

## Contents

Preface . . . . .	Preface-1
1. Introduction . . . . .	1-1
1.1 Purpose of this Document . . . . .	1-1
1.1.1 General Comments . . . . .	1-1
1.1.2 Reasons for GR, Issue 1 . . . . .	1-2
1.1.2.1 Technical Information . . . . .	1-2
1.1.2.2 Context . . . . .	1-2
1.1.3 Relation to Other Documents . . . . .	1-2
1.2 General System Description . . . . .	1-3
1.2.1 Configurations . . . . .	1-4
1.2.2 Functional Terminology . . . . .	1-4
1.2.3 Modes of Operation . . . . .	1-9
1.2.3.1 Mode I . . . . .	1-9
1.2.3.2 Mode II . . . . .	1-9
1.2.3.3 Mode III . . . . .	1-10
1.3 Organization of this GR . . . . .	1-14
2. Electrical Specifications . . . . .	2-1
2.1 General . . . . .	2-1
2.2 Loss . . . . .	2-1
2.3 Delay . . . . .	2-1
3. Framing and Signaling . . . . .	3-1
3.1 DS1 Frame Organization — General . . . . .	3-1
3.2 Channel Numbering . . . . .	3-1
3.3 Time Slot Assignment . . . . .	3-2
3.3.1 Modes I and III . . . . .	3-2
3.3.2 Mode II . . . . .	3-7
3.4 Per-Channel Signaling . . . . .	3-7
3.4.1 A and B Bit Signaling . . . . .	3-7
3.4.2 Signaling States . . . . .	3-7
3.5 The Data Link . . . . .	3-8
3.5.1 Data Link Format . . . . .	3-8
3.5.2 Concentrator Field . . . . .	3-12
3.5.3 First Spoiler Field . . . . .	3-12
3.5.4 Maintenance Field . . . . .	3-12
3.5.5 Alarm Field . . . . .	3-13
3.5.6 Protection Line Switch Field . . . . .	3-13
3.5.7 Second Spoiler Field . . . . .	3-15
4. Call Control . . . . .	4-1
4.1 Per-Channel Signaling for Call Control . . . . .	4-1
4.2 Concentrator Field Messages for Call Control . . . . .	4-1
4.3 Call Control Examples: Single Party Channel Units . . . . .	4-4
4.3.1 Customer On-Hook . . . . .	4-4

4.3.1.1	Mode I . . . . .	4-4
4.3.1.2	Mode II . . . . .	4-4
4.3.2	Calls Originating at the RT . . . . .	4-5
4.3.2.1	Mode I . . . . .	4-5
4.3.2.2	Mode II . . . . .	4-5
4.3.2.3	Call Setup After Origination Reporting . . . . .	4-9
4.3.3	Calls Terminating on the RT . . . . .	4-9
4.3.3.1	Mode I . . . . .	4-9
4.3.3.2	Mode II . . . . .	4-9
4.3.3.3	Ringling and Ring Trip . . . . .	4-10
4.3.4	Stable Calls . . . . .	4-10
4.3.5	Call Disconnect . . . . .	4-10
4.3.5.1	Mode I . . . . .	4-10
4.3.5.2	Mode II . . . . .	4-10
4.3.5.3	Forward Disconnect . . . . .	4-11
4.3.6	Summary of Mode II Call Control Messages . . . . .	4-11
4.3.6.1	Messages Sent to the RT . . . . .	4-11
4.3.6.2	Messages Sent to the LDS . . . . .	4-12
4.3.7	Unequipped Channels . . . . .	4-13
4.3.7.1	Mode I . . . . .	4-13
4.3.7.2	Mode II . . . . .	4-13
4.4	Call Control For Multiparty Channel Units . . . . .	4-14
4.4.1	Signaling Patterns Sent to the RT . . . . .	4-15
4.4.1.1	Tip Party Test . . . . .	4-15
4.4.1.2	Ringling . . . . .	4-16
4.4.1.3	Channel Test . . . . .	4-16
4.4.1.4	Idle . . . . .	4-16
4.4.2	Signaling Patterns Sent to the LDS . . . . .	4-16
4.4.2.1	Off-Hook . . . . .	4-16
4.4.2.2	Tip Party Ground . . . . .	4-17
4.4.2.3	On-Hook . . . . .	4-17
4.5	Call Control For Coin Channels . . . . .	4-17
4.5.1	Signaling Patterns Sent to the RT . . . . .	4-18
4.5.1.1	Negative Loop Mode . . . . .	4-18
4.5.1.2	Positive Loop Mode . . . . .	4-18
4.5.1.3	Ground Start . . . . .	4-19
4.5.1.4	Ringling . . . . .	4-19
4.5.1.5	Negative Coin Check . . . . .	4-19
4.5.1.6	Positive Coin Check . . . . .	4-19
4.5.1.7	Negative Coin Control . . . . .	4-20
4.5.1.8	Positive Coin Control . . . . .	4-21
4.5.1.9	Channel Test . . . . .	4-21
4.5.2	Signaling Patterns Sent to the LDS . . . . .	4-22
4.5.2.1	Coin Ground . . . . .	4-22
4.5.2.2	Off-Hook . . . . .	4-22
4.5.2.3	On-Hook . . . . .	4-23
4.6	Call Control For Switched VF Ground Start Circuits . . . . .	4-23

4.6.1	Signaling Patterns Sent to the RT . . . . .	4-23
4.6.1.1	Idle . . . . .	4-23
4.6.1.2	Ring . . . . .	4-23
4.6.1.3	Ground Start . . . . .	4-24
4.6.1.4	Channel Test . . . . .	4-24
4.6.2	Signaling Patterns Sent to the LDS . . . . .	4-24
4.6.2.1	Ring Ground . . . . .	4-24
4.6.2.2	Off-Hook . . . . .	4-25
4.6.2.3	On-Hook . . . . .	4-25
4.7	Call Control for Direct Inward Dialing Channel Units . . . . .	4-25
4.7.1	Signaling Patterns Sent to the RT . . . . .	4-25
4.7.1.1	Loop Open . . . . .	4-25
4.7.1.2	Loop Closure . . . . .	4-26
4.7.2	Signaling Patterns Sent to the LDS . . . . .	4-26
4.7.2.1	Normal Battery . . . . .	4-26
4.7.2.2	Reverse Battery . . . . .	4-26
4.8	Call Control of Switched VF Specials Using D4 Channel Units . . . . .	4-26
4.8.1	Mode I . . . . .	4-26
4.8.2	Mode II . . . . .	4-27
4.8.3	Mode III . . . . .	4-27
5.	System Maintenance . . . . .	5-1
5.1	System Maintenance Information . . . . .	5-1
5.1.1	The Data Link . . . . .	5-1
5.1.1.1	Alarm Field . . . . .	5-2
5.1.1.2	Concentrator Field: No Alarm Message . . . . .	5-3
5.1.1.3	Maintenance Field: Test Alarm RC Message . . . . .	5-3
5.1.2	Yellow Alarm . . . . .	5-3
5.1.3	AIS (Blue) Alarm . . . . .	5-3
5.1.4	Maintenance Information at the NOTE . . . . .	5-4
5.2	Maintenance Information Detected by the LDS . . . . .	5-4
5.2.1	Data Link Information Detection . . . . .	5-4
5.2.2	Loss of Data: Modes I and III . . . . .	5-5
5.2.3	Loss of Data: Mode II . . . . .	5-5
5.2.4	PCM Looping Test . . . . .	5-7
5.2.5	Yellow Alarm . . . . .	5-7
5.2.6	Out-of-Frame Detection . . . . .	5-8
5.2.7	Continuous Loss of Signal . . . . .	5-8
5.2.8	Bipolar Violations . . . . .	5-9
5.2.9	Protection Line . . . . .	5-10
5.3	Maintenance Information Detected by the RT . . . . .	5-10
5.3.1	Data Link Information Detection . . . . .	5-10
5.3.2	Loss of Data: Modes I and III . . . . .	5-10
5.3.3	Loss of Data: Mode II . . . . .	5-11
5.3.4	Yellow Alarm . . . . .	5-11
5.3.5	Out-of-Frame Detection . . . . .	5-11
5.3.6	Continuous Loss of Signal . . . . .	5-12

5.3.7	Bipolar Violations . . . . .	5-13
5.3.8	Protection Line . . . . .	5-14
5.4	Automatic Maintenance Capability . . . . .	5-14
5.5	Manual Maintenance Capability . . . . .	5-15
6.	Channel and Customer Loop Testing . . . . .	6-1
6.1	General . . . . .	6-1
6.2	Initiation of Test Configuration . . . . .	6-1
6.3	Failure to Establish a Test Configuration . . . . .	6-4
6.4	Channel Tests . . . . .	6-4
6.4.1	Transmission Tests . . . . .	6-5
6.4.1.1	Channel Loss . . . . .	6-6
6.4.1.2	Echo Return Loss . . . . .	6-6
6.4.1.3	Noise Test . . . . .	6-6
6.4.2	Signaling Tests . . . . .	6-6
6.4.2.1	Ringling Tests . . . . .	6-6
6.4.2.2	Off-Hook Detection . . . . .	6-7
6.4.2.3	Two Party ANI . . . . .	6-7
6.4.2.4	Coin Telephone Control Signaling . . . . .	6-7
6.5	Metallic Testing of the Customer Loop . . . . .	6-7
7.	Protection Line Switching . . . . .	7-1
7.1	General Requirements . . . . .	7-1
7.2	Causes of a Protection Line Switch . . . . .	7-1
7.2.1	LDS . . . . .	7-2
7.2.2	RT . . . . .	7-2
7.2.3	LDS and RT . . . . .	7-2
7.3	Protection Line Switching Procedure . . . . .	7-3
7.4	Protection Hierarchy . . . . .	7-7
7.5	Failure to Complete Protection Line Switch . . . . .	7-7
7.6	Concurrent A Line and P Line Failures . . . . .	7-8
7.7	Multiple DS1 Line Failures . . . . .	7-8
7.8	Data Link Message Delay . . . . .	7-10
7.9	Protection Switching and FELP - Far End Loop . . . . .	7-10
	Glossary . . . . .	Glossary-1
	References . . . . .	References-1
Appendix A: An Interface Between Loop Testing Systems and Local Digital Switches for Lines Served by Integrated Digital Loop Carrier (IDLC) Systems		
	A-1	
A.1	Introduction . . . . .	A-1
A.2	General Description of the Interface . . . . .	A-1
A.2.1	LDS Test Circuits . . . . .	A-1
A.2.2	Bypass Pair . . . . .	A-2
A.2.3	INHIBIT Lead . . . . .	A-3
A.3	Test Access Request . . . . .	A-4
A.3.1	Overflow State . . . . .	A-4

A.3.2	Metallic Test Access State . . . . .	A-4
A.3.3	Line Circuit Test State . . . . .	A-5
A.3.4	Dual-Tone-Multifrequency Dial Test State . . . . .	A-6
A.4	Bypass Initiate Signal . . . . .	A-6
A.5	Carrier Channel Tests . . . . .	A-9
A.6	Reporting Channel Test Results . . . . .	A-10
A.7	Test Trunk Disconnect . . . . .	A-11
Appendix B: Differences Between Issue 1 and Issue 2 of TR-TSY-000008 . . . . .		B-1



## List of Figures

Figure 1-1	SLC-96 RT Interfacing with an LDS Through Network Office Terminating Equipment (NOTE) . . . . .	1-6
Figure 1-2	SLC-96 RT Interfacing with an LDS Through Standard Office Repeater Bay (ORB) . . . . .	1-7
Figure 1-3	A SLC-96 RT Interfacing with an LDS Through A Fiber Optic System . . . . .	1-8
Figure 1-4	Mode I RT Connected to Network Office Terminating Equipment (NOTE) . . . . .	1-12
Figure 1-5	Mode II RT Connected to Network Office Terminating Equipment (NOTE) . . . . .	1-13
Figure 1-6	Mode III RT Connected to Network Office Terminating Equipment (NOTE) . . . . .	1-14
Figure 3-1	DS1 Frame Organization . . . . .	3-3
Figure 3-2	Data Link Frame Structure . . . . .	3-12
Figure 5-1	Pseudo Bank Loop Back . . . . .	5-6
Figure 6-1	Channel and Drop Testing . . . . .	6-3
Figure A-1	Test Access to Lines Served by Integrated Loop Carrier Systems . . . . .	A-3
Figure A-3	Integrated Loop Carrier DC Signature . . . . .	A-5
Figure A-2	Test Circuit for Grounded Inhibit Lead . . . . .	A-5
Figure A-4	Valid Test Initiate Signals . . . . .	A-7
Figure A-5	Invalid Test Initiate Signals . . . . .	A-8



## List of Tables

Table 1-1.	Compatible Equipment Codes . . . . .	1-11
Table 3-1.	SLC-96 System Channel Numbering Scheme . . . . .	3-4
Table 3-2a.	Channel Number/Time Slot Mapping for Mode I . . . . .	3-5
Table 3-2b.	Channel Number/Time Slot Mapping for Mode III . . . . .	3-6
Table 3-3.	Line Number Channel Number Mapping for Mode II . . . . .	3-9
Table 3-4.	DS1 Frame Bit Assignments . . . . .	3-10
Table 3-5.	Signaling States for SLC-96 System Channel Units . . . . .	3-11
Table 3-6.	Alarm Message Format for a NOTE . . . . .	3-14
Table 3-7.	Thirteen Data Link Frame Alarm Message Format . . . . .	3-15
Table 3-8.	Sixteen Data Link Frame Alarm Message Format . . . . .	3-16
Table 4-1.	Concentrator Field Messages Sent to the RT . . . . .	4-3
Table 4-2.	Concentrator Field Messages Sent to the LDS . . . . .	4-7
Table 4-3.	Mapping Between Line Numbers and a MESS1 Bits in Activity Messages . . . . .	4-8
Table 4-4.	PCM Tests Words . . . . .	4-8
Table 4-5.	Superimposed Ringing . . . . .	4-14
Table 4-6.	Frequency-Selective Ringing . . . . .	4-15
Table 4-7.	Coin Channel Unit Response Times . . . . .	4-21
Table 6-1.	Maintenance Messages . . . . .	6-3
Table 6-2.	Passive RT Terminations for Channel Unit Testing . . . . .	6-5
Table 7-1.	Protection Line Switch Field Messages . . . . .	7-3
Table A-1.	Channel Test Results . . . . .	A-10
Table B-1.	Difference Between Issue 1 and Issue 2 . . . . .	B-1