

Reliability Requirements for Passive Optical Components

Contents

| | |
|---|-----------|
| Preface..... | Preface-1 |
| 1. Introduction..... | 1-1 |
| 1.1 Scope and Purpose | 1-1 |
| 1.2 Changes in the Document..... | 1-2 |
| 1.2.1 Changes From TA-NWT-001221 Issue 2 to GR-1221-CORE Issue 1..... | 1-2 |
| 1.2.2 Changes From GR-1221-CORE, Issue 1 to Issue 2..... | 1-3 |
| 1.2.3 Future Additions/Changes..... | 1-3 |
| 1.3 Related Telcordia Documents..... | 1-4 |
| 1.4 Requirements Terminology | 1-4 |
| 1.5 Requirement Labeling Conventions | 1-5 |
| 1.5.1 Numbering of Requirement and Related Objects..... | 1-5 |
| 1.5.2 Requirement, Conditional Requirement, and Objective Object Identification..... | 1-5 |
| 1.6 Operating Environments..... | 1-6 |
| 1.6.1 Central Office (CO) Environment..... | 1-6 |
| 1.6.2 Remote Terminal (RT) Environment | 1-6 |
| 1.6.3 Uncontrolled Environment..... | 1-7 |
| 1.7 Other Terminology..... | 1-7 |
| 1.7.1 Suppliers, Vendors, and Manufacturers..... | 1-7 |
| 1.7.2 Quality Levels..... | 1-7 |
| 2. Reliability Assurance - Overview and Philosophy..... | 2-1 |
| 2.1 Overview of Reliability Assurance..... | 2-1 |
| 2.2 Generic Requirements Philosophy | 2-2 |
| 3. Basic Reliability Assurance Program Requirements..... | 3-1 |
| 3.1 Vendor and Device Qualification | 3-1 |
| 3.1.1 Specification and Control..... | 3-2 |
| 3.1.2 Vendor Approval..... | 3-2 |
| 3.1.3 General Criteria for Device Qualification..... | 3-3 |
| 3.1.3.1 Qualification Tests | 3-4 |
| 3.1.3.2 Device Codes that Fail Qualification | 3-4 |
| 3.1.3.3 Qualification of Devices by Similarity | 3-4 |
| 3.1.3.4 Use of Nonconforming Devices for Qualification..... | 3-5 |
| 3.1.3.5 Provisional Use of Devices..... | 3-5 |
| 3.1.3.6 Low Volume Parts | 3-6 |
| 3.1.3.7 Hermeticity..... | 3-7 |
| 3.1.3.8 Solder Flux..... | 3-7 |
| 3.1.3.9 Use of Vendor-Supplied Data..... | 3-7 |
| 3.1.3.10 Treatment of Internally Manufactured Devices | 3-8 |

| | | |
|----------|---|------|
| 3.1.4 | Environment, Health, and Safety Considerations | 3-8 |
| 3.1.4.1 | Environment Considerations | 3-8 |
| 3.1.4.2 | Health Considerations | 3-8 |
| 3.1.4.3 | Safety Considerations | 3-9 |
| 3.1.5 | Other General Information for Qualification | 3-9 |
| 3.1.6 | Requalification | 3-12 |
| 3.2 | Lot-To-Lot Quality and Reliability Controls | 3-13 |
| 3.2.1 | General Criteria for Lot Controls..... | 3-14 |
| 3.2.1.1 | Definition of a Lot | 3-14 |
| 3.2.1.2 | Purchase Specifications | 3-15 |
| 3.2.1.3 | Source Inspection/Incoming Inspection..... | 3-15 |
| 3.2.1.4 | Ship-to-Stock Programs..... | 3-16 |
| 3.2.1.5 | Test Plan..... | 3-17 |
| 3.2.1.6 | Test Equipment..... | 3-17 |
| 3.2.1.7 | Data Recording and Retention..... | 3-17 |
| 3.2.1.8 | Treatment of Defective Devices and Lots | 3-18 |
| 3.2.1.9 | Summary of Vendor History Data | 3-18 |
| 3.2.1.10 | Low Volume Parts | 3-18 |
| 3.2.1.11 | Use of Vendor-Supplied Data..... | 3-19 |
| 3.2.1.12 | Treatment of Internally Manufactured Devices | 3-19 |
| 3.2.2 | Other General Information for Lot-To-Lot Controls | 3-19 |
| 3.3 | Standardized Test Procedures | 3-20 |
| 3.4 | Feedback and Corrective Action | 3-20 |
| 3.4.1 | Incoming Inspection and Screening..... | 3-22 |
| 3.4.2 | System-Level Testing..... | 3-22 |
| 3.4.3 | Repair of Field Returns..... | 3-22 |
| 3.4.4 | Data Collection and Analysis | 3-23 |
| 3.4.5 | Unconfirmed Failures | 3-23 |
| 3.4.6 | Device Failure Analysis..... | 3-23 |
| 3.5 | Device Storage and Handling | 3-24 |
| 3.5.1 | Nonconforming Material..... | 3-24 |
| 3.5.2 | Material Review System..... | 3-24 |
| 3.5.3 | Stockroom Inventory Practices | 3-25 |
| 3.5.3.1 | FIFO Inventory Policy | 3-25 |
| 3.5.3.2 | Reworked Parts | 3-25 |
| 3.5.4 | ESD..... | 3-25 |
| 3.6 | Documentation and Test Data | 3-26 |
| 3.6.1 | Availability of Documentation | 3-26 |
| 3.6.2 | Availability of Other Information | 3-27 |
| 3.7 | Availability of Devices..... | 3-28 |
| 4. | Specific Reliability and Quality Criteria | 4-1 |
| 4.1 | Qualification of Passive Optical Devices | 4-1 |
| 4.1.1 | Characterization..... | 4-1 |
| 4.1.2 | Reliability Tests..... | 4-2 |
| 4.2 | Qualification of Integrated Passive Optical Module..... | 4-7 |
| 4.3 | Quality Assurance and Lot Controls..... | 4-8 |

| | | |
|--------|---|--------------|
| 4.3.1 | Visual Inspection..... | 4-8 |
| 4.3.2 | Optical Testing | 4-8 |
| 4.3.3 | Stress Screening..... | 4-9 |
| 4.3.4 | Optical Adhesives | 4-11 |
| 4.3.5 | Optical Fiber..... | 4-11 |
| 4.4 | Reliability and Quality of Optical Adhesives..... | 4-11 |
| 4.4.1 | Qualification and Requalification | 4-12 |
| 4.4.2 | Raw Material Storage | 4-14 |
| 4.4.3 | Lot-To-Lot Controls | 4-15 |
| 5. | Performance Criteria..... | 5-1 |
| 5.1 | Optical Requirements and Objectives | 5-1 |
| 5.2 | Optical Test Procedures..... | 5-1 |
| 5.3 | Optical Fiber and Optical Connectors | 5-1 |
| 6. | Reliability Test Procedures | 6-1 |
| 6.1 | Reliability Test Pass/Fail Criteria | 6-1 |
| 6.2 | Reliability Test Procedures | 6-2 |
| 6.2.1 | Mechanical Shock (Impact Test)..... | 6-2 |
| 6.2.2 | Variable Frequency Vibration Test..... | 6-3 |
| 6.2.3 | Thermal Shock Test..... | 6-3 |
| 6.2.4 | High Temperature Storage Test (Dry Heat) | 6-4 |
| 6.2.5 | High Temperature Storage Test (Damp Heat)..... | 6-4 |
| 6.2.6 | Low Temperature Storage Test..... | 6-5 |
| 6.2.7 | Temperature Cycling Test | 6-6 |
| 6.2.8 | Cyclic Moisture Resistance Test..... | 6-6 |
| 6.2.9 | Residual Gas Analysis | 6-7 |
| 6.2.10 | ESD Threshold | 6-7 |
| | Appendix A: Lot Tolerance Percentage Defective (LTPD) Table | A-1 |
| | Appendix B: Reliability Calculation..... | B-1 |
| | References..... | References-1 |
| | Glossary..... | Glossary-1 |

List of Figures

| | | |
|-------------|--|-----|
| Figure 2-1. | Elements of a Comprehensive Reliability Assurance Program..... | 2-2 |
| Figure 6-1. | Thermal Profile of Cyclic Moisture Resistance Test | 6-6 |
| Figure B-1. | Example of a Lognormal Probability Plot..... | B-4 |
| Figure B-2. | Goldthwaite Curves | B-5 |
| Figure B-3. | Nomograph for Calculating Random Failure Rates..... | B-7 |

List of Tables

| | | |
|------------|--|------|
| Table 1-1. | Definition of Quality Levels | 1-8 |
| Table 3-1. | Sample Format for Reporting Failure Rate Predictions..... | 3-11 |
| Table 3-2. | Sample Report Format for Reliability Test Status | 3-11 |
| Table 4-1. | Typical Characterization Tests for Branching Components..... | 4-2 |
| Table 4-2. | Required Reliability Tests | 4-4 |
| Table 4-3. | Test Matrix for Demonstrating Acceleration Factors | 4-6 |
| Table 4-4. | Typical Optical Parameters s for Branching Components..... | 4-9 |
| Table A-1. | LTPD Sampling Plan | A-1 |
| Table B-1. | Sample Format for Reporting Reliability Information | B-8 |