Soldering to Gold Alloy Choice and Limitations

APPLICATION NOTE

Gold is a noble metal and therefore does not oxidize or tarnish to any appreciable extent. In electronics, this property makes gold suitable for a number of uses, including contacts for switches and connectors, where it is plated as a surface finish. Gold is also used as a solderable surface or as a preserving finish on circuit boards and other assemblies.

Flux Choice

It is possible to solder gold without flux, under certain circumstances. However, if the plated layer is thin, the gold can become totally assimilated into the solder. In this situation, flux choice is then determined by the characteristics of the underlying metal.

For reflow temperatures in excess of 330°-350°C, forming gas is effective and may be used instead of flux. An inert atmosphere will increase flux efficiency and simplify cleaning issues in high temperature applications where a flux is still required. For fluxless soldering with high-indium alloys, an inert atmosphere is obligatory.

Alloy Choice

The tin in molten solder rapidly dissolves gold. If sufficient gold is dissolved, brittle intermetallic compounds can be formed in the solder joint. Joint configuration or alloy choice needs to be done in such a way as to avoid these formations, as they can lead to premature failure in service. The precise amount of tolerable gold will depend on joint design and service conditions, but it is possible to make a few guidelines.

For eutectic or near eutectic tin-lead solders, the maximum permissible amount of gold is generally considered to be 3% by weight of the solder joint. There is little danger of this being reached when soldering conventional Electroless Nickel Immersion Gold coated PCBs where the gold thickness is typically only 0.03 - 0.07 microns. If the gold thickness is greater than 0.5 microns, the risk of embrittlement is considered significant and non tin-based alloys, such as those based on indium, are recommended.

Indium dissolves gold at a much slower rate than tin, and a number of indium-based alloys are available to suit different requirements. When considering alloy choice, both the operating temperature of the device being soldered and the maximum process temperature should be taken into account. A good rule of thumb is to choose a solder with solidus no less than 50°C above the maximum device operational temperature. An optimum process temperature will typically be in the 30°-50°C range over liquidus.

The following indium alloys can be used successfully against gold without the harmful effects caused when tin-bearing alloys are used:

Indalloy Number	Melting Temperature (Liquidus / Solidus)	Composition
# 290	143°C E	97In 3Ag
# 2	154°C / 149°C	80In 15Pb 5Ag
# 4	157°C MP	100In
# 204	175°C / 165°C	70In 30Pb
# 205	181°C / 173°C	60In 40Pb
# 7	210°C / 178°C	50In 50Pb
# 206	231°C / 197°C	60Pb 40In
# 3	237°C / 141°C	90In 10Ag
# 10	266°C / 240°C	75Pb 25In
# 150	275°C / 260°C	81Pb 19In
# 12	310°C / 290°C	90Pb 5In 5Ag
# 164	310°C / 300°C	92.5Pb 5In 2.5Ag
# 11	313°C / 300°C	95Pb 5In

Form No. 97743 R2

S O L D E R

INDIUM CORPORATION OF AMERICA®

www.indium.com
askus@indium.com
PRC +86 (0)512 628 34900
SINGAPORE +65 6 268 8678
UK +44 (0) 1908 580400
USA +1 315 853 4900

Soldering to Gold Alloy Choice and Limitations

APPLICATION NOTE

Precautions

Even though indium and indium-based solders solve numerous critical joining applications, certain precautions must be followed concerning metal compatibility and corrosion.

- If the device operating temperature exceeds 125°C, indium-based solders are not recommended for use against gold metallizations, as solid-state diffusion of the gold may occur. In such cases, gold-tin eutectic or a high lead alloy solder can be used instead, according to process or commercial restraints.
- Indium can be corroded by halides. Indium-based joints should be protected in service from halide containing materials, or if humidity will exceed 85% in the presence of halides (a marine environment for example). This can be accomplished with the use of a conformal coating.
- Fluxes based on halide activators (and any cleaners containing chlorinated hydrocarbons) should be avoided when using indium-based alloys. If this precaution is not followed, corrosion of the solder joint may occur at a higher rate than for a tin-lead joint.

S O L D E R

INDIUM CORPORATION OF AMERICA®

www.indium.com
askus@indium.com
PRC +86 (0)512 628 34900
SINGAPORE +65 6 268 8678
UK +44 (0) 1908 580400
USA +1 315 853 4900