FMEA Analysis Report
circuit

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 circuit circuit design to identify potential failure modes and assess associated risks. The analysis examined 16 components across 0 subsystems.

Key Findings

Metric	Value	Status
Total Failure Modes Analyzed	57	✓ Good
Critical Risk Modes (RPN ≥ 300)	3	■ Attention
High Risk Modes (125 ≤ RPN < 300)	34	■ Attention
Average RPN Score	177.4	■ Attention

System Overview

Circuit analysis of circuit.json

Subsystems

FMEA Analysis Table

#	Component	Failure Mode	S	O	D	RPN	Risk
1	J1 - USB_C_Receptacle_USB2.0_16P	Solder joint failure	9	7	7	441	Critical
2	J2 - Conn_02x03_Odd_Even	Solder joint failure	9	7	7	441	Critical
3	U1 - AMS1117-3.3	Thermal shutdown	8	7	6	336	Critical
4	U2 - ESP32-C6-MINI-1	ESD damage	9	4	8	288	High
5	U1 - AMS1117-3.3	Input overvoltage failure	9	4	7	252	High
6	C1 - C	ESR increase	6	6	7	252	High
7	C2 - C	ESR increase	6	6	7	252	High
8	C3 - C	ESR increase	6	6	7	252	High
9	C4 - C	ESR increase	6	6	7	252	High
10	U1 - AMS1117-3.3	Output voltage drift	7	5	7	245	High
11	C1 - C	Capacitance degradation	5	7	7	245	High
12	C2 - C	Capacitance degradation	5	7	7	245	High
13	C3 - C	Capacitance degradation	5	7	7	245	High
14	C4 - C	Capacitance degradation	5	7	7	245	High
15	U1 - AMS1117-3.3	Dropout voltage increase	6	5	8	240	High

Detailed Failure Analysis

Component	Failure Mode	Root Cause	Effect	Recommendation
J1 - USB_C_Receptacle_USB2.0_16P	Solder joint failure	Thermal cycling, mechanical stress	Complete loss of connection, system failure	CRITICAL: Add mechanical support, use thicker copper pours, implement strain relief
J2 - Conn_02x03_Odd_Even	Solder joint failure	Thermal cycling, mechanical stress	Complete loss of connection, system failure	CRITICAL: Add mechanical support, use thicker copper pours, implement strain relief

U1 - AMS1117-3.3	Thermal shutdown	Overcurrent, poor heatsinking	System power loss, unexpected reset	CRITICAL: Improve heatsinking, add thermal vias, consider higher-rated component
U2 - ESP32-C6-MINI-1	ESD damage	Handling, environmental discharge	Complete MCU failure, system inoperable	CRITICAL: Add TVS diodes, implement ESD protection circuits, use guard rings
U1 - AMS1117-3.3	Input overvoltage failure	Transient spikes	Cascading component damage	CRITICAL: Review design and implement appropriate mitigation
C1 - C	ESR increase	Electrolyte drying	Power supply instability, heating	Important: Review design and implement appropriate mitigation
C2 - C	ESR increase	Electrolyte drying	Power supply instability, heating	Important: Review design and implement appropriate mitigation
C3 - C	ESR increase	Electrolyte drying	Power supply instability, heating	Important: Review design and implement appropriate mitigation
C4 - C	ESR increase	Electrolyte drying	Power supply instability, heating	Important: Review design and implement appropriate mitigation
U1 - AMS1117-3.3	Output voltage drift	Component aging, temperature	Component malfunction, reduced reliability	Important: Review design and implement appropriate mitigation

Risk Assessment Matrix

Risk Level	RPN Range	Count	Action Required
Critical	≥ 300	3	Immediate action required
High	125-299	34	Action required before production
Medium	50-124	19	Monitor and improve if feasible
Low	< 50	1	Acceptable risk level

Recommendations

Priority Actions

• **J1 - USB_C_Receptacle_USB2.0_16P** - Solder joint failure: CRITICAL: Add mechanical support, use thicker copper pours, implement strain relief

• **J2 - Conn_02x03_Odd_Even** - Solder joint failure: CRITICAL: Add mechanical support, use thicker copper pours, implement strain relief

• **U1 - AMS1117-3.3** - Thermal shutdown: CRITICAL: Improve heatsinking, add thermal vias, consider higher-rated component

• **U2 - ESP32-C6-MINI-1** - ESD damage: CRITICAL: Add TVS diodes, implement ESD protection circuits, use guard rings

• **U1 - AMS1117-3.3** - Input overvoltage failure: CRITICAL: Review design and implement appropriate mitigation

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