

# Table of Contents

**Notice of Disclaimer** . . . . . iii  
**List of Figures** . . . . . xi  
**List of Tables** . . . . . xiv

## 1 Scope and Objectives

1.1 General Characteristics . . . . . 1-2  
    1.1.1 PCM Line Organization . . . . . 1-2  
    1.1.2 DS-1 Operation . . . . . 1-2  
    1.1.3 DS-1C Operation . . . . . 1-3  
    1.1.4 Test Requirements . . . . . 1-3  
1.2 Framing . . . . . 1-3  
    1.2.1 Format . . . . . 1-3  
    1.2.2 Out-of-Frame Detection . . . . . 1-3  
    1.2.3 False Framing . . . . . 1-3  
    1.2.4 Reframe Duration . . . . . 1-3  
    1.2.5 Signaling Freezing (New Requirement) . . . . . 1-4  
    1.2.6 Extended Framing (Objective) . . . . . 1-4  
1.3 Channel Assignment . . . . . 1-4  
1.4 Per-Channel Signaling . . . . . 1-4  
1.5 Compression Law . . . . . 1-5  
    1.5.1 General . . . . . 1-5  
    1.5.2 CODEC Transfer Characteristics . . . . . 1-5  
    1.5.3 Decision Levels . . . . . 1-6  
    1.5.4 Code Assignments . . . . . 1-6  
    1.5.5 Prohibited Code Words . . . . . 1-6  
        1.5.5.1 Unequipped Channels . . . . . 1-6  
        1.5.5.2 Equipped Channels . . . . . 1-6  
    1.5.6 Unequipped Channel - Signaling . . . . . 1-7  
1.6 Maintenance (see also PUB 43803) . . . . . 1-7  
    1.6.1 General . . . . . 1-7  
    1.6.2 Standard Level Digital Signal - Digital Milliwatt . . . . . 1-7  
    1.6.3 Carrier Group Alarm (CGA) System . . . . . 1-8  
    1.6.4 Carrier Failure Alarm . . . . . 1-8  
    1.6.5 Trunk Conditioning and Coordination . . . . . 1-8  
    1.6.6 Failure Sectionalization . . . . . 1-9  
        1.6.6.1 Remote Looping (Objective) . . . . . 1-9  
    1.6.7 Audible and Visual Alarm Indicators . . . . . 1-9  
        1.6.7.1 Indicator Colors or Messages . . . . . 1-10  
1.7 Electrical Stress . . . . . 1-10  
    1.7.1 Lightning . . . . . 1-10  
    1.7.2 Surge and AC Tests (Objective) . . . . . 1-11  
    1.7.3 Supply Voltage . . . . . 1-11  
1.8 Operational and Environmental Considerations . . . . . 1-11  
    1.8.1 Temperature and Humidity . . . . . 1-11  
    1.8.2 Office Battery Voltage Variation . . . . . 1-11  
    1.8.3 Battery Noise . . . . . 1-11

- 1.8.3.1 Power Source Disturbance . . . . . 1-12
- 1.9 Physical Considerations . . . . . 1-12
  - 1.9.1 General . . . . . 1-12
  - 1.9.2 Equipment Size . . . . . 1-12
  - 1.9.3 Aisle Space . . . . . 1-12
  - 1.9.4 Fire Resistance . . . . . 1-12
    - 1.9.4.1 Qualification Tests . . . . . 1-12
    - 1.9.4.2 Non-Combustible Requirement . . . . . 1-13
    - 1.9.4.3 Flame Retardant Materials . . . . . 1-13
    - 1.9.4.4 Bay Configurations . . . . . 1-13
  - 1.9.5 Shock and Vibration Requirement . . . . . 1-13
  - 1.9.6 Heat Release . . . . . 1-14
  - 1.9.7 Floor Load . . . . . 1-14
- 1.10 Network Considerations . . . . . 1-14
  - 1.10.1 Compatibility - General . . . . . 1-14
  - 1.10.2 End-to-End Compatibility . . . . . 1-15
    - 1.10.2.1 Jitter . . . . . 1-16

**2 Voice Frequency (VF) Operating Characteristics**

- 2.1 General . . . . . 2-1
  - 2.1.1 Test Requirements . . . . . 2-1
  - 2.1.2 Testing A/D & D/A . . . . . 2-1
- 2.2 Transmission Levels (At the VF Interface) . . . . . 2-1
  - 2.2.1 4-Wire E&M . . . . . 2-1
  - 2.2.2 2-Wire DPO, DPT, MFO, E&M, RPO, and RPT . . . . . 2-2
- 2.3 Office Cabling Compensation . . . . . 2-3
- 2.4 Channel Attenuation Versus Frequency Characteristic . . . . . 2-3
  - 2.4.1 Requirement . . . . . 2-3
- 2.5 Loss Stability . . . . . 2-3
- 2.6 Tracking . . . . . 2-3
- 2.7 Four Wire Impedance . . . . . 2-4
- 2.8 2-Wire Return Loss . . . . . 2-4
- 2.9 Relative Transhybrid Loss . . . . . 2-4
- 2.10 Crosstalk . . . . . 2-5
- 2.11 Longitudinal Balance . . . . . 2-5
- 2.12 Noise . . . . . 2-6
  - 2.12.1 Idle Channel Noise . . . . . 2-6
  - 2.12.2 Impulse Noise . . . . . 2-6
  - 2.12.3 Signal to Distortion . . . . . 2-7
  - 2.12.4 Single Frequency Distortion . . . . . 2-8
  - 2.12.5 Intermodulation Distortion . . . . . 2-8
- 2.13 Peak to Average Ratio (P/AR) . . . . . 2-8

**3 Signaling Characteristics**

- 3.1 General . . . . . 3-1
  - 3.1.1 Scope . . . . . 3-1
  - 3.1.2 Test Requirements . . . . . 3-1
  - 3.1.3 Testing of Units . . . . . 3-1
  - 3.1.4 Test Equipment . . . . . 3-1

- 3.1.5 Definition of Pulsing Percent Break . . . . . 3-1
- 3.1.6 Solid State Contacts . . . . . 3-2
- 3.1.7 Signaling Format . . . . . 3-2
- 3.1.8 Signaling States . . . . . 3-2
- 3.2 Sleeve Ground Dial Pulse Originating Channel Unit (SDPO) . . . . . 3-2
  - 3.2.1 Internal Resistance and Conductor Polarity . . . . . 3-2
  - 3.2.2 Immunity to AC Induction . . . . . 3-2
  - 3.2.3 Sensitivity . . . . . 3-3
  - 3.2.4 Immunity to On-Hook Transients . . . . . 3-3
  - 3.2.5 Dial Pulse Distortion . . . . . 3-3
  - 3.2.6 Dial Pulse Mutilation . . . . . 3-4
  - 3.2.7 Sleeve Grounding Delay . . . . . 3-4
  - 3.2.8 Disconnect Time Delay . . . . . 3-4
  - 3.2.9 Out-of-Frame - Conditioning (New Requirement) . . . . . 3-4
  - 3.2.10 Carrier Failure Trunk Conditioning . . . . . 3-4
- 3.3 Dial Pulse Originating (2-Wire) Channel Unit (DPO) . . . . . 3-4
  - 3.3.1 Internal Resistance and Conductor Polarity . . . . . 3-4
  - 3.3.2 Immunity to AC Induction . . . . . 3-5
  - 3.3.3 Sensitivity . . . . . 3-5
  - 3.3.4 Immunity to On-Hook Transients . . . . . 3-5
  - 3.3.5 Immunity to Off-Hook Transients . . . . . 3-5
  - 3.3.6 Dial Pulse Distortion . . . . . 3-5
  - 3.3.7 Out-of-Frame - Conditioning (New Requirement) . . . . . 3-6
  - 3.3.8 Carrier Failure Trunk Conditioning . . . . . 3-6
- 3.4 Dial Pulse Terminating Channel Unit (DPT) . . . . . 3-7
  - 3.4.1 Internal Resistance . . . . . 3-7
  - 3.4.2 Immunity to AC Induction . . . . . 3-7
  - 3.4.3 Sensitivity . . . . . 3-7
  - 3.4.4 Immunity to Off-Hook Transients . . . . . 3-7
  - 3.4.5 Wink Distortion . . . . . 3-7
  - 3.4.6 Out-of-Frame - Conditioning (New Requirement) . . . . . 3-7
  - 3.4.7 Carrier Failure Trunk Conditioning . . . . . 3-8
- 3.5 E&M Lead Channel Units . . . . . 3-8
  - 3.5.1 Internal Resistances and Potentials . . . . . 3-8
  - 3.5.2 M-Lead Sensor Sensitivity . . . . . 3-8
  - 3.5.3 Dial Pulse Distortion . . . . . 3-8
  - 3.5.4 Out-of-Frame - Conditioning (New Requirement) . . . . . 3-8
  - 3.5.5 Carrier Failure Trunk Conditioning . . . . . 3-9
- 3.6 Foreign Exchange Channel Unit - Station End (FXS) . . . . . 3-9
  - 3.6.1 Internal Resistance and Conductor Polarity . . . . . 3-9
    - 3.6.1.1 Loop signaling . . . . . 3-9
    - 3.6.1.2 Ringing . . . . . 3-9
  - 3.6.2 Immunity to AC Induction . . . . . 3-9
  - 3.6.3 Sensitivity . . . . . 3-10
    - 3.6.3.1 Loop Signaling . . . . . 3-10
    - 3.6.3.2 Ground-Start Signaling . . . . . 3-10
    - 3.6.3.3 Ring Trip . . . . . 3-10
  - 3.6.4 Distinctive Ringing (Objective) . . . . . 3-10
  - 3.6.5 Immunity to On-Hook Transients . . . . . 3-10
  - 3.6.6 Dial Pulse Distortion . . . . . 3-10

- 3.6.7 Dial Pulse Mutilation . . . . . 3-11
- 3.6.8 Pretripping . . . . . 3-11
- 3.6.9 Disconnect Time Delay . . . . . 3-11
- 3.6.10 Out-of-Frame - Conditioning (New Requirement) . . . . . 3-11
- 3.6.11 Carrier Failure Trunk Conditioning . . . . . 3-11
- 3.7 Foreign Exchange Channel Unit - Office End (FXO) . . . . . 3-12
  - 3.7.1 Internal Resistances . . . . . 3-12
    - 3.7.1.1 Loop Signaling . . . . . 3-12
    - 3.7.1.2 Ground-Start Signaling . . . . . 3-12
    - 3.7.1.3 Ringing . . . . . 3-12
  - 3.7.2 Immunity to AC Induction . . . . . 3-12
  - 3.7.3 Sensitivity . . . . . 3-13
  - 3.7.4 Distinctive Ringing (Objective) . . . . . 3-13
  - 3.7.5 Immunity to False Tip Ground Signal . . . . . 3-13
  - 3.7.6 Out-of-Frame - Conditioning (New Requirement) . . . . . 3-13
  - 3.7.7 Carrier Failure Trunk Conditioning . . . . . 3-14
- 3.8 Multifrequency Signaling (2-Wire) Originating Channel Unit (MFO) . . . . . 3-14
  - 3.8.1 Internal Resistance and Conductor Polarity . . . . . 3-14
  - 3.8.2 Immunity to AC Induction . . . . . 3-14
  - 3.8.3 Sensitivity . . . . . 3-14
  - 3.8.4 Immunity to On-Hook Transients . . . . . 3-14
  - 3.8.5 Immunity to Off-Hook Transients . . . . . 3-14
  - 3.8.6 Carrier Failure Trunk Conditioning . . . . . 3-15
- 3.9 Notes for Requirements Testing . . . . . 3-15

**4 Bibliography**

**Appendix A: Testing Procedures and Arrangements for Evaluating Digital Channel Banks**

- A.1 Test Equipment, Channel Arrangement, and Pre-Evaluation Tests . . . . . A-2
  - A.1.1 Test Equipment . . . . . A-2
  - A.1.2 Channel Arrangement . . . . . A-2
  - A.1.3 Preliminary Inspection and Testing . . . . . A-2

**Appendix B: Operational Characteristics and Maintenance Tests**

- B.1 General . . . . . B-1
- B.2 PCM Output Pulse Shape . . . . . B-1
- B.3 Special Digital Outputs . . . . . B-1
- B.4 Transmit Clock Pull-In Range . . . . . B-1
- B.5 Alarm Initiate Time . . . . . B-2
- B.6 Automatic Alarm Restoral . . . . . B-2
- B.7 Alarm Hit Integration . . . . . B-2
- B.8 Delay Time Between CFA and Initiating Trunk Processing . . . . . B-2
- B.9 Electrical Stress . . . . . B-2
- B.10 Office Battery Variations . . . . . B-3
- B.11 Battery Noise . . . . . B-3
- B.12 Temperature and Humidity . . . . . B-3
- B.13 Loop Timing Jitter Tolerance . . . . . B-3

B.13.1 Method I . . . . . B-4  
B.13.2 Method II . . . . . B-4

**Appendix C: Voice Frequency Tests**

C.1 General . . . . . C-1  
C.2 Transmission Levels (At the VF Interface) . . . . . C-1  
C.3 Office Cabling Compensation . . . . . C-1  
C.4 Channel Frequency Response . . . . . C-1  
C.5 Loss Stability . . . . . C-2  
C.6 Tracking . . . . . C-2  
C.7 Four-Wire Impedance . . . . . C-2  
C.8 Two-Wire Return Loss . . . . . C-2  
C.9 Transhybrid Loss . . . . . C-3  
C.10 Crosstalk . . . . . C-3  
C.11 Longitudinal Balance Methods . . . . . C-3  
C.12 Idle Channel Noise . . . . . C-4  
C.13 Impulse Noise . . . . . C-4  
C.14 Signal to Distortion . . . . . C-4  
C.15 Single Frequency Distortion . . . . . C-5  
C.16 Channel Distortion (P/AR) . . . . . C-5

**Appendix D: Signaling Tests**

D.1 General . . . . . D-1  
D.2 E&M Lead Channel Units . . . . . D-1  
    D.2.1 Internal Resistances and Potentials . . . . . D-1  
    D.2.2 Battery Voltage for Test . . . . . D-1  
    D.2.3 M-Lead Sensor Sensitivity . . . . . D-1  
    D.2.4 Dial Pulse Distortion . . . . . D-2  
    D.2.5 Carrier Failure Trunk Processing . . . . . D-2  
D.3 Dial Pulse Originating (2-Wire) Channel Unit (DPO) . . . . . D-2  
    D.3.1 Conductor Polarity . . . . . D-2  
    D.3.2 Battery Voltage for Test . . . . . D-2  
    D.3.3 Immunity to AC Induction . . . . . D-2  
    D.3.4 Sensitivity . . . . . D-3  
    D.3.5 Immunity to On-Hook Transients . . . . . D-3  
    D.3.6 Immunity to Off-Hook Transients . . . . . D-3  
    D.3.7 Dial Pulse Distortion . . . . . D-3  
    D.3.8 Carrier Failure Trunk Processing . . . . . D-4  
D.4 Sleeve Ground Dial Pulse Originating Channel Unit (SDPO) . . . . . D-4  
    D.4.1 Internal Resistance and Conductor Polarity . . . . . D-4  
    D.4.2 Battery Voltage for Tests . . . . . D-5  
    D.4.3 Immunity to AC Induction . . . . . D-5  
    D.4.4 Sensitivity . . . . . D-5  
    D.4.5 Immunity to On-Hook Transients . . . . . D-5  
    D.4.6 Dial Pulse Distortion . . . . . D-5  
    D.4.7 Dial Pulse Mutilation . . . . . D-6  
    D.4.8 Sleeve Grounding Delay . . . . . D-6  
    D.4.9 Disconnect Time Delay . . . . . D-6  
    D.4.10 Carrier Failure Trunk Processing . . . . . D-6

- D.5 Multifrequency Signaling (2-Wire) Originating Channel Unit (MFO) . . . . . D-7
  - D.5.1 Internal Resistance and Conductor Polarity . . . . . D-7
  - D.5.2 Battery Voltage for Test . . . . . D-7
  - D.5.3 Immunity to AC Induction . . . . . D-7
  - D.5.4 Sensitivity . . . . . D-7
  - D.5.5 Immunity to On-Hook Transients . . . . . D-7
  - D.5.6 Immunity to Off-Hook Transients . . . . . D-8
  - D.5.7 Carrier Failure Trunk Processing . . . . . D-8
- D.6 Dial Pulse Terminating Channel Unit (DPT) . . . . . D-8
  - D.6.1 Internal Resistance . . . . . D-8
  - D.6.2 Battery Voltage for Test . . . . . D-8
  - D.6.3 Immunity to AC Induction . . . . . D-8
  - D.6.4 Sensitivity . . . . . D-9
  - D.6.5 Immunity to Off-Hook Transients . . . . . D-9
  - D.6.6 Wink Distortion . . . . . D-9
  - D.6.7 Carrier Failure Trunk Processing . . . . . D-9
- D.7 Foreign Exchange Channel Unit-Station End (FXS) . . . . . D-10
  - D.7.1 Internal Resistance and Conductor Polarity . . . . . D-10
    - D.7.1.1 Loop Signaling Option . . . . . D-10
    - D.7.1.2 Ground-Start Signaling Option . . . . . D-10
    - D.7.1.3 Ringing . . . . . D-10
  - D.7.2 Battery Voltage for Test . . . . . D-10
  - D.7.3 Immunity to AC Induction . . . . . D-10
  - D.7.4 Sensitivity . . . . . D-11
    - D.7.4.1 Loop Signaling Option . . . . . D-11
    - D.7.4.2 Ground-Start Signaling Option . . . . . D-11
    - D.7.4.3 Ring Trip . . . . . D-11
  - D.7.5 Immunity to On-Hook Transients . . . . . D-11
  - D.7.6 Dial Pulse Distortion . . . . . D-11
  - D.7.7 Dial-Pulse Mutilation . . . . . D-12
  - D.7.8 Pretripping . . . . . D-12
  - D.7.9 Disconnect Time Delay . . . . . D-12
  - D.7.10 Carrier Failure Trunk Processing . . . . . D-12
- D.8 Foreign Exchange Channel Unit - Office End (FXO) . . . . . D-13
  - D.8.1 Internal Resistances . . . . . D-13
    - D.8.1.1 Loop Signaling Option . . . . . D-13
    - D.8.1.2 Ground-Start Signaling Option . . . . . D-13
    - D.8.1.3 Ringing . . . . . D-13
  - D.8.2 Battery Voltage for Test . . . . . D-13
  - D.8.3 Immunity to AC Induction . . . . . D-13
  - D.8.4 Sensitivity . . . . . D-14
  - D.8.5 Immunity to False Tip Ground Signal . . . . . D-14
  - D.8.6 Carrier Failure Trunk Processing . . . . . D-15

**Appendix E: Test Arrangement Figures**

## List of Figures

Figure 1-1	Frame Organization . . . . .	1-17
Figure 1-2	Assignment of S-Bit . . . . .	1-18
Figure 1-3	Channel Bank - DSX-1 Relationship . . . . .	1-18
Figure 1-4	DSX-1C Signal Format . . . . .	1-19
Figure 1-5	Extended Framing Format . . . . .	1-20
Figure 1-6	Channel & Time Slot Number Assignments . . . . .	1-21
Figure 1-7	Codec Transfer Characteristic - Information Frame . . . . .	1-22
Figure 1-8	Codec Transfer Characteristic - Signaling Frame . . . . .	1-23
Figure 1-9	Code Decision Levels . . . . .	1-24
Figure 1-10	Assignment of Transmitted Codes and Decoded Levels . . . . .	1-24
Figure 1-11	CFA Timing . . . . .	1-26
Figure 1-12	Lightning Surge Simulation . . . . .	1-27
Figure 1-13	Surge Tests . . . . .	1-27
Figure 1-14	AC Tests . . . . .	1-28
Figure 1-15	High Impedance Inductive Source Test Circuit . . . . .	1-29
Figure 1-16	Battery Disturbance Test Setup . . . . .	1-29
Figure 1-17	1.544 Mbps Peak-to-Peak Input Jitter Tolerance . . . . .	1-30
Figure 2-1	Transmission Test Arrangement . . . . .	2-9
Figure 2-2	4-Wire Frequency Response Requirement . . . . .	2-10
Figure 2-3	2-Wire Frequency Response Requirement . . . . .	2-11
Figure 2-4	Transhybrid Loss Measurement . . . . .	2-12
Figure 2-5	Minimum Equal Level Coupling Loss . . . . .	2-13
Figure 2-6	Longitudinal Balance Measurement Setup . . . . .	2-14
Figure 2-7	Idle Circuit Noise Measurements . . . . .	2-15
Figure 2-8	Crosstalk Measurement Connections . . . . .	2-16
Figure 2-9	Phase Bounds . . . . .	2-17
Figure 3-1	DPO . . . . .	3-15
Figure 3-2	DPT . . . . .	3-16
Figure 3-3	E&M . . . . .	3-16
Figure 3-4	RPO . . . . .	3-16
Figure 3-5	RPT . . . . .	3-17
Figure 3-6	SDPO . . . . .	3-17
Figure 3-7	DX . . . . .	3-17
Figure 3-8	ETO, TO . . . . .	3-18
Figure 3-9	FXO . . . . .	3-18
Figure 3-10	FXS . . . . .	3-19
Figure 3-11	PLAR . . . . .	3-20
Figure 3-12	PLR . . . . .	3-20
Figure 3-13	RD . . . . .	3-21
Figure 3-14	SDPO Immunity to On-Hook Transients . . . . .	3-22
Figure 3-15	DPO Immunity to On-Hook Transients . . . . .	3-22
Figure 3-16	M-Lead Sensor Sensitivity . . . . .	3-23
Figure 3-17	FXS Immunity to On-Hook Transients . . . . .	3-23
Figure A-1	Pre-Testing Temperature Cycling . . . . .	A-5
Figure E-1	PCM Output Signal Tests . . . . .	E-2
Figure E-2	Special Digital Outputs (CFA and Looping) and Alarm Hit Integration . . . . .	E-3



Figure E-3	Transmit Clock Pull-in Range . . . . .	E-4
Figure E-4	Alarm Timing . . . . .	E-5
Figure E-5	Battery Supply Effects . . . . .	E-6
Figure E-6	Electrical Stress . . . . .	E-7
Figure E-7	Lightning Surge Simulation By Voltage Surge . . . . .	E-8
Figure E-8	Battery Noise Effects . . . . .	E-8
Figure E-9	General Voice Frequency Arrangement . . . . .	E-9
Figure E-10	4-Wire Image Impedance (Return Loss) . . . . .	E-10
Figure E-11	Return Loss (2-Wire Units) . . . . .	E-11
Figure E-12	Trans Hybrid Loss . . . . .	E-12
Figure E-13	Near End Crosstalk . . . . .	E-13
Figure E-14	Far End Crosstalk . . . . .	E-15
Figure E-15	Longitudinal Balance . . . . .	E-17
Figure E-16	Longitudinal Balance Circuit . . . . .	E-18
Figure E-17	Impulse Noise (Dial Pulsing in Channels Adjacent to Channel Under Test) . . . . .	E-19
Figure E-18	Impulse Noise (E & M Signaling in Channels Adjacent to Channel Under Test) . . . . .	E-21
Figure E-19	Impulse Noise (20Hz Ringing in Channel Adjacent to Channel Under Test) . . . . .	E-23
Figure E-20	Channel Distortion Peak to Average Ratio (P/AR) . . . . .	E-25
Figure E-21	Resistance and Potential (E&M Channel Units) . . . . .	E-26
Figure E-22	Dial Pulse Distortion and M-Lead Sensor Sensitivity (E&M Channel Units) . . . . .	E-27
Figure E-23	Immunity to AC Induction . . . . .	E-28
Figure E-24	Sensitivity and Internal Resistance and Potential (DPO/SDPO/MFO Channel Unit) . . . . .	E-29
Figure E-25	Immunity to Transients DPO (On Hook or Off Hook Transients) SDPO (On Hook Transients) . . . . .	E-30
Figure E-26	Dial Pulse Distortion With Loop Pulsing Applied (DPO Channel Unit) Internal Resistance (DPT Channel Unit) . . . . .	E-31
Figure E-27	Dial Pulse Distortion Battery and Ground Pulsing from 150/150 Ohm Source Over 600 Ohm V.F. Extension (DPO Channel Unit) . . . . .	E-32
Figure E-28	Dial Pulse Distortion with Battery and Ground Pulsing Over Zero Loop (DPO/SDPO Channel Unit) . . . . .	E-33
Figure E-29	Dial Pulse Distortion, Loop Pulsing Applied, 2 $\mu$ F and 600 Ohm Across Pulsing Contact, 600 Ohm VF Extension (DPO Channel Unit) . . . . .	E-34
Figure E-30	Dial Pulse Distortion Loop Pulsing with 1500 Ohm Loop Resistance (FXS, SDPO Channel Unit) . . . . .	E-35
Figure E-31	Dial Pulse Distortion Loop Pulsing, 15,000 Ohm Leakage, 4 Bridged Ringers (SDPO, FXS Channel Unit) . . . . .	E-36
Figure E-32	Dial Pulse Distortion with Battery and Ground Pulsing and 2000 Ohm Loop (SDPO Channel Unit) . . . . .	E-37
Figure E-33	Dial Pulse Mutilation (SDPO, FXS Channel Unit) . . . . .	E-38
Figure E-34	Sleeve Ground Delay and Disconnect Delay and CFA Trunk Processing (SDPO Channel Unit) . . . . .	E-39
Figure E-35	Immunity to Disconnect (SDPO Channel Unit) . . . . .	E-40
Figure E-36	Immunity to Transients (MFO Channel Unit) . . . . .	E-41
Figure E-37	Sensitivity . . . . .	E-42
Figure E-38	Immunity to Transients DPT Channel Unit . . . . .	E-43



Figure E-39	Wink Distortion (DPT Channel Unit) . . . . .	E-44
Figure E-40	E&M Interface and Signaling Test Ckt . . . . .	E-45
Figure E-41	Superimposed DC On, Ringing Ckt . . . . .	E-45
Figure E-42	20 Hz Ringing Pulser (2 Sec On - 4 Sec Off) . . . . .	E-45
Figure E-43	Signaling Test Circuit - see General Note 6 . . . . .	E-46
Figure E-44	Signaling Test Circuit . . . . .	E-46
Figure E-45	Signaling Test Circuit - see General Note 8 . . . . .	E-46
Figure E-46	Signaling Test Circuit . . . . .	E-47
Figure E-47	Signaling Test Circuit . . . . .	E-47
Figure E-48	Signaling Test Circuit . . . . .	E-47
Figure E-49	Signaling Test Circuit . . . . .	E-47
Figure E-50	Signaling Test Circuit . . . . .	E-48
Figure E-51	Signaling Test Circuit . . . . .	E-48
Figure E-52	Hold Circuit . . . . .	E-48
Figure E-53	Tip Ground Adapter . . . . .	E-49
Figure E-54	15,000 Ohm Leakage . . . . .	E-49
Figure E-55	Bridged Ringer (WECO C4A Type Or Equivalent) . . . . .	E-49
Figure E-56	Termination 1 . . . . .	E-49
Figure E-57	Termination 2 . . . . .	E-49
Figure E-58	Signaling Test Circuit . . . . .	E-50
Figure E-59	Signaling Test Circuit (see General Note 14) . . . . .	E-50
Figure E-60	Internal Resistance and Conductor Polarity (FXS, FXO) . . . . .	E-51
Figure E-61	Sensitivity (FXS Channel Unit) . . . . .	E-52
Figure E-62	Immunity to On-Hook Transients (FXS Channel Unit) . . . . .	E-53
Figure E-63	Pretripping (FXS Channel Unit) . . . . .	E-54
Figure E-64	Disconnect Time Delay (FXS) . . . . .	E-55
Figure E-65	20 Hz Ringing Impedance (FXS, FXO) . . . . .	E-56
Figure E-66	Immunity to AC Induction (FXO Channel Unit) . . . . .	E-57
Figure E-67	Sensitivity (FXO Channel Unit) . . . . .	E-58
Figure E-68	Immunity to False Tip Ground Signal (FXO Channel Unit) . . . . .	E-59
Figure E-69	Remove-Ring-Ground Time (FXO) . . . . .	E-60
Figure E-70	Signaling Test Circuit . . . . .	E-61
Figure E-71	Signaling Test Circuit . . . . .	E-61
Figure E-72	Signaling Test Circuit . . . . .	E-61
Figure E-73	Cord Balancing Network . . . . .	E-62
Figure E-74	Test Method I - Loop Timing Jitter Tolerance . . . . .	E-63
Figure E-75	Test Method II - Loop Timing Jitter Tolerance . . . . .	E-64

## List of Tables

Table A-1	Test Equipment List . . . . .	A-3
Table A-2	Channel Type Assignment for Digroups A or (B) . . . . .	A-4