ISO/TR 9839:2023-08 (E)

Road vehicles - Application of predictive maintenance to hardware with ISO 26262-5

Contents

Page

Foreword iv

Introduction v

1 Scope 1

2 Normative references 1

3 Termsanddefinitions 1

4 Abbreviated terms 2

5 Literature survey of degrading faults 4
5.1 General 4
5.2 Degrading faults in industry standards 4
5.2.1 JEDEC JEP122H[4] 4
5.3 Degrading faults in technical publications 5
5.3.1 Advanced CMOS Reliability Update: Sub 20 nm FinFET Assessment[5] 5
5.3.2 Circuit-Based Reliability Consideration in FinFET Technology[6] 6
5.3.3 Intermittent Faults and Effects on Reliability of Integrated Circuits[7] 6

6 Literature survey on predictive maintenance 6
6.1 General 6
6.2 Predictive maintenance in industry standards 6
6.2.1 IEC 61508[9] 6
6.2.2 IEEE Std 1856[3] 6
6.3 Predictive maintenance in technical publications 7
6.3.1 A Survey of Online Failure Prediction Methods[10] 7
6.3.2 An Odometer for CPUs[11] 7
6.3.3 Circuit Failure Prediction for Robust System Design in Scaled CMOS [12] 8
6.3.4 A Circuit Failure Prediction Mechanism (DART) for High Field Reliability [13] 8
6.3.5 Predicting Remediations for Hardware Failures in Large-Scale Datacenters[14] 8
6.3.6 Improving Analog Functional Safety Using Data-Driven Anomaly Detection [15] 8

7 Degrading faults and the ISO 26262 series 8
7.1 Understanding the lifecycle of degrading faults 8
7.2 Classification of degrading faults 12
7.3 Quantifying degrading fault base failure rate 12
7.3.1 Industry standards and models 12
7.3.2 Field data 13
7.3.3 Expert judgement 13

8 Applying predictive maintenance 13
8.1 Diagnostic coverage (DC) evaluation for predictive mechanisms 13
8.2 Considering random hardware metrics 13
8.2.1 Impacting the SPFM and LFM 13
8.2.2 Application as a dedicated measure 14
8.3 Considering RUL prediction 14

Annex A (informative) An approach to handling degrading faults 16

Bibliography 18