

# Table of Contents

## Preface

### 1 Introduction

1.1 Requirements Terminology . . . . .	1-2
1.2 Requirement Labeling Conventions . . . . .	1-3
1.2.1 Numbering of Requirement Objects . . . . .	1-3
1.2.2 Requirement Object Element Identification . . . . .	1-4
1.3 Revision History . . . . .	1-4
1.3.1 Changes from Issue 3 to Issue 4 . . . . .	1-4
1.3.2 Changes from Issue 2 to Issue 3 . . . . .	1-5
1.3.3 Changes from Issue 1 to Issue 2 . . . . .	1-7
1.3.4 Requirement Object Absolute Number Assignment . . . . .	1-10

### 2 General Clock Concepts

2.1 Applications . . . . .	2-1
2.2 NE Interfaces . . . . .	2-1
2.3 Stratum Hierarchy . . . . .	2-3
2.4 Timing Distribution . . . . .	2-4
2.5 Clock Operating Environments . . . . .	2-5
2.6 Performance Measurement Parameters and Units . . . . .	2-5
2.6.1 Slips . . . . .	2-5
2.6.2 Unit Interval (UI) . . . . .	2-6
2.6.3 Jitter . . . . .	2-6
2.6.4 Wander . . . . .	2-6
2.6.5 Time Delay, Phase-Time or Phase . . . . .	2-6
2.6.6 Frequency Accuracy . . . . .	2-7
2.6.7 Frequency Drift . . . . .	2-7
2.7 Test Measurement Parameters . . . . .	2-7
2.7.1 Time Interval Error (TIE) . . . . .	2-7
2.7.2 Maximum Time Interval Error (MTIE) . . . . .	2-8
2.7.3 Time Deviation (TDEV) . . . . .	2-9
2.7.4 Time Variance (TVAR) . . . . .	2-9
2.7.5 Fractional Frequency Offset and Drift . . . . .	2-10
2.8 Test Methodology . . . . .	2-11

### 3 General Functional Criteria

3.1 Clock Performance Criteria Summary . . . . .	3-1
3.2 NE Timing Modes . . . . .	3-2
3.2.1 External Timing . . . . .	3-2
3.2.1.1 External Timing Functionality . . . . .	3-3
3.2.1.2 Physical Interface to the Synchronization Network . . . . .	3-4
3.2.2 Line Timing . . . . .	3-5
3.2.3 Loop Timing . . . . .	3-6
3.2.4 Through Timing . . . . .	3-6
3.3 Duplication of Equipment . . . . .	3-7
3.4 Timing Reference Switching . . . . .	3-8

- 3.4.1 Timing Reference Failure Conditions . . . . . 3–9
- 3.4.2 Performance During Reference Switching . . . . . 3–11
- 3.4.3 Revertive and Nonrevertive Reference Switching . . . . . 3–12
- 3.5 Pull-In/Hold-In Ranges and Related Times . . . . . 3–13
- 3.6 Switching Between Clock Modes . . . . . 3–15
- 3.7 Reference Validation Times . . . . . 3–16
  
- 4 Input Tolerance Criteria**
- 4.1 Short Signal Interruptions . . . . . 4–1
- 4.2 Jitter Tolerance . . . . . 4–2
- 4.3 Wander Tolerance . . . . . 4–3
- 4.4 Phase Transient Tolerance . . . . . 4–5
  
- 5 Output Signal Criteria**
- 5.1 Free-Run Frequency Accuracy . . . . . 5–1
- 5.2 Holdover Frequency Stability . . . . . 5–1
- 5.3 Wander Generation . . . . . 5–7
- 5.4 Wander Transfer . . . . . 5–9
- 5.5 Jitter Generation and Transfer . . . . . 5–11
- 5.6 Phase Transients . . . . . 5–11
- 5.7 Phase Build-Out . . . . . 5–16
- 5.8 Phase Changes During Pull-In . . . . . 5–18
  
- 6 Additional Criteria Related To DS0 Interconnections**
- 6.1 Support of CC Reference Signals . . . . . 6–2
- 6.2 Phase Alignment Requirements . . . . . 6–2
- 6.3 CC Robustness . . . . . 6–2
  - 6.3.1 Composite Clock Reference Failures . . . . . 6–3
  - 6.3.2 Composite Clock Reference Switching . . . . . 6–4
  - 6.3.3 CC Phase Transients and Phase Hits . . . . . 6–4
  - 6.3.4 CC Holdover . . . . . 6–5
  
- 7 Primary Reference Sources**
  
- 8 Alarms, Reports and Control Commands**
- 8.1 Alarms and Non-Alarmed Conditions . . . . . 8–1
  - 8.1.1 Minor Alarms . . . . . 8–2
  - 8.1.2 Major Alarms . . . . . 8–3
  - 8.1.3 Critical Alarms . . . . . 8–3
  - 8.1.4 Alarm Escalation . . . . . 8–3
  - 8.1.5 Non-Alarmed Conditions . . . . . 8–4
- 8.2 Performance Monitoring Data Retention . . . . . 8–5
- 8.3 Controls . . . . . 8–6
- 8.4 Status Indicators . . . . . 8–8
  
- 9 Other Generic Criteria**
- 9.1 Physical and Environmental Criteria . . . . . 9–1
  - 9.1.1 Operational Environment for Equipment . . . . . 9–1

9.1.2 Electromagnetic Compatibility (EMC) . . . . . 9-2  
9.2 Documentation and Training . . . . . 9-2  
9.3 Internal Diagnostics . . . . . 9-3

**Appendix A: Deleted Requirement-Objects List**

A.1 Requirement Objects Deleted as of Issue 2 . . . . . A-1  
A.2 Requirement Objects Deleted as of Issue 3 . . . . . A-2  
A.3 Requirement Objects Deleted as of Issue 4 . . . . . A-2

**References**

**Acronyms**

**Requirement-Object Index**



## List of Figures

Figure 2-1	Conceptual Block Diagram of Clocks Embedded in an NE . . . . .	2-2
Figure 2-2	TIE and MTIE Example . . . . .	2-7
Figure 2-3	MTIE Definition . . . . .	2-8
Figure 3-1	External Timing Example . . . . .	3-3
Figure 3-2	Line-Timing Example . . . . .	3-5
Figure 3-3	Loop-Timing Example . . . . .	3-6
Figure 3-4	Through-Timing Example . . . . .	3-7
Figure 3-5	Synchronization Reference Frequency Offset Treatment . . . . .	3-10
Figure 4-1	DS1 Reference Input Jitter Tolerance . . . . .	4-3
Figure 4-2	Wander Tolerance . . . . .	4-4
Figure 4-3	Wander Tolerance for NEs That Support Only DS1 Line-Timing . . .	4-5
Figure 4-4	Input DS1 Phase Transient MTIE Mask for a Line-Timed NE . . . .	4-6
Figure 5-1	Holdover Stability for Stratum 3E Clocks (Worst-Case) . . . . .	5-4
Figure 5-2	Holdover Stability for Stratum 3 Clocks (Worst-Case) . . . . .	5-5
Figure 5-3	Holdover Stability for Stratum 2 Clocks (Worst-Case) . . . . .	5-6
Figure 5-4	Wander Generation – TDEV . . . . .	5-8
Figure 5-5	Wander Generation – MTIE . . . . .	5-9
Figure 5-6	Wander Transfer . . . . .	5-10
Figure 5-7	Phase Transient MTIE Mask for Most Rearrangements . . . . .	5-13
Figure 5-8	Phase Transient MTIE Masks for Entry Into Holdover . . . . .	5-15
Figure 5-9	MTIE Mask for Input/Output Phase Transients . . . . .	5-16
Figure 5-10	Phase-Time Deviation Limits During Pull-In – Example 1 . . . . .	5-21
Figure 5-11	Phase-Time Deviation Limits During Pull-In – Example 2 . . . . .	5-22



## List of Tables

Table 3-1	Clock Requirements Summary . . . . .	3-1
Table 3-2	Frequency Offset Failure Declaration Time . . . . .	3-11
Table 3-3	Example of Nonrevertive and Revertive Reference Switching . . .	3-12
Table 3-4	Maximum Settling Time . . . . .	3-14
Table 3-5	Reference Requalification Time After Frequency Offset Failure . .	3-17
Table 5-1	Holdover Components for Stratum 3E and 3 Clocks . . . . .	5-3
Table 5-2	Example “Worst-case” Pull-in Process Frequency Offsets . . . . .	5-20