

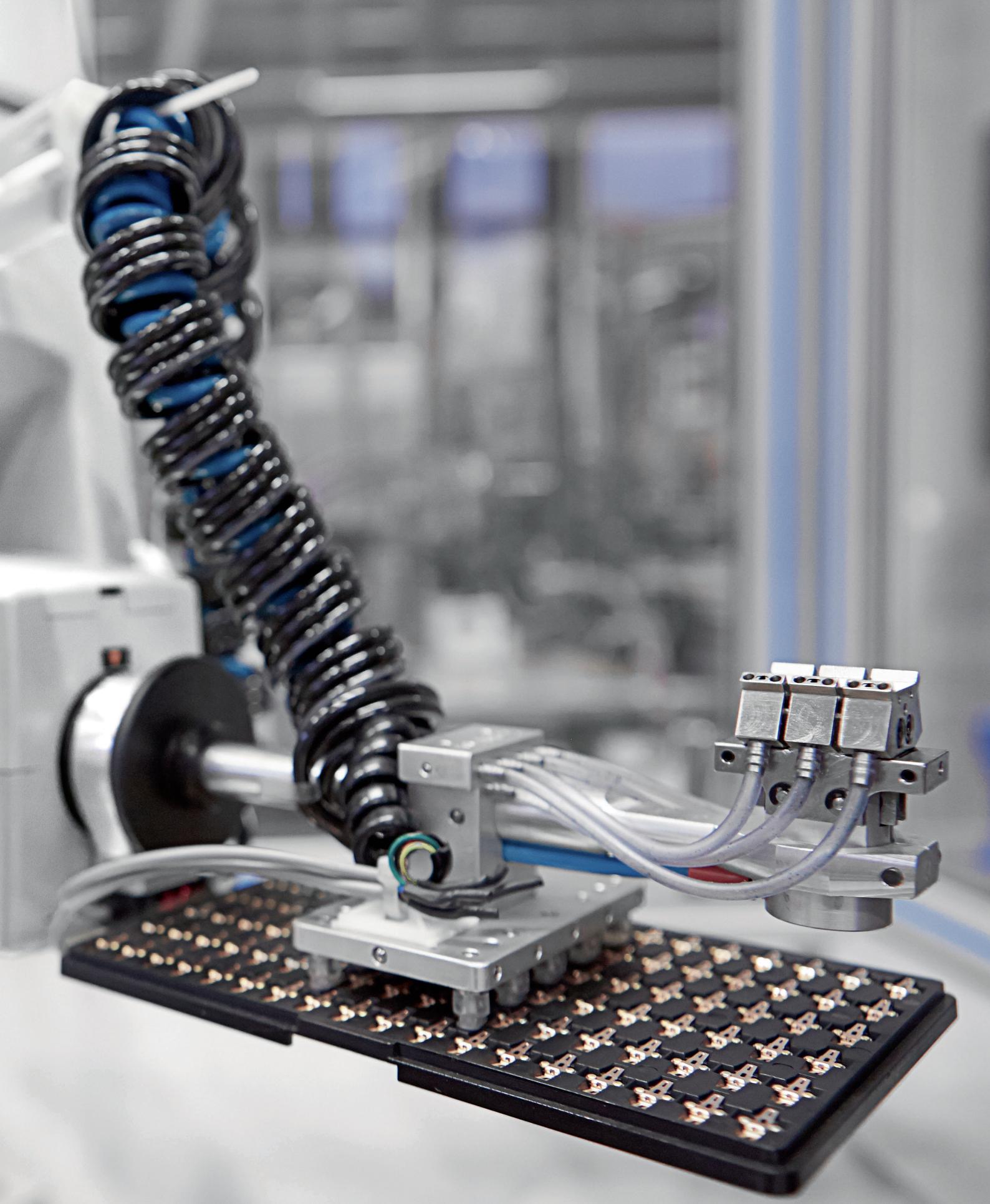


White Paper

Benefits of Gold-Plated vs. Silver Contacts. *In Electrical Pushbuttons, Lever Switches, Keylock Switches, Emergency- and Stop Switches.*

Introduction

In electrical pushbuttons and different switches such as emergency stop switches, contact materials play a pivotal role in determining the switch's performance, reliability, and longevity. Two of the most commonly used materials for contacts are gold and silver. While both materials have their unique advantages, choosing the appropriate one depends on the specific application and operating environment of the switch. This whitepaper explores the benefits of using gold-plated contacts versus silver contacts, with a focus on HMIs for various applications, from low-level signal circuits to high-load industrial machinery.



Overview of Silver and Gold-Plated Contacts

Silver Contacts

Silver is a highly conductive material, making it an excellent choice for electrical contacts, particularly in high-power applications. Silver contacts are used in applications requiring high current, such as industrial machinery, power switches, and appliance switches. However, silver has a notable drawback: it tends to oxidise when exposed to air and humidity. This oxidation increases the contact resistance, reducing the switch's reliability over time, especially in low-load applications.

Gold-Plated Contacts

Gold is corrosion-resistant and offers excellent conductivity at low voltages. When used as a plating material over a base metal like silver, gold prevents oxidation, ensuring a clean and stable connection over time. Gold-plated contacts are ideal for low-level applications such as signal processing, control panels, and audio-video equipment where precision and reliability are paramount.



Performance Comparison: Gold-Plated vs. Silver Contacts

High-Level Applications

Silver contacts are highly effective applications that involve medium to higher voltages of around 20V and above and currents up to 10A. The ability of silver to handle such high loads ensures efficient and reliable performance, and any oxidation that forms on silver contacts is often "electrically cleaned" by the high current flow, which burns off the oxidation layer. This self-cleaning mechanism allows silver contacts to maintain performance in environments with high electrical stress.

Typical Applications:

- Industrial machinery switches
- High-power appliance switches
- Direct switching circuits

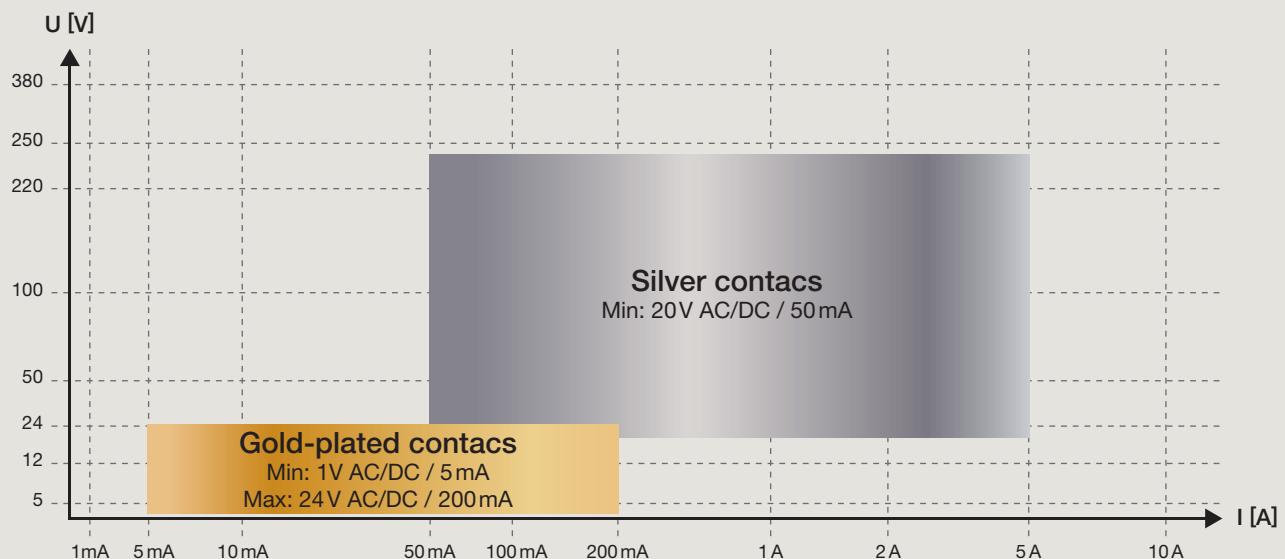
Low-Level Applications

For lower-level applications, such as signal processing circuits, and voltages below around 20V silver contacts may fall short due to their tendency to oxidise. When low currents are used, the contacts lack the energy to break through the oxidation layer, leading to unreliable switching. In such cases, gold-plated contacts offer a clear advantage. Gold, being inert and resistant to oxidation, maintains a clean surface, ensuring low resistance switching at lower currents and voltages.

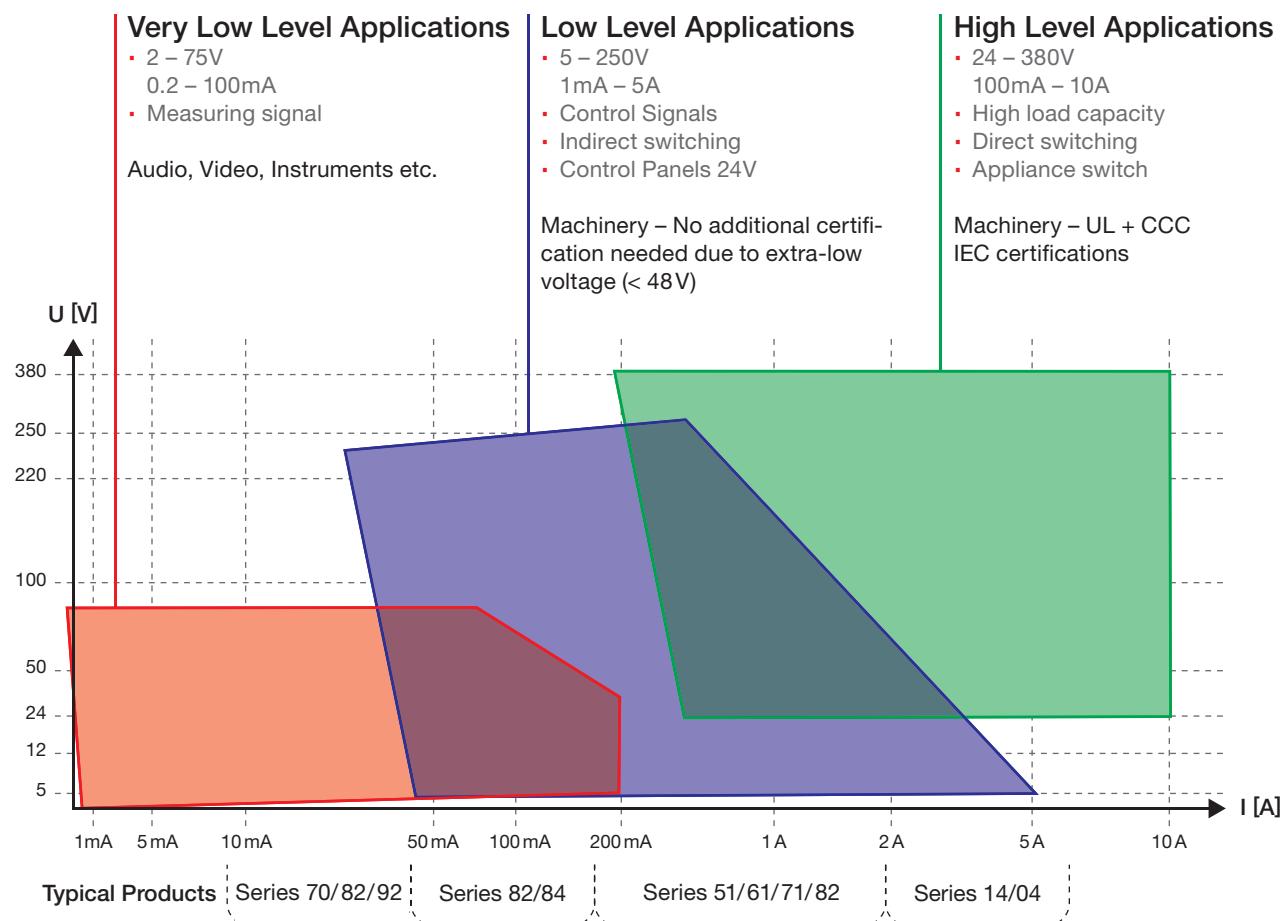
Typical Applications:

- Control signals for machinery
- Outdoor remote control systems with E-Stops
- Instrumentation switches
- Audio and video equipment

Switching Voltage and Current – Contact material Recommendations



Voltage and Current Switching Domain diagram with applicable EAO Series number



Benefits of Gold-Plated Contacts

1. Oxidation Resistance

The most significant benefit of gold-plated contacts is their resistance to corrosion and oxidation. While silver contacts form an oxidation layer over time that can lead to higher contact resistance, gold remains oxidation-free. This makes gold-plated contacts particularly valuable in low-level signal applications where even minor increases in contact resistance can disrupt the circuit's operation.

2. Reliability in Polluted and Humid Environments

Gold-plated contacts are ideal for applications in harsh environments, where moisture, dust, and other pollutants are present. In such environments, silver contacts will oxidize more rapidly, while gold contacts continue to function reliably without degradation. This makes gold-plated contacts a preferred choice for switches used outdoors or in industrial settings exposed to environmental contaminants.

3. Low-Level Signal Switching

Gold-plated contacts are superior for applications that involve lower voltage and lower current. These include control systems, precision instruments, and audio-video equipment where the signal integrity must be maintained without interference from increased contact resistance.

4. Additional benefits of homogenous silver/gold alloy contacts

“ With the right choice of materials and products, your application can function at the highest quality for several years at an optimum cost-benefit ratio. ”

Electrical contacts on some premium switches utilise a special silver/gold alloy for the whole of the switching contact pill. This offers superior performance for applications demanding highly reliable switches suitable for long term operation measured in decades and in both low level (<17V) and higher level switching applications and even in areas where there might be the likelihood of oxidation from moisture and contamination.

Should a higher voltage signal such as 110VDC or 250VAC be switched, the integrity of the switch contact is maintained as there is no gold plating to burn off. The switch contact still retains its low contact resistance and oxidation resistance should there be a need to later switch lower voltage

Limitations and Considerations

Cost

Gold is a precious metal, and plating contacts with gold adds to the manufacturing cost. For high-load applications where silver contacts suffice, the additional expense of gold plating may not be justified. However, for low-level and sensitive signal applications, the enhanced performance of gold-plated contacts or even the superior homogenous silver/gold alloy contacts often outweighs the added cost over the lifetime of the switch.

Contact Load Range

While silver contacts can handle higher loads up to 500V AC gold-plated contacts are generally limited to lower voltages and currents (up to 24V AC/DC and 200mA) Therefore, it is crucial to match the contact material with the application's electrical load requirements to ensure optimal performance.



Conclusion

The choice between gold-plated and silver contacts depends on the specific application and environmental conditions in which the pushbuttons and switches will be used. Silver contacts excel in high-load, high-power applications where self-cleaning through oxidation removal is possible. However, for low-level applications, gold-plated or even homogenous silver/gold alloy contacts offer superior performance by preventing oxidation and ensuring reliable and stable switching, especially in polluted or humid environments.

By understanding the strengths and limitations of both materials, designers and engineers can make informed decisions that optimise the performance and longevity of their electrical push button switches.

Recommendations:

- **Use gold-plated contacts** in applications where reliability, especially in low-level signals, is critical and where voltages are below around 20V or in applications where moisture or other environmental contaminants might cause silver oxidisation, e.g. E-Stop Switches
- **Use homogenous silver/gold alloy contacts** in high value applications that demand extremely long-term reliability, improved resistance to moisture and contaminants and/or where both low and high voltage switching may be required in the same switch circuit
- **Use silver contacts** in high voltage industrial applications above 20V where cost-effectiveness and load capacity are priorities, and oxidation can be managed through electrical cleaning

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