

FMEA Analysis Report

sensor_interface

**Failure Mode and Effects Analysis
for Electronic Circuit Board**

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Standard:	AIAG-VDA FMEA / IPC-A-610
Classification:	Quality Assurance Document

Executive Summary

This FMEA analysis evaluates the sensor_interface circuit design to identify potential failure modes and assess associated risks. The analysis examined 7 components across 0 subsystems.

Key Findings

Metric	Value	Status
Total Failure Modes Analyzed	23	✓ Good
Critical Risk Modes (RPN ≥ 300)	2	■ Attention
High Risk Modes (125 ≤ RPN < 300)	14	■ Attention
Average RPN Score	187.9	■ Attention

System Overview

Circuit analysis of sensor_interface.json

Subsystems

FMEA Analysis Table

ID	Component	Failure Mode	Effect	S	O	D	RPN	Risk
1	J1 - Conn_01x04	Solder joint failure	Complete loss of connection, s	9	7	7	441	Critical
2	U2 - ATmega328P-AU	ESD damage	Complete MCU failure, system i	10	4	8	320	Critical
3	C1 - C	ESR increase	Power supply instability, heat	6	6	7	252	High
4	C2 - C	ESR increase	Power supply instability, heat	6	6	7	252	High
5	C1 - C	Capacitance degradation	Increased ripple, filtering in	5	7	7	245	High
6	C2 - C	Capacitance degradation	Increased ripple, filtering in	5	7	7	245	High
7	U2 - ATmega328P-AU	Flash corruption	Firmware corruption, boot fail	8	4	7	224	High
8	U2 - ATmega328P-AU	Thermal damage	Component malfunction	9	4	6	216	High
9	R1 - R	Resistance drift	Component malfunction	4	6	8	192	High
10	R2 - R	Resistance drift	Component malfunction	4	6	8	192	High
11	J1 - Conn_01x04	Contact oxidation	Intermittent connection, data	5	6	6	180	High
12	U2 - ATmega328P-AU	I/O pin failure	Peripheral communication loss	7	5	5	175	High
13	R1 - R	Thermal damage	Component malfunction	7	4	6	168	High
14	R2 - R	Thermal damage	Component malfunction	7	4	6	168	High
15	U2 - ATmega328P-AU	Clock failure	System hang, timing errors	9	3	6	162	High
16	J1 - Conn_01x04	Mechanical damage	Connection loss, physical dama	7	5	4	140	High
17	C1 - C	Short circuit	Power rail short, system damag	8	3	5	120	Medium
18	C2 - C	Short circuit	Power rail short, system damag	8	3	5	120	Medium
19	J1 - Conn_01x04	Pin misalignment	Component malfunction	6	4	5	120	Medium
20	C1 - C	Open circuit	Component malfunction	7	3	5	105	Medium
21	C2 - C	Open circuit	Component malfunction	7	3	5	105	Medium
22	R1 - R	Open circuit	Component malfunction	6	3	5	90	Medium
23	R2 - R	Open circuit	Component malfunction	6	3	5	90	Medium

Risk Assessment Matrix

Risk Level	RPN Range	Count	Action Required
Critical	≥ 300	2	Immediate action required
High	125-299	14	Action required before production
Medium	50-124	7	Monitor and improve if feasible
Low	< 50	0	Acceptable risk level

Recommendations

Priority Actions

- **J1 - Conn_01x04** - Solder joint failure: CRITICAL: Add mechanical support, use thicker copper pours, implement strain relief
- **U2 - ATmega328P-AU** - ESD damage: CRITICAL: Add TVS diodes, implement ESD protection circuits, use guard rings
- **C1 - C** - ESR increase: Important: Review design and implement appropriate mitigation
- **C2 - C** - ESR increase: Important: Review design and implement appropriate mitigation
- **C1 - C** - Capacitance degradation: Use higher-grade capacitors, derate voltage, add redundancy

General Recommendations

- Implement design review process with focus on high-RPN items
- Establish component derating guidelines (50-80% of maximum ratings)
- Add test points for critical signals to improve detection capability
- Implement thermal analysis and management for power components
- Establish incoming inspection procedures for critical components
- Document lessons learned and update FMEA regularly