soldered, especially when soldered by the technology of mounting on the surface, when the contact plane (CP) thickness is 10-20 microns.
4. During the soldering process, compounds are formed which, in conditions of high humidity, can cause corrosion and reduce insulation resistance of printed circuit boards, especially with high density of printed assembly (distance between conductive tracks is 10 - 30 microns). Maleic acid has a very large fluxing activity, but at its content of ≈ 0.5 - 3.0%, the insulation resistance after soldering is reduced by 1-2 orders of magnitude, which is in accordance with the requirements of the STD, but is not acceptable for special purpose radioelectronic equipment (REE).
5. High activity of fluxing components (diethylamine hydrochloric acid and maleic acid (or maleic anhydride) leads to the maturation and dissolution of soldered metal, especially when soldered using surface mount technology, when the CP thickness is of 10-20 μm (Fig. 1).

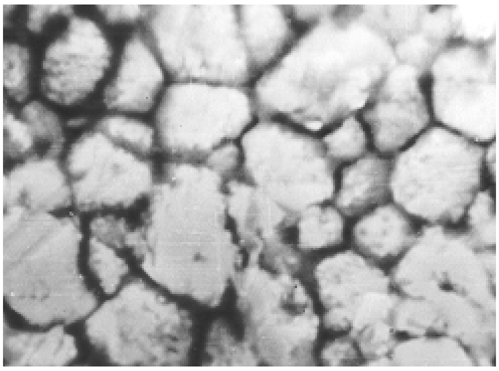

**Fig. 1 Solder seam surface destruction. Raster electron microscope. Mode of the secondary electrons. Increase 2000$^x$.**

6. The paste fluxing activity reducing during its storage. Because of the high corrosion activity of the fluxing components (diethylamine hydrochloric acid and maleic acid (or maleic anhydride)) with the paste prolonged storage (warranty period of 3 months or more) due to the developed surface of the solder powder, its oxidation occurs, which significantly reduces the technological characteristics of the paste: fluxing activity, wettability , spread ratio.

These factors reduce the reliability of the contact of the optical and X-ray image sensor to the board on which it is mounted. Their removing leads to the reduction of material costs, time and funds for soldering technology.

Due to the fact that the distance between the current paths may be less than 10 microns, the solder paste should have high fluxing activity and should not cause corrosion while providing satisfactory soldering. For this purpose, as an active fluxing component, rosin and extra relatively inactive succinic acid and glycerin, which have the properties of a reducing agent and greatly enhance the fluxing effect of the rosin, are selected. The introduction of the solvent paste of succinic acid and glycerine reduces the content of the rosin, which significantly reduces the amount of product of the resinification and simplifies the operation of laundering after soldering.

In the proposed composition, the optimal quantitative ratios of active reagents - rosin, succinic acid, glycerol are selected in such way as to provide sufficient fluxing activity (required for wetting and spreading) without increasing the corrosion activity of the paste solder.

The proposed composition is prepared in this way [2].

Amber acid is thoroughly rubbed in a mortar to a fine powder, then add glycerol and dissolve in alcohol at a temperature of 70-80 ° C. In the resulting solution, add a solder powder and mix. Rosin is thoroughly rubbed in a mortar to a fine powder then adds castor oil and dibutylphthalate. The resulting mixture is heated to 90-120$^0$C and, when stirred, dissolved to obtain a homogeneous mass. Both solutions are combined and also thoroughly mixed.

The trial of the proposed paste solder and the known paste were performed by soldering the prototype of optical and X-ray image sensor samples to the printed circuit boards. The paste remnants after soldering were not removed. Further, accelerated tests of printed circuit boards in a climate chamber at a temperature of 40$^0$C and a relative humidity of 98% were carried out. After soldering and after performed accelerated tests, the insulation resistance of printed circuit boards was measured, which depends on the corrosion activity of the compositions. Fluxing activity was determined by the coefficient of diffusion (for copper, silver). Results of comparative tests are given in tables 1, 2.

Table 1

| **Technical characteristics** | **Paste flux, which is offered** | **Prototype solder paste** |
|---|---|---|
| Residual corrosive activity after soldering. | Resistance to PCB insulation after soldering does not change.<br>After accelerated tests, the resistance does not change. | Resistance to PCB insulation after soldering does not change.<br>After accelerated tests, the resistance decreases by 5-10 times. |

Table 2

| **Paste rheological characteristics** | **Paste flux, which is offered** | **Prototype solder paste** |
|---|---|---|
| Dispersion coefficient (after manufacturing) | 1.4 | 1.4 |
| Dispersion coefficient (after 1 month of storage) | 1.4 | 1.3 |
| Dispersion coefficient (after 2 months of storage) | 1.4 | 1.25 |
| Dispersion coefficient (after 3 months of storage) | 1.4 | 1.0 |

The advantage of the proposed paste solder is low corrosion activity and high fluxing ability when soldered, which does not decrease with prolonged storage (the warranty period is 3 months or more). The resistance of PCB insulation after soldering and accelerated testing is not changed. After soldering, no cleaning of the PCBs surface and contact nodes from paste residues or chemical reactions is required. The introduction into the composition of the paste solder of succinic acid and glycerol allows to reduce the content of rosin, which significantly reduces the resinification products amount. The economic efficiency at the invention implementing is that, when practically the same cost of chemical components (ingredients) as the prototype paste, the soldering quality is significantly increased and the reliability and operating (time) of the equipment as a whole increases.

1. Smyntyna V. A. Image sensor on the basis of nonideal heterojunction with rigid raster/ Smyntyna V.A., Borschak V.A., Kutalova M.I., Zatovskaya N.P., Balaban A.P.// Photoelectronics.- 2006.- №15.- P.21-23.
2. Patent of Ukraine № 70407. «Paste form» / Lepich Ya.I., Sh.D.Kurmashev, T.I.Lavrenova, T.M. Bugayova. Public 11.06 2012, bul. No. 11

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**Keywords:** solder, sensor, contact

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## ПРИПОЙ ДЛЯ СОЗДАНИЯ КОНТАКТА К ПРЕОБРАЗОВАТЕЛЯМ ОПТИЧЕСКОГО И РЕНТГЕНОВСКОГО ИЗОБРАЖЕНИЙ В ЭЛЕКТРИЧЕСКИЙ СИГНАЛ

Пастообразный припой используется в технологии монтажа электрорадиоэлементов. Такие элементы могут быть микросхемами и микроэлектронными датчиками оптических и рентгеновского изображений с твердым растром [1]. Лужение контактных площадок контакта сенсора и печатной платы на которую такие сенсоры монтируются есть важной проблемой из-за необходимости удаления коррозийно активных остатков пасты. Преимуществом разработанного  припоя является низкая коррозийная активность деятельность и высокая флюсующая способность. После пайки, нет необходимости очищать поверхность печатной платы и контактов датчика от остатков пасты и продуктов химических реакций.

**Ключевые слова:** припой, сенсор, контакт

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## ПРИПОЙ ДЛЯ СТВОРЕННЯ КОНТАКТУ ДО ПЕРЕТВОРЮВАЧА ОПТИЧНОГО ТА РЕНТГЕНІВСЬКОГО ЗОБРАЖЕНЬ В ЕЛЕКТРИЧНИЙ СИГНАЛ

Пастоподібний припій використовується в технології монтажу електрорадіоелементів. Такими елементами можуть бути мікросхеми і мікроелектронні сенсори опричного та рентгенівського зображень з жорстким растром [1]. Лудіння контактних площинок таких сенсорів та друкованих плат, на яких такі сенсори монтуються і паяння сенсорів є чималою проблемою через необхідність видалення корозийно активних залишків пасти. Перевагою розробленого припою є низька корозійна активність та висока флюсуюча здатність. Після паяння не потрібне очищення поверхні друкованих плат та контактних сенсору від залишків пасти та продуктів хімічних реакцій.

**Ключові слова:** припой, сенсор, контакт