

VOICE AND VOICEBAND DATA CHANNELS SIGNALING TESTS REQUIREMENTS AND LIMITS

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Appendixes

1. Preservice Test Definitions

1. GENERAL

1.01 This section provides the network personnel with signaling test requirements and limits for voice and voiceband data channels. The specified requirements and limits are based on the engineering recommendations and the design of the network channel. This section provides only signaling requirements and limits for the network side of the network interface (NI) located on customer premises (CP). Test requirements and limits for channel segments are not addressed in this section.

1.02 Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph.

1.03 The transmission path must be completed and the proper options applied to the transmission and signaling equipment before the signaling tests can be completed.

1.04 *All customer premises equipment (CPE) must be disconnected before tests are performed.* The tester should be familiar with the transmission and signaling considerations, requirements, and procedures covered in the following sections:

SECTION	TITLE
313-100-100	General Introduction, Preservice and Maintenance, Voice and Voiceband Data Channels

SECTION	TITLE
313-110-100	Transmission, Test Considerations, Voice and Voiceband Data Channels
313-110-101	Signaling, Test Considerations, Voice and Voiceband Data Channels
313-120-100	Transmission Tests, Requirements and Limits, Voice and Voiceband Data Channels
313-130-100	Central Office, Transmission and Signaling Test Procedures, Voice and Voiceband Data Channels
313-130-101	Customer Premises, Transmission and Signaling Test Procedures, Voice and Voiceband Data Channels.

2. REQUIRED SIGNALING TESTS

2.01 Signaling tests are performed to ensure that the signaling functions of the channel operate in the prescribed manner. These tests must be made for each of the signaling states that will be encountered on the channel during its normal operation. If signaling exists in both directions on a channel, both directions must be tested, and any failures to signal properly must be corrected before the channel is released to the customer.

2.02 Perform preservice tests for loop current and dial tone on channels consisting of bare cable or on channels with only loop signaling extenders/loop signaling repeaters (LSE/LSR). The remaining required tests in Table A will be performed on trouble basis only. With more complex channels (those with other signaling enhancement equipment in addition to LSE/LSR), the required preservice tests given in Table A for the particular type of signaling used will be performed.

Note: Pulsing tests are excluded except on trouble basis for transmission grades that are classified as line channels. (See Section 313-120-100 for transmission grades.)

2.03 Tests used for trouble isolation are to be selected from Table A as required.

2.04 Benchmark tests are recommended during the preservice testing activity. They are to be used as an aid in localizing subsequent channel signaling problems.

3. DESCRIPTION OF SIGNALING TYPES

3.01 Section 313-110-101 provides the description of the types of signaling that are used on the channels at the NI. The types of signaling operation and interfaces used at the NI are listed below:

- (a) Loop signaling (loop-start), 2- or 4-wire interface
- (b) Loop signaling (ground-start), 2- or 4-wire interface
- (c) Loop reverse battery (terminating end), 2-wire interface
- (d) Simplex signaling used for automatic identified outward dialing (AIOD) data channels, 2-wire interface
- (e) E and M leads, types I and II (A or B)
- (f) Ringdown—automatic 2-wire interface
- (g) Ringdown—manual 2- or 4-wire interface.

4. SIGNALING TEST LIMITS

4.01 The required tests given are for the end-to-end channel signaling test limits for the facilities and equipment provided by the telephone company. With the proper wiring, cross-connections, and equipment options, it is expected that the limits will be met and the channel will operate satisfactorily. When the channel does not function or the signaling test limits are not met, the signaling test details for the specific signaling system or equipment involved should be consulted.

4.02 In order to perform preservice testing, test equipment must be capable of simulating the electrical characteristics as shown in Fig. 1 through 8.

4.03 Figures 1 through 12 are to be used in conjunction with Fig. 13 through 33 for meeting preservice signaling test limits.

SECTION 313-120-101

4.04 The specific use of the signaling test limits and arrangements are shown in Fig. 13 through 33 and related Tables B through V as follows:

FIGURE	DESCRIPTION
13 through 16	Loop signaling (loop-start)
17 through 20	Loop signaling (ground-start)
21 through 25	Loop reverse battery, automatic and manual ringdown, and simplex signaling
26 through 29	Type I E and M lead signaling
30 through 33	Type II E and M lead signaling.

5. GLOSSARY OF TERMS

5.01 The following abbreviations (terms) are used in this section.

TERM	DEFINITION
AIOD	Automatic identified outward dialing
AP	Access point
CO	Central office
CP	Customer premises
CPE	Customer premises equipment
CLR	Conductor loop resistance

TERM	DEFINITION
CKT	Circuit
GRD	Ground
GS	Ground-start
LS	Loop-start
LSE	Loop signaling extender
LSR	Loop signaling repeater
NCTE	Network channel terminating equipment
NI	Network interface
NL	Nonlocking
R	Required
REN	Ringer equivalent number
SIG	Signal
SX	Simplex
TRK	Trunk
V	Volts
≥	Equal to or greater than
≤	Equal to or less than

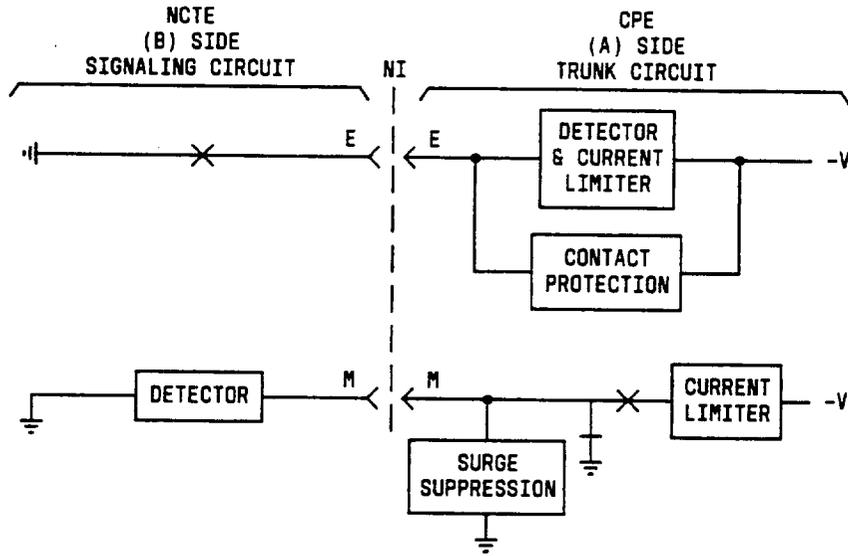
TABLE A

REQUIRED PRESERVICE SIGNALING TESTS (NOTE)

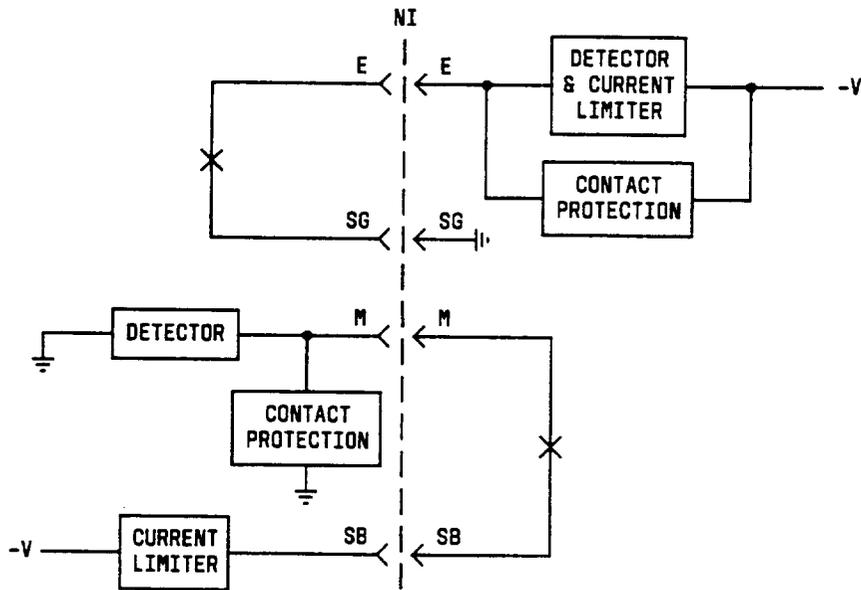
TYPES OF SIGNALING AND CHANNELS		FIGURE	LOOP CURRENT AND/OR DIAL TONE	ON-HOOK LOOP CURRENT	RINGING VOLTAGE	RINGING TRIP	SUPPLY RINGING VOLTAGE	SEND DIAL PULSES	RECEIVE DIAL PULSES	LOOP RESISTANCE	E AND M LEADS ON-HOOK - IDLE	E AND M LEADS OFF-HOOK - SEIZURE	TIP OPEN	DISCONNECT	BID SIGNAL		
Loop Signaling	Loop-Start	2-W CP-CO	13	R		R	R		R*								
		4-W CP-CO	14	R		R	R		R*								
		2-W CP-CP, NI(A)-NI(Z)	15	R		R				R*							
		2-W CP-CP, NI(Z)-NI(A)	16	R	R					R*							
	Ground-Start	2-W CP-CO	17	R		R	R		R*					R	R		
		4-W CP-CO	18	R		R	R		R*					R	R		
		2-W CP-CP, NI(A)-NI(Z)	19	R	R	R			R*					R			
		2-W CP-CP, NI(Z)-NI(A)	20	R	R					R*					R		
Loop Reverse Battery	2-W CP-CO	21	R	R				R						R			
Ringdown	Automatic	2-W CP-CP	22	R		R	R										
	Manual	2-W CP-CP, CP-CO	23			R		R									
		4-W CP-CP, CP-CO	24			R		R									
AIOD Data Channel SX	2-W CP-CO	25							R		R		R	R			
E and M Lead Signaling	Type I-A	Call Originating on M Lead Toward CO	26					R	R		R	R					
		Call Originating on M Lead Toward NI	27					R	R		R	R					
	Type I-B	Call Originating on E Lead Toward CO	28					R	R		R	R					
		Call Originating on E Lead Toward NI	29					R	R		R	R					
	Type II-A	Call Originating on M Lead Toward CO	30					R	R		R	R					
		Call Originating on M Lead Toward NI	31					R	R		R	R					
	Type II-B	Call Originating on E Lead Toward CO	32					R	R		R	R					
		Call Originating on E Lead Toward NI	33					R	R		R	R					

Note: See Appendix 1 for Preservice test definitions.

* Pulsing tests are excluded except on trouble basis for transmission grades that are classified as line channels. (See Section 313-120-100 for transmission grades.)



(a) Type I Interface With E And M Leads (CPE On "A" Side)



(b) Type II Interface With E And SG And M And SB Leads (CPE On "A" Side)

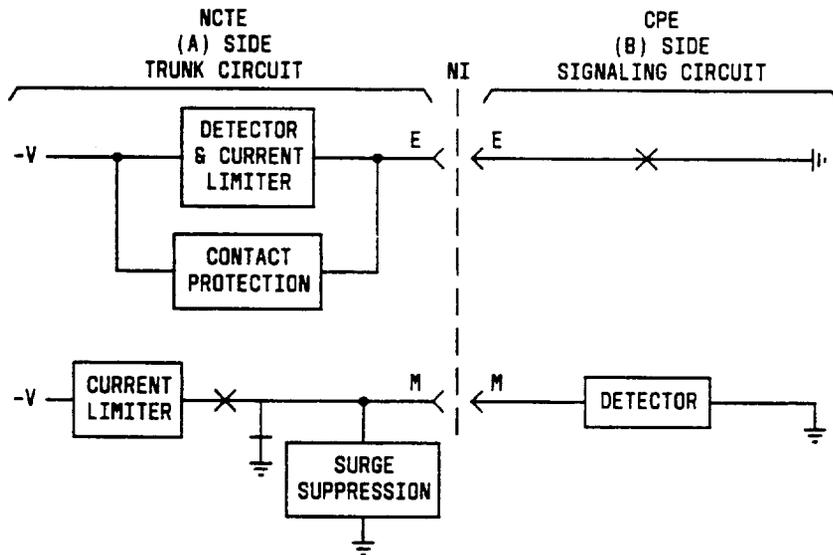
LEGEND:

-V = -42.5 TO -52.5 VOLTS DC

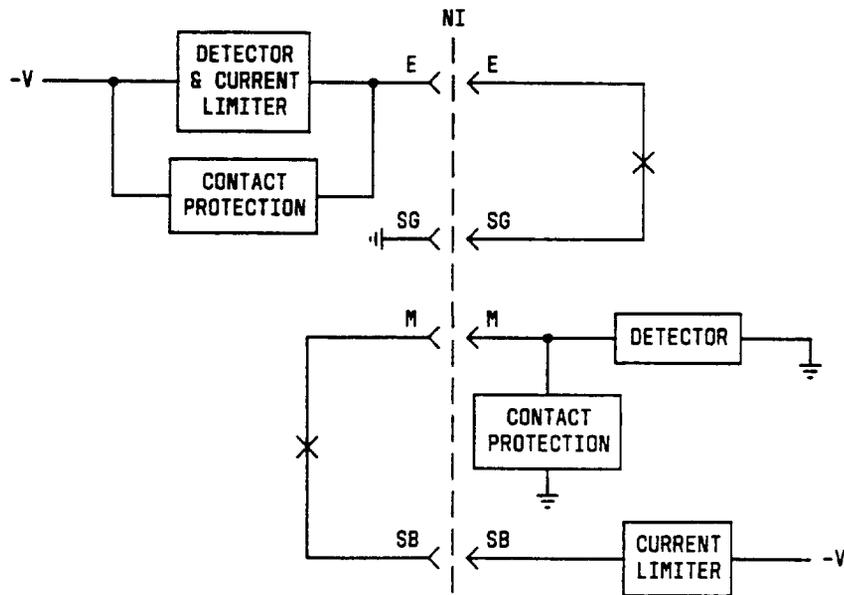
—< ← = JACK AND PLUG

⊥ = SIGNAL GROUND

Fig. 1—Type I and II Signaling Interface With E and M Leads (Sheet 1 of 2)

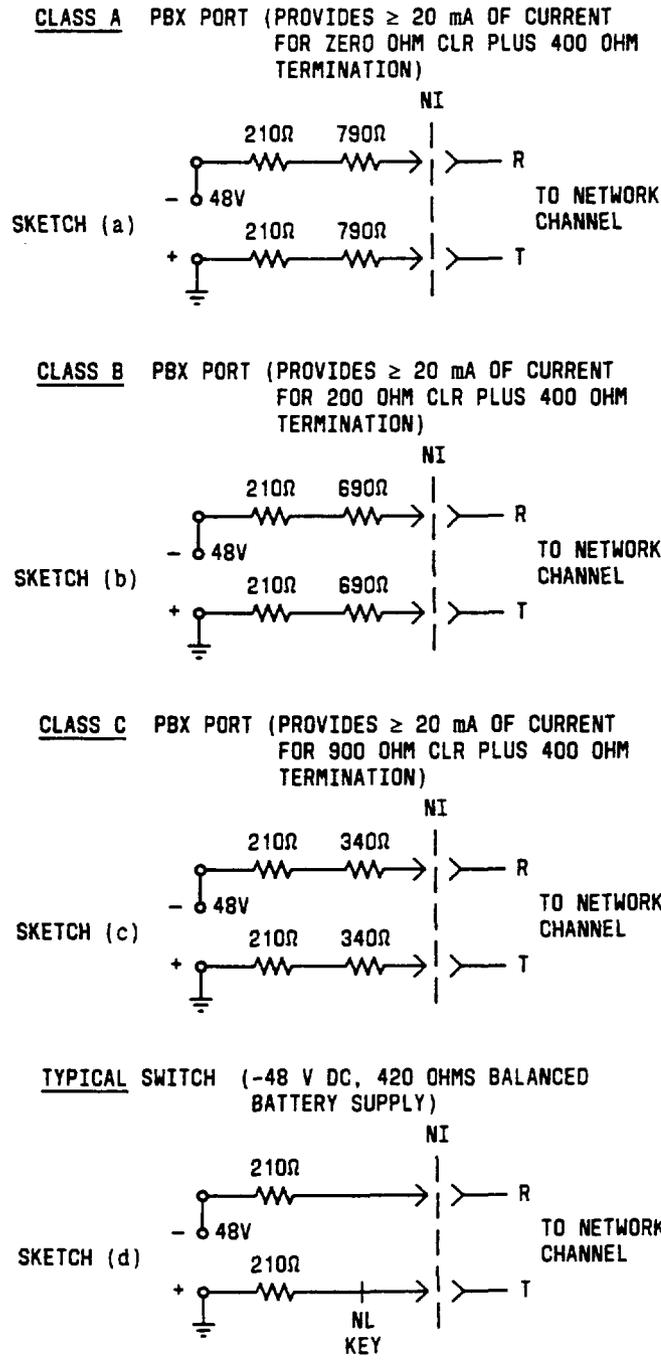


(c) Type I Interface With E And M Leads (CPE On "B" Side)



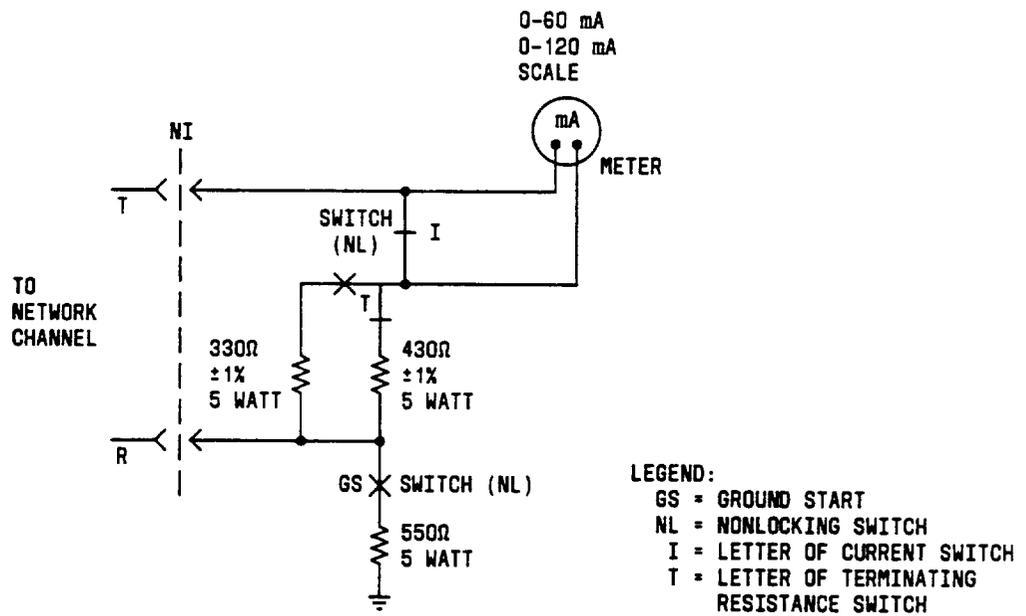
(d) Type II Interface With E And SG And M And SB Leads (CPE On "B" Side)

Fig. 1—Type I and II Signaling Interface With E and M Leads (Sheet 2 of 2)

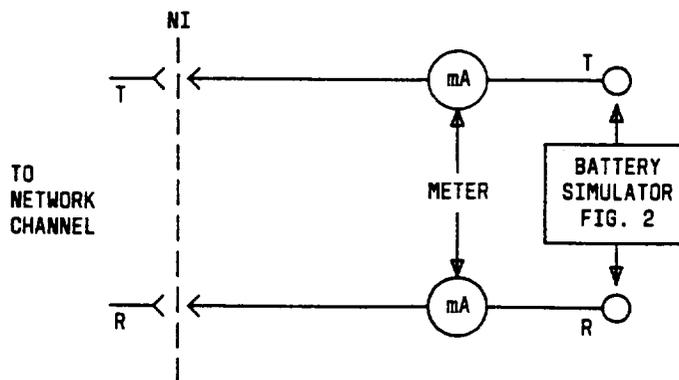


LEGEND:
 CLR = CONDUCTOR LOOP RESISTANCE
 NL = NONLOCKING

Fig. 2—Battery Supply Simulator for CPE

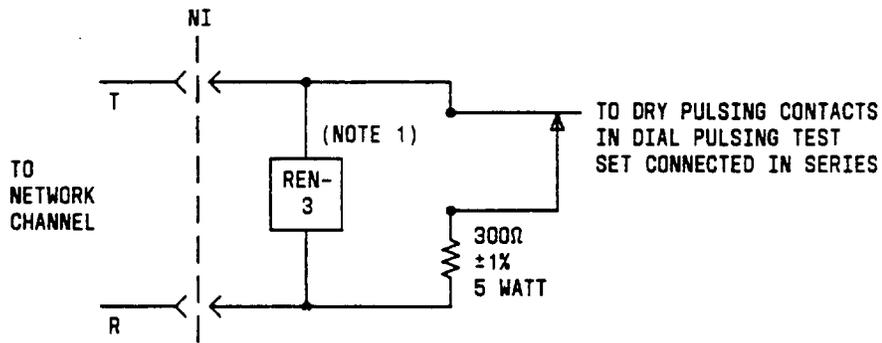


(a) Off-Hook Current Condition



(b) On-Hook Current Condition

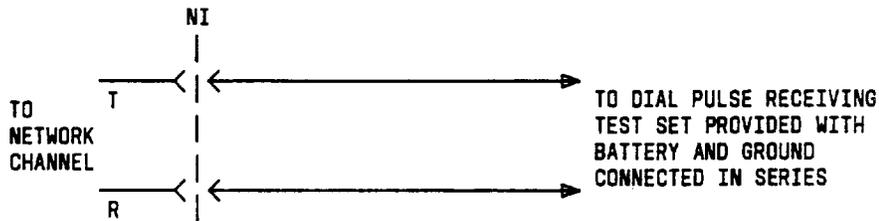
Fig. 3—Loop- and Ground-Start Current Simulators for CPE



NOTE:

1. THE "REN 3" INDICATES THE EQUIVALENT OF THREE C4A RINGERS CONNECTED IN PARALLEL. A C4A RINGER CAN BE SIMULATED BY CONNECTING A 3650-OHM 110-HENRY INDUCTOR IN SERIES WITH 0.45 μF CAPACITOR. THREE SUCH CIRCUIT ARRANGEMENTS CONNECTED IN PARALLEL CONSTITUTES WHAT IS REFERRED TO AS "REN 3".

(a) Dry Dial Pulsing Simulator



(b) Dial Pulse Receiving Test Set Simulator

Fig. 4—Dial Pulsing Simulators for CPE

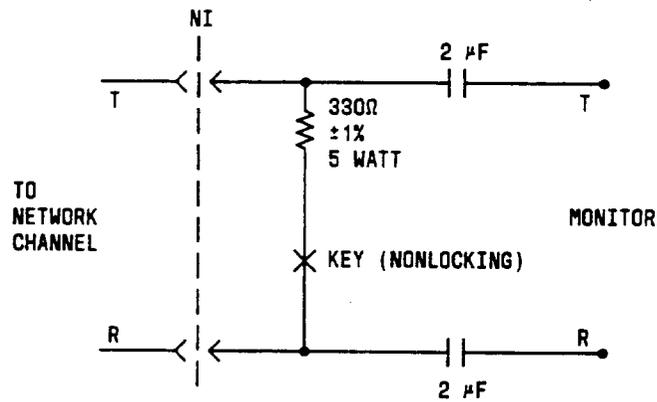
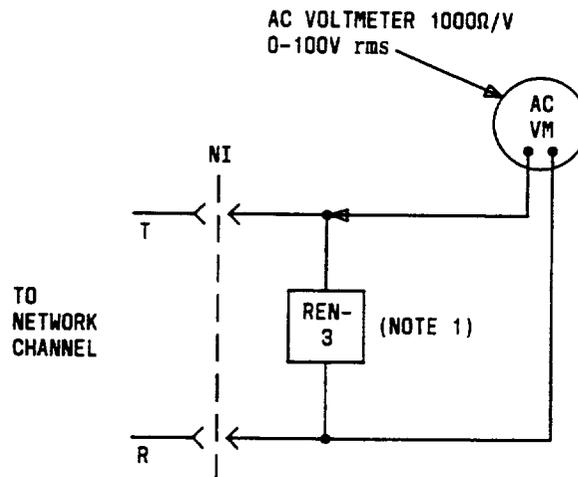


Fig. 5—Ringing Trip Simulator for CPE

**NOTE:**

1. THE "REN 3" INDICATES THE EQUIVALENT OF THREE C4A RINGERS CONNECTED IN PARALLEL. A C4A RINGER CAN BE SIMULATED BY CONNECTING A 3650-OHM 110-HENRY INDUCTOR IN SERIES WITH 0.45μF CAPACITOR. THREE SUCH CIRCUIT ARRANGEMENTS CONNECTED IN PARALLEL CONSTITUTES WHAT IS REFERRED TO AS "REN 3".

Fig. 6—Ringer Simulator for CPE

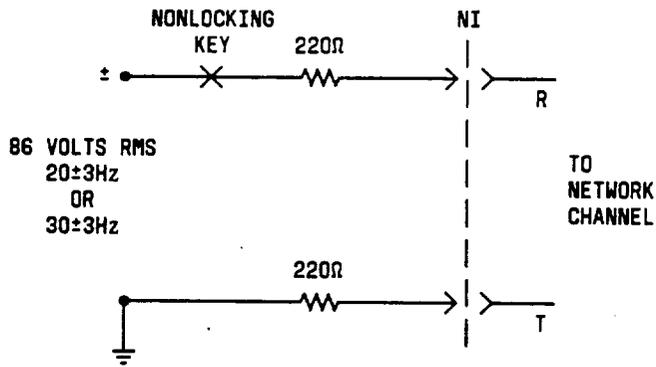


Fig. 7—Ringing Supply Voltage Simulator for CPE

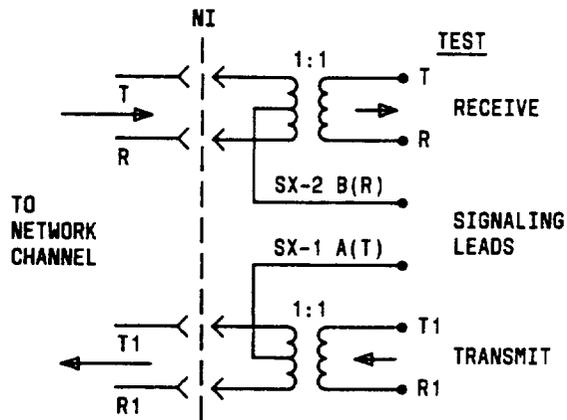


Fig. 8—4-Wire Termination Simulator for CPE

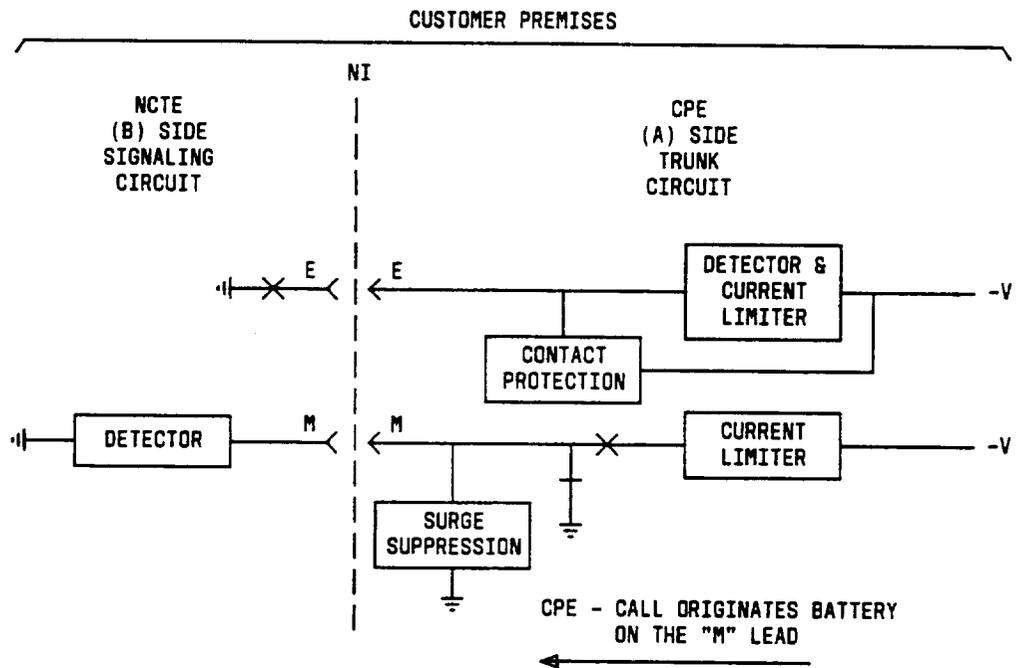


Fig. 9—Type I-A Signaling Interface

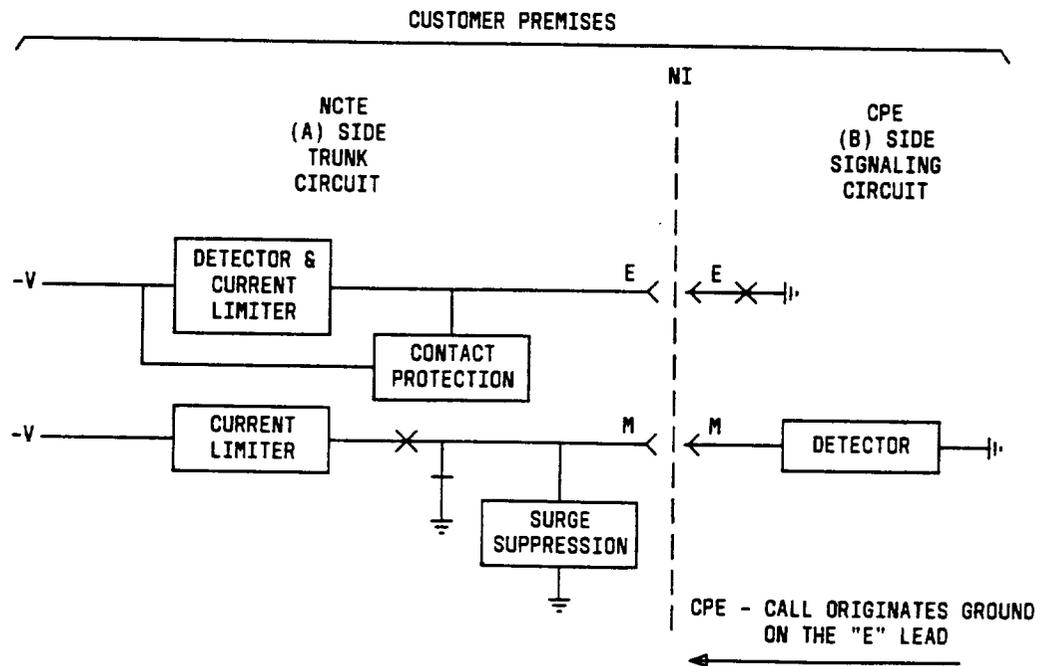


Fig. 10—Type I-B Signaling Interface

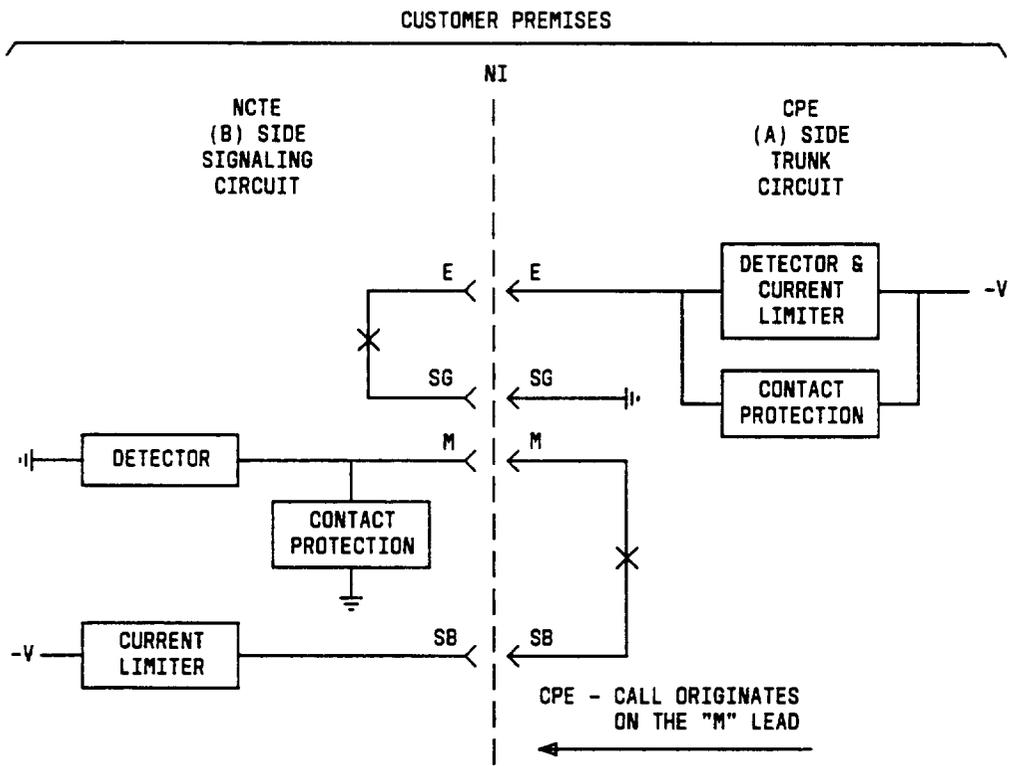


Fig. 11—Type II-A Signaling Interface

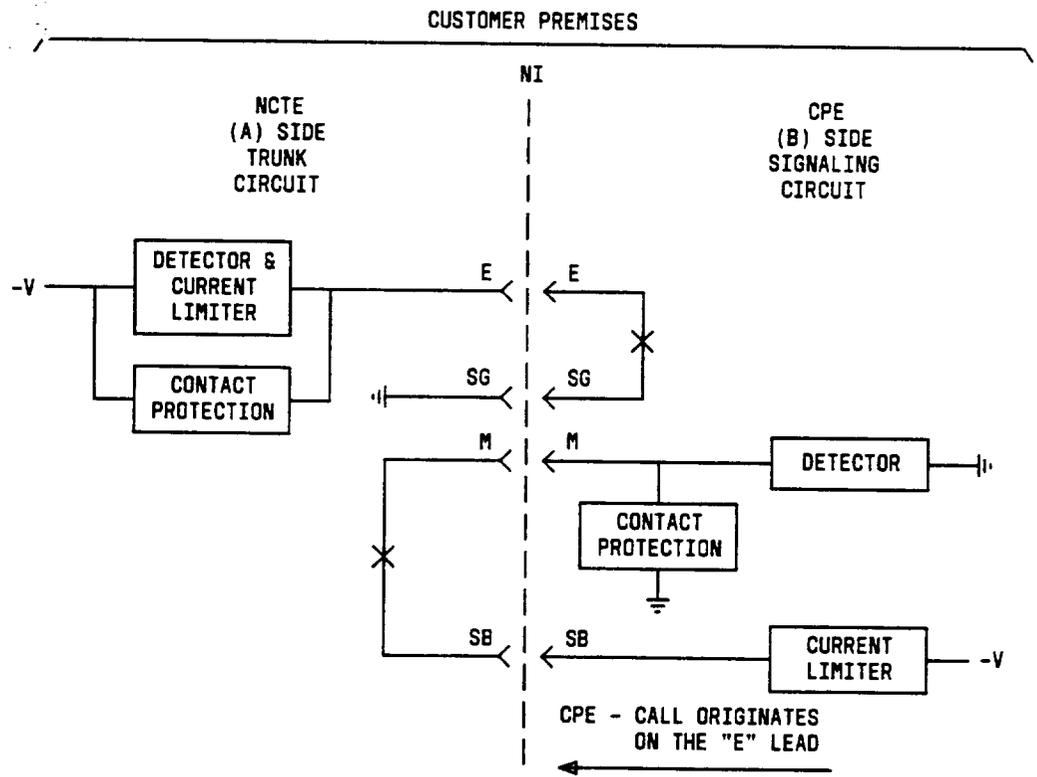
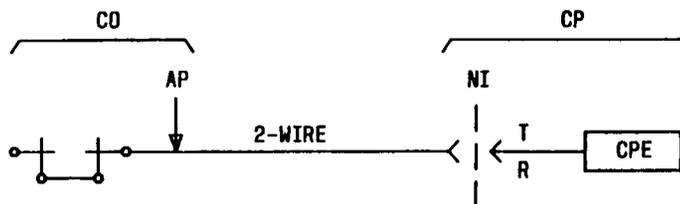


Fig. 12—Type II-B Signaling Interface



NOTE:

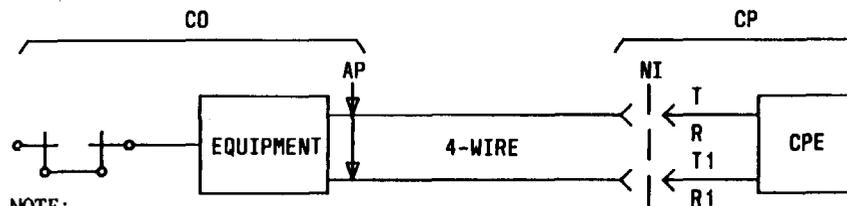
1. See Table B for Signaling Test Limits.

Fig. 13—2-Wire Loop-Start Signaling Access, CP to CO (Note 1)

TABLE B

SIGNALING TEST LIMITS RELATED TO FIG. 13

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Loop Current	X					X		≥ 20 mA With 430Ω Fig. 3(a)	
2	Dial Tone	X					X		Yes	
3	Ringing Voltage Option	X		20 Hz ± 1 Hz		X			≥ 40V RMS Fig. 6	Ringing To Trip With Fig. 5
		X		17 To 23 Hz (CO Supply)		X			≥ 55V RMS Fig. 6	
4	Ringing Trip	X		20 Hz ± 1 Hz			X		Trip Ringing With Fig. 5	
				17 To 23 Hz (CO Supply)						
5	Dial Pulse Distortion	X			Pulses On Tip And Ring		X	Pulses On Tip And Ring		Pulsing Test Set, Dry Pulsing Contacts Fig. 4(a)
					8/42-84			8/64		
	Pulses Per Second/Percent Break	X			11/42-84		X	11/58		



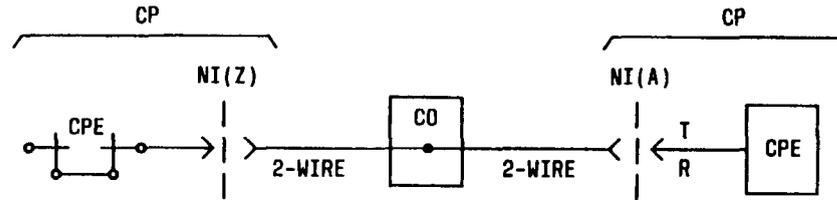
NOTE:
1. See Table C for Signaling Test Limits.

Fig. 14—4-Wire Loop-Start Signaling Access, CP to CO (Note 1)

TABLE C

SIGNALING TEST LIMITS RELATED TO FIG. 14

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Loop Current	X					X		≥ 20 mA With 430Ω Fig. 8, 3(a)	Terminate With Fig. 8 And Terminate SX1 & SX2 Leads Of Fig. 8 With Fig. 3(a)
2	Dial Tone	X					X	Yes		
3	Ringing Voltage Option	X		20 Hz ± 1 Hz		X			≥ 40V RMS Fig. 6, 8	Terminate SX1 & SX2 Leads Of Fig. 8 With Fig. 6
		X		17 To 23 Hz (CO Supply)		X			≥ 55V RMS Fig. 6, 8	
4	Ringing Trip	X		20 Hz ± 1 Hz			X		Trip Ringing With Fig. 5	
				17 To 23 Hz (CO Supply)						
5	Dial Pulse Distortion	X			Pulses On SX1 & SX2 Leads		X	Pulses On SX1 & SX2 Leads		Pulsing Test Set, Dry Pulsing Contacts Fig. 4(a) Between SX1 & SX2 Leads Of Fig. 8
				8/42-84	8/64					
	Pulses Per Second/Percent Break	X			11/42-84		X	11/58		

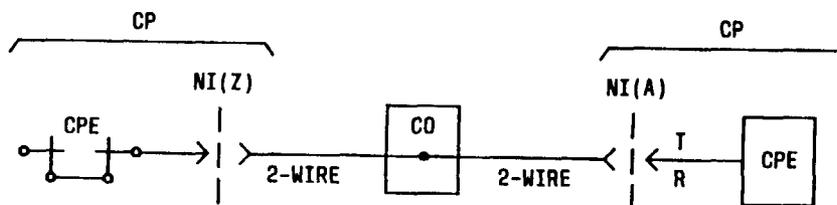


NOTE:
1. See Table D for Signaling Test Limits.

Fig. 15—2-Wire Loop-Start Signaling Access, CP NI(A) to CP NI(Z) (Note 1)

TABLE D
SIGNALING TEST LIMITS RELATED TO FIG. 15

ITEM NO.	TESTS	OUTGOING		AT NI (Z)		OUTGOING		AT NI (A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Loop Current	X		-48V To Ring, Grd To Tip Fig. 2			X	≥ 20 mA With 430Ω Fig. 3(a)	Use Battery Simulators Class A, B, or C Fig. 2	
2	Ringing Voltage	X		86V RMS Fig. 7		X		≥ 55V RMS Fig. 6		
3	Dial Pulse Distortion	X			8/42-84		X	8/64	Pulsing Test Set, Dry Pulsing Contacts Fig. 4(a)	
	Pulses Per Second/Percent Break	X			11/42-84		X	11/58		



NOTE:

1. See Table E for Signaling Test Limits.

Fig. 16—2-Wire Loop-Start Signaling Access, CP NI(Z) to CP NI(A) (Note 1)

TABLE E

SIGNALING TEST LIMITS RELATED TO FIG. 16

ITEM NO.	TESTS	OUTGOING		AT NI(Z)		OUTGOING		AT NI(A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Loop Current	X		-48V To Ring, Grd To Tip Fig. 2	≤ 3.2 mA Fig. 3(b)	X			Tip And Ring Open	Use Battery Simulators Class A, B, or C Fig. 2
2	Loop Current	X		-48V To Ring Grd To Tip Fig. 2			X		≥ 20 mA With 430Ω Fig. 3(a)	
3	Dial Pulse Distortion	X			8/42-84		X	8/64		Dial Pulse Receiving Test Set Fig. 4(b)
	Pulses Per Second/Percent Break	X			11/42-84		X	11/58		

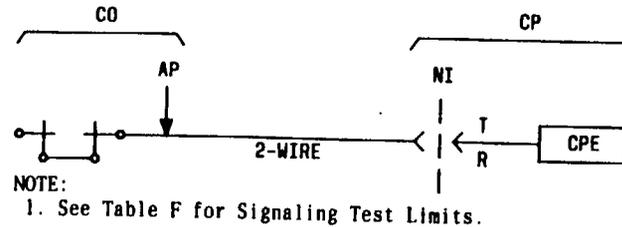
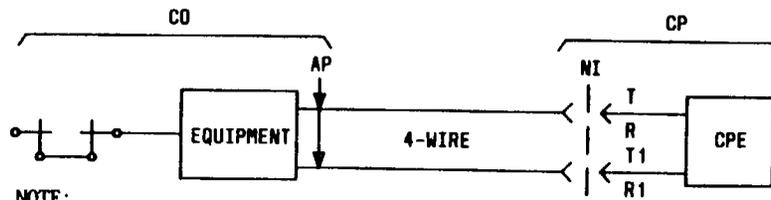


Fig. 17—2-Wire Ground-Start Signaling Access, CP to CO (Note 1)

TABLE F

SIGNALING TEST LIMITS RELATED TO FIG. 17

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Resistance	X		Tip Lead Open		X			Tip Lead Open, Tip To Grd $\geq 30K \Omega$	
2	Loop Current	X					X	Ring Lead Grd Fig. 3(a)	≥ 20 mA With 430Ω Fig. 3(a)	Operate Momentarily GS Switch For Ring Lead Grd Fig. 3(a)
3	Dial Tone	X					X		Yes (Within 3 Seconds)	
4	Ringing Voltage Option	X		$20 \text{ Hz} \pm 1 \text{ Hz}$ & Tip Grd		X			$\geq 40V$ RMS Fig. 6	
		X		17 To 23 Hz (Co Supply) & Tip Grd		X			$\geq 55V$ RMS Fig. 6	
5	Ringing Trip	X		$20 \text{ Hz} \pm 1 \text{ Hz}$ & Tip Grd 17 To 23 Hz (CO Supply) & Tip Grd			X		Trip Ringing With Fig. 5	
6	Disconnect	X		CO Switch To Disconnect		X			Tip to Grd $\geq 30K \Omega$ Fig. 5	After Removal Of Fig. 5
7	Dial Pulse Distortion	X			$8/42-84$		X	$8/64$		Pulsing Test Set, Dry Pulsing Contacts Fig. 4(a)
	Pulses Per Second/Percent Break	X			$11/42-84$		X	$11/58$		



NOTE:

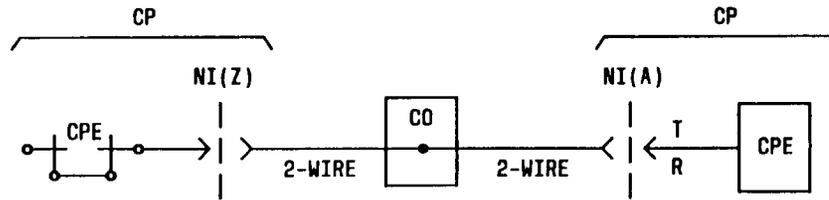
1. See Table G for Signaling Test Limits.

Fig. 18—4-Wire Ground-Start Signaling Access, CP to CO (Note 1)

TABLE G

SIGNALING TEST LIMITS RELATED TO FIG. 18

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Resistance	X		Tip Lead Open		X			SX1 Lead To Grd Of Transmt Pair $\geq 15K \Omega$	Tip Lead Open
2	Loop Current	X					X	Ring Lead Grd To SX2 Of Receive Pair Fig. 3(a), 8	≥ 20 mA With 430Ω Fig. 3(a)	Terminate SX Leads Of Fig. 8 With Fig. 3(a), Operate Momentarily GS Switch For Ring Lead Grd Fig. 3(a)
3	Dial Tone	X					X		Yes (Within 3 Seconds)	
4	Ringing Voltage Option	X		20 Hz \pm 1 Hz & Tip Grd		X			$\geq 40V$ RMS Fig. 6	Terminate SX Leads Of Fig. 8 With Fig. 6
		X		17 To 23 Hz (CO Supply) & Tip Grd		X			$\geq 55V$ RMS Fig. 6	
5	Ringing Trip	X		20 Hz \pm 1 Hz & Tip Grd or 17 To 23 Hz (CO Supply) & Tip Grd			X		Trip Ringing With Fig. 5	Terminate SX Leads Of Fig. 8 With Fig. 5
6	Disconnect	X		CO Switch To Disconnect					SX1 Lead To Grd Of Transmt Pair $\geq 30K \Omega$ Fig. 8	After Removal Of Fig. 5 From Fig. 8
7	Dial Pulse Distortion	X			8/42-84		X	8/64		Pulsing Test Set. Dry Pulsing Contacts Fig. 4(a) Between Simplex Leads Of Fig. 8
	Pulses Per Second/Percent Break	X			11/42-84		X	11/58		



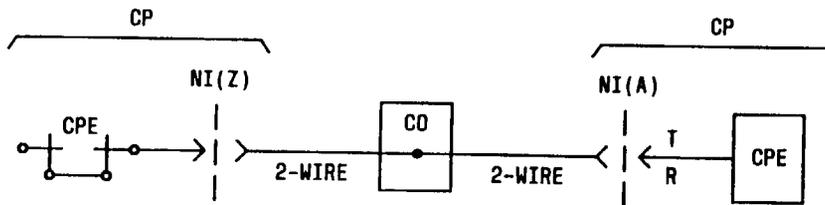
NOTE:
1. See Table H for Signaling Test Limits.

Fig. 19—2-Wire Ground-Start Signaling Access, CP NI(A) to CP NI(Z) (Note 1)

TABLE H

SIGNALING TEST LIMITS RELATED TO FIG. 19

ITEM NO.	TESTS	OUTGOING		AT NI (Z)		OUTGOING		AT NI (A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Resistance	X		Tip Lead Open		X			Tip Lead Open ≥ 30K Ω	
2	Loop Current	X		-48V To Ring, Grd To Tip Fig. 2 (d)			X		≥ 20 mA With 430Ω Fig. 3(a)	
3	Ring Voltage	X		86V RMS To Ring, Grd To Tip Fig. 7		X			≥ 55V RMS Fig. 6	
4	Dial Pulse Distortion	X			8/42-84		X	8/64		Pulsing Test Set. Dry Pulsing Contacts Fig. 4(a)
	Pulses Per Second/Percent Break	X			11/42-84		X	11/58		



NOTE:

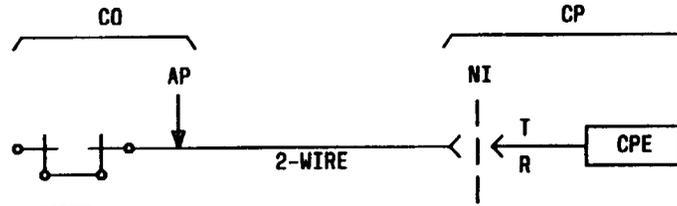
1. See Table I for Signaling Test Limits.

Fig. 20—2-Wire Ground-Start Signaling Access, CP NI(Z) to CP NI(A) (Note 1)

TABLE I

SIGNALING TEST LIMITS RELATED TO FIG. 20

ITEM NO.	TESTS	OUTGOING		AT NI (Z)		OUTGOING		AT NI (A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Loop Current	X		-48V To Ring, Grd To Tip Fig. 2 (d)	Using Fig. 3(b) Sum Of Current In Tip Lead + Current In Ring Lead = ≤ 6 mA	X			Tip & Ring Leads Open	
		X		-48V To Ring, Grd To Tip Fig. 2 (d)			X		≥ 20 mA With 430Ω Fig. 3(a)	
2	Disconnect	X		-48V To Ring, Grd To Tip Fig. 2 (d)	Using Fig. 3(b) Sum Of Current In Tip Lead + Current In Ring Lead = ≤ 6 mA	X				Make Measurement At NI(Z) Immediately Upon Removal Fig. 3(a) From NI(A)
3	Dial Pulse Distortion	X			8/42-84		X	8/64		Dial Pulse Receiving Test Set Fig. 4(b)
	Pulses Per Second/Percent Break	X			11/42-84		X	11/58		



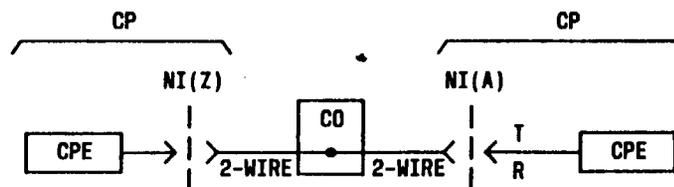
NOTE:
1. See Table J for Signaling Test Limits.

Fig. 21—2-Wire Loop-Reverse Battery Signaling Access, CP to CO (Note 1)

TABLE J

SIGNALING TEST LIMITS RELATED TO FIG. 21

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook Resistance	X				X			Tip To Ring, Tip To Grd & Ring To Grd ≥ 30K Ω	
2	Loop Current		X	Trunk Seized		X			≥ 16 mA Fig. 2(c), 3(b)	
3	Disconnect	X		Release Trunk (Disconnect)		X			≤ 1.6 mA Loop Current Fig. 2(c), 3(b)	
4	Dial Pulse Distortion		X	8/64		X			8/42-84	Dial Pulse Receiving Test Set Fig. 4(b)
	Pulses Per Second/Percent Break		X	11/58		X			11/42-84	



NOTE:

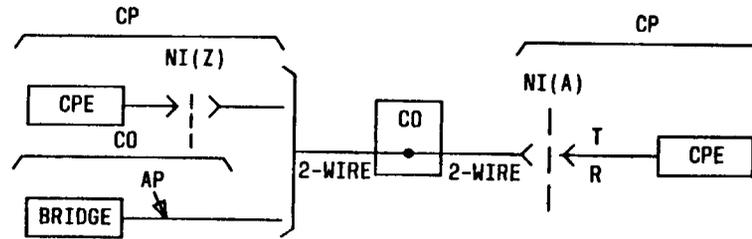
1. See Table K for Signaling Test Limits.

Fig. 22—2-Wire Automatic Ringdown Signaling Access, CP to CP (Note 1)

TABLE K

SIGNALING TEST LIMITS RELATED TO FIG. 22

ITEM NO.	TESTS	OUTGOING		AT NI (Z)		OUTGOING		AT NI (A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Loop Current		X		≥ 20 mA With 330Ω Fig. 3(a)		X		≥ 20 mA With 330Ω Fig. 3(a)	Terminate Tip And Ring Leads With 330Ω Of Fig. 3(a) At NI(Z) And NI(A)
2	Ring Voltage NI(A) To NI(Z)	X			≥ 55V RMS Fig. 6		X	Terminate Tip And Ring With 330Ω Of Fig. 3(a)		
3	Ring Voltage NI(Z) To NI(A)		X	Terminate Tip And Ring With 330Ω Of Fig. 3(a)		X			≥ 55V RMS Fig. 6	
4	Ring Voltage NI(A) To NI(Z)		X		Trip Ringing With Fig. 5		X	Terminate Tip And Ring With 330Ω Of Fig. 3(a)		
	Ring Voltage NI(Z) To NI(A)		X	Terminate Tip And Ring With 330Ω Of Fig. 3(a)			X		Trip Ringing With Fig. 5	



NOTE:

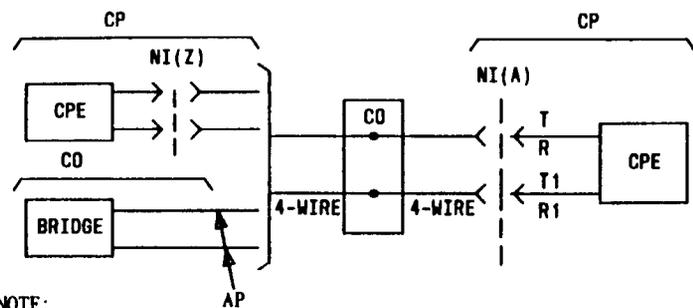
1. See Table L for Signaling Test Limits.

Fig. 23—2-Wire Manual Ringdown Signaling Access, CP to CP and CP to CO (Note 1)

TABLE L

SIGNALING TEST LIMITS RELATED TO FIG. 23

ITEM NO.	TESTS	OUTGOING		AT NI (Z) OR CO BRIDGE		OUTGOING		AT NI (A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Manual Incoming Ringing at NI(A)	X		86V RMS Fig. 7		X			≥ 55V RMS Fig. 6	
2	Code Select Incoming Ringing at NI(A)	X		Proper Station Selection Code Or Codes To Ring NI(A)		X			≥ 55V RMS Fig. 6	Code Select Ringing Voltage Will be Provided For Only One Ringing Cycle
3	Manual Outgoing Ringing At NI(A)	X			≥ 55V RMS Fig. 6 At NI(Z)	X		86V RMS Fig. 7		
4	Outgoing Ringing at NI(A) For Code Select At CO Bridge	X			-48V on SG Lead (During Ringing) GRD on SG Lead (Idle State) At CO Bridge Leg	X		86V RMS Fig. 7		



NOTE:
1. See Table M for Signaling Test Limits.

Fig. 24—4-Wire Manual Ringdown Signaling Access, CP to CP and CP to CO (Note 1)

TABLE M

SIGNALING TEST LIMITS RELATED TO FIG. 24

ITEM NO.	TESTS	OUTGOING		AT NI (Z) OR CO BRIDGE		OUTGOING		AT NI (A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Manual Incoming Ringing At NI(A)	X		86V RMS Fig. 7		X			≥ 55V RMS Across Simplex Leads Fig. 6, 8	Terminate T & R And T1 & R1 Leads With Fig. 8, Terminate Simplex Leads of Fig. 8 With Fig. 6
2	Code Select Incoming Ringing At NI(A)	X		Proper Station Selection Code Or Codes To Ring NI(A)		X			≥ 55V RMS Across Simplex Leads Fig. 6, 8	Terminate T & R And T1 & R1 Leads With Fig. 8, Terminate Simplex Leads of Fig. 8 With Fig. 6, Code Select Ringing Voltage Will Be Provided For Only One Ringing Cycle.
3	Manual Outgoing Ringing At NI(A)	X			≥ 55V RMS Fig. 6 At NI(Z)	X		86V RMS Fig. 7, 8		Terminate T & R And T1 & R1 Leads With Fig. 8, Terminate Simplex Leads Of Fig. 8 With Fig. 7
4	Outgoing Ringing at NI(A) For Code Select At CO Bridge	X			-48V on SG Lead (During Ringing) GRD on SG Lead (Idle State) At CO Bridge Leg	X		86V RMS Fig. 7, 8		



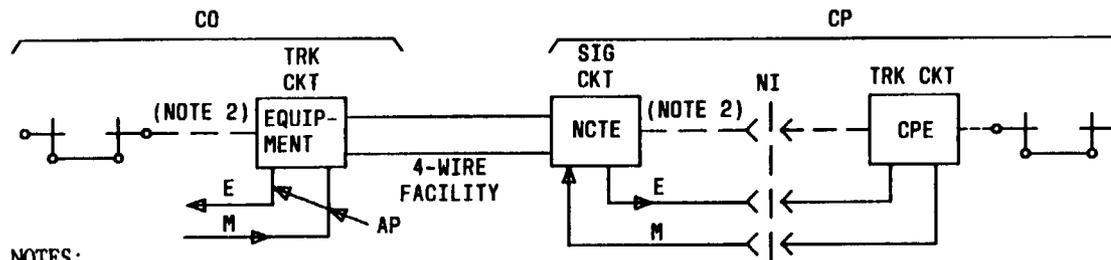
NOTE:
1. See Table N for Signaling Test Limits.

Fig. 25—2-Wire Simplex Signaling (Automatic Identified Outward Dialing) Access, CP to CO (Note 1)

TABLE N

SIGNALING TEST LIMITS RELATED TO FIG. 25

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	Loop Resistance of AIOD		X	Short Tip And Ring Leads			X		Across Tip And Ring Leads ≤ 1436 OHMS	
2	Incoming Idle	X		GRD to AIOD Data Channel SX		X		CPE Provides Battery to AIOD Data Channel SX	SX Current minimum 24 mA	
3	BID Signal From CPE	X			Request For Data Receiver		X	CPE Change From Battery To GRD On AIOD Data Channel SX	SX Current Drop To Near Zero mA	
4	After Receipt of BID Signal		X	Battery To AIOD Data Channel SX			X		SX Current Minimum 22 mA	
5	CO Disconnect	X		GRD To AIOD Data Channel SX			X		SX Current Drop To Near Zero mA	
6	CPE Disconnect	X				X		CPE Change From GRD To Battery On AIOD Data Channel SX	SX Current Minimum 24 mA	



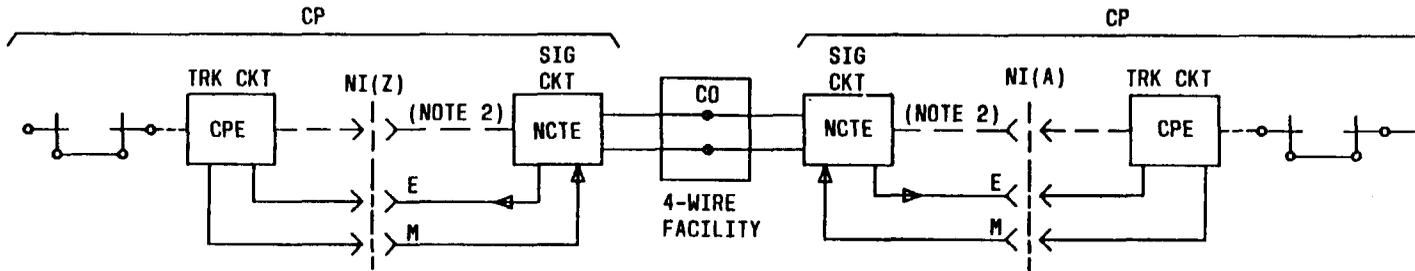
- NOTES:
1. See Table O for Signaling Test Limits.
 2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 26—E and M Lead Signaling Access Type I-A, CP to CO (Note 1)

TABLE O

SIGNALING TEST LIMITS RELATED TO FIG. 26

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook - Idle	X		M Lead To GRD ≤ 1.0 Vdc	E Lead To GRD $\geq 20K \Omega$	X		M Lead To GRD ≤ 1.0 Vdc	E Lead To GRD $\geq 20K \Omega$	See Fig. 1, 9
2	Off Hook Seizure CP To CO	X			E Lead To GRD $\leq 150\Omega$		X	M Lead To GRD -42.5 Vdc		Call Originates On M Lead At CP
3	Off Hook Seizure CO To CP		X	M Lead To GRD -42.5 Vdc		X			E Lead To GRD $\leq 150\Omega$	Call Originates On M Lead At CO
4	Dial Pulse Distortion		X	Pulses on M Lead		X		Pulses on E Lead		
		8/64		8/42-84						
		11/52		11/42-84						
	Pulses per Second/Percent Break	X			Pulses on E Lead		X	Pulses on M Lead		
				8/42-84			8/64			
				11/42-84			11/52			



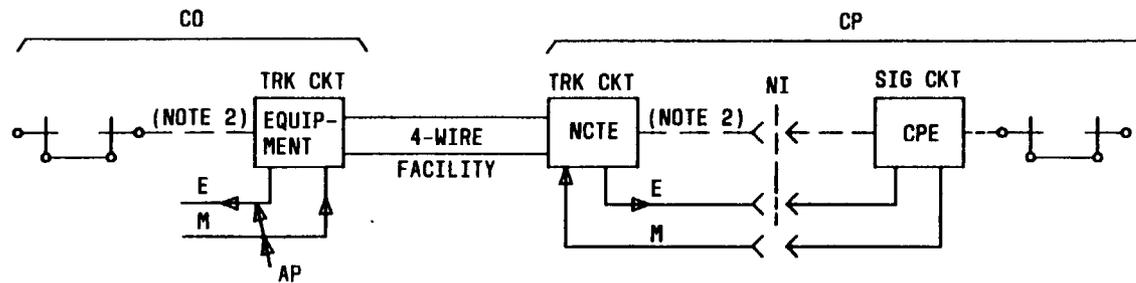
- NOTES:
1. See Table P for Signaling Test Limits.
 2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 27—E and M Lead Signaling Access Type I-A, CP to CP (Note 1)

TABLE P

SIGNALING TEST LIMITS RELATED TO FIG. 27

ITEM NO.	TESTS	OUTGOING		AT NI (Z)		OUTGOING		AT NI (A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook - Idle	X		M Lead To GRD ≤ 1.0 Vdc	E Lead To GRD $\geq 20K \Omega$	X		M Lead To GRD ≤ 1.0 Vdc	E Lead To GRD $\geq 20K \Omega$	See Fig. 1, 9
2	Off Hook Seizure NI(A) To NI(Z)	X			E Lead To GRD $\leq 150\Omega$		X	M Lead To GRD -42.5 Vdc		Call Originates On M Lead At NI(A)
3	Off Hook Seizure NI(Z) To NI(A)		X	M Lead To GRD -42.5 Vdc		X			E Lead To GRD $\leq 150\Omega$	Call Originates On M Lead At NI(Z)
4	Dial Pulse Distortion		X	Pulses on M Lead		X		Pulses on E Lead		
				8/64				8/42-84		
				11/52				11/42-84		
	Pulses per Second/Percent Break	X			Pulses on E Lead		X	Pulses on M Lead		
				8/42-84			8/64			
				11/42-84			11/52			



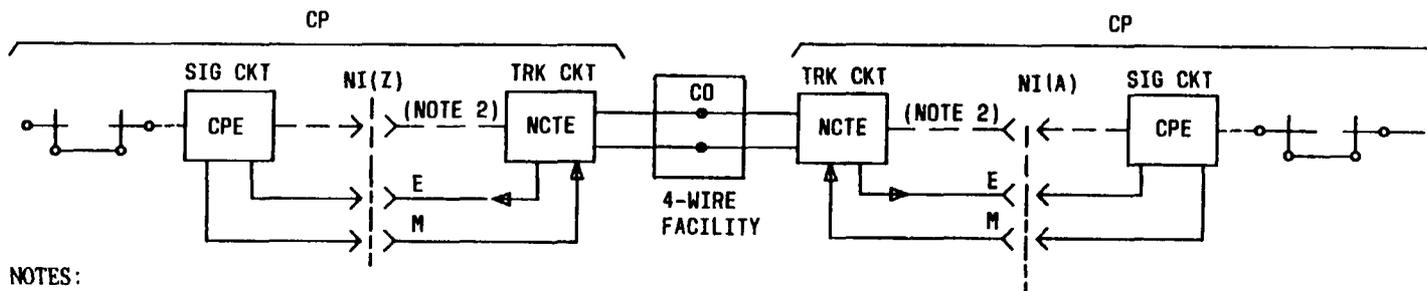
- NOTES:
1. See Table Q for Signaling Test Limits.
 2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 28—E and M Lead Signaling Access Type I-B, CP to CO (Note 1)

TABLE Q

SIGNALING TEST LIMITS RELATED TO FIG. 28

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook - Idle	X		E Lead To GRD $\geq 20K \Omega$	M Lead To GRD ≤ 1.0 Vdc	X		E Lead To GRD $\geq 20K \Omega$	M Lead To GRD ≤ 1.0 Vdc	See Fig. 1, 10
2	Off Hook Seizure CP To CO	X			M Lead To GRD ≥ -42.5 Vdc		X	E Lead To GRD 150Ω		Call Originates On E Lead At CP
3	Off Hook Seizure CO To CP		X	E Lead To GRD 150Ω		X			M Lead To GRD ≥ -42.5 Vdc	Call Originates On E Lead At CO
4	Dial Pulse Distortion		X		Pulses On M Lead To GRD		X	Pulses on E Lead To GRD		
					8/42-84			8/64		
					11/42-84			11/52		
Pulses per Second/Percent Break	X			Pulses on E Lead To GRD		X		Pulses on M Lead To GRD		
				8/64				8/42-84		
				11/52				11/42-84		



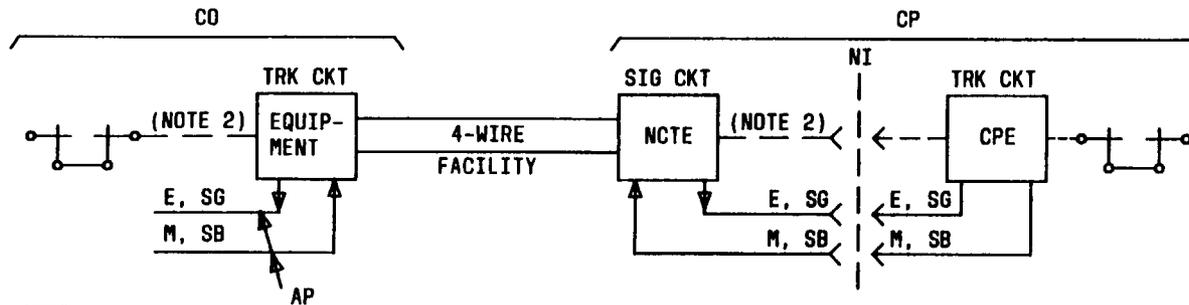
- NOTES:
 1. See Table R for Signaling Test Limits.
 2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 29—E and M Lead Signaling Access Type I-B, CP to CP (Note 1)

TABLE R

SIGNALING TEST LIMITS RELATED TO FIG. 29

ITEM NO.	TESTS	OUTGOING		AT NI(Z)		OUTGOING		AT NI(A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook - Idle	X		E Lead To GRD $\geq 20K \Omega$	M Lead To GRD ≤ 1.0 Vdc	X		E Lead To GRD $\geq 20K \Omega$	M Lead To GRD ≤ 1.0 Vdc	See Fig. 1, 10
2	Off Hook Seizure NI(A) To NI(Z)	X			M Lead To GRD ≥ -42.5 Vdc		X	E Lead To GRD 150Ω		Call Originates On E Lead At NI(A)
3	Off Hook Seizure NI(Z) To NI(A)		X	E Lead To GRD 150Ω		X			M Lead To GRD ≥ -42.5 Vdc	Call Originates On E Lead At NI(Z)
4	Dial Pulse Distortion	X			Pulses On M Lead To GRD		X	Pulses on E Lead To GRD		
					8/42-84			8/64		
					11/42-84			11/52		
	Pulses per Second/Percent Break		X		Pulses on E Lead To GRD		X		Pulses on M Lead To GRD	
				8/64				8/42-84		
				11/52				11/42-84		



NOTES:

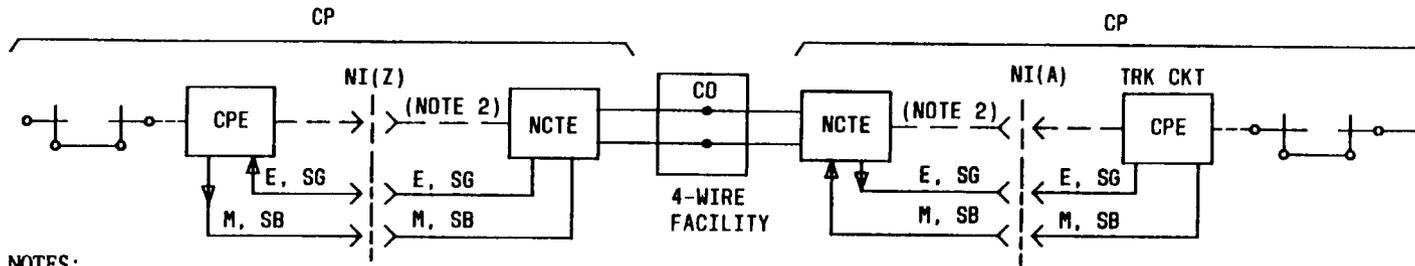
1. See Table S for Signaling Test Limits.
2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 30—E and M Lead Signaling Access Type II-A, CP to CO (Note 1)

TABLE S

SIGNALING TEST LIMITS RELATED TO FIG. 30

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook - Idle	X		M to SB Leads $\geq 500K \Omega$ Open	E to SG Leads $\geq 500K \Omega$ Open	X		M to SB Leads $\geq 500K \Omega$ Open	E to SG Leads $\geq 500K \Omega$ Open	See Fig. 1, 11
2	Off Hook Seizure CP to CO	X			E to SG Leads $\leq 40\Omega$ Short		X	M to SB Lead 300Ω Short		Call Originates on M and SB Leads at CP
3	Off Hook Seizure CO to CP		X	M to SB Leads 300Ω Short		X			E to SG Leads $\leq 40\Omega$ Short	Call Originates on M and SB Leads at CO
4	Dial Pulse Distortion	X			Pulses on E to SG Leads		X	Pulses on M to SB Leads		
					8/42-84			8/64		
					11/42-84			11/52		
	Pulses Per Second/Percent Break		X	Pulses on M to SB Leads		X		Pulses on E to SG Leads		
				8/64				8/42-84		
				11/52				11/42-84		



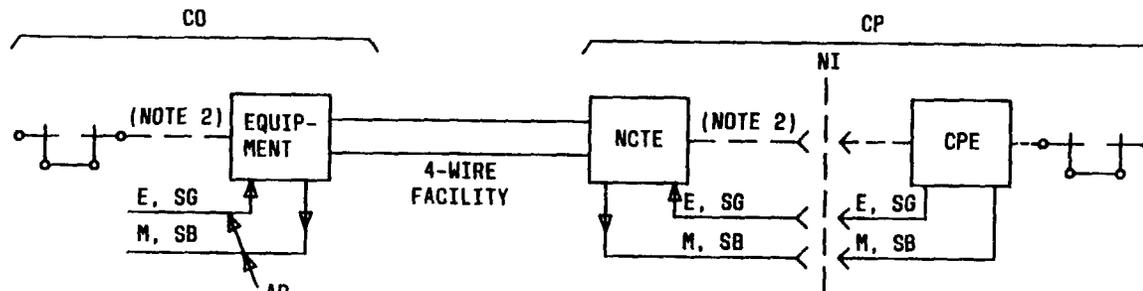
- NOTES:
1. See Table T for Signaling Test Limits.
 2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 31—E and M Lead Signaling Access Type II-A, CP to CP (Note 1)

TABLE T

SIGNALING TEST LIMITS RELATED TO FIG. 31

ITEM NO.	TESTS	OUTGOING		AT NI (Z)		OUTGOING		AT NI (A)		CONDITIONS	
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE		
1	On Hook - Idle	X		M To SB Leads $\geq 500K \Omega$ Open	E To SG Leads $\geq 500K \Omega$ Open	X		M To SB Leads $\geq 500K \Omega$ Open	E To Sg Leads $\geq 500K \Omega$ Open	See Fig. 1, 11	
2	Off Hook Seizure NI(A) To NI(Z)	X			E To SG Leads $\leq 40\Omega$ Short		X	M To SB Leads 300Ω Short		Call Originates On M And SB Leads At NI(A)	
3	Off Hook Seizure NI(Z) To NI(A)		X	M To SB Leads 300Ω Short		X			E To SG Leads $\leq 40\Omega$ Short	Call Originates On M And SB Leads At NI(Z)	
4	Dial Pulse Distortion	X			Pulses On E To SG Leads		X	Pulses on M To SB Leads			
					8/42-84						8/64
					11/42-84						11/52
	Pulses per Second/Percent Break		X		Pulses on M To SB Leads		X		Pulses on E To SG Leads		
				8/64				8/42-84			
				11/52				11/42-84			



NOTES:

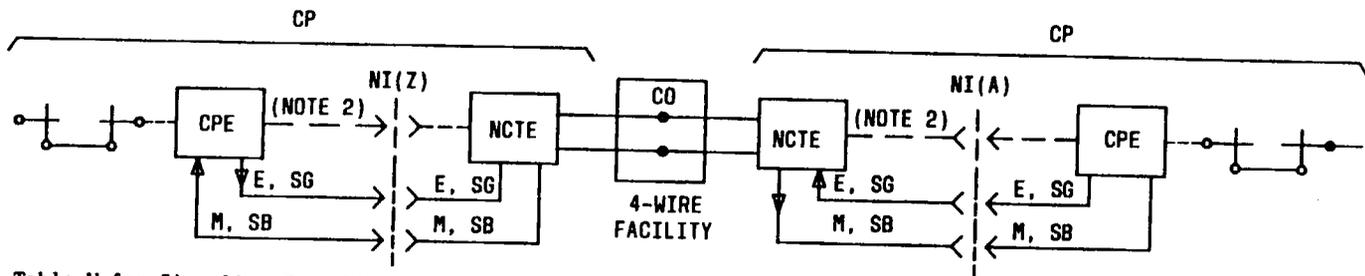
1. See Table U for Signaling Test Limits.
2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 32—E and M Lead Signaling Access Type II-B, CP to CO (Note 1)

TABLE U

SIGNALING TEST LIMITS RELATED TO FIG. 32

ITEM NO.	TESTS	OUTGOING		AT CO		OUTGOING		AT CP NI		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook - Idle	X		E to SG Leads $\geq 500K \Omega$ Open	M to SB Leads $\geq 500K \Omega$ Open	X		E to SG Leads $\geq 500K \Omega$ Open	M to SB Leads $\geq 500K \Omega$ Open	See Fig. 1, 12
2	Off Hook Seizure CP to CO	X			M TO SB Leads $\leq 40\Omega$ Short		X	E to SG Leads 300Ω Short		Call Originates on E and SG Leads at CP
3	Off Hook Seizure CO to CP		X	E to SG Leads 300Ω Short		X			M to SB Leads $\leq 40\Omega$ Short	Call Originates on E and SG Leads at CO
4	Dial Pulse Distortion	X			Pulses on M to SB Leads		X	Pulses on E to SG Leads		
					8/42-84			8/64		
					11/42-84			11/52		
	Pulses per Second/Percent Break		X	Pulses on E to SG Leads		X				Pulses on M to SB Leads
8/64				8/42-84						
11/52				11/42-84						



NOTES:

1. See Table V for Signaling Test Limits.
2. Voice and Voiceband Data Transmission Leads maybe 2- or 4-Wire.

Fig. 33—E and M Lead Signaling Access Type II-B, CP to CP (Note 1)

TABLE V

SIGNALING TEST LIMITS RELATED TO FIG. 33

ITEM NO.	TESTS	OUTGOING		AT NI(Z)		OUTGOING		AT NI(A)		CONDITIONS
		ON-HOOK	OFF-HOOK	SEND	RECEIVE	ON-HOOK	OFF-HOOK	SEND	RECEIVE	
1	On Hook -- Idle	X		E To SG Leads $\geq 500K \Omega$ Open	M To SB Leads $\geq 500K \Omega$ Open	X		E To SG Leads $\geq 500K \Omega$ Open	M To SB Leads $\geq 500K \Omega$ Open	See Fig. 1, 12
2	Off Hook Seizure NI(A) To NI(Z)	X			M To SB Leads $\leq 40\Omega$ Short		X	E To SG Leads 300 Ω Short		Call Originates On E And SG Leads At NI(A)
3	Off Hook Seizure NI(Z) To NI(A)		X	E To SG Leads 300 Ω Short		X			M To SB Leads $\leq 40\Omega$ Short	Call Originates On E And SG Leads At NI(Z)
4	Dial Pulse Distortion	X			Pulses on M To SB Leads	X		Pulses on E To SG Leads		
					8/42-84			8/64		
					11/42-84			11/52		
	Pulses per Second/Percent Break		X		Pulses on E To SG Lead		X		Pulses on M To SB Leads	
				8/64				8/42-84		
				11/52				11/42-84		