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High Contact Resistance in Spring Loaded Micro-S itches

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Background

A group of small switches were found to exhibit contact resistance readings which exceeded the maximum allowed. Initially, this was thought to be the result of contamination on the surface of the plated contacts within the switch.

he switch is spring loaded (spring steel), and consists of gold plated (0.0001" [2.5µm]) silver spheres (~1mm dia.) riding on silver (~0.00025" [6.4µm]) / gold (~0.0001"[2.5µm]) plated copper arms. he contacts themselves consist of silver / gold plated brass. In the "rest" position, the spheres contact the lower surfaces. When the switch is activated via a push button, the spheres hit the upper contacts. On the left side, this is the same contact, top and bottom. On the right side, the contacts are separate, with the signal traveling out of either one of two prongs at the base of the switch. For comparison, the following contact resistance measurements are given for two switches each, good and bad:

	G D SWITCHES		BAD SWITCHES	
	Position 1	**Position 2**	**Position 1**	**Position 2**
S itch "A"	5.6 µ	5.4 µ	367 µ	16.4 µ
S itch "B"	3.7 µ	5.3 µ	56.2 µ	21.2 µ

Other "bad" switches exhibited contact resistances of 14 to 134 µ in Position 1, and 8.1 to 53.1 µ in position two.

Cross-Sectional Analysis

One face of the housing was gently removed with a razor blade, exposing the interior of the switch. Initial examination at low magnification did not reveal any evident contamination on the plated surfaces. he part was then mounted in clear media, metallographically polished, and etched with 50-50 nitric-acetic acid. Examination was initially made at 10 ~ 30X, and photographs were taken. It was immediately apparent that the arms which the gold plated spheres attach to were contacting at an abnormal angle. Comparison to known "good" examples showed that the sphere-arm contact point should be flat and head on (see attached photographs). Higher power examination at 100X revealed gaps at the interface (due to the angle of contact) and a smaller than normal contact area, hence higher resistance. his was observed on both the left and right spheres.

Conclusion

As this was an obvious physical defect, the gold plater was exonerated of the problem. Adjustments to the manufacturing process alleviated the issue. On a side note, it was highly likely that plating processing solutions were trapped and then dried within the gaps formed by the abnormal attachment, further increasing the contact resistance. his was a secondary effect, however, and would not come into play if the attachment were normal.

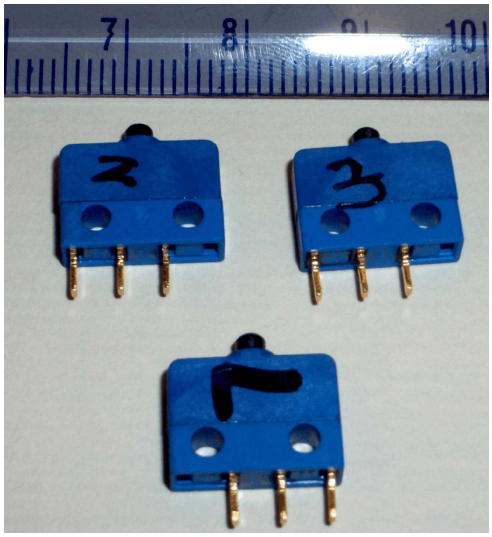

Fig. 1 - Overview of submitted samples.

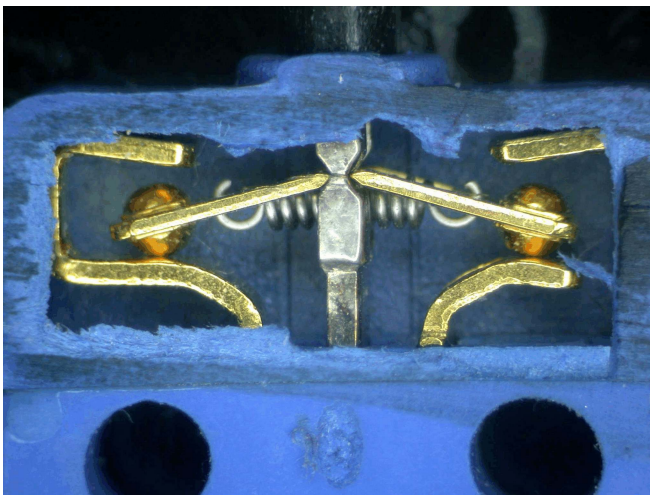

Fig. 2 - Internal view of a switch which exhibits high contact resistance.

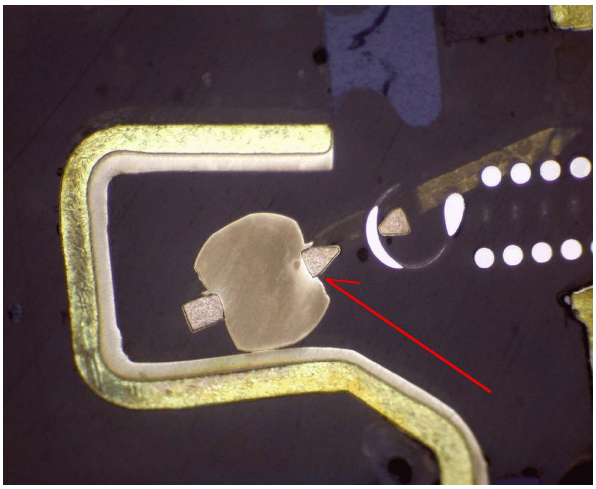

Fig. 3 - Good contact showing square attachment.

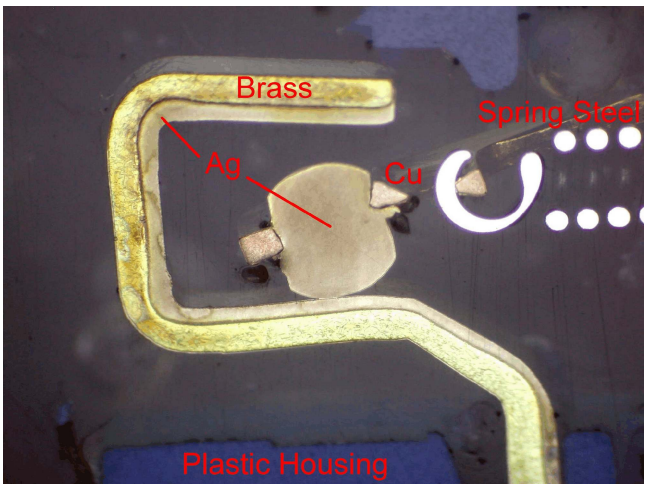

Fig. 4 - Bad contact. Note angle of attachment.

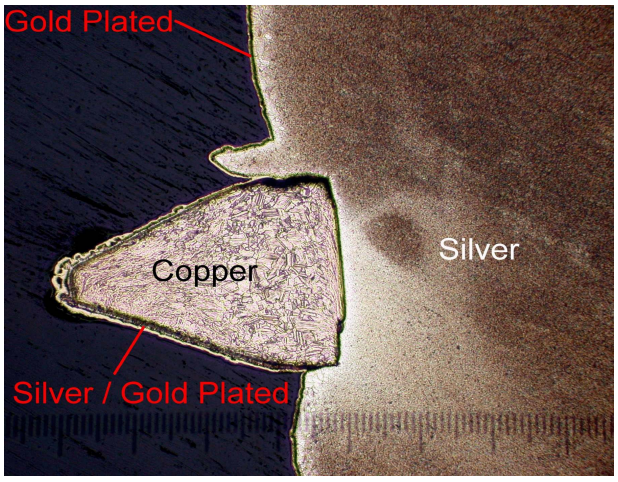

Fig. 5 - Normal attachment on a good contact.

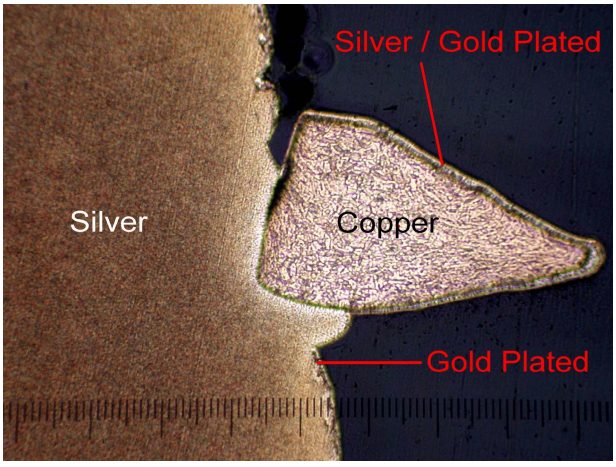

Fig. 6 - Angled attachment on a bad contact. Note gap as well.

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