SPECIAL AND SWITCHED ACCESS CHANNELS SIGNALING LIMITS AND TEST PROCEDURES

CONTENTS PAGE

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1. GENERAL

1.01 This practice provides test procedures for verifying the signaling performance of channels provided by the operating telephone companies for access service. The tests, that include the following signals, will insure the signaling parameter limits are met.

- Supervisory Signals
- Control Signals
- Address Signals
- Alerting Signals

1.02 Audible tones and announcements, used to inform the user of call progress, are not included in this section. Transmission tests covered in other sections should be adequate to verify that these signals are satisfactory.

1.03 Loop current requirements are included in this section when the signaling equipment and/or telephone type transmitters depend on these current requirements.

1.04 Signaling tests are required at the following locations:

- End user network interface
- *Interexchange Carrier Point of Termination (POT).*

1.05 Signaling is divided into two general groups:

(a) Signaling between a telephone set or similar termination and a switching machine or another telephone termination. This type of signaling is referred to as loop and is either loop or ground start signaling. Customer loop signaling is described in BR975-110-100.

(b) Signaling between two switching machines is often referred to as inter-office or trunk type signaling. A complete description of interoffice signaling is included in BR975-120-100.

1.06 Customer loop signaling requires the following tests:

- dc loop current for supervision and control
- 20 Hz ringing with superimposed dc for alerting and ring trip ability
- opening and closing the loop for addressing signals.

1.07 Interoffice signaling, when designed as an integral part of the channel, can be one of two forms:

(a) ***Loop Reverse Battery signaling:*** Loop-Reverse Battery signaling makes use of the tip and ring transmission conductors and is limited to one way trunks (trunks that originate calls in one direction only). When 4-wire cable facilities are used, the simplex paths of the transmission pairs are used for signaling.

(b) ***E&M lead signaling:*** Separate signaling conductors designated E, M and (when required) SB and SG are used for E&M lead signaling.

These signaling paths can be used for supervisory, control and addressing signals.

1.08 Conversion from one type signaling to another is provided by the Telephone Company to accommodate distances beyond the normal signaling range, such as, when long haul carrier facilities are used and when it is necessary for meeting the user requests.

1.09 The requirements, limits and procedures covered are directed to tests of the telephone company facilities at the *user premises network interface.* The test requirements are determined by the type of service or channel being provided and the type of termination at the test location. Segments of NCI codes indicate, among other things, the type of signaling to be provided at the users premises and interexchange carrier POT. The signaling protocol is coded in character positions 3 and 4 with necessary options in character positions 6, 7, and 8. These code characters define the type of signaling and signaling tests required for the telephone company channel at the interexchange carrier or end *user network interface.* A list of the signaling protocols and options is provided in Table A with the tests required.

2. TYPES OF SERVICE

2.01 Two major types of Access Service are provided, Special and Switched. The signaling testing procedures at the *Interexchange Carrier POT* are the same for both Special and Switched services. Special access service has two terminations within the LATA, one is the *user Netwrok Interface* location, and the other at the *Interexchange Carrier POT* location. The requirements and limits cover the telephone company equipment and facilities between these two terminations. Switched services have only one termination at the interexchange carrier facility or switch. The requirements and limits cover the telephone company equipment and facilities between the telephone company switch and the *Interexchange Carrier POT*. The telephone company switch may be at an end office, access tandem, or a centrex.

2.02 It is advisable to assure that channel signaling is satisfactory before channel transmission tests are made since signaling is often necessary for seizing the channel (placing in off hook condition) for valid transmission testing.

3. TEST ACCESS

3.01 Test access at the end *user network interface or Interexchange Carrier POT* will use channel signaling or transmission leads as necessary. Test equipment is required for various types of interfaces and should comply with industry standards such as IEEE Standard 753-1983. Test set capabilities required for this practice are listed in Table B. The test equipment will be used at the following types of channel interfaces.

(a) ***Type I E&M Lead access*** for high capacity analog, DX signaling and single frequency signaling

(b) ***Digital Hierarchy*** for A & B bit stream signaling channels.

For some signaling tests, simulators that represent the customer's equipment are necessary. These simulators are described in Technical Reference PUB-48502 Network Circuit Access Test Set - Functional Criteria.

4. ON-PREMISES PRE-SERVICE TEST PROCEDURES

4.01 All access service signaling tests require indications or operations from the distant or intermediate location. With the proper wiring, cross-connections and equipment options, overall pulsing failures rarely occur if supervisory and control signal objectives are met. Therefore, it may not be necessary to make overall pulsing tests except in case of trouble. It is, however, necessary that other signaling tests meet the required limits.

4.02 The detailed test specifications are described by Interface Protocol regardless of the POT location. From the work order and record detail (WORD) or equivalent document, determine the interface protocol at the testing location and the distant end or the type of signaling required for the operating telephone company switch.

4.03 Each test procedure is complete for protocol code and location and, where appropriate, includes transmission of test signal to the distant end as a last step. The tests and limits required for the diatant end are, however, dependent on the interface protocol code for that location and will be included in the appropriate procedure in this section.

5. TESTING AT LOCATIONS WITH PROTOCOL CODES AB OR AC

5.01 The signaling tests consist of measuring the received ringing voltage and applying a ringing voltage for measuring at the distant end of the Telephone Company provided facilities.

5.02 When the interface is 4-wire, the simplex leads of the transmission pairs provide the signaling path and are arranged for test access.

A. The Distant End is 20 Hz (Protocol AB or AC) or Equivalent Signaling

STEP	PROCEDURE
1	Connect a ringer load REN-3 (3-C4A ringers with capacitors in parallel) between the Tip & Ring or simplex conductors.
2	Request distant end of Telephone Company facility to send ringing signal (20 ±3 Hz at 86V).
3	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
4	Send ringing signal (20 ±3 Hz at 86V with grounded side of supply to Tip conductor) as requested by distant end or intermediate location of the Telephone Company facility.

B. Distant end is Analog High Capacity (Protocol AH), DX (Protocol DX or DY), Single Frequency (Protocol SF) or E&M Lead (Protocol EA, EB or EC) signaling

STEP	PROCEDURE
1	Connect a ringer lead REN-3 (3-C4A ringers with capacitors in parallel) between the Tip and Ring or simplex conductors.
2	Request distant end of Telephone Company facility to send ringing signal (ground to M lead for interface protocol EA-M and EC-M or open to the M lead for protocol EB-M; or ground to E lead for EA-E, EB-E or EC-E)
3	Measure ringing voltage across REN-3 load. *LIMIT:* Equal to or greater than 55V rms.
4	Send ringing signal (20 ±3 Hz at 86V rms with grounded side of supply to Tip conductor) as requested by the distant end or intermediate location on the Telephone Company provided facility.

C. Distant end is Digital Hierarchy (Protocol DS)

STEP	PROCEDURE
1	Connect ringer load REN-3 (3-C4A ringers with capacitors in parallel) between the Tip & Ring or simplex conductors.
2	Request distant end to send ringing signal (signaling channel A logic state 0).
3	Measure ringing voltage across REN-3 load. *LIMIT:* Equal to or greater than 55V rms.
4	Send ringing signal (20 $\pm$3 Hz at 86V rms with grounded side of supply to Tip conductor) as requested by the distant end or intermediate location on the Telephone Company provided facility.

6. TESTING AT INTERFACE PROTOCOL CODE AH

6.01 The test set or testing method must include a 4-wire type I E&M lead SF unit. The AH interface must be demodulated to the individual channel to be tested. The signaling test consists of measuring incoming signals on the E signaling lead and sending signals on the M signaling lead of the test SF unit.

A. Distant end has E&M lead (Protocol EA, EB or EC) or Loop-Reverse Battery (Protocol RV) Signaling

6.02 The SF operation for these signaling methods is as follows:

(a) ***Idle (on hook):*** SF tone 2600 $\pm$5 Hz at -20dBm0.

(b) ***Seized (off-hook):*** SF tone removed

(c) ***Pulsing:*** SF tone 2600 $\pm$5 Hz at -8 dBm0 on (break)/off (make).

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal to or greater than 20K ohms).
3	Request distant end to seize the circuit (go off-hook).
4	Measure E lead resistance to ground. *LIMIT:* Short (equal to or less than 150 ohms).

STEP	PROCEDURE
5	Request distant end to send dial pulses. *Note 1:* If the sending end is the the ***user network interface*** or ***Telephone Comapny switch***, send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2:* If the sending end is the ***Interexchange Carrier POT***, send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead pulses. *LIMIT 1:* 48 TO 68% Break when measuring at ***Interexchange Carrier POT***. *LIMIT 2:* 42 to 74% Break when measuring at the the ***user network interface*** or ***Telephone Comapny switch***.
7	Send Idle (ground on M lead), Seizure (battery on M lead) or pulsing on M lead as requested by the distant end or intermediate location of Telephone Company provided facility.

B. Distant End is STATION With Loop Signaling-Loop Start,(Protocol LS) Signaling

6.03 The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company facility:***

(1) ***Idle (on-hook):*** SF tone 2600 ±5 Hz at -20dBm0.

(2) ***Seized (off-hook):*** SF tone removed.

(3) ***Pulsing:*** SF tone 2600 ±5 Hz at -8 dBm0 on (break)/off (make).

(b) ***To the Telephone Company facility:***

(1) ***Idle (on-hook):*** No SF tone

(2) ***Seized (off-hook):*** No SF tone

(3) ***Ringing:*** SF tone 2600 ±5 Hz at -8 dBm0.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).

STEP	PROCEDURE
2	Measure E lead resistance to ground. *LIMIT:* Open (equal to or greater than 20k ohms).
3	Request distant end to send seizure (off-hook).
4	Measure E lead resistance to ground. *LIMIT:* Short (equal to or less than 150 ohms).
5	Request distant end to send dial pulses. *Note 1:* If sending end is the ***user network interface*** or ***Telephone Comapny switch*** send 8 PPS at 64% break and 11 PPS at 58% break. *Note 2:* If sending end is ***Interexchange Carrier POT***, send 8 PPS at 70% break and 11PPS at 46% break.
6	Measure E lead pulses. *LIMIT 1:* 48-68% Break when measuring at ***Interexchange Carrier POT*** *LIMIT 2:* 42-74% Break when measuring at the ***user network interface*** or ***Telephone Comapny switch.***
7	Send Idle (battery on M lead), Ringing (ground on M lead) as requested by the distant end or intermediate location of the Telephone Company facility.

C. Distant End is SWITCH With Loop Signaling-Loop Start (Protocol LA, LB, LC or LO) or Equivalent Signaling

6.04 The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company Facility:***

(1) ***Idle (On-hook):*** No SF tone.

(2) ***Seized (Off-hook):*** No SF tone.

(3) ***Ringing:*** SF tone 2600 $\pm$5 Hz at -8 dBm0 on/off

(b) ***To the Telephone Company Facility:***

(1) ***Idle (on-hook):*** SF tone 2600 Hz $\pm$5 Hz at -20 dBm0

(2) *Seized (off-hook):* SF tone removed.

(3) *Dialing:* SF tone 2600 ±5 Hz at -8 dBm0 on (break)/off (make)

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal to or greater than 20k ohms).
3	Request distant end to send seizure (off-hook).
4	Measure E lead resistance to ground. *LIMIT:* Open (equal, or less than 150 ohms).
5	Request distant end to send ringing.
6	Measure E lead resistance to ground. *LIMIT:* Short (150 ohms or less) during the ringing interval of ringing cycle and open (20K ohms or more) during silent interval.
7	Send idle (ground or M lead), seizure (battery on M lead) or pulsing on the M lead as requested by the distant end or intermediate location of the Telephone Company provided facility.

D. Distant end is STATION with loop Signaling-Ground Start (Protocol GS) or Equivalent Signaling

6.05 The SF operation for this signaling method is as follows:

(a) *From the Telephone Company facility*

(1) *Idle (on-hook):* SF tone 2600 ±5 Hz at -20dBm0.

(2) *Seized (off-hook):* SF tone removed.

(3) *Pulsing:* SF tone 2600 ±5 Hz at -8 dBm0 on (break)/off (make).

(b) *To the Telephone Company facility*

(1) *Idle (on-hook):* SF tone 2600 ±5 Hz at -20dBm0.

(2) ***Seized (off-hook):*** SF tone removed.

(3) ***Ringing:*** SF tone modulated at 20-Hz rate.

STEP	PROCEDURE
1	Request distant end to send idle.
2	Measure E lead resistance to ground. ***LIMIT:*** Open (equal to or greater than 20k ohms).
3	Request distant end to send seizure.
4	Measure E lead resistance to ground. ***LIMIT:*** Short (equal to or less than 150 ohms).
5	Request distant end to send dial pulses (8 PPS at 64% break and 11 PPS at 58% break).
6	Measure E lead pulses. ***LIMIT 1:*** 48-68% Break when measuring at ***Interexchange Carrier POT.*** ***LIMIT 2:*** 42-74% Break when measuring at the ***user network interface*** or ***Telephone Comapny switch.***
7	Send idle (ground on M lead), Seizure (battery on M lead) as requested by the distant end or intermediate location of the Telephone Company provided facility. ***Note:*** Ringing cannot be provided from the M lead.

E. Distant end is SWITCH with Loop Signaling-Ground Start, (Protocol GO) or Equivalent Signaling

6.06 The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company facilities:***

(1) ***Idle (on-hook):*** SF tone 2600 $\pm$5 Hz at -20dBm0

(2) ***Seized (off-hook):*** SF tone removed.

(3) ***Ringing:*** SF tone modulated at 20-Hz rate.

(b) ***To the Telephone Company facilities:***

(1) *Idle (on-hook):* SF tone 2600 ±5 Hz at 20dBm0

(2) *Seized (off-hook):* SF tone removed.

(3) *Dialing:* SF tone 2600 ±5 Hz at -8 dBm0 on (break)/off (make).

STEP	PROCEDURE
1	Request distant end to send idle
2	Measure E lead resistance to ground *LIMIT:* Open (equal to or greater than 20k ohms).
3	Request distant end to send seizure.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal to or less than 150 ohms). *Note:* The E lead cannot respond to the ringing signal (SF tone modulated at 20-Hz rate).
5	Send idle (ground on M lead), seizure (battery on M lead) or pulsing on M lead as requested by the distant end or intermediate location on the Telephone Company facility.

F. Distant End has 20 Hz Ringdown (Protocol AB or AC) Signaling

6.07 The SF operation for this signaling method provides SF tone for ringing and no SF tone on all other states.

STEP	PROCEDURE
1	Request distant end to ring.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal to or greater than 20k ohms).
3	Request distant end to remove ringing.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal to or less than 150 ohms).

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STEP	PROCEDURE
5	Send ringing (ground on M lead) or idle state (battery on M lead) as requested by distant end or intermediate location of the Telephone Company provided facility.

G. Distant End is Private Line Automatic Ringing PLAR (interface protocol LR) Signaling.

6.08 The SF operation for this type signaling is as follows:

(a) ***From the Telephone Company facilities***

(1) ***Idle State:*** No SF tone

(2) ***Ringing:*** SF tone (2600 ±5 Hz at -8 dBm0) on during ringing interval (2 sec) off during silent interval (4 sec) of each ringing cycle.

(b) ***To the Telephone Company facilities:***

On-hook: SF tone (2600 ±5 Hz at -20dBm0 Off-hook: No SF tone

STEP	PROCEDURE
1	Provide ground to M lead
2	Request distant end of Telephone Company facilities to provide ringing i.e., go off-hook.
3	Measure E lead resistance to ground. ***LIMIT:*** Open during the ringing interval (±2sec) and short during the silent interval (±4sec) of each ringing cycle.
4	Provide battery to M lead (Trip ringing).
5	Measure E lead resistance to ground. ***LIMIT:*** Short (equal or less than 150 ohms).
6	Send on-hook (ground on M lead) and off-hook (battery on M lead) as requested by distant end or intermediate location of Telephone Company facility.

H. Distant end has DX signaling (interface protocol DY)

6.09 It is assumed that the distant end test access will include a DX-1 signaling unit or equivalent to provide type I E&M signaling leads for testing purposes.

6.10 SF Operation for the signaling method is as follows:

(a) ***From and to the Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone 2600 ±5 Hz at -20dBm0

(2) ***Seized (off-hook):*** SF tone removed

(3) ***Pulsing:*** SF tone 2600 ±5 Hz at -8 dBm0 on (break)/off (make).

STEP	PROCEDURE
1	Request distant end to send idle.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms).
3	Request distant end to send seizure.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
5	Request distant end to send dial pulses. (1) If sending end is the *user network interface* or *Telephone Comapny switch* send 8 PPS at 64% break and 11 PPS at 58% break. (2) If sending end is *Interexchange Carrier POT* send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead pulses. *LIMIT 1:* 48-68% Break when measuring at ***Interexchange Carrier POT*** *LIMIT 2:* 42-74% Break when measuring at the ***user network interface*** or ***Telephone Comapny switch.***
7	Send Idle (ground on M lead), Seizure (battery on M lead) or pulsing 8 PPS at 64% Break and 11 PPS at 52% Break on M lead as requested by distant end or intermediate location of Telephone Company provided facility.

7. TESTING AT INTERFACE PROTOCOL CODE DS

7.01 The signaling tests consists of observing and controlling the A & B signaling channel states of the channel under test. Each of the A & B signaling channels has two logic states, either 1 or 0. Singularly or in combination they determine, or are determined by, the signaling information applied to or received from the Channel Unit voice frequency or signaling lead extension.

A. Distant end is Ring-down Signaling (interface protocol AB or AC).

STEP	PROCEDURE
1	Request the distant end to apply ringing (20 $\pm$3 Hz at 86V rms).
2	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 0, *LIMIT 2:* B signaling channel logic state 1 or 0.
3	Request distant end to remove ringing.
4	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 1 *LIMIT 2:* B signaling channel logic state 1 or 0.
5	Send ringing signal (logic state 0 on both A & B signaling channels) or no ringing signal (logic state 1 on both A & B signaling channels) as requested by distant end or intermediate location of Telephone Company facility.

B. Distant end has E & M lead (protocol EA-E, EA-M, EB-E, EB-M, or EC) or Loop-Reverse Battery (Protocol RV-0 or RV-T) signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
2	Observe A & B signaling channel logic. *LIMIT:* Both A & B signaling channels logic state 0.
3	Request distant end to send seizure (off-hook).

STEP	PROCEDURE
4	Observe A & B signaling channel logic. *LIMIT:* Both A & B signaling channels logic state 1.
5	*Pulsing from the E & M lead or Loop-Reverse Battery Originating (RV-0) distant end will change both A & B signaling channels from logic state 0 (make) to logic state 1 (break). At present, no limits have been established for pulsing between these interface protocols.*
6	Send idle (logic state 0 on both A & B signaling channels) or seizure (logic state 1 on both A & B signaling channels) as requested by distant end or intermediate location on the Telephone Company facility.

C. Distant end has DX (Protocol DX or DY) type signaling.

STEP	PROCEDURE
1	Request distant end to send idle.
2	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 0, *LIMIT 2:* B signaling channel logic state 0 or 1.
3	Request distant end to send seizure. *LIMIT 1:* A signaling channel logic state 1, *LIMIT 2:* B signaling channel logic state 0 or 1.
4	*Pulsing from the distant end will change the A signaling channel from logic state 1 (make) to logic state 0 (break). At present, no limits have been established for pulsing between these interface protocols.*
5	Send idle (logic state 0 on A signaling channel) or seizure (logic state 1 on A signaling channel) as requested from distant end or intermediate location of Telephone Company provided facility.

D. Distant end is a STATION with Loop Signaling — Ground Start, (protocol GS) or equivalent signaling.

STEP	PROCEDURE
1	Request distant end to send idle, Tip & Ring conductor open and no ground on Ring conductor.
2	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic 0 *LIMIT 2:* B signaling channel logic 1.
3	Request distant end to provide seizure, ground on Ring conductor.
4	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 0 *LIMIT 2:* B signaling channel logic state 0.
5	Send logic state 0 on A signaling channel and logic state 1 on B signaling channel (simulate Tip conductor ground) toward distant end, of Telephone Company facility.
6	Request distant end to provide loop closure (Tip & Ring conductor connected together through 430 ohm) and then remove Ring conductor ground.
7	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 1 *LIMIT 2:* B signaling channel logic state 1.
8	Pulsing from the distant end of the Telephone Company provided facility changes the A signaling channel logic from 0 (break) to 1 (Make). At present, no limits have been established for pulsing between these interfaces.
9	Provide the following as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* logic state 1 on A signaling channel and logic state 1 on B signaling channel (simulate Tip conductor open) *Seizure:* logic state 0 on A signaling channel and logic state 1 on B signaling channel (simulate Tip conductor ground) *Ringing:* logic state 0 on both A & B signaling channels.

E. Distant end is a SWITCH with Loop Signaling — Ground Start, (Protocol GO) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle, Tip conductor open and battery on Ring Conductor.
2	*LIMIT 1:* A signaling channel logic state 1. *LIMIT 2:* B signaling channel logic state 1.
3	Request distant end to send seizure, Tip conductor grounded and battery on Ring conductor.
4	*LIMIT 1:* A signaling channel logic state 0. *LIMIT 2:* B signaling channel logic state 1.
5	Request distant end to send ringing, 20 $\pm$3 Hz at 86V rms.
6	Observe A & B signaling channel logic. *LIMIT:* A & B signaling channel logic 0.
7	Provide ringing trip signal to distant end (send logic state 1 on A & B signaling channels).
8	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 0. *LIMIT 2:* B signaling channel logic state 1
9	Provide the following as requested by the distant end or intermediate location of Telephone Company provided facility. *Idle:* A signaling channel logic state 0 and B signaling channel logic state 1 (simulate Tip & Ring conductors open and no ground on Ring conductor). *Seizure:* A & B signaling channel logic state 0 (simulate Tip & Ring conductors open and Ring conductor ground) *Loop closure:* A & B signaling channel logic state 1 (simulate Tip & Ring conductor short and no Ring conductor ground)

F. Distant is a STATION with Loop Signaling — Loop Start, (Protocol LS) or equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle, Tip and Ring conductors open.
2	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 0 *LIMIT 2:* B signaling channel logic state 1.
3	Request distant end to send seizure, Tip and Ring conductor shorted.
4	Observe A & B signaling channel logic. *LIMIT 1:* A signaling channel logic state 1 *LIMIT 2:* B signaling channel logic state 1.
5	Pulsing from the distant end of the Telephone Company provided facility changes the A signaling channel logic from 0 (break) to 1 (make). At present, no limits have been established for pulsing between these interfaces.
6	Provide idle, (A signaling channel logic state 0 and B signaling channel logic state 1) or ringing, (A and B signaling channel logic state 0) as requested by distant end or intermediate location of Telephone Company provided facility.

G. Distant is a SWITCH with Loop Signaling — Loop Start, (Protocol LA, LB, LC or LO) or equivalent signaling.

STEP	PROCEDURE
1	Request distant end to send idle.
2	Observe A and B signaling channel logic. *LIMIT 1:* A signaling channel logic state 0 *LIMIT 2:* B signaling channel logic state 1.
3	Request distant end to ring, 20 ± 3 Hz at 86V rms.
4	Observe A & B signaling channel logic.

STEP	PROCEDURE
	LIMIT 1: A signaling channel logic state 0
	LIMIT 2: B signaling channel logic state 0.
5	Provide logic state 1 to A signaling channel toward distant end to trip ringing.
	LIMIT: B signaling channel logic state 1.
6	Provide idle, (A signaling channel logic state 0) or seized (A signaling channel logic state 1) as requested by distant end or intermediate location of Telephone Company provided facility. Logic state of B signaling channel can be either 0 or 1.

H. Distant end has Automatic Ring-down (Protocol LR) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
2	Observe A & B signaling channels.
	LIMIT: Both A & B signaling channels logic state 0.
3	Request distant end to send seizure (off-hook).
4	Observe A & B signaling channels.
	LIMIT: Both A & B signaling channels logic state 1.
5	Send idle (on-hook) logic state 0 on A & B signaling channels and ringing logic state 1 on A & B signaling channels as requested by distant end or intermediate location of Telephone Company provided facility.

8. TESTING AT INTERFACE PROTOCOL CODE DX OR DY

8.01 The test set or testing method must include a type I E&M lead signaling DX unit or equivalent. This test DX unit must provide the correct facility balancing resistance and capacity (i.e., cable between the test DX unit and Telephone Company DX unit).

8.02 The signaling tests consists of observing the E lead for incoming signals and sending signals on the M lead of the test DX unit.

A. Distant end has E&M lead (Protocol EA, EB or EC) or DX (Protocol D .or DY) signaling.

8.03 The testing method described in paragraph 8.01 is also required at the distant end.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook). The signaling lead conditions are: ***Interface Protocol EA and EC:*** M lead grounded, E lead open. ***Interface Protocol EB-E:*** M lead open, E lead open.
2	Measure E lead resistance to ground. ***LIMIT:*** Open (equal or greater than 20K ohms)
3	Request distant end to send seizure (off-hook), battery to M lead or ground to E lead for interface Protocol EA-E or EB-E.
4	Measure E lead resistance to ground. ***LIMIT:*** Short (equal or less than 150 ohms)
5	Request distant end to send dial pulses. ***Interface Protocol EB-M:*** open/battery to M lead. ***Interface Protocol EA-E or EB-E:*** Open/ground to E lead. ***Interface Protocol EA-m and EC:*** Battery/ground to M lead. ***Note 1:*** If sending end is ***user network interface*** or Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break. ***Note 2:*** If sending end ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead pulses. ***LIMIT 1:*** 48 to 68% Break when measuring at ***Interexchange Carrier POT*** ***LIMIT 2:*** 42 to 74% Break when measuring at ***user network interface***
7	Send Idle, Seizure, or pulsing on M lead as requested by the distant end or intermediate location of Telephone Company provided facility. ***Idle:***

STEP	PROCEDURE
	Interface Protocol EA-M or EC = Ground on M lead Interface Protocol EB-M = Open on M lead *Seizure:* Interface Protocol EA-M, EB-M and EC = Battery on M lead.

B. Distant end is SWITCH with Loop Signaling — Loop Start, (Protocol LA, LB, LC or LO) or equivalent signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook), battery to Ring conductor & ground to Tip conductor.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms).
3	Request distant end to send ringing
4	Measure E lead *LIMIT 1:* Short during the ringing interval of the ringing cycle *LIMIT 2:* Open during the silent interval.
5	Send idle, seizure, or pulsing on the M lead as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* Interface protocols EA-M and EC = Ground on M lead Interface protocol EB-M = Open on M lead *Seizure:* Interface protocols EA-M, EB-M and EC = Battery on M lead.

C. Distant end of the Telephone Company facility is Loop Signaling — Loop Start, STATION (interface protocol LS) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook) Tip & Ring conductors open.
2	Measure E lead resistance to ground. *LIMIT 1:* Open during the silent interval. *LIMIT 2:* Open (equal or greater than 20K ohms)
3	Request distant end to send seizure (off-hook). Tip & Ring conductors connected together through 430 ohms.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms)
5	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure E lead Pulses *LIMIT 1:* 48-68% Break when measuring at ***Interexchange Carrier POT*** *LIMIT 2:* 42-74% Break when measuring at ***user network interface***
7	Send Idle or ringing as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* Interface protocols EA-M and EC = Ground on M lead Interface protocol EB-M = Open on M lead

D. Distant Originating End has Loop-Reverse Battery (Protocol RV-0) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (Tip and Ring conductors open).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)

STEP	PROCEDURE
3	Request distant end to send seizure (Tip and Ring conductor connected together through 600 ohms)
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms)
5	Request distant and to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break
6	Measure E lead pulses *LIMIT 1:* 48-68% break when measuring at ***Interexchange Carrier POT*** *LIMIT 2:* 42-74% break when measuring at ***user network interface*** or Telephone Company
7	Send Idle or reverse battery (battery on M lead) as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* Interface protocols EA-M and EC = Ground on M lead. Interface protocol EB-M = Open on M lead.

E. Distant end is TERMINATING END with Loop-Reverse Battery (Protocol RV-T) or Equivalent Signaling

STEP	PROCEDURE
1	Request distant end to send idle (battery on Ring conductor and ground on Tip Conductor)
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant end to send reverse battery (ground on Ring conductor and battery on Tip conductor).
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms) *Note:* It may be necessary to send seizure signal, battery on M lead, toward distant end to receive battery signal.

STEP	PROCEDURE
5	Provide idle, seizure, and pulsing as requested by distant end or intermediate location or Telephone Company provided facility. *Idle:* Interface protocol EA-M or EC = Ground on M lead Interface protocol EB-M = Open on M Lead *Seizure:* Battery on M lead

F. Distant end has Single Frequency (Protocol SF) signaling.

STEP	PROCEDURE
1	Request distant end to send idle (SF tone on).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms).
3	Request distant end to send seizure (remove SF tone).
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms)
5	Request distant end to send pulses, (SF tone on-break and off-make). *Note 1:* If sending location is the ***user network interface*** or Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2:* If send location ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead pulses. *LIMIT 1:* 48-68% Break when measuring at POT *LIMIT 2:* 42-74% Break when measuring at network interface
7	Send Idle, seizure, or pulsing as requested by distant end or intermediate locating of Telephone Company providing facility.

STEP	PROCEDURE
	Idle:
	Interface protocol EA-M or EC = Grounded M lead
	Interface protocol EB-M = Open M lead

9. TESTING AT INTERFACE PROTOCOL CODE EA-E

9.01 The signaling tests consist of observing the M lead for incoming signals and sending signals on the E lead.

A. Distant end of the Telephone Company facility is 20 Hz Ring-down (interface protocol AB or AC) or equivalent signaling.

STEP	PROCEDURE
1	Request distant end to send idle state i.e. no ringing.
2	Measure M lead voltage to ground.
	LIMIT: Equal or more than -42.5V DC
3	Request distant end to ring.
4	Measure M lead voltage to ground.
	LIMIT: Equal or less than 1V dc.
5	Provide idle (ground, 150 ohms or less, to E lead), or ringing (open, 20K ohms or more, to E lead) as requested by distant end or intermediate location of Telephone Company provided facility.

B. Distant end has E&M lead (Protocol EA, EB, or EC) or E&M leads are derived for testing (protocol AH, DY or DX)

STEP	PROCEDURE
1	Request distant end to send idle,
	Interface protocol EA-M and EC: Grounded M lead
	Interface protocol EB-M Open M lead

STEP	PROCEDURE
	Interface protocol EA-E, EB-E, or EC-E: Open E lead
2	Measure M lead voltage to ground. ***LIMIT:*** Equal or less than 1V dc.
3	Request distant end to send seizure (off-hook), battery to M lead or ground to E lead for interface protocol EA-E or EB-E.
4	Measure M lead voltage to ground. ***LIMIT:*** Equal or greater than -42.5 V dc.
5	Request distant end to send pulses. ***Interface protocol EB-M:*** Open/battery to M lead ***Interface protocols EA-M and EC-M:*** Battery/ground to M lead ***Interface protocol EA-E or EB-E:*** Open/ground to E lead. ***Note 1.*** If sending end is ***user network interface*** or Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break. ***Note 2.*** If sending end is at the ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure the M lead pulses. ***LIMIT 1:*** 48 to 68% Break when measuring at POT. ***LIMIT 2:*** 42 to 74% Break when measuring at network interface or Telephone Company switch.
7	Send idle (E lead open 20K ohms or more), seizure (E lead grounded 150 ohms or less) and pulsing on the E lead as requested by the distant end or intermediate location of the Telephone Company provided facility.

C. Distant end is a SWITCH with Loop Signaling — Loop Start, (Protocol LA, LB, LC or LO) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook), battery to Ring conductor and ground to Tip conductor.
2	Measure M lead voltage to ground. *LIMIT:* Equal or greater than -42.5V dc.
3	Request distant end to send ringing.
4	Measure M lead voltage to ground. *LIMIT:* Equal or less than 1V dc
5	Send idle — on hook (open, 20K ohms or more on E lead), seizure — off hook (ground, 150 ohms or less on E lead) and pulsing on E lead as requested by distant end or intermediate location of Telephone Company provided facility.

D. Distant end is STATION with Loop Signaling — Loop Start, (Protocol LS)

STEP	PROCEDURE
1	Request the distant end to send idle (on-hook). Tip & Ring conductors open.
2	Measure M lead voltage to ground. *LIMIT:* Equal or less than 1V dc.
3	Request the distant end to send seizure (off-hook) Tip & Ring conductors connected together through 430 ohms.
4	Measure M lead voltage to ground. *LIMIT:* Equal or more than 42.5V dc.
5	Request the distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure M lead pulses. *LIMIT 1:* 48-68% break when measuring at ***Interexchange Carrier POT.*** *LIMIT 2:* 42-74% break when measuring at ***user network interface*** or Telephone Company switch.

STEP	PROCEDURE
7	Send idle or seizure (E lead open) or ringing (E lead ground) as requested by the distant end or intermediate location on Telephone Company facilities.

E. Distant ORIGINATING End has Loop-Reverse Battery, (Protocol RV-0) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (Tip & Ring conductors open).
2	Measure M lead voltage to ground. *LIMIT:* Equal or less than 1V dc.
3	Request distant end to send seizure (Tip & Ring conductors connected together through 600 ohms).
4	Measure M lead voltage to ground. *LIMIT:* Equal or greater than -42.5V dc.
5	Request distant end to send pulses at 8 PPS at 64% break and 11 PPS and 11 PPS at 58% break.
6	Measure M lead pulses. *LIMIT 1:* 48 to 68% Break when measuring at ***Interexchange Carrier POT*** *LIMIT 2:* 42 to 74% Break when measuring at ***user network interface*** or Telephone Company.
7	Send idle (E lead open) or reverse battery (E lead ground) as requested by distant end or intermediate location on Telephone Company facility.

F. Distant TERMINATING END has Loop-reverse Battery, (Protocol RV-T) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (battery on Ring and ground on Tip conductors)
2	Measure M lead voltage to ground. *LIMIT:* Equal or less than 1V dc.

STEP	PROCEDURE
3	Request distant end to send reverse battery (ground on Ring and battery on Tip conductors).
4	Measure M lead voltage to ground. *LIMIT:* Equal or greater than -42.5V dc.
5	Send idle (E lead open), seizure (E lead ground) or pulsing on E lead as requested by distant end or intermediate location of Telephone Company facility.

G. Distant end has Single Frequency (Protocol SF) signaling.

9.02 It is assumed that the distant end has a Type I E&M lead SF unit or equivalent test set to access the E&M leads.

STEP	PROCEDURE
1	Request distant end to send idle (SF tone on).
2	Measure M lead voltage to ground. *LIMIT:* Equal or less than 1V dc.
3	Request distant end to send seizure (SF tone off).
4	Measure M lead voltage to ground. *LIMIT:* Equal or greater than -42.5V dc.
5	Request distant end to send pulses (SF tone off, break, SF tone on make) *Note 1.* If sending location is ***user network interface*** send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2.* If sending location is ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure M lead pulses. *LIMIT 1:* 48 to 68% Break when measuring at ***Interexchange Carrier POT*** *LIMIT 2:* 42 to 74% break when measuring at ***user network interface***

STEP	PROCEDURE
7	Send idle, (E lead open, 20K ohms or more), seizure (E lead grounded, 150 ohms or less) and pulsing on the E lead as requested by the distant end or intermediate location of the provided facility.

10. TESTING AT INTERFACE PROTOCOL CODE EA-M

10.01 The signaling tests consist of observing the E lead for incoming signals and applying battery and ground to the M lead as outgoing signals.

A. Distant end has 20 Hz Ring-down (Protocol AB or AC) or Equivalent Signaling.

STEP	PROCEDURE
1	Request Distant end to ring.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal, or greater than 20K ohms).
3	Request distant end to remove ringing.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
5	Send ringing (ground on M lead) or idle state (battery on M lead) as requested by distant end or intermediate location of the Telephone Company provided facility.

B. Distant end has E & M lead (Protocol EA, EB, EC) or E & M leads are derived for testing (Protocol AH, DY, or DX)

STEP	PROCEDURE
1	Request distant end to send idle. ***Interface protocol EA-M and EC-M:*** Grounded M lead ***Interface protocol EB-M:*** Open M lead ***Interface protocol EA-E, EB-E, or EC-E:*** Open E lead

STEP	PROCEDURE
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms).
3	Request distant end to send seizure (off-hook), battery to M lead or ground to E lead for interface protocol EA-E or EB-E.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
5	Request distant end to send dial pulses. *Note 1.* If sending end is the ***user network interface*** or ***Telephone Company switch*** send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2.* If sending end is the ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead pulses. *LIMIT 1:* 48 to 68% Break when measuring at the POT *LIMIT 2:* 42 to 74% Break when measuring at the ***user network interface*** or ***Telephone Company switch***
7	Send Idle, Seizure, or pulsing on M lead as requested by distant end or intermediate location of Telephone Company provided facility. *Idle:* Ground on M lead *Seizure:* Battery on M lead

C. Distant SWITCH has Loop Signaling-Loop Start, (Protocol LA, LB, LC or LO) or equivalent type signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook), battery to Ring conductor and ground to Tip conductor.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms).

STEP	PROCEDURE
3	Request distant end to send ringing.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms) during the ringing interval of the ringing cycle and open (equal or greater than 20K ohms) during the silent interval.
5	Send idle, seizure or pulsing on M lead as requested by the distant end or intermediate location of Telephone Company provided facility. *Idle:* Ground on M lead *Seizure:* Battery on M lead

D. Distant STATION End has Loop Signaling-Loop Start; (Protocol LS) or Equivalent Type Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook), Tip and ring conductors open.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant end to send seizure (off-hook), Tip and Ring conductors connected together with 430 ohms.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
5	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure E lead pulses. *LIMIT 1:* 48-68% Break when measuring at the ***Interexchange Carrier POT*** *LIMIT 2:* 42-74% Break when measuring at the ***user network interface*** or ***Telephone Company switch.***
7	Send idle (battery on M lead) or Ringing (ground on M lead) as requested by the distant end or intermediate location of the Telephone Company provided facility.

E. Distant End is Loop-Reverse Battery ORIGINATING End (interface protocol RV-0) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (Tip & Ring conductors open).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant end to send seizure (Tip and Ring conductor connected together through 600 ohms).
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms)
5	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure E lead pulses. *LIMIT 1:* 48-68% break when measuring at the POT. *LIMIT 2:* 42-74% break when measuring at the ***user network interface or Telephone Company switch.***
7	Send Idle (ground on M lead) or reverse battery (battery on M lead) as requested by the distant end or intermediate location of the Telephone Company provided facility.

F. Distant TERMINATING END has Loop-Reverse Battery (Protocol RV-T) or Equivalent Signaling

STEP	PROCEDURE
1	Request distant end to send idle (battery on Ring conductor and ground on Tip Conductor).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal to or greater than 20K ohms)
3	Request distant end to send reverse battery (ground on Ring conductor and battery on Tip conductor).
4	Measure E lead resistance to ground. *LIMIT:* Short (Equal to or less than 150 ohms). *Note:* It may be necessary to send seizure signal, battery on M lead, toward distant end to receive the reverse battery signal.

STEP	PROCEDURE
5	Provide idle, seizure and pulsing on M lead as requested by distant end or intermediate location of Telephone Company provided facility. *Idle:* Ground on M lead *Seizure:* Battery on M lead

G. Distant End is Single Frequency (interface protocol SF) Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (SF tone on).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant end to send seizure (remove SF tone).
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
5	Request distant end to send pulses, (SF tone on-break and off-make). *Note 1.* If sending location is the ***user network interface*** or ***Telephone Company switch*** send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2.* If sending location is the ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead. *LIMIT 1:* 48-68% break when measuring at the ***Interexchange Carrier POT*** *LIMIT 2:* 42-74% break when measuring at the ***user network interface or Telephone Company switch.***
7	Send idle, seizure or pulsing on M lead as requested by distant end or intermediate location of Telephone Company provided facility. *Idle:* Ground on M lead *Seizure:* Battery on M lead

11. TESTING AT INTERFACE PROTOCOL CODE EB-E

11.01 The signaling tests consists of measuring the resistance between the M and SB leads for incoming signals and applying a short (300 ohms) between the E and SG leads for outgoing signals.

A. Distant End has 20 Hz Ring-down (Protocol AB or AC) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle state, i.e., no ringing.
2	Measure resistance between the M and SB leads. *LIMIT:* Equal or less than 40 ohms.
3	Request distant end to ring.
4	Measure resistance between the M and SB leads. *LIMIT:* Equal or more than 500K ohms.
5	Provide idle (300 ohms between E and SG leads) or ringing (open, 500K ohms or more, between E and SG leads) as requested by distant end or intermediate location of Telephone Company facility.

B. Distant end has E & M lead (Protocol EA, EB or EC) or E & M Leads Are Derived For Testing (Protocol AH, DX or DY).

STEP	PROCEDURE
1	Request distant end to send idle. *Interface protocol EA-M and EC-M:* Grounded M lead *Interface protocol EB-M:* Open M lead *Interface protocol EA-E and EC-E:* Open E lead.
2	Measure resistance between the M and SB leads. *LIMIT:* Equal or more than 500K ohms.
3	Request distant end to send seizure (off-hook), battery to M lead or ground to E lead for interface protocol EA-E or EB-E.

STEP	PROCEDURE
4	Measure resistance between the M and SB leads. *LIMIT:* Equal or less than 40 ohms
5	Request distant end to send dial pulses. ***Interface protocol EA-M and EC-M:*** Battery/ground to M lead ***Interface protocol EB-M:*** Open/battery to M lead ***Interface protocol EA-E or EB-E:*** Open/ground to E lead. *Note 1.* If sending end is the ***user network interface*** or Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2.* If sending is at the ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure the % Break between the M and SB leads. *LIMIT 1:* 48 to 68% Break when measuring at the POT. *LIMIT 2:* 42 to 74% Break when measuring at ***user network interface or Telephone Company switch.***
7	Send idle (open, 20K ohms or more, between M and SB leads), seizure (short, 300 ohms, between the E and SG leads) and pulsing between E & SG leads as requested by the distant end or intermediate location of the Telephone Company provided facility.

C. Distant end is Loop Signaling — Loop Start, SWITCH (interface Protocol LA, LB, LC or LO) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook), battery on Ring conductor and ground on Tip conductor.
2	Measure resistance between the M and SB leads. *LIMIT:* Equal or less than 40 ohms.
3	Request distant end to send ringing.
4	Measure resistance between the M and SB leads

STEP	PROCEDURE
	LIMIT: Equal or more than 500K ohms
5	Send idle — on hook (open, 20K ohms or more between E and SG leads), seizure — off hook (short, 300 ohms, between E and SG leads) and pulsing between the E and SG leads as requested by distant end or intermediate location of Telephone Company provided facility.

D. Distant STATION End has Loop Signaling — Loop Start, (interface protocol LS) or Equivalent Type Signaling.

STEP	PROCEDURE
1	Request the distant end to send idle (on-hook), Tip & Ring conductors open.
2	Measure resistance between the M and SB leads.
	LIMIT: Equal or more than 500K ohms
3	Request the distant end to send seizure, Tip & Ring conductors connected together through 430 ohms.
4	Measure resistance between the M and SB leads.
	LIMIT: Equal or less than 40 ohms
5	Request the distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure % Break between the M and SB leads
	LIMIT 1: 48-68% break when measuring at the POT
	LIMIT 2: 42-74% break when measuring at the ***user network interface or Telephone Company switch.***
7	Send idle (open, 20K ohms or more, between E and SG leads) or ringing (short, 300 ohms, between E and SG leads) as requested by the distant end or intermediate location on Telephone Company facility.

E. Distant end is Loop-Reverse Battery, ORIGINATING End (interface protocol RV-0) or Equivalent Signaling.

STEP	PROCEDURE

STEP	PROCEDURE
1	Request distant end to send idle (Tip & Ring conductors open)
2	Measure resistance between M and SB leads. *LIMIT:* Equal or greater than 500K ohms.
3	Request distant end to send seizure (Tip & Ring conductors connected together through 600 ohms).
4	Measure resistance between the M and SB leads. *LIMIT:* Equal or less than 40 ohms.
5	Request distant end to send pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure % Break between the M and SB leads. *LIMIT 1:* 48 to 68% Break when measuring at the POT *LIMIT 2:* 42 to 74% Break when measuring at the ***user network interface or Telephone Company switch***.
7	Send idle (open, 20K ohms or more between E and SG leads) or reverse battery (short, 300 ohms, between E and SG leads) as requested by distant end or intermediate location on Telephone Company facility.

F. Distant end is Loop-Reverse Battery, TERMINATING End (Interface Protocol RV-T) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (battery on Ring conductor and ground on Tip conductor).
2	Measure resistance between the M & SB lead. *LIMIT:* Equal or greater than 500K ohms.
3	Request distant end to send reverse battery (ground on Ring conductor and battery on Tip conductor).
4	Measure resistance between the M and SB leads. *LIMIT:* Equal or less than 40 ohms.

STEP	PROCEDURE
5	Send idle, seizure, or pulsing between E and SG leads as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* Open (20K ohms or more between E and SG leads) *Seizure:* Short (300 ohms, between E and SG leads)

G. Distant end is Single Frequency (interface protocol SF) Signaling.

11.02 It is assumed that the distant end has a Type I E & M lead SF unit or equivalent test set to access the E & M leads.

STEP	PROCEDURE
1	Request distant end to send idle (SF tone on).
2	Measure resistance between the M and SB leads. *LIMIT:* Equal or greater than 500K ohms.
3	Request distant end to send seizure (SF tone off).
4	Measure resistance between the M and SB leads. *LIMIT:* Equal or less than 40 ohms.
5	Request distant end to send dial pulses (SF tone off-break, SF tone on-make) *Note 1.* If sending location is the ***user network interface*** send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2.* If sending location is the ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure % Break between M and SB leads. *LIMIT 1:* 48 to 68% Break when measuring at the POT. *LIMIT 2:* 42 to 74% break when measuring at the ***user network interface***.
7	Send idle, seizure and pulsing between the E and SG leads as requested by the distant end or intermediate location of Telephone Company provided facility.

STEP	PROCEDURE
	Idle: Open (20K ohms or more, between E and SG leads)
	Seizure: Short (300 ohms, between E and SG leads)

12. TESTING AT INTERFACE PROTOCOL CODE EB-M

12.01 The signaling tests consists of measuring the resistance between the E and SG leads for incoming signals and applying a short (300 ohms) between the M and SB leads for outgoing signals.

A. Distant end is 20 Hz Ring-down (Interface Protocol AB or AC) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle state, i.e., no ringing.
2	Measure resistance between the E and SG leads. Equal or less than 40 ohms.
3	Request distant end to ring.
4	Measure resistance between the E and SG leads.
	LIMIT: Equal or more than 500K ohms.
5	Provide idle or ringing as requested by distant end or intermediate location of Telephone Company provided facility.
	Idle: (300 ohms between M and SB leads)
	Ringing: (open, 500K ohms or more, between M and SB leads)

B. Distant End has E & M Leads (Protocol EA, EB, EC or Equivalent) or Derived E & M Leads for Testing (Protocol AH, DX or DY).

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
	Interface protocol EA-M and EC-M: Ground on M lead
	Interface protocol EB-M: Open M lead

STEP	PROCEDURE
	Interface protocol EA-E, EB-E: Open E lead
2	Measure resistance between the E and SG leads. ***LIMIT:*** Equal or more than 500K ohms.
3	Request distant end to send seizure (off-hook), battery to M lead or ground to E lead for interface protocol EA-E or EB-E.
4	Measure resistance between the E and SG leads. ***LIMIT:*** Equal or less than 40 ohms.
5	Request distant end to send dial pulses. ***Interface protocol EA-M or EC-M:*** Battery/ground to M lead. ***Interface protocol EB-M:*** Open/battery to M lead ***Interface protocol EA-E or EB-E:*** Open/ground to E lead *Note 1.* If sending end is the ***user network interface or Telephone Company switch*** send 8 PPS at 64% break and 11 PPS at 58% break. *Note 2.* If sending is at the ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46 % break.
6	Measure the % Break between the E and SG leads. ***LIMIT 1:*** 48 to 68% Break when measuring at the POT. ***LIMIT 2:*** 42 to 74% Break when measuring at the ***user network interface or Telephone Company switch***.
7	Send idle, seizure and pulsing between M and SB leads as requested by the distant end or intermediate location of Telephone Company provided facility. ***Idle:*** Open (20K ohms or more, between M and SB leads) ***Seizure:*** Short (300 ohms, between the M and SB leads)

C. Distant end is Loop Signaling — Loop Start, SWITCH (interface protocol LA, LB, LC, or LO) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook), battery to Ring conductor & ground to Tip conductor.
2	Measure resistance between the E and SG leads. *LIMIT:* Equal or less than 40 ohms.
3	Request distant end to send ringing.
4	Measure resistance between the E and SG leads. *LIMIT:* Equal or more than 500K ohms.
5	Send idle (on hook), seizure (off hook), and pulsing between M and SB leads as requested by distant end or intermediate location of Telephone Company provided facility. *Idle:* Open (20K ohms or more, between M and SB leads). *Seizure:* Short (300 ohms, between M and SB leads)

D. Distant end of the Telephone Company facility is Loop Signaling — Loop Start, STATION (interface protocol LS)

STEP	PROCEDURE
1	Request the distant end to send idle, on-hook, Tip and Ring conductors open.
2	Measure resistance between the E and SG leads. *LIMIT:* Equal or more than 300K ohms.
3	Request the distant end to send seizure, Tip and Ring conductors connected together through 430 ohms.
4	Measure resistance between the E and SG leads. *LIMIT:* Equal or less than 40 ohms.
5	Request the distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure % Break between the E and SG leads. *LIMIT 1:* 48-68% break when measuring at the POT

STEP	PROCEDURE
	LIMIT 2: 42-74% break when measuring at the ***user network interface or Telephone Company switch.***
7	Send idle or ringing as requested by the distant end or intermediate location on Telephone Company facility. *Idle:* Open (20k ohms or more, between M and SB leads) ***Ringing:*** Short (300 ohms, between M and SB leads)

E. Distant end Is Loop-Reverse Battery, ORIGINATING End (interface protocol RV-0) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (Tip & Ring conductors open)
2	Measure resistance between the E and SG leads *LIMIT:* Equal or greater than 500K ohms
3	Request distant end to send seizure (Tip & Ring conductors connected together through 600 ohms).
4	Measure resistance between the E and SG leads *LIMIT:* Equal or less than 40 ohms
5	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break
6	Measure % Break between the E and SG leads *LIMIT 1:* 48 to 68% Break when measuring at the POT *LIMIT 2:* 42 to 74% Break when measuring at the ***user network interface*** or ***Telephone Company switch***.
7	Send idle or reverse battery as requested by distant end or intermediate location on Telephone Company provided facility. *Idle:* Open (20K ohms or more, between M and SB leads) ***Reverse Battery:*** Short (300 ohms, between M and SB leads)

F. Distant End Is Loop-Reverse Battery, TERMINATING End (interface protocol RV-T) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (battery on Ring conductor and ground on Tip conductor)
2	Measure resistance between the E and SG lead *LIMIT:* Equal or greater than 500K ohms.
3	Request distant end to send reverse battery (ground on Ring conductor and battery on Tip conductor).
4	Measure resistance between the E and SG leads *LIMIT:* Equal or less than 40 ohms
5	Send idle, seizure or pulsing between M and SB leads as requested by the distant end or intermediate location of Telephone Company provided facility. *Idle:* Open (20K ohms or more, between M and SB leads). *Seizure:* Short (300 ohms, between M and SB leads)

G. Distant End has Single Frequency (interface protocol SF) Signaling

12.02 It is assumed that the distant end has a Type I E & M lead SF unit or equivalent test set to provide access to the E & M leads or equivalent.

STEP	PROCEDURE
1	Request distant end to send idle (SF tone on).
2	Measure resistance between the E and SG leads. *LIMIT:* Equal or more than 500K ohms.
3	Request distant end to send seizure (SF tone off).
4	Measure resistance between the E and SG leads. *LIMIT:* Equal or less than 40 ohms.
5	Request distant end to send pulses (SF tone off-break, SF tone on-make).

STEP	PROCEDURE
	Note 1. If sending location is the ***user network interface*** send 8 PPS at 64% break and 11 PPS at 52% break.
	Note 2. If sending location is the ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure % Break between E and SG leads.
	LIMIT 1: 48 to 68% Break when measuring at the POT.
	LIMIT 2: 42 to 74% Break when measuring at the ***user network interfaceP.***
7	Send idle, seizure and pulsing between the E and SG leads as requested by the distant end or intermediate location of Telephone Company provided facility.
	Idle: Open (20K ohms or more, between M and SB leads).
	Seizure: Short (300 ohms or less, between M and SB leads).

13. TESTING AT INTERFACE PROTOCOL CODE EC

13.01 The signaling test consists of observing the E lead for incoming signals and providing open and shorts between the M lead and the SB or SG leads for outgoing signals.

A. Distant End has E & M lead (Protocol EA, EB, or EC) or DX (Interface Protocol DY) or Equivalent Type Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
	Interface protocol EA-M and EC-M: Ground on M lead
	Interface protocol EB-M: open to M lead
	Interface protocol EA-E or EB-E Open to E lead
2	Measure E lead resistance to ground.
	LIMIT: Open (equal or greater than 500K ohms).
3	Request distant end to send seizure (off-hook), battery to M lead or ground to E lead for interface protocol EA-E or EB-E.

STEP	PROCEDURE
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 40 ohms).
5	Request distant end to send dial pulses. ***Interface protocol EB-M:*** open/battery to M lead ***Interface protocol EA-M and EC-M:*** Battery/ground on M lead ***Interface protocol EA-E or EB-E:*** open/ground to E lead *Note 1.* If sending end is Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2.* If sending end is ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead pulses. *LIMIT:* 48 to 68% Break when measuring at POT.
7	Send idle, seizure, or pulsing on M lead as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* 500 ohms between M & SG leads *Seizure:* 500 ohms between M & SB leads

B. Distant End has Single Frequency (Interface Protocol SF) or Equivalent Signaling

STEP	PROCEDURE
1	Request distant end to send idle (SF tone-on).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal, or greater than 500K ohms).
3	Request distant end to send seizure (SF tone-off).
4	Measure E lead resistance to ground.

STEP	PROCEDURE
	LIMIT: Short (equal or less than 40 ohms).
5	Request the distant end to send dial pulses. *Note 1.* If sending end is Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break. *Note 2.* If sending end is ***Interexchange Carrier POT*** send 8 PPS at 70% break 11 PPS at 46% break.
6	Measure E lead pulses. *LIMIT:* 48 to 68% Break when measuring at POT.
7	Send idle, seizure or pulsing on M lead as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* 500 ohms between B and SG leads. *Seizure:* 500 ohms between M and SB leads

14. TESTING AT INTERFACE PROTOCOL CODE EX-A

14.01 The signaling tests consist of observing the E & E1 signal leads for open or ground for incoming signals and providing open or ground to EX & EX1 leads for outgoing signals.

A. Distant STATION END has Loop Signaling-Ground Start, (Interface Protocol GS) or Equivalent Type Signaling

STEP	PROCEDURE
1	Request distant end to send idle, on-hook, (Tip & Ring conductors open and no ground on Ring conductor).
2	Provide open to EX & EX1 signal leads. Tip open and no ringing to distant end).
3	Measure resistance of E & E1 signal leads to ground. *LIMIT:* Open (equal or greater than 20K ohms)
4	Request distant end to send seizure, (Tip & Ring conductor open, ground on Ring conductor).
5	Measure resistance of E & E1 signal leads to ground.

STEP	PROCEDURE
	LIMIT 1: E signal lead open, equal or greater than 20K ohms.
	LIMIT 2: E1 signal lead short equal or less than 1150 ohms.
6	Change EX signal lead from open (Step 2 above) to ground (Tip ground to station).
7	Request distant end to send loop closure signal and remove Ring conductor ground.
8	Measure resistance of E & E1 signal leads to ground.
	LIMIT 1: E signal lead short (equal or less than 150 ohms).
	LIMIT 2: E1 signal lead short, equal or less than 1150 ohms.
9	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
10	Observe pulses on E signal lead, (no specific % break limits are given). If pulsing is a problem, substitute the equivalent Central Office end of FX service (i.e., FX0 or FLA) for tandem unit and measure % Break on T & R leads. See testing at Interface Protocol code GO for limits.
11	Change EX signal lead from ground (Step 8 above) to open.
12	Request distant end to send idle, on-hook (Tip & Ring conductors open and no ground on Ring conductor).
13	Change EX signal lead from open (A14 above) to ground and change EX-1 signal lead from open (A2 above) to ground to provide seizure.
14	Request distant end to send seizure, off hook (Tip & Ring conductors connected together through 430 ohms).
15	Measure E signal lead resistance to ground.
	LIMIT: E signal lead short, equal or less than 1150 ohms.

B. Distant STATION END has Loop Signaling-Loop Start, (Interface Protocol LS) or Equivalent Type Signaling.

STEP	PROCEDURE
1	Provide ground to EX signal lead and open to EX-1 signal lead (Tip ground to station end & no ringing).

STEP	PROCEDURE
2	Request distant end to send idle, on-hook. (Tip & Ring Conductors open)
3	Measure resistance of E & E1 signal leads to ground. *LIMIT 1:* E signal lead open, equal or greater than 20K ohms. *LIMIT 2:* E1 signal lead open, equal or greater than 20K ohms.
4	Request distant end to send seizure, off-hook Tip & Ring Conductors connected together through 430 ohms).
5	Measure resistance of E & E1 signal leads to ground. *LIMIT 1:* E signal lead short, equal or less than 150 ohms *LIMIT 2:* E1 signal lead open, equal or greater than 20K ohms
6	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
7	Observe pulses on E signaling lead (no specific % Break limits are given). If pulsing is a problem, substitute the equivalent central office end (i.e., FXO or FLA) for tandem unit and measure % Break on T & R leads. See testing at interface Protocol Code LO for limits.
8	Request distant end send idle signal, on-hook.
9	Change EX-1 signal lead from open (B1 above) to ground, to provide ringing to distant end.
10	Request distant end to send off-hook. Tip & Ring conductors connected together through 430 ohms.
11	Measure resistance of E & E1 signal leads to ground. *LIMIT 1:* E Signal lead short, equal or less than 150 ohms. *LIMIT 2:* E1 Signal lead open, equal or greater than 20k ohms.

15. TESTING AT INTERFACE PROTOCOL CODE EX-B

15.01 The signaling tests consist of observing the E & E1 signaling leads for incoming signals and providing open or ground to the EX & EX1 signal leads for outgoing signals.

A. Distant END OFFICE has Loop Signaling-Ground Start, (interface protocol GO) or Equivalent Signaling

STEP	PROCEDURE
1	Provide open to EX & EX1 signaling leads (on-hook signal to distant end).
2	Request distant end to send idle, on-hook signal (Tip conductor open).
3	Measure the E & E1 signaling lead resistance to ground. *LIMIT 1:* E signaling lead open, equal or greater than 20K ohms *LIMIT 2:* E1 signaling lead open, equal or greater than 20K ohms
4	Request distant end to send seizure, Tip conductor ground.
5	Measure the E & E1 signal lead resistance to ground. *LIMIT 1:* E signaling lead short, equal or less than 150 ohms. *LIMIT 2:* E1 signaling lead open, equal or greater than 20K ohms
6	Request distant end to send ringing.
7	Measure the E & E1 signaling lead resistance to ground. *LIMIT:* E signaling lead short, equal or less than 150 ohms E1 signaling lead short, equal or less than 1150 ohms
8	Change EX signaling lead from open (see A1 above) to ground, to trip ringing.
9	Measure resistance of E1 signaling lead to ground. *LIMIT:* Open (equal or greater than 20K ohms)
10	Change EX signaling lead from ground (see All above) to open.
11	Request distant end to send idle, on hook signal (Tip Conductor open).
12	Change EX-1 signaling lead from open (see A1 above) o ground. (Seizure, Tip ground, signal to distant end.)
13	Distant end should observe Tip ground.

B. Distant end of Telephone Company facility is Loop Signaling-Loop Start, OFFICE (interface protocol LA, LB, LC or LO) or Private Line Automatic Ringing (interface protocol LR) Signaling

STEP	PROCEDURE
1	Provide open to EX & EX1 signaling leads (on-hook signal to distant end).
2	Request distant end to end idle, battery on Ring conductor & Ground on Tip conductor and no ringing.
3	Measure E & E1 signaling lead resistance to ground. *LIMIT:* E Signal Lead short, equal or less than 150 ohms E1 Signal lead open, equal or greater than 20 K ohms
4	Request distant end to provide ringing signal.
5	Measure E & E1 signal lead resistance to ground. *LIMIT:* E signal lead short, equal or less than 150 ohms. E1 signal lead short equal or less than 1150 ohms.
6	Change EX signaling lead from open (see B1 above) to ground. (loop closure, off-hook signal to distant end).
7	Measure E & E1 signaling lead resistance to ground. *LIMIT 1:* E signaling lead short, equal or less than 150 ohms *LIMIT 2:* E1 signaling lead open, equal or greater than 20K ohms.

16. TESTING AT INTERFACE PROTOCOL CODE GO

16.01 The signaling tests consists of supplying battery & ground and measuring the dc current in the Tip & Ring conductors and dial pulse distortion. Tip ground and ringing (20 Hz) are provided as outgoing signal.

16.02 When the interface is 4-wire, the simplex of the transmission pairs provide the DC signaling path. The simplex of the T & R designated conductors is the equivalent of the Tip conductor. The simplex of the T1 & R1 designated conductors is the equivalent of the Ring conductor.

A. Distant STATION END has Loop Signaling-Ground Start, (Interface Protocol GS) or Equivalent Signaling

STEP	PROCEDURE
1	Connect Telephone Company SWITCH type battery supply, (-48V and ground)* to the Ring & Tip conductors respectively.
2	Request distant end to send on-hook, (Tip & Ring conductors open and no ground on the Ring conductor).
3	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc currently in Tip conductor plus dc current in Ring conductor equal or less than 6.0 mA.
4	Request distant end to send off-hook (Tip & Ring conductors connected together through 430 ohms).
5	Measure current in Tip conductor. *LIMIT:* Equal or greater than 16 mA.
6	Request distant end to provide on-hook (remove the 430 ohm termination).
7	Measure current in Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 6.0 mA.
8	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
9	Measure dial Pulse distortion — Dial Pulse receiving test set to provide battery and ground through "A" relay to Tip & Ring conductors. *LIMIT:* 42-74% Break.
10	Send idle, seizure, or ringing as requested by distant end or intermediate location of Telephone Company provided facility. *Idle:* Battery on Ring conductor & open on Tip conductor. *Seizure:* Battery on Ring conductor and ground on Tip conductor. *Ringing:* 20 $\pm$3 Hz to Tip & Ring conductors with grounded side of the ringing supply to Tip conductor

*-48V dc 420 ohm balanced central office battery supply and ground

B. Distant End has Back to Back carrier using Tandem signaling units (interface protocol EX-B)

STEP	PROCEDURE
1	Connect Telephone Company SWITCH type battery supply, (-48V and ground)* to the Ring & Tip conductor respectively.
2	Request distant end to provide on-hook (EX & EX1 signal leads open).
3	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 6.0 mA.
4	Request distant end to provide off-hook (EX lead grounded, EX1 lead open).
5	Measure dc current in Tip conductor. *LIMIT:* Equal or greater than 16 mA.
6	Request distant end to return to on-hook (EX & EX1 signal lead open).
7	Measure dc current in Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 6.0 mA.
8	Measure dial pulse distortion. Dial pulses cannot be provided at the tandem arrangement. If necessary to measure dial pulses, replace tandem unit with FX0 type unit and pulse following tests in A10 above.
9	Send idle, seizure, or ringing as requested by distant end or intermediate office on Telephone Company provided facility. *Idle:* Battery on Ring conductor & open on Tip conductor *Seizure:* Battery on Ring & ground on Tip conductors *Ringing:* 20 $\pm$3 Hz to Tip & Ring conductors with grounded side of the ringing supply to Tip conductor

*-48V dc 420 ohm balanced central office battery supply and ground

C. Distant end of the Telephone Company provided facility has digital hierarchy (interface protocol DS) with bit stream signaling

STEP	PROCEDURE
1	Connect Telephone Company SWITCH type battery, (-48V and ground)* to Tip & Ring conductors respectively.
2	Request distant end to send on-hook (A signaling channel logic state 0 B signaling channel logic state 1)
3	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 6.0 mA.
4	Request distant end to send off-hook (A signaling channel logic state 1 B signaling logic state 0)
5	Measure current on Tip conductor. *LIMIT:* Equal or greater than 16 mA.
6	Request distant end to send on-hook.
7	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor pulse dc current in Ring conductors equal or less than 6.0 mA.
8	Request distant end to send dial pulses. A signaling channel logic changing from state 0 (break) to 1 (make) and B signaling channel logic state 1. *LIMIT:* AT present no dial pulse distortion % break limits have been established between these interfaces.
9	Send idle, seizure or ringing as requested by distant end or intermediate location of Telephone Company facility. *Idle:* Tip conductor open & battery on Ring conductor *Seizure:* Tip conductor ground & batter on Ring conductor

*-48V dc 420 ohm balanced central office battery supply and ground

D. Distant End has High Capacity Analog (Protocol AH); Single Frequency (Protocol SF) or Equivalent Signaling.

STEP	PROCEDURE
1	Connect Telephone Company SWITCH type battery supply, (-48V and ground)* to the Ring and Tip conductors respectively.
2	Request distant end to send on-hook (SF tone on).
3	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 6.0 mA.
4	Request distant end to send seizure and off-hook (SF tone removed).
5	Measure current in Tip conductor. *LIMIT:* Equal or greater than 16 mA.
6	Request distant end to send dial pulses SF tone on (break)/SF tone off (make) *LIMIT:* At present no dial pulse % Break distortion limits have been established between these interfaces.
7	Send idle, seizure, or ringing as requested by the distant end or intermediate location of the Telephone Company facility. *Idle:* Battery on Ring conductor & open on Tip conductor *Seizure:* Battery on ring conductor & ground on Tip conductor

17. TESTING AT INTERFACE PROTOCOL CODE GS

17.01 The signaling tests consist of measuring resistance, the loop current in the Tip & Ring conductors and the ringing voltage. Tip conductor ground, Tip to Ring conductor closure and dial pulsing are used as outgoing signals.

17.02 When the interface is 4-wire, the simplex of the transmission pairs provide the DC signaling path. The simplex of the T & R designated conductors is the equivalent of the Tip conductor and the simplex of the T1 & R1 designated conductors is the equivalent of the Ring conductor.

*-48V dc 420 ohm balanced central office battery supply and ground

A. Distant End Has Loop Signaling-Ground Start Office (Protocol GO) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle. Battery* on Ring & Conductor & Tip Conductor open.
2	Measure Tip conductor resistance to ground.
	LIMIT: Equal or greater than 30 K ohms.
3	Request distant end to send seizure (Telephone Company switch type battery Supply)* battery on Ring conductor and ground on Tip conductor).
4	Connect Tip & Ring conductors together through 430 ±1-ohm resistor. Measure Tip & Ring conductor loop current.
	LIMIT: Equal or greater than 20ma.
5	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
6	Request distant end to ring (20 ±3 Hz).
7	Measure ringing voltage across REN-3 load.
	LIMIT: Equal or greater than 55V rms.
8	Provide 330 ±1 ohm resistor across the REN-3 load to provide ringing trip to distant end.
	LIMIT: Ringing to trip within 200 milliseconds, or ringing trip signal (loop closure) to be observed at distant end.
9	Remove REN-3 load and 330 ohm resistor.
10	Request distant end to send idle, top conductor open.
11	Measure Tip conductor resistance to ground.
	LIMIT: Equal or greater than 30K ohms.
12	Send idle, seizure and pulsing as requested by distant end or intermediate location of the Telephone Company provided facility.
	Idle: Tip & Ring conductor open & ungrounded
	Seizure: Ring conductor grounded, 550 ohms

*-48V dc 420 ohm balanced central office battery supply and ground
†-48V dc 420 ohm balanced central office battery supply and ground

B. Distant End Has Back-to-Back Carrier Using Tandem Signaling Units(Protocol EX-A)

STEP	PROCEDURE
1	Request distant end to send idle, EX and EX1 signal leads open.
2	Measure tip conductors resistance to ground. *LIMIT:* Equal or greater than 30K ohms.
3	Request distant end to send seizure, EX signal lead ground, EX-1 signal lead open.
4	Connect Tip & Ring conductors together with 430 ±1 ohm resistor. Measure Tip & Ring conductor loop current. *LIMIT:* Equal or greater than 20ma.
5	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
6	Request distant end to ring, EX & EX1 signal leads ground.
7	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V vms.
8	Provide 330 ±1 ohm resistor across the REN-3 load to provide ringing trip to distant end. *LIMIT:* Ringing to trip within 200 milliseconds, or loop closure signal, ground on E signal lead, to be observed at distant end).
9	Remove REN-3 load and 330 ohm resistor.
10	Request distant end to send idle, EX & EX1 signal leads open.
11	Measure Tip conductor resistance to ground. *LIMIT:* Equal or greater than 30K ohms.
12	Send idle, seizure, and pulsing as requested by distant end or intermediate location of Telephone Company provided facility. *Idle:* Tip & Ring conductors open and ungrounded *Seizure:* Ring conductor grounded and connected to Tip with 430 ohms

C. Distant End Has Digital Hierarchy (Protocol DS) With Bit Stream Signaling

STEP	PROCEDURE
1	Request distant end to send idle (A signaling channel logic state 1, B signaling channel logic state 0 or 1).
2	Measure Tip conductor resistance to ground.
	LIMIT: Equal or greater than 30K ohms.
3	Request distant end to send seizure (A signaling channel logic state, 0, B signaling channel logic state 1).
4	Connect Tip & Ring conductors together through 430 $\pm$1 ohm resistor. Measure Tip & Ring loop current.
	LIMIT: Equal or greater than 20ma.
5	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
6	Request distant end to ring (A & B signaling channels logic state 0).
7	Measure ringing voltage across REN-3 load.
	LIMIT: Equal or greater than 55V rms.
8	Provide 330 $\pm$1% ohm resistor across REN-3 load to provide ringing trip signal.
	LIMIT: Ringing to trip within 200 m sec, or ringing trip signal (A & B signaling channel logic state 1) to be observed at distant end.
9	Send idle, seizure, off-hook, and pulsing as requested by distant end or intermediate location of the Telephone Company provided facility.
	Idle: Tip & Ring conductors open and ungrounded
	Seizure: Ring conductor grounded through 550 ohms
	Off-hook: Tip & Ring conductors connected together through 430 ohms

D. Distant End Has Single Frequency (Protocol SF) Signaling

STEP	PROCEDURE
1	Request distant end to send idle (SF tone on).
2	Measure Tip conductor resistance to ground. *LIMIT:* Equal to or greater than 30K ohms.
3	Request distant end to send seizure (SF tone off).
4	Connect Tip & Ring conductors together through 430 ±1% ohm resistor. Measure Tip & Ring current. *LIMIT:* Equal or greater than 20ma.
5	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
6	Ringing signal from distant end requires that the SF tone to be modulated by the 20 HZ ringing signal.
7	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
8	Send idle, seizure, off hook, and pulsing as requested by distant end or intermediate location of the Telephone Company provided facilities. *Idle:* Tip & Ring conductors open and ungrounded *Seizure:* Ring conductor grounded through 550 ohms *Off hook:* Tip & Ring conductors connected together through 430 ohms

18. TESTING AT INTERFACE PROTOCOL CODE LA, LB, LC or LO

18.01 The signaling tests consists of supplying battery and ground and measuring the dc current in the Tip & Ring conductors and measuring dial pulse distortion. Ringing (20 Hz) is provided as outgoing signal.

18.02 When the interface is 4-wire, the simplex of the transmission pairs provide the DC signaling path. The simplex of the T & R designated conductors is the equivalent of the Tip conductor. The simplex of the T1 & R1 designated conductors is the equivalent of the Ring conductor.

A. Distant STATION END Has Loop Signaling-Loop-Start, (protocol LS) or Equivalent Signaling.

STEP	PROCEDURE
1	Connect Type A, B or C PBX port or C0 battery supply* as specified to the ring & Tip conductors respectively. * (a) PBX Class A port (16ma into 200 ohm load) (b) PBX Class B port (20ma into 600 ohm load) (c) PBX Class C port (20ma into 1300 ohm load) (d) -48V dc 420 ohm balanced central office battery supply.
2	Request distant end to send on-hook, Tip & Ring conductors open.
3	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 3.2ma.
4	Request distant end to send off-hook. Tip & Ring conductors connected together through 430 $\pm$1% ohm resistor.
5	Measure dc current in Tip conductor. *LIMIT:* Equal or greater than 16ma.
6	Request distant end to send on-hook, remove the 430 ohm termination.
7	Measure dc current in Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 3.2ma.
8	Request distant end to send dial pulses. *Note 1.* If sending end is ***user network interface*** send 8 PPS at 64% break and 11 PPS at 58% break. *Note 2.* If sending end is ***Interexchange Carrier POT*** send 8 PPS at 76% break and 11 PPS at 48% break.
9	Measure dial Pulse distortion — Dial Pulse receiving test set to provide battery and ground through "A" relay to Tip & Ring conductors. *LIMIT 1:* 52-72% Break when measuring at POT. *LIMIT 2:* 42-84% Break when measuring at NI or Telephone Company switch when measuring at NI or Telephone Company switch

STEP	PROCEDURE
10	Send idle or ringing as requested by distant end or intermediate location of the Telephone Company provided facilities. *Idle:* Battery on Ring conductor & ground on Tip conductor *Ringing:* 20 ±3Hz to Tip & Ring conductors with grounded side of the ringing supply to Tip conductor

B. Distant End has Back to Back carrier using Tandem signaling units (interface protocol EX-B)"

STEP	PROCEDURE
1	Connect Type A, B or C PBX port or C.O. battery supply* as specified to the Ring & Tip conductor respectively. * (a) PBX Class A port (16ma into a 200 ohm load). (b) PBX Class B port (20ma into 600 ohm load). (c) PBX Class C port (20ma into a 1300 ohm load). (d) -48V dc 420 ohm balanced central office battery supply.
2	Request distant end to send on-hook (EX & EX1 signal leads open).
3	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 3.2ma.
4	Request distant end to send off-hook (EX & EX1 leads grounded).
5	Measure dc current in Tip conductor. *LIMIT:* Equal or greater than 16ma.
6	Request distant end to return to on-hook (EX & EX1 signal lead open).
7	Measure dc current in Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than .2ma.
8	Measure dial pulse distortion. Dial pulses cannot be provided at the tandem location, to measure dial pulse distortion replace distant end tandem unit with FXS type unit and test following A11, A12, A13 preceding.

STEP	PROCEDURE
9	Send idle or ringing as requested by distant end or intermediate location of the Telephone Company provided facility. *Idle:* Battery or Ring conductor & ground on Tip conductor *Ringing:* 20 ±3Hz to Tip & Ring conductors with grounded side of the ringing supply to Tip conductor

C. Distant End Has E&M Leads (Protocol EA or EB,) or Requires Test Unit (Type I E&M Lead SF, Type I E&M Lead EX Unit or Equivalent) for E&M signal leads (Protocol AH, SF or DX).

STEP	PROCEDURE
1	Connect Type A, B or C PBX port or C.O. battery supply* as specified to the Ring and Tip conductors respectively. * (a) PBX Class A port (16ma into a 200 ohm load). (b) PBX Class B port (20ma into 600 ohm load). (c) PBX Class C port (20ma into a 1300 ohm load). (d) -48V dc 420 ohm balanced central office battery supply.
2	Request distant end to send on-hook signal, battery on M lead.
3	Measure dc current in Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in TIP conductor plus dc current in Ring conductor equal or less than 3.2ma.
4	Request distant end to send off-hook signal, ground on M lead.
5	Measure dc current in Tip lead. *LIMIT:* Equal or greater than 16ma.
6	Request distant end to send on-hook signal, battery on M lead.
7	Measure dc current in Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductor equal or less than 3.2ma.
8	Send idle or ringing as requested by distant end or intermediate location of the Telephone Company facility.

STEP	PROCEDURE
	Idle: Battery on Ring conductor & ground on Tip conductor *Ringing:* 20 ±3 Hz to Tip & Ring conductors with grounded side of ringing supply to Tip conductor

D. Distant End Has Digital Hierarchy Interface With Bit Stream Signaling (Protocol DX)."

STEP	PROCEDURE
1	Connect Type A, B or C PBX port or C.O. battery supply* as specified to the Ring & Tip conductors respectively. * PBX Class A port (16ma into a 200 ohm load). PBX Class B port (20ma into 600 ohm load). PBX Class C port (20ma into a 1300 ohm load). -48V dc 420 ohm balanced central office battery supply.
2	Request distant end to provide idle, on hook (Logic state 0 to A signaling channel).
3	Measure dc current in the Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in Tip conductor plus dc current in Ring conductors equal or less than 3.2ma.
4	Request distant end to provide seizure, off hook (Logic state 1 to A signaling channel).
5	Measure dc current in Tip lead. *LIMIT:* Equal or greater than 16ma.
6	Request distant end to send idle, on-hook (Logic state 0 to A signaling channel).
7	Measure dc current in Tip & Ring conductors independently. *LIMIT:* Absolute value of dc current in tip conductor plus current in Ring conductor equal or less than 3.2ma.
8	Send idle or ringing as requested by distant end or intermediate location of the Telephone Company facility. *Idle:* Battery on Ring conductor & ground on Tip conductor *Ringing:* 20 ±3Hz to Tip & Ring conductors with grounded side of ringing supply to Tip conductor

19. TESTING AT INTERFACE PROTOCOL CODE LR

19.01 The signaling tests consists of measuring the loop current in the Tip & Ring conductors and the ringing voltage. Tip to Ring conductor closure is the outgoing signal.

19.02 When the interface is 4-wire, the simplexes of the transmission pairs provide the DC signaling path.

A. Distant End Has E&M Leads (Protocol EA or EB or Equivalent) or Requires a Test Unit to access the Signaling (Protocol AH, DX or SF).

STEP	PROCEDURE
1	Request distant end to send idle signal (Battery* on M lead or open on E lead for EA-E or EB-E interface protocol).
2	Connect Tip & Ring conductors together through a 430 ±1% ohm resistor. Measure loop current in Tip & Ring conductors. *LIMIT:* Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent-load (3-C4A ringers with capacitors in parallel).
4	Request distant end to send ringing signal (open M lead or ground on E lead for EA-E or EA-B interface protocol).
5	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
6	Provide 330 ±1% ohm resistor across REN-3 load to provide ringing trip to distant end. *LIMIT:* Ringing to trip within 200 M sec.
7	Send idle signal or ringing signal as requested by distant end or intermediate location of the Telephone Company provided facility. ***Idle signal:*** Tip & Ring conductors open ***Ringing signal:*** Tip & Ring conductors connected together through 430 ±1 ohm resistor

*48V dc and ground, to simulate Class A, B or C ports as required.

B. Distant End Has Digital Hierarchy (Protocol DS)

STEP	PROCEDURE
1	Request distant end to send idle signal (Logic state 0 on A & B signaling channels).
2	Connect Tip & Ring conductors together with 430 ±1% ohm resistor. Measure loop current on Tip & Ring conductors. *LIMIT:* Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors are parallel).
4	Request distant end to send ringing signal (logic state 1 on A & B signaling channels).
5	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
6	Provide 330 ±1% ohm resistor across REN-3 load to provide ringing trip to distant end. *LIMIT:* Ringing to trip within 200 m sec.
7	Send idle signal or ringing signal as requested by distant end or intermediate location of the Telephone Company provided facility. *Idle signal:* Tip & Ring conductors open *Ringing signal:* Tip & Ring conductor connected together through 430 ±1% ohm resistor

C. Distant End Has Back-to-back Carrier Tandem (Protocol EX-B)

19.03 The distant end of the Telephone Company facility provides OFFICE type Loop Signaling, Loop Start.

STEP	PROCEDURE
1	Request distant end to send idle signal (open to EX & EX1 signaling leads).
2	Connect Tip & Ring conductors together through 430 ±1% ohm resistor. Measure Loop current in Tip & Ring conductors. *LIMIT:* Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).

STEP	PROCEDURE
4	Request distant end to send ringing signal (ground to EX signaling lead and open to EX1 signaling lead).
5	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
6	Provide 330 ±1% ohm resistor across REN-3 load to provide ringing trip to distant end. *LIMIT:* Ringing to trip within 200 m sec.
7	Send idle signal or ringing signal as requested by distant end or intermediate location of the Telephone Company provided facility. ***Idle signal:*** Tip & Ring conductors open Ringing signal Tip & Ring conductors connected together through 430 ±1% ohm resistor

D. Distant End Has Private Line Automatic Ringing (Protocol LR)

STEP	PROCEDURE
1	Request distant end to send idle, on-hook signal (Tip & Ring conductors open).
2	Connect Tip & Ring conductors together through a 430 ±1% ohm resistor. Measure loop current in Tip & Ring conductors. *LIMIT:* Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
4	Request distant end to send ringing signal (connect Tip & Ring conductors together through 430 ±1% ohm resistor.
5	Measure voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
6	Provide 330 ±1% ohm resistor across REN-3 load to provide ringing trip to distant end. *LIMIT:* Ringing to trip within 200 m sec.
7	Send idle and ringing signals as requested by the distant end or intermediate location on Telephone Company provided facility.

STEP	PROCEDURE
	Idle signal: Tip & Ring conductors open *Ringing signal:* Tip & Ring conductors connected together through 430 ±1 ohm resistor

20. TESTING AT INTERFACE PROTOCOL CODE LS

20.01 The signaling tests consist of measuring the loop current in the Tip & Ring conductors and the ringing voltage. Tip to Ring conductor closure and dial pulsing are used as outgoing signals.

20.02 When the interface is 4-wire, the simplexes of the transmission pairs provide the DC signaling path. The simplex of the T & R designated conductors is the equivalent of the Tip conductor and the simplex of the T1 & R1 designated conductors is the equivalent of the Ring conductor.

A. Distant End OFFICE Has Loop Signaling-Loop Start (Protocol LA, LB, LC or LO) or Equivalent Signaling.

STEP	PROCEDURE
1	Request distant end to send idle. Battery* on Ring Conductor & ground on the Tip Conductor.
2	Connect Tip & Ring conductors together through 430 ±1 ohm resistor. Measure Tip & Ring Conductors loop current. *LIMIT:* Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
4	Request distant end to ring (20 ±3Hz).
5	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
6	Provide 330 ±1% ohm resistor across the REN-3 load to provide ringing trip to distant end. *LIMIT:* Ringing to trip within 200 milliseconds, or ringing trip signal (loop closure) to be observed at distant end.
7	Provide idle, seizure and pulsing as requested by distant end or the intermediate location of the Telephone Company provided facility.

*48V dc & ground, to simulate Class A, B or C port as required.

STEP	PROCEDURE
	Idle: Tip & Ring conductor open *Seizure:* Tip & Ring connected together through 430 ohms

B. Distant End Has Back-to-Back Carrier Tandem Signaling Units (Protocol EX-A).

STEP	PROCEDURE
1	Request distant end to send idle, EX signal lead ground and EX1 signal lead open.
2	Connect Tip & Ring conductors together through 430 ±1-ohm resistor. Measure Tip & Ring conductor loop current. *LIMIT:* Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
4	Request distant end to ring. EX to EX1 signal leads ground.
5	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V vms.
6	Provide 330 ±1% ohm resistor across the REN-3 load to provide ringing trip to distant end. *LIMIT:* Distant end to observe, ground on E signal lead.
7	Send idle, seizure and pulsing as requested by distant end or the intermediate location of the Telephone Company provided facility. *Idle:* Tip & Ring conductors open *Seizure:* Tip & Ring conductors connected together through 430 ohms

C. Distant End Has E&M leads (Protocol EA, EB or EC) or a Test Signaling Unit for (interface protocol AH, DX or SF).

STEP	PROCEDURE
1	Request distant end to send idle. ***Protocol EA-M and EC-M:*** Grounded M lead ***Protocol EB-M:*** Open M lead ***Protocol EA-E, EB-E or EC-E:*** Open E lead
2	Connect Tip & ring conductors together through 430 ±1-ohm resistor. Measure Tip & Ring conductor loop current. ***LIMIT:*** Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
4	Request distant end to ring. ***Protocol EA-M and EC-M:*** Grounded M lead ***Protocol EB-M:*** Open M lead ***Protocol EA-E or EB-E:*** Open M or Grounded E lead
5	Measure ringing voltage across REN-3 load. ***LIMIT:*** Equal or greater than 55V rms.
6	Provide 330 ±1% ohm resistor across the REN-3 load to provide ringing trip to distant end. ***LIMIT:*** Ringing trip signal to be observed at distant end. (E lead ground or M lead battery for EA-E or EB-E interface protocol).
7	Provide idle, seizure and pulsing as requested by the distant end or the intermediate location of the Telephone Company facility. ***Idle:*** Tip & Ring conductors open ***Seizure:*** Tip conductor connected to Ring conductor through 430 ohms

D. Distant End is Digital Hierarchy (Protocol DS) With Bit Stream Signaling.

STEP	PROCEDURE
1	Request distant end to send idle (A signaling channel logic state 0 and B signaling channel logic state 1).
2	Connect Tip & Ring conductors together with 430 ±1% ohm resistor. Measure Tip & Ring conductor loop current. *LIMIT:* Equal or greater than 20ma.
3	Replace 430 ohm resistor with REN-3 equivalent load (3-C4A ringers with capacitors in parallel).
4	Request distant end to ring (A & B signaling channel logic state 0).
5	Measure ringing voltage across REN-3 load. *LIMIT:* Equal or greater than 55V rms.
6	Provide 330 ±1% ohm resistor across the REN-3 load to provide ringing trip to distant end. *LIMIT:* Distant end to observe A signaling channel logic state 1.
7	Provide on hook-idle (Tip & Ring conductors open), off hook-seizure (Tip conductor connected to Ring conductor with 430 ohms) and pulsing as requested by distant end or intermediate location of Telephone Company provided facilities.

21. TESTING AT INTERFACE PROTOCOL CODE RV-0

21.01 The signaling tests consists of observing the battery and ground status of the Tip and Ring conductors and sending loop closure signals.

21.02 When the interface is 4-wire, the simplexes of the transmission pairs provide the DC signaling path. The simplex of the T&R designated conductors is the equivalent of the Tip conductor, and the simplex of the T1 & R1 designated conductors is the equivalent of the Ring conductor.

A. Distant TERMINATING END is Loop-Reverse Battery (Protocol RV-T) Signaling.

STEP	PROCEDURE
1	Request the distant end to send idle signal (battery on Ring conductor and ground on Tip conductor).
2	Measure voltage Tip to Ring conductor. *LIMIT:* Ring conductor negative with respect to Tip conductor.

STEP	PROCEDURE
3	Connect 600 ohm resistor between Tip & Ring conductor and measure loop current. *LIMIT:* Equal or greater than 15ma.
4	Request the distant end to send reverse battery signal (ground on Ring conductor and battery on Tip conductor).
5	Loop current to reverse through 600 ohm resistor. *LIMIT:* Equal or greater than 15ma (current reversed when referenced to A 3 above).
6	Send seizure (Tip & Ring conductors connected together through 600 ohm resistor) and pulsing as requested by the distant end or intermediate location on the Telephone Company provided facility.

B. Distant End Has E & M leads (Protocol EA, EB or EC) or Requires Test Unit to Access Signaling channels (interface protocol AH, DX, DY, or SF).

STEP	PROCEDURE
1	Request distant end to provide idle signal. ***Protocol EA-M and EC-M:*** Ground M lead ***Protocol EB-M:*** Open M lead ***Protocol EA-E or EB-E:*** Open E lead
2	Measure voltage Tip to Ring conductor. *LIMIT:* Ring conductor negative with respect to Tip conductor.
3	Connect 600 ohm resistor between Tip and Ring conductors and measure loop current. *LIMIT:* Equal or greater than 15ma.
4	Request distant end to provide reverse battery signal (battery on M lead or ground on E lead for EA-E and EB-E interface protocol).
5	Loop current to reverse through 600 ohm resistor. *LIMIT:* Equal or greater than 15ma (current reversed when referenced to B 3 above).

STEP	PROCEDURE
6	Send seizure (Tip & Ring conductors connected together through 600 ohm resistor) and pulsing as requested by the distant end or intermediate location on the Telephone Company provided facilities.

C. Distant end is Digital Hierarchy interface (interface protocol DS) using bit stream signaling.

STEP	PROCEDURE
1	Request distant end to send idle signal (logic state 0 on both A & B signaling channels).
2	Measure voltage Tip to Ring conductor. *LIMIT:* Ring conductor negative with respect to Tip conductor.
3	Connect 600 ohm resistor between Tip & Ring conductors and measure loop current. *LIMIT:* Equal or greater than 15ma.
4	Request the distant end to send reverse battery signal (logic state 1 on both A & B signaling channels).
5	Loop current to reverse through 600 ohm resistor. *LIMIT:* Equal or greater than 15ma (current reversed when referenced to C 3 above).
6	Send idle signal (Tip & Ring conductors open), seizure signal (Tip & Ring conductors converted together through 600 ohms) and pulsing as requested by distant end or intermediate location on the Telephone Company provided facilities.

22. TESTING AT INTERFACE CODE RV-T

22.01 The signaling tests consists of supplying battery and ground and measuring loop current with idle and seized signals and measuring dial pulse distortion.

22.02 When the interface is 4 wire, the simplexes of the transmission pairs provide the DC signaling path. The simplex of the T&R designated conductors is the equivalent of the Tip conductor and the simplex of the T1 & R1 designated conductors is the equivalent of the Ring conductor.

A. Distant ORIGINATING END Has Loop-Reverse Battery (Protocol RV-0) signaling

STEP	PROCEDURE
1	Provide battery simulator *, negative voltage to Ring conductor and ground (positive battery) to Tip conductor.
2	Request distant end to send idle signal (Tip & ring conductors open).
3	Measure current in Ring conductor. *LIMIT:* Equal or less than 1.6ma.
4	Request distant end to send seizure signal (Tip & Ring conductors connected together through 600 ohms).
5	Measure current in Ring conductor. *LIMIT:* Equal or greater than 16ma.
6	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
7	Measure the % Break. Battery and ground must be supplied to the Ring & Tip conductors respectively through the "A" relay of the pulse receiving test set. *LIMIT:* 42 to 74% break.
8	Send idle signal or reverse battery signal as requested by the distant end or intermediate location on Telephone Company provided facilities. *Idle signal:* Battery on Ring conductor and ground on Tip conductor *Reverse battery signal:* Ground on Ring conductor & battery on Tip conductor)

B. Distant End Has E & M Leads (Protocol EA or EB or equivalent) or Requires Test Unit to Access Signaling Channels (Protocol AH, DX, DY, or SF).

STEP	PROCEDURE
1	Provide battery simulator*, negative voltage to Ring conductor and ground (positive battery) to Tip conductor.

*48V dc & ground, 1300 ohm supply (For Class C PBX Port)
†48V dc & ground, 1300 ohm supply (For Class C PBX Port).

STEP	PROCEDURE
2	Request distant end to send idle (off hook) signal. ***Protocols EA-M and EC-M:*** Ground on M lead ***Protocol EB-M:*** Open M lead ***Protocol EA-E or EB-E:*** Open E lead
3	Measure current in Ring conductor. ***LIMIT:*** Equal or less than 1.6ma.
4	Request distant end to send reverse battery signal (battery on M lead or ground on E lead for interface protocol EA-E or EB-E).
5	Measure current in Ring conductor. ***LIMIT:*** Equal or greater than 16ma.
6	Request distant end to send dial pulses ***NOTE 1.*** If sending end is ***user network interface*** or Telephone Company switch, send 8 PPS at 64% break and 11 PPS at 52% break. ***Note 2.*** If sending end is ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
7	Measure the % Break. Battery & ground must be supplied to the Ring & Tip conductors respectively through the "A" relay of the pulse receiving test set. ***LIMIT:*** 42 to 74% break.
8	Send idle or reverse battery signal as requested by distant end or intermediate location of the Telephone Company provided facility. ***Idle signal:*** Battery on Ring Conductor & ground on Tip conductor ***Reverse battery signal:*** Ground on Ring conductor & battery on Tip conductor

C. Distant End is Digital Hierarchy (Protocol DS) With Bit Stream Signaling.

STEP	PROCEDURE
1	Provide battery simulator*, negative voltage to Ring conductor and ground (positive battery) to Tip conductor).
2	Request distant end to send idle signal (logic state 0 on both A & B signaling channels).
3	Measure current in Ring conductor. *LIMIT:* Equal or less than 1.6ma.
4	Request distant end to send seizure signal (logic state 1 on both A & B signaling channels).
5	Measure current in Ring conductor. *LIMIT:* Equal or greater than 16ma.
6	Request distant end to send dial pulses (A signal lead logic 0 break, logic 1 make). *LIMIT:* % break limits not yet established from DS interface protocol.
7	Provide idle or reverse battery signal as requested by the distant end or intermediate location of the Telephone Company provided facility. ***Idle signal:*** Battery on Ring conductor and ground on Tip conductor ***Reverse battery signal:*** Ground on Ring conductor & battery on Tip conductor

23. TESTING AT INTERFACE PROTOCOL CODE SF

23.01 The test set or testing method must include a 4-wire type I E & M lead SF unit. the signaling tests consists of measuring incoming signals on the E signaling lead and sending signals on the M signaling lead of the test SF unit.

A. Distant End has E & M Lead (Protocol EA, EB or EC) or Equivalent Type Signaling

23.02 The SF operation for these signaling methods is as follows:

- Idle (on hook): SF tone 2600 $\pm$5Hz at -20dBm0.
- Seized (off-hook): SF tone removed
- Pulsing: SF tone 2600 $\pm$5Hz at -8dBm0 on (break)/off (make).

*48V dc & ground, 1300 ohm supply (For Class C PBX Port).

STEP	PROCEDURE
1	Requesting distant end to send idle (on-hook). ***Protocol EA-M and EC-M:*** Ground on M lead ***Protocol EB-M:*** Open M lead ***Protocol EA-E or EB-E:*** Open E lead
2	Measure E lead resistance to ground. ***LIMIT:*** Open (equal or greater than 20K ohms.
3	Request distant end to send seizure, off-hook (battery on M lead on ground on E for EA-E or EB-E protocol).
4	Measure E lead resistance to ground. ***LIMIT:*** Short (equal or less than 150 ohms)
5	Request distant end to send dial pulses. ***Note 1.*** If sending end is ***user network interface*** or Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break. ***Note 2.*** If sending end is ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.
6	Measure E lead pulses. ***LIMIT 1:*** 48 to 68% Break when measuring at POT ***LIMIT 2:*** 42 to 74% Break when measuring at ***user network interface*** or Telephone Company switch
7	Send Idle (ground on M lead), Seizure (battery on M lead) or pulsing on M lead as requested by the distant end or intermediate location of Telephone Company provided facilities.

B. Distant End Has 20 Hz Ring-down (Protocol AB or AC) or Equivalent Signaling

23.03 The SF operations for this signaling method provided SF tone for ringing and no SF tone in all other states.

STEP	PROCEDURE

STEP	PROCEDURE
1	Request distant end to ring.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant end to remove ringing.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms)
5	Send ringing (ground on M lead) or idle state (battery on M lead) as requested by distant end or intermediate location of the Telephone Company provided facility.

C. Distant End Has DX Signaling (Protocol DX or DY)

23.04 It is assumed that the distant end test access will include a DX-1 signaling unit or equivalent to provide type I E & M signaling leads for testing purposes.

23.05 SF Operation for the signaling method is as follows:

(a) ***From and to the Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone 2600 ±5Hz at -20 dBm0

(2) ***Seized (off-hook):*** SF tone removed

(3) ***Pulsing:*** SF tone 2600 ±5Hz at -8 dBm0 on (break)/off (make)

STEP	PROCEDURE
1	Request distant end to send idle.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant end to send seizure.
4	Measure E lead resistance to ground.

STEP	PROCEDURE

LIMIT: Short (equal or less than 150 ohms)

5 Request distant end to send dial pulses.

Note 1. If sending end is ***user network interface*** or Telephone Company switch send 8 PPS at 64% break and 11 PPS at 52% break.

Note 2. If sending end is ***Interexchange Carrier POT*** send 8 PPS at 70% break and 11 PPS at 46% break.

6 Measure E lead pulses.

LIMIT 1: 48-68% Break when measuring at POT.

LIMIT 2: 42-74% Break when measuring at ***user network interface*** or Telephone Company switch.

7 Send Idle (ground on M lead), Seizure (battery on M lead) or pulsing on M lead as requested by distant end or intermediate location of Telephone Company provided facility.

D. Distant end has Back to Back Carrier Tandem (Protocol EX-A) Signaling

23.06 The distant end of the Telephone Company provided facilities provides OFFICE type Loop Signaling either Loop Start, (23.07) or Ground Start (23.08).

23.07 The distant end is providing Loop Start (OFFICE) signaling. The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company facility***

Idle (on-hook): No SF tone

Seized (off-hook): No SF tone

Ringing: SF tone, 2600 ±5Hz at -8 dBm0

(b) ***To Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone ±5Hz at -20 dBm0

(2) ***Seized (off-hook):*** No SF tone

(3) ***Dial pulsing:*** SF tone at -8 dBm0 (break)/no SF tone (make)

STEP	PROCEDURE
1	Send on hook, idle, to distant end (open to M lead) SF tone transmitted.
2	Request distant end to send idle (ground to EX signal lead & open to EX1 signal lead).
3	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
4	Request distant end to send ringing signal (ground to EX & EX1 signal leads).
5	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms.
6	Send idle (on hook), seizure (off hook) signals and pulsing on M lead as requested by the distant end or intermediate location on Telephone Company facilities. ***Idle (on hook) signal:*** Open to M lead ***Seized (off hook) signal:*** Battery to M lead

23.08 The distant end is providing Ground Start (OFFICE) signaling, the SF operation for this Signaling method is as follows:

(a) ***From Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone, 2600 ±5Hz at -20dBm0

(2) ***Seized (off-hook):*** No SF tone

(3) ***Ringing:*** SF tone, 2600 ±5Hz at -8dBm0 modulated at 20 Hz ringing rate.

(b) ***To Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone, 2600 ±5Hz at -20dBm0

(2) ***Seizure (off-hook):*** No SF tone

(3) ***Dial Pulsing:*** SF tone at -8Bm0 (break)/No SF tone (make)

STEP	PROCEDURE
1	Send on hook, idle, to distant end (open to M lead) SF tone transmitted.
2	Request distant end to send idle (open to EX & EX1 signal leads).
3	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
4	Request distant end to send seizure signal (ground to EX and open to EX1 signal leads).
5	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
6	Request distant end to send ringing signal (ground to EX & EX 1 signal leads). *LIMIT:* 2600 Hz SF tone modulated at 20 Hz rate during ringing interval of ringing cycle and no SF tone during silent interval of ringing cycle. E lead cannot respond to this ringing signal.
7	Provide ringing trip signal to distant end (battery to M lead).
8	Distant end to observe ground on EX signal lead.
9	Send idle (on-hook), seizure (off-hook) signals and dial pulsing on M lead as requested by the distant end or intermediate location on the Telephone Company provide facility. ***Idle (on-hook) signal*** Open to M lead ***Seizure (off-hook) signal:*** Battery to M lead

E. Distant End Has Back to Back Carrier Tandem (Protocol EX-B) Signaling.

23.09 The distant end of the Telephone Company provided facility provides STATION type Loop Signaling either Loop Start (Paragraph 23.10) or Ground Start (Paragraph 23.11).

23.10 The distant end is providing Loop Start (STATION) signaling, the SF operation for this signaling method is as follows:

(a) ***From Telephone Company facility***

(1) ***Idle (on Hook):*** SF tone, 2600 $\pm$5Hz at -20dBm0

(2) ***Seized (off hook):*** No SF tone

(3) *Dial pulsing:* SF tone at -8Bm0 (break)/No SF tone (make)

(b) *To Telephone Company facility*

(1) *Idle (on hook):* No SF tone

(2) *Seized (off hook):* No SF tone

(3) *Ringing:* SF tone at -8dBm0.

STEP	PROCEDURE
1	Send idle signal toward distant end (battery to M lead) no SF tone transmitted.
2	Request distant end to send idle (on-hook) signal (open to EX & EX1 signal leads).
3	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
4	Request distant end to send seizure (off hook) signal (ground to EX signal lead & open to EX1 signal lead).
5	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms.
6	Request distant end to send dial pulses open [(break) & ground (make)] to EX signal lead.
7	Observe E lead pulses. *LIMIT:* No pulsing limits presently established when pulsing from EX-B interface protocol.
8	Send idle signal (battery to M lead) and ringing signal (open to M lead) as requested by distant end or intermediate location at Telephone Company provided facility.

23.11 Where the distant end is providing Ground Start (STATION) signaling, the SF operation for this signaling method is as follows:

(a) *From the Telephone Company facility*

(1) *Idle (on hook):* No SF tone, 2600 Hz -20dBm0

(2) *Seized (off hook):* No SF tone

(3) ***Dial pulsing:*** SF tone -8dBm0 (break)/No SF tone (make)

(b) ***To Telephone Company facility***

(1) ***Idle (on hook):*** SF tone, 2600 Hz -20dBm0

(2) ***Seized (off hook):*** No SF tone

(3) ***Ringing:*** SF tone -8dBm0 modulated at 20 Hz ringing rate

STEP	PROCEDURE
1	Send idle signal toward distant end (open to M lead). SF tone transmitted.
2	Request distant end to send idle, on-hook signal (open to EX & EX1 signal leads).
3	Measure E lead resistance to ground. ***LIMIT:*** Open (equal or greater than 20K ohms).
4	Request distant end to send seizure (open to EX signal lead & ground to EX1 signal lead).
5	Measure E lead resistance to ground. ***LIMIT:*** Short (equal or less than 150 ohms.
6	Request distant end to send off-hook (ground to EX signal lead and open to EX1 signal lead).
7	Measure E lead resistance to ground. ***LIMIT:*** Short equal or less than 150 ohms.
8	Request distant end to send dial pulses [open (break) & ground (make)] to EX signal lead.
9	Observe E lead pulses. ***LIMIT:*** No pulsing limits presently established when pulsing from EX-B interface protocol.
10	Send idle signal (open to M lead) and seizure (battery to M lead as requested by distant end or intermediate location of Telephone Company provided facilities. Ringing signal cannot be provided from the E lead. Ringing is the 2600 Hz SF tone modulated by 20 Hz ringing signal.

F. Distant SWITCH Has Loop Signaling-Ground Start, (Protocol GO) or Equivalent Signaling.

23.12 The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone 2600 ±5Hz at -20dBm0

(2) ***Seized (off-hook):*** SF tone removed.

(3) ***Ringing:*** SF tone modulated at 20 Hz rate

(b) ***To the Telephone Company facility***

(1) ***Idle (on hook):*** SF tone removed

(2) ***Seized (off-hook):*** SF tone removed

(3) ***Dialing:*** SF tone 2600 ±5Hz at -8 dBm0 on (break)/off (make).

STEP	PROCEDURE
1	Request distant end to send idle.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms).
3	Request distant end to send seizure.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms. *Note:* The E lead cannot respond to the ringing signal (SF tone modulated at 20 Hz rate).
5	Send idle (ground on M lead), seizure (battery on M lead) or pulsing on M lead as requested by the distant end or intermediate location of the Telephone Company provided facility.

G. Distant STATION END Has Loop Signaling-Ground Start, (Protocol GS) or Equivalent Signaling

23.13 The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone 2600 ±5Hz at -2 dBm0

(2) ***Seized (off-hook):*** SF tone removed

(3) ***Pulsing:*** SF tone 2600 ±5Hz at -8 dBm0 on (break)/off (make)

(b) ***to the Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone 2600 ±5Hz at -20dBm0

(2) ***Seized (off-hook):*** SF tone removed

(3) ***Ringing:*** SF tone modulated at 20 Hz rate.

STEP	PROCEDURE
1	Request distant end to send idle.
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant end to send seizure.
4	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
5	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure E lead pulses. *LIMIT 1:* 48-68% Break when measuring at POT *LIMIT 2:* 42-74% Break when measuring at ***user network interface*** or Telephone Company switch
7	Send Idle (ground on M lead), Seizure (battery on M lead) as requested by the distant end or intermediate location of the Telephone Company provided facility. Note: Ringing cannot be provided from the M lead.

H. Distant SWITCH Has Loop Signaling-Loop Start, (Protocol LA, LB, LC or LO) or Equivalent Signaling.

23.14 The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company facility***

(1) *Idle (on-hook):* No SF tone

(2) *Seized (off-hook):* No SF tone

(3) *Ringing:* SF tone 2600 ±5Hz at -8 dBm0 on/off

(b) *To the Telephone Company facility*

(1) *Idle (on-hook):* SF tone 2600 ±5Hz -20 dBm0

(2) *Seized (off-hook):* SF tone removed

(3) *Dialing:* SF tone 2600 ±5Hz at -8dBm0 on (break)/off (make)

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
2	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms)
3	Request distant to send seizure (off-hook).
4	Measure E lead resistance to ground. *LIMIT:* Open (equal or greater than 20K ohms).
5	Request distant end to send ringing.
6	Measure E lead resistance to ground. *LIMIT:* Open (20k ohms or more) during the ringing interval (±2 sec) and short (150 ohms or less) during silent interval (±4 sec) of each ringing cycle.
7	Send idle, seizure or pulsing on the M lead as requested by the distant end or intermediate location of the Telephone Company provided facility. *Idle:* Ground on M lead *Seizure:* Battery on M lead

I. Distant End has Private Line Automatic Ringing (PLAR) (Protocol LR) Signaling

23.15 The SF operation for this type signaling is as follows:

(a) ***From the Telephone Company facilities***

(1) ***Quiescent State:*** No SF tone

(2) ***Ringing:*** SF tone (2600 ±5Hz at -8 dBm0) on during ringing interval (2 sec) off during silent interval (4 sec) of each ringing cycle.

(b) ***to the Telephone Company facilities***

(1) ***On-hook:*** SF tone (2600 ±5Hz at -20 dBm0)

(2) ***Off-hook*** No SF tone

STEP	PROCEDURE
1	Provide ground to M lead, 150 ohms or less.
2	Request distant end of Telephone Company facilities to provide i.e., go off-hook.
3	Measure E lead resistance to ground. *LIMIT:* Open (20K ohms or more) during the ringing interval (±2 sec) and short (150 ohms or less) during the silent interval (±4 sec) of each ringing cycle.
4	Provide battery to M lead (Trip ringing).
5	Measure E lead resistance to ground. *LIMIT:* Short (equal or less than 150 ohms).
6	Send on-hook (ground on M lead) or off-hook (battery on M lead) as requested by distant end or intermediate location of Telephone Company provided facility.

J. Distant STATION Has Loop Signaling-Loop Start, (Protocol LS) or Equivalent Signaling

23.16 The SF operation for this signaling method is as follows:

(a) ***From the Telephone Company facility***

(1) ***Idle (on-hook):*** SF tone 2600 ±5Hz at -20 dBm0

(2) ***Seized (off-hook):*** SF tone removed

(3) ***Pulsing:*** SF tone 2600 ±5Hz on (break)/off (make)

(b) ***To the Telephone Company facilities***

(1) ***Idle (on-hook:*** No SF tone

(2) ***Seized (off-hook):*** No SF tone

(3) ***Ringing:*** SF tone 2600 ±5Hz at -8 dBm0

STEP	PROCEDURE
1	Request distant end to send idle (on-hook).
2	Measure E lead resistance to ground.
	LIMIT: Open (equal or greater than 20K ohms).
3	Request distant end to send seizure (off-hook).
4	Measure E lead resistance to ground.
	LIMIT: Short (equal or less than 150 ohms).
5	Request distant end to send dial pulses at 8 PPS at 64% break and 11 PPS at 58% break.
6	Measure E lead pulses
	LIMIT 1: 48-68% Break when measuring at POT
	LIMIT 2: 42-74% Break when measuring at***user network interface***or Telephone Company switch
7	Send Idle (battery on M lead), Ringing (ground on M lead) as requested by the distant end or intermediate location of the Telephone Company provided facilities.

K. Distant TERMINATING END Has Loop-Reverse battery (Protocol RV-T) or Equivalent Type Signaling

23.17 The SF operation for this signaling method is as follows:

(1) ***Idle (on-hook):*** SF tone 2600 ±5Hz at -20dBm0

(2) ***Reverse-Battery (off-hook):*** SF tone removed

STEP	PROCEDURE

1 Request the distant end to send idle signal (battery on Ring conductor and ground on Tip conductor).

2 Measure E lead resistance to ground.

LIMIT: Open (equal or greater than 20K ohms).

3 Request the distant end to send reverse battery signal (ground on the Ring conductor and battery on the Tip conductor).

4 Measure E lead resistance to ground.

LIMIT: Short (equal or less than 150 ohms).

5 Send idle (open to M lead, SF tone on), seizure (battery to M lead, SF tone off) and pulsing on M lead as requested by the distant end or intermediate location of the Telephone Company provided facilities.

L. Distant ORIGINATING END Has Loop-Reverse Battery (Protocol RV-0) or Equivalent Type Signaling.

23.18 The SF operation for this signaling method is as follows:

(1) ***Idle (on-hook):*** SF tone 2600 $\pm$5Hz at -20dBm0

(2) ***Seized (off-hook):*** SF tone removed

(3) ***Pulsing:*** SF tone 2600 $\pm$5Hz at -8dBm0 on (break)/off (make)

STEP	PROCEDURE

1 Request the distant end to send idle (Tip & Ring conductor open).

2 Measure E lead resistance to ground.

LIMIT: Open (equal or greater than 20K ohms).

3 Request the distant end to send seizure (Tip conductor connected to Ring conductor through 600 ohm resistor).

4 Measure E lead resistance to ground.

LIMIT: Short (equal or less than 150 ohms).

5 Request distant end to send dial pulses at 8 PPS at 62% break and 11 PPS at 58% break.

6 Measure E lead pulses.

STEP	PROCEDURE
	LIMIT 1: 48-68% Break when measuring at POT
	LIMIT 2: 42-74% Break when measuring at Telephone Company switch
7	Send idle (open to the M lead) or reverse battery (battery to the M lead) as requested by the distant end or intermediate location of the Telephone Company provided facilities.

TABLE A

INTERFACE PROTOCOL DESCRIPTION

CHARACTER POSITION 34 678	DEFINITION
AB ---	20Hz To & From Telephone Company Office at Interexchange Carrier POT
AC ---	20Hz To & From Telephone Company Office at End User Network Interface.
AH B--	Analog Group Frequency (SF Signaling Assumed)
AH C--	Analog Super Group Frequency (SF Signaling Assumed)
AH D--	Analog Master Group Frequency (SF Signaling Assumed)
DS 15-	Digital DS1 Rate Bit Stream Signaling
DS 27-	Digital DS4 Rate Bit Stream Signaling
DS 31-	Digital DS1C Rate Bit Stream Signaling
DS 44-	Digital DS3 Rate Bit Stream Signaling
DS 63-	Digital DS2 Rate Bit Stream Signaling
DX ---	DX Signaling at Interexchange Carrier POT
DY ---	DX Signaling at End User Network Interface

TABLE A

CONTINUED

INTERFACE PROTOCOL DESCRIPTION

CHARACTER POSITION 34 678	DEFINITION
EA E--	E/M Lead Signaling Type I (Battery on M lead at Telephone Company Office toward End User or Interexchange POT)
EA M--	E/M Lead Signaling Type I (Ground on E Lead toward End User or Interexchange POT)
EB E--	E/M Lead Signaling Type II (M and SB Leads shorted at Telephone Company Office toward End User or Interexchange Carrier POT)
EB M--	E/M Lead Signaling Type II (E and SG Leads shorted at Telephone Company Office toward End User or Interexchange Carrier POT)
EC ---	E/M Lead Signaling Type III (Ground on E Lead at Telephone Company Office toware End User or Interexchange Carrier POT)
EX A--	Tandem Channel Unit Signaling (Closed end toward station)
EX B--	Tandem Channel Unit Signaling (Open End toward Telephone Office)
GO ---	Loop Signaling -Ground Start (Closed End Toward End User Network Interface)
GS ---	Loop Signaling - Ground Start (Open end toward switch)

TABLE A

CONTINUED

INTERFACE PROTOCOL DESCRIPTION

CHARACTER POSITION 34 678	DEFINITION
LA ---	Loop Signaling _ Loop Start (Closed end toward End User Network Interface)
LB ---	Loop Signaling - Loop Start (Closed End toward End User Network Interface)
LC ---	Loop Signaling - Loop Start (Clsoed End toward station) (Closed End toward End User Network Interface) (Telephone Company provides PLR)
LS ---	Loop Signaling - Loop Start (Open End toward Switch)
RV O--	Loop - Reverse Battery Signaling (Toward Terminating End)
RV T--	Loop - Reverse Battery Signaling (Toward Originating End)
SF ---	Single Frequency Signlaing

TABLE B

REQUIRED TEST SET CAPABILITIES

CHARACTERISTIC	MEASUREMENT	SIGANL GENERATION
1. Voltage	0-100 V rms. Across REN 3 load.	
2. DC Res.	0-500k ohms	
3. Pulsing and % Break	(1) 42-74% break at 8 to 12 pps. (2) Dial Pulse Rec. Test set providing battery and ground	Dial Sender. (1)Open/Battery (M-lead) (2) Open/Close (E-lead) (3) 8 pps at 64 and 70 % Break. (4) 11 pps at 46, 52 and 58% Break.
4. Alternate DC Res.	150 ohms (4 sec) followed by 20 k ohms (2 sec) [Short ckt. (4 sec) followed by open ckt (2 sec.)]	
5. Digital signal Ch. logic.	Identify A and B signaling chan. logic as 1 or 0	Transmit over A and/or B signaling channels a logic state of 1 or 0
6. DC volts to ground	M lead voltage to ground Range = 0 to 45V DC	
7. DC current	0 to 20 milliamps	
8. Timing	Ring trip timing $\leq$200ms	
9. Ringing signal.		Send 20 Hz $\pm$3 Hz at 86v ac.

TABLE B

CONTINUED

REQUIRED TEST SET CAPABILITIES

CHARACTERISTIC	MEASUREMENT	SIGANL GENERATION
10. SF Signal		(1) 2600Hz ±5 Hz at -20 dBm0 and -8 dBm0 (2) 2600Hz ±5 Hz modulated at 20Hz rate
11. DX tests		DX test unit must include facility balancing resistance and capacitance
12. E & M Tests		4-wire type E & M lead SF unit or Equiv. test set.
13. Battery supply		Type A, B or C PBX or Co battery supply. -48V DC