ANTI-SULFURATION

INTRODUCTION

Sulfur corrosion-related failures with high levels of atmospheric pollution and with high relative humidity levels commonly found in the Asia georegion. It has all led to increased rates of hardware failures associated with particulate and gaseous contamination. Especially the growth of silver sulfide, resulting from silver corrosion, can cause an increase in resistance and eventually, an electrical open of the chip resistor.

There are two solutions to solve the threat of sulfur corrosion. First one is making the products more robust against sulfur corrosion. The best method to increase the robustness of resistors in high sulfur environments is to employ Anti-Sulfur Resistors. Second one is gaining better understanding of the allowable levels of contamination, temperature and humidity under which IT equipment can operate reliably.

It is very important for Silicon Power Industrial products to classify the robustness against sulfur corrosion of electronics hardware for industrial applications especially for networking equipments in datacenter, IIoT devices, automotive and medical segments.

METHODS OF ANTI-SULFURATION

There are several methods to elevate the anti-sulfur corrosion capacity of electronics equipment including anti-sulfur chip resistor and conformal coating application.

The typical chip resistor with silver electrode can be replaced with an anti-sulfur chip resistor. Besides, conformal coating is a system-level solution which can protect the board and component to prevent the sulfur corrosion occurrence.

According to research paper “Evaluation of the Anti-Sulfur Corrosion Capacity for Chip Resistor and Conformal Coating by Way of Flower-of-Sulfur (FoS) Methodology", published on International Microsystems, Packaging Assembly and Circuits Technology Conference, the international standard of EIA-977 FoS test was adopted to evaluate the anti-sulfur corrosion capacity for chip resistor and conformal coating. EIA-977 FoS test is the latest sulfur corrosion qualification for the electronic passive components exposure to atmospheric sulfur which was published in 2017. This test method is a modified form of ASTM B 809 and also suitable for electronic passive components exposure to atmospheric sulfur.

ANTI-SULFUR CHIP RESISTOR

Typical ship resistors with silver-based inner electrodes can lose conductivity when the silver reacts with sulfur in a high-sulfur environment. The electrodes can lose all conductivity and disconnect the circuit as sulfuration continues. Anti-sulfur chip resistors and arrays are designed to protect against sulfuration of the resistor electrodes and pass ASTM B809-95 105°C, 750 hours anti-sulfuration FOS testing.

EFFECTIVENESS OF ANTI-SULFUR CORROSION CAPACITY

DRAM Modules with anti-sulfur chip resistors and arrays without conformal coating can survive for at least 600 hours (25 days) in the research paper. According to ISA Standard 71.04 G2 level is the most recognized severity level of airborne contaminants in developed regions for applications in Data centers. Silicon Power DDR4 modules are ready to equip the industrial standard anti-sulfur chip resistors and arrays to withstand ISA standard 71.04 G2 severity level with 3-year warranty.

❖ Classification of Severity of Airborne Contaminants-Gases

- Guideline from the ISA standard 71.04-2013 was used to classify the measured thickness of airborne contaminants into the various severity level rankings：

ISA STANDARD S71.04-2013			
Severity Level	Reactivity Level	Copper Corrosion	Silver Corrosion
G1	Mild	＜300 Angstroms / 30 days	＜200 Angstroms / 30 days
G2	Moderate	＜1000 Angstroms / 30 days	＜1000 Angstroms / 30 days
G3	Harsh	＜2000 Angstroms / 30 days	＜2000 Angstroms / 30 days
G4	Severe	＞2000 Angstroms / 30 days	＞2000 Angstroms / 30 days

ISA 71.04-G2 SEVERITY LEVEL	Expected Film Thickness for Corrosion	
	Silver (Ag)	Copper (Cu)
1-year warranty (12 months)	12,000	12,000
2-year warranty (24 months)	24,000	24,000
3-year warranty (36 months)	36,000	36,000
Accelerated Corrosion (xx days; MFG or FoS)	----	----
Assessed Simulation Time in G2 Environment	year	year

REFERENCE

Dem Lee, Leo Yao and Jeffrey L.,, “Evaluation of the Anti-Sulfur Corrosion Capacity for Chip Resistor and Conformal Coating by Way of Flower-of-Sulfur (FoS) Methodology", International Microsystems, Packaging Assembly and Circuits Technology Conference.