

## Surface Finish Overview

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| Abbreviated Designation                   | ASIG   | ENAG   | ENEPIG  | ENIG                                | ENIPIG  | EP                             | EPAG  | EPIG   | GalvNIG hard   | GalvNIG soft   | HAL lead free              | HAL lead containing        | IS                   | ISIG                                | IT                 | OSP                         |
|---|--|--|---|-------------------------------------|---|--------------------------------|---|--|--|--|----------------------------|----------------------------|----------------------|-------------------------------------|--------------------|-----------------------------|
| <b>Description (CONTI)</b>                | Electroless Silver/<br>Immersion Gold  | Electroless Nickel/<br>Electroless Gold  | Electroless Nickel/<br>Electroless Palladium/<br>Immersion Gold                                   | Reductive Nickel/<br>Immersion Gold | Electroless Nickel/<br>Immersion Palladium/<br>Immersion Gold                                     | Electroless Palladium          | Electroless Palladium/<br>Electroless Gold                  | Electroless Palladium/<br>Semireductive Gold |  |  | HAL                        | HAL lead containing        | Immersion Silver     | Immersion Silver/<br>Immersion Gold | Immersion Tin      | OSP                         |
| <b>Remarks</b>                            | Semireductive Gold bath. The reductive Silver bath has proven too instable. Therefore, this process has been replaced by ISIG. | Phosphorous Ni. The reductive Au-bath is very instable. Therefore, this surface finish is increasingly replaced by Pd-containing alternatives. | Phosphorous Ni and Pd; higher Au-thickness is possible via semi-reductive Au-deposition (Umicore) | Phosphorous Ni                      | Phosphorous Ni and Pd; higher Au-thickness is possible via semi-reductive Au-deposition (Umicore) | Pd without Ph                  | Pd without Ph; Umicore uses a semireductive (TRG) Gold bath | Pd without Ph                                | Co- oder Fe-doped Gold baths; Ni-hardness 400-450HV, Au-hardness 140-170HV | Fine Gold electrolytes for bonding and soldering applications; Ni-hardness 400-450HV, Au-hardness 80-110HV | Often denoted as HASL      | Often denoted as HASL      |                      | Semireductive Gold bath             |                    | Organic Surface Passivation |
| <b>Layer type and thickness</b>           |  | Ni 3-7µm<br>Au 0,1-0,3µm   | Ni 3-7µm<br>Pd 0,05-0,3µm<br>Au 0,04-0,1µm  | Ni 3-7µm<br>Au 0,05-0,125µm         | Ni 3-7µm<br>Pd 0,01-0,05µm<br>Au 0,04-0,1µm   | Pd 0,1-0,2µm                   | Pd 0,1-0,2µm<br>Au 0,1-0,2µm                                | Pd 0,1-0,2µm<br>Au 0,04-0,2µm                | Ni >4µm<br>Au 0,8-3µm  | Ni >4µm<br>Au 0,2-0,5µm  | SnCuNi-Leg. 1-50µm         | SnPb-Leg. 1-50µm           | Ag 0,2-0,4µm         | Ag 0,2-0,3µm<br>Au 0,04-0,15µm      | Sn 0,8-1,3µm       | Coating 0,2-0,6µm           |
| <b>Soldering</b>                          |  | ▲  | ▲   | ▲                                   | ▲   | ▲                              | ▲   | ▲  | ■  | ▲  | ▲                          | ▲                          | ▲                    | ▲                                   | ▲                  | ▲                           |
| <b>Multiple Solderability</b>             |  | 2x   | 3x  | 3x                                  | 3x  | 3x                             | 3x  | 3x   | no   | no   | 3x                         | 3x                         | 3x                   | 3x                                  | 3x                 | 1-2x                        |
| <b>Bonding Al-wire</b>                    |  | ▲  | ▲   | ▲                                   | ▲   | ■                              | ▲   | ▲  | ▼  | ▲  | ▼                          | ▼                          | ▲                    | ▲                                   | ▼                  | ▼                           |
| <b>Bonding Au-wire</b>                    |  | ▲  | ▲   | ▼                                   | ▲   | ■                              | ▲   | ▲  | ▼  | ▲  | ▼                          | ▼                          | ▲                    | ▲                                   | ▼                  | ▼                           |
| <b>Fine Pitch (Pad distance &lt;75µm)</b> |  | ■  | ■   | ■                                   | ■   | ■                              | ▲   | ▲  | ▼  | ▼  | ▼                          | ▼                          | ▲                    | ▲                                   | ▲                  | ▲                           |
| <b>High frequency application</b>         |  | ■  | ■   | ■                                   | ■   | ▲                              | ▲   | ▲  | ■  | ■  | ■                          | ■                          | ▲                    | ▲                                   | ■                  | ▲                           |
| <b>Pressfit</b>                           |  | ■  | ■   | ■                                   | ■   | ▲                              | ▲   | ▲  | ■  | ■  | ▲                          | ▲                          | ■                    | ■                                   | ▲                  | ▼                           |
| <b>Key Press</b>                          |  | ▲  | ▲   | ▲                                   | ▲   | ■                              | ▲   | ▲  | ▲  | ▲  | ▼                          | ▼                          | ▼                    | ▼                                   | ▼                  | ■                           |
| <b>Corrosion resistance</b>               |  | ▲  | ▲   | ■                                   | ▲   | ■                              | ▲   | ▲  | ▲  | ▲  | ▲                          | ▲                          | ■                    | ■                                   | ▲                  | ▼                           |
| <b>Shelf life</b>                         |  | ▲  | ▲   | ▲                                   | ▲   | ▲                              | ▲   | ▲  | ▲  | ▲  | ▲                          | ▲                          | ■                    | ▲                                   | ■                  | ■                           |
| <b>Refreshable</b>                        |  | no   | no  | no                                  | no  | no                             | no  | no   | no   | no   | yes                        | yes                        | no                   | no                                  | yes                | yes                         |
| <b>Long term/market references</b>        | ■  | ▲  | ■   | ▲                                   | ■   | ▼                              | ▼   | ▼  | ▲  | ▲  | ▲                          | ▲                          | ▲                    | ■                                   | ▲                  | ▲                           |
| <b>Serial costs</b>                       |  | 140%   | 120%  | 100%                                | 115%  | 90%                            | 125%  | 125%   | not specified (local spots)  | >200%  | 70%                        | 70%                        | 50%                  | 125%                                | 60%                | 30%                         |
| <b>Chemistry suppliers (inter alia)</b>   |  | Umicore  | Atotech<br>Umicore (TRG)  | OMG<br>Atotech<br>Umicore           | OMG<br>Umicore (TRG)  | Atotech (Pallabond)<br>Umicore | Atotech (Pallabond)   | Umicore (TRG)                                | Dow<br>Atotech<br>Umicore  | Dow<br>Atotech<br>Umicore  | Balver Zinn<br>Felder Lote | Balver Zinn<br>Felder Lote | MacDermid<br>Umicore | Umicore (TRG)                       | Atotech (Smarttin) | Enthone<br>(Entek+ HT)      |

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