

# PRELIMINARY

**Bell System Voice Communications  
TECHNICAL REFERENCE**

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**Protective  
Connecting  
Arrangements**

**TSPXY**

**TSPZI**

**Interface  
Specification**

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**March 1975**

ENGINEERING DIRECTOR – CUSTOMER EQUIPMENT SYSTEMS



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If further information is required, please contact:

Engineering Director - Customer Equipment Systems  
American Telephone and Telegraph Company  
195 Broadway  
New York, New York 10007

# TECHNICAL REFERENCE

## PROTECTIVE CONNECTING ARRANGEMENTS TSPXY AND TSPZ1

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## PRELIMINARY

### PROTECTIVE CONNECTING ARRANGEMENTS TSPXY AND TSPZ1

#### 1. GENERAL

##### 1.1 Introduction

F.C.C. tariffs and corresponding intrastate tariffs filed by the Bell System Companies provide for the electrical connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to the Bell System telecommunications network by means of a protective connecting arrangement. The connecting arrangement includes circuit elements to provide network control signaling unit functions as well as certain other network protection functions and is furnished, installed, and maintained by the Telephone Company. In addition, the tariffs require compliance by the customer-provided equipment with network protection criteria specified therein.

##### 1.2 Application

Protective Connecting Arrangements TSPXY and TSPZ1 provide means for automatically connecting customer-provided recording and/or control equipment to one-way outgoing central office trunks from Bell System PBX equipment located on the customer's premises (Fig. 1). Both of these protective connecting arrangements enable the customer-provided equipment to split the outgoing trunk in order that the station user may dial digits into customer-provided equipment before a seizure is sent to the central office. After the desired digits have been dialed, Protective Connecting Arrangement TSPZ1 can be directed to connect the PBX party to the central office after which he will obtain dial tone and dial the normal DDD number. Voltage sensing resistors are provided to allow customer-provided equipment to record the dialed number. The split condition can be re-established at any time for such purposes as call restriction if desired.

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Protective Connecting Arrangement TSPXY provides the same capability as Protective Connecting Arrangement TSPZ1 (with slightly different control signals) while providing an additional feature whereby the customer-provided equipment may dial a DDD number on behalf of the station user prior to removing the split condition.

If the customer-provided equipment is disconnected, or fails in certain detectable ways, the protective connecting arrangement provides a cut-through path to permit all outgoing calls.

### 1.3 Power Outage Provisions

Protective Connecting Arrangements TSPXY and TSPZ1 will normally be powered from the PBX power supply. If the PBX is equipped with battery reserve, the connecting arrangements will also have battery reserve. Should the power to the protective connecting arrangement fail while the PBX power continues, TSPXY and TSPZ1 will revert to a metallic cut-through condition and become transparent to outgoing calls.

Should the power fail in the customer-provided equipment while PBX power continues, the normally operated split control relay should be released by the customer-provided equipment causing the connecting arrangement to go into the metallic cut-through mode.

In either case, the customer-provided equipment should perform certain tests (described in Section 3.9) before initiating a split after power has been restored.

### 1.4 Ordering and Identification

The protective connecting arrangements described in this Technical Reference are identified by the Bell System as Uniform Service Order Codes (USOC) TSPXY and TSPZ1. When ordering this service, the customer should

specify one of these codes. One connecting arrangement should be ordered for each one-way outgoing trunk which is to be connected to the customer-provided equipment. The local Telephone Company business office or marketing representative will provide information regarding availability and rates for these services.

## 2. DESCRIPTION

### 2.1 Functions

The major functions of these protective connecting arrangements are:

- (a) To protect Telephone Company personnel and facilities from hazardous voltages which may be applied by the customer-provided equipment.
- (b) To provide isolation against longitudinal imbalance.
- (c) To provide speech transmission to and from the telecommunications network.
- (d) To provide network control signaling to the network, including dc dial pulses, on-hook, off-hook, etc.
- (e) To limit abnormally high speech and tone address signal levels from the customer-provided equipment.
- (f) To provide a means by which the customer-provided equipment can split a one-way outgoing trunk in either the idle or busy state.
- (g) To provide dial pulses from PBX stations on a dry contact basis when in the split mode.

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- (h) To provide dial pulse and TOUCH-TONE information to the customer-provided equipment by means of voltage sensing resistors in both the split and cut-through mode.
- (i) To provide a dry contact closure when the associated outgoing trunk has been seized by a station.
- (j) To provide a dry contact closure when current is flowing in the loop to the central office.
- (k) To provide a dry contact closure when the trunk is in a metallic cut-through mode.
- (l) To provide a means whereby the customer-provided equipment can seize the central office portion of the trunk for the purpose of dialing into the central office while in the split mode (TSPXY only).
- (m) To provide means whereby the customer-provided equipment can send a central office address using either dial pulses or TOUCH-TONE signals (TSPXY only).
- (n) To provide a fail safe operation such that disconnection of, or detectable failure in, customer-provided equipment causes a metallic cut-through which remains until the trouble is cleared.

2.2 Physical

Protective Connecting Arrangements TSPXY and TSPZ1 consist of wire spring relay type apparatus mounted on 23" x 4" plates for relay rack mounting (Fig. 2). Three circuits are mounted on each plate. These plates are mounted in spare or specially provided space in Bell System PBX equipment. The

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protective connecting arrangement will operate within the ambient temperature and humidity limits of the PBX.

2.3 Interface Leads

Sixteen interface leads per circuit are normally provided from Protective Connecting Arrangement TSPXY or TSPZ1 to the Interface Connecting Block for the customer's use (Figs. 1 and 3). Technical information pertaining to these leads is discussed in Section 4. The customer-provided equipment is not required to use all of the available leads or functions.

The leads and their functions are as follows:

<u>Lead Designation</u>	<u>Functions</u>
CT) CR	Voice and TOUCH-TONE signals from a PBX station, transmission of voice and/or tone to a PBX station, dial tone from the central office, and tone signaling to the central office
CFW	Used in conjunction with CSP to seize the central office when in the split mode
CSP	Used in conjunction with CG to effect a split or cut-through condition
CPL	Used in conjunction with CG to send dial pulses to the central office
CG	Common ground for CSP and CPL
CTS1) CTS2	Trunk seizure by calling party
CDP1) CDP2	Seizure and dial pulses from calling party before cut-through
CCO1) CCO2	Central office loop current indicator

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CCT1 ) CCT2 )	Verification of cut-through
CDPT ) CDPR )	Voltage sensing for dial pulse or TOUCH-TONE detection before and after cut-through

Leads from these protective connecting arrangements will be terminated on Telephone Company-provided Interface Connecting Blocks conveniently located to permit testing, maintenance, trouble isolation, and ease of connection to the customer-provided equipment. In no case will this location be more than 50 feet from the interconnecting unit itself. The customer must provide and install the conductors necessary for the connection of his equipment to the connecting arrangement at this block.

A typical Interface Connecting Block is shown in Fig. 3. This "quick connect" type "66" connecting block utilizes tin plated spring clip terminal strips which accommodate unstripped, insulated conductors of 20 to 26 gauge. A Reliable Electric R714B Tool or equivalent is used to press the insulated wire down into the slot. The spring pressure of the clip cuts away the insulation and makes the electrical connection. The Telephone Company will provide bridging clips between the second and third terminals of the block to interconnect the leads. The clips should be removed by the customer's representative when it is necessary to test toward the customer-provided equipment and then be replaced to restore the circuit to service.

### 3. OPERATION

#### 3.1 Idle Condition

The trunk must be held in the split mode by the customer equipment in the idle condition. The split should be accomplished by a relay in the customer-provided equipment which has a normally open contact wired between CSP and

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CG of the interface. The relay should be operated in the idle condition to close CSP to CG splitting the trunk. The intent of this operation is to provide an arrangement which will release the split condition in the event that the customer-provided equipment is disconnected or experiences a power failure. Closure in the idle condition also prevents sending false seizures to the central office. The pulsing pair CPL and CG must also be closed in the idle condition.\*

When the above connections are made, the following conditions will exist on the signal leads to and from the customer-provided equipment. (Direction of each signal is not given, but meaning should be obvious from Figure 4.)

CT)		CDP1)	
CR)	not connected	CDP2)	open
CFW)		CCO1)	
CSP)	open	CCO2)	open
CSP)		CCT1)	
CG)	closed	CCT2)	open
CPL)		CDPT)	not connected to tip
CG)	closed*	CDPR)	and ring
CTS1)			
CTS2)	open		

### 3.2 Trunk Seized by PBX Station

A station user seizes the associated one-way outgoing trunk by dialing one or two digits in the normal manner. At the time of seizure, the following signals are provided at the interface connecting block.

CT)	connected to PBX station	CDP1)	
CR)	via associated trunk for	CDP2)	closed upon seizure
	voice or tone transmission		
CFW)		CCO1)	
CSP)	open	CCO2)	open

\*TSPXY only - must be open on TSPZL

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CSP) CG)	closed	CCT1) CCT2)	open
CPL) CG)	closed*	CDPT) CDPR)	connected to tip and ring
CTS1) CTS2)	closed upon seizure		

At this point the customer-provided equipment should provide an announcement or tone on the CT-CR leads as an indication that dialing into the customer-provided equipment should now commence.

3.3 Station User Dials Into Customer-Provided Equipment

The station user can now dial as many digits as required by the customer-provided equipment. When the station is equipped with a rotary dial, the dial pulses will appear as momentary open signals on the CDP1-CDP2 contact at the interface connecting block. When TOUCH-TONE is used, the signals will appear at the CT-CR leads. In addition, both dial pulse and TOUCH-TONE signals will also appear, via 100k ohm resistors, on leads CDPT and CDPR. While the station user is dialing into the customer-provided equipment, the signals at the interface connecting block are as follows:

CT) CR)	connected to PBX station via associated trunk for TOUCH-TONE signals when used	CDP1) CDP2)	one momentary open for each pulse in dial pulse train
CFW) CSP)	open	CCO1) CCO2)	open
CSP) CG)	closed	CCT1) CCT2)	open
CPL) CG)	closed*	CDPT) CDPR)	connected to tip and ring for TOUCH-TONE or dial pulse detection
CTS1) CTS2)	closed indicating seizure		

\*TSPXY only - must be open on TSPZ1

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3.4 Cut-Through After Dialing Into Customer-Provided Equipment - TSPZ1 Only

When the customer-provided equipment has received the required digits, the calling station user can be cut-through to the central office. Once cut-through, the station user will obtain dial tone from the central office and dial the DDD number in the usual way. The station is cut-through by opening the closure between CSP and CG at the interface connecting block. The ground start function will take place automatically and the split will be removed immediately after current begins to flow in the loop to the central office. After cut-through is complete, the following signals will appear at the interface connecting block.

CT CR	) not connected	CDP1, CDP2	) open
CFW, CSP	) open	CCO1, CCO2	) closed indicating central office loop current
CSP, CG	) open	CCT1, CCT2	) closed indicating trunk is cut-through
CPL, CG	) closed*	CDPT, CDPR	) connected to tip and ring
CTS1, CTS2	) closed indicating seizure		

3.5 Station User Dials Into the Central Office

As the station user dials into the central office, the address signals can be detected via the 100k ohm resistors connected to the tip and ring (CDPT and CDPR). Dial pulses will not be available on CDP1 and CDP2 at this time since that contact is open while in the cut-through mode. CT and CR are also open when in the cut-through mode. The signals available at the interface connecting block as dialing proceeds are as follows:

\*TSPXY only - must be open for TSPZ1

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CT) CR	not connected	CDP1) CDP2)	open
CFW) CSP	open	CC01 CC02	closed indicating central office loop current
CSP) CG	open	CCT1) CCT2	closed indicating trunk is cut-through
CPL) CG	closed*	CDPT) CDPR	TOUCH-TONE or dial pulse address signals via 100k ohm resistor
CTS1) CTS2	closed indicating seizure		

3.6 Customer-Provided Equipment Dials Into the Central Office - TSPXY Only

After receiving the required information from the calling station, the customer-provided equipment can seize the central office and send dial pulse or TOUCH-TONE address signals before removing the split condition. To do this, the customer-provided equipment must follow a prescribed sequence:

- (a) The seizure is initiated by the customer-provided equipment closing CFW to CSP. This closure can be either momentary (50 ms minimum) or continuous until the circuit is released. The closure initiates a ground start sequence into the central office.
- (b) When the ground start sequence is complete, current will flow in the central office loop. This is indicated at the interface connecting block by a closure between CC01 and CC02. At this time the CT

\*TSPXY only - must be open for TSPZ1

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and CR connection will be transferred from the PBX station to the central office loop. CT and CR then provide the required connection for both central office dial tone detection and subsequent sending of TOUCH-TONE address signals.

- (c) After detecting both loop current (CCO1 and CCO2 closed) and dial tone (CT and CR), the customer-provided equipment can send an address to the central office. If TOUCH-TONE sending is used, the tones are connected to the CT-CR leads of the interface connecting block. If dial pulses are used, they are sent by opening the normally closed connection between CPL and CG once for each dial pulse. (See Figure 5).
- (d) After sending, the split condition must be removed by opening the closure between CSP and CG. When this is done, the station will be cut-through to the central office. A verification of the cut-through condition will be indicated by a closure on CCT1 and CCT2.
- (e) After sending and cut-through are complete, the signals at the interface connecting block will be as follows:

CT )		CDP1 )	
CR )	not connected	CDP2 )	open
CFW )	closed or open after	CCO1 )	closed indicating central
CSP )	momentary (50 ms minimum)	CCO2 )	office loop current
	closure		
CSP )		CCT1 )	closed indicating trunk
CG )	open	CCT2 )	is cut-through

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CPL) CDPT) connected to tip and ring  
CG) closed\* CDPR) via 100K ohm resistors

CTS1)  
CTS2) closed indicating seizure

The closure between CFW and CSP can be opened any time before CSP-CG is closed again by the customer-provided equipment.

3.7 Cut-Through After Dialing Into Customer-Provided Equipment - TSPXY Only

If TSPXY is used, and it is desired to cut the station through to the central office rather than send an address on a particular call, this can be done by following the procedure of paragraph 3.6, omitting the address part of step (c), and going to step (d).

3.8 Disconnect

If either the calling (PBX) or called (central office) parties disconnect\*\*, it will be indicated by an open on the CTS1 and CTS2 leads of the interface connecting block. At this point, the customer-provided equipment should remove the forward seizure closure between CFW and CSP if not already open. This closure can be removed any time after 50 milliseconds and must be removed before the trunk can be split again. Following the removal of the CFW-CSP closure, the customer can resplit the trunk in anticipation of the next call by connecting CSP to CG. The trunk is now back to the idle state as described in paragraph 3.1.

After disconnect, the signals at the interface connecting block are as follows:

CT) CTS1)  
CR) not connected CTS2) open

\*TSPXY only - must be open for TSPZ1

\*\*Disconnect signals are not always available from the central office.

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CFW ) CSP )	open	CC01 ) CC02 )	open
CSP ) CG )	closed	CCT1 ) CCT2 )	open
CPL ) CG )	closed*	CDPT ) CDPR )	open
CTS1 ) CTS2 )	open		

### 3.9 Power Failure

Should power to either the protective connecting arrangement or the customer-provided equipment fail, the TSPXY or TSPZ1 will automatically cut-through regardless of what state it might have been in. The arrangement will remain cut-through until power is restored. At the time power is restored, the customer-provided equipment should check each circuit for a call in progress before re-establishing the split condition. Whenever a call is in progress, central office loop current will be flowing and CC01 will be closed to CC02. The connecting equipment should, therefore, wait until CC01 and CC02 are open before re-establishing the split condition to avoid disconnecting an existing call.

## 4. SPECIFIC DESIGN CONSIDERATIONS

### 4.1 Transmission Path (Leads CT and CR)

#### 4.1.1 Insertion Loss

The insertion loss of Protective Connecting Arrangement TSPXY or TSPZ1 is a nominal 1 dB over the voice frequency range 300 to 3000 Hz in each direction when in the split mode. No voice amplification is provided. When cut-through, there is essentially no loss in this circuit.

\*TSPXY only - must be open for TSPZ1

#### 4.12 Impedance

Protective Connecting Arrangement TSPXY or TSPZ1 is transformer-coupled to CT and CR. The input impedance at this point is a function of the impedance of the line to the PBX station or to the central office. For design purposes, the input impedance of this arrangement should be considered to be 600 ohms. Therefore, the impedance of the customer-provided equipment should be 600 ohms for optimal speech transmission performance.

#### 4.13 Bandwidth

The nominal voice-frequency bandwidth of the telecommunications network extends from about 300 to about 3000 Hz. In general, an end-to-end connection may be expected to have a loss characteristic which increases on either side of this band. This protective connecting arrangement does not limit the bandwidth.

#### 4.14 Signal Power Levels

The tariffs state that the average power (in any 3-second interval) delivered at the central office should not exceed -12 dBm in order to prevent excessive noise and crosstalk from interfering with other services. To meet this specification for voice-only applications using Protective Connecting Arrangement TSPXY, the maximum available power from a customer-provided source when averaged over any 3-second interval (measured at the CT and CR leads with a 600 ohm load substituted for the connecting arrangement) should not exceed -9 dBm. This limit has been set so that when the average loss of PBX trunks in the Bell System is considered (including the insertion loss of the connecting arrangement), the limit of -12 dBm will be met.

Using measuring Method A (see Paragraph 4.15), the maximum power averaged over any 3-second interval, can, in almost all cases, be found by subtracting 93 dB from the maximum meter swing. With the additional damping of measuring Method B, the power averaged over any 3-second interval can be found by using a 91 dB correction for speech.

4.15 Measuring Maximum Available Inband Power

The measuring methods described below are satisfactory for estimating the maximum power averaged over a 3-second interval to determine that the inband signal power criteria specified in Paragraph 4.14 are being met.

Method A

Operate the customer-provided equipment into a 600 ohm load (this assumes that the customer-provided equipment has a 600 ohm source impedance), bridged by a Hewlett-Packard Transmission and Noise Measuring Set - Model 3555B, or a Western Electric 3-Type Noise Measuring Set, or the equivalent.\* To insure a proper measurement technique, the control settings on these meters should be as shown below.

<u>Western Electric 3-Type Noise Measuring Set</u>		<u>Hewlett-Packard Transmission and Noise Measuring Set Model 3555B</u>	
<u>Control</u>	<u>Setting</u>	<u>Control</u>	<u>Setting</u>
FUNCTION (Switch)	BRDG	INPUT (Switch)	NOISE/BRDG
NORM/DAMP (Switch)	DAMP	FUNCTION (Pushbutton)	VF/Nm-600 BAL
WTG (Plug-in Network)	3Kc FLAT	NOISE WTG (Switch)	3k Hz FLAT
		NORM/DAMP (Switch)	DAMP

Method B

The accuracy of Method A can be somewhat improved by increasing the size of the damping capacitance in the Western Electric 3-Type Noise Meter

\*These meters do not have a 3-second averaging time but, when used to measure speech, they give a reliable estimate of a 3-second average. The use of meters with shorter time constants, such as VU meters or standard voltmeters, is not recommended.

by 150 microfarads. To do this, connect the negative lead of a 150 microfarad capacitor to either terminal of the NORM/DAMP switch and connect the positive lead to ground. This allows the meter to more nearly approximate a 3-second averaging meter. (NOTE: This modification does not necessarily hold for the Model 3555B or noise meters other than the Western Electric 3-Type.)

#### 4.16 Signal Power Distribution

The telecommunications network incorporates tone signaling devices that are used for network control functions. These devices, which are connected at all times to the telephone circuit, are designed to detect a single-frequency tone at 2600 Hz. They are, however, relatively insensitive to energy at this frequency if sufficient energy is present at the same time at other frequencies in the voiceband.

In order to prevent the interruption or disconnection of a call, or interference with network control signaling, it is necessary that the signal applied by the customer-provided equipment to the protective connecting arrangement at no time have energy solely in the 2450 to 2750 Hz band. If signal power is in the 2450 to 2750 Hz band, it must not exceed the power present at the same time in the 800 to 2450 Hz band.

#### 4.17 Out-of-Band Signal Power Limits

To protect other services, it is necessary that the signal which is applied by the customer-provided equipment to the Telephone Company interface, located on the customer's premises, meet the following limits:

- (a) The power in the band from 3995 Hz to 4005 Hz shall be at least 18 dB below the signal level specified in Paragraph 4.14.

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- (b) The power in the band from 4005 Hz to 10,000 Hz shall not exceed 16 dB below one milliwatt.
- (c) The power in the band from 10,000 Hz to 25,000 Hz shall not exceed 24 dB below one milliwatt.
- (d) The power in the band from 25,000 Hz to 40,000 Hz shall not exceed 36 dB below one milliwatt.
- (e) The power in the band above 40,000 Hz shall not exceed 50 dB below one milliwatt.

4.18 Signal Limiting

A voice signal limiter is incorporated in the transmission path CT-CR to protect the telecommunications network from applications of abnormally high signal levels. This has no effect on normal voice or normal tone address signals.

When in the cut-through mode, there is essentially no loss in the protective connecting arrangement.

4.19 Tone Address Signaling

When TOUCH-TONE service has been ordered by the customer, Protective Connecting Arrangement TSPXY permits customer-provided tone address signals to be transmitted to the central office TOUCH-TONE for network address signaling. The signaling code for the Bell System TOUCH-TONE calling system provides for 16 distinct signals. Each signal is composed of two voiceband frequencies, one from each of two mutually exclusive frequency groups of four frequencies each. The signal frequencies are spaced and selected on the basis that the two frequencies of any valid signal combination are not harmonically related. The frequency pairs assigned for the signaling are as follows:

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		<u>Nominal High Group Frequencies (Hz)</u>			
		<u>1209</u>	<u>1336</u>	<u>1477</u>	<u>1633</u>
<u>Nominal</u>	<u>697</u>	1	2	3	Spare
<u>Low Group</u>	<u>770</u>	4	5	6	Spare
<u>Frequencies</u>	<u>852</u>	7	8	9	Spare
<u>(Hz)</u>	<u>941</u>	*	0	#	Spare

In order for the central office receiver to properly register the digits, the tone address signals shall meet the following requirements (measured by the customer into a 600 ohm test termination on the CT and CR leads at the interface):

1. Signal Levels

Nominal level per frequency: -6 to -4 dBm

Minimum level per frequency ( Low Group: -10 dBm  
High Group: - 8 dBm

Maximum difference in levels between frequencies: 4 dB

Maximum level per frequency pair: +2 dBm

2. Frequency Deviation

Tone frequencies should be within +1.5 percent of their nominal values.

3. Extraneous Frequency Components

The total power of all extraneous frequencies accompanying the signal should be at least 20 dB below the signal power, in the voiceband above 500 Hz.

4. Voice Suppression

Voice energy from the telephone transmitter or other source should be suppressed (e.g. the transmitter should be muted) at least 45 dB during tone signal transmission. In the case

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of automatic dialing, the suppression should be maintained continuously until pulsing is completed. Protective Connecting Arrangement TSPXY holds the calling telephone when connected equipment is sending address information to the central office.

5. Rise Time

Each of the two frequencies of the signal should attain at least 90 percent of full amplitude within 5 ms, and preferably within 3 ms for automatic dialers, from the time that the first frequency begins.

6. Pulsing Rate

Minimum duration of  
two-frequency tone signal: 50 ms

Minimum interdigital time: 45 ms

Minimum cycle time (period): 100 ms

7. Tone Leak

Tone leak during signal off time should be less than -55 dBm.

8. Transient Voltages

Peak transient voltages generated during tone signaling should be no greater than 12 dB above the zero-to-peak voltages of the composite two-frequency tone signal.

4.2 DC Signaling Paths

4.21 Split Control (CSP, CG)

Connecting CSP (customer split) to CG (customer ground) places the protective connecting arrangement in a split mode. In order to provide fail safe operation, CSP should be connected to CG by means of a normally open relay contact or equivalent. To split the trunk, the relay would be operated connecting CSP to CG. Should power fail in the customer-provided equipment, the contact would open causing the trunk to revert to the cut-through mode.

In order to prevent false seizures of the serving central office, the connecting arrangement should be held in the split mode when idle. The range of the CSP-CG connection is 50 ohms. As shown in Figure 4, CSP provides an operate path for a relay of approximately 1300 ohms connected to -48 volts.

#### 4.22 Seizure (CTS1, CTS2)

CTS1 (customer trunk seizure) is connected to CTS2 when the trunk associated with this interface is seized by the calling party. This contact remains closed until the calling party releases the associated trunk. Connecting equipment should limit the load on these contacts to a maximum of 500 milliamperes.

#### 4.23 Seizure and Dial Pulsing (CDP1, CDP2)

CDP1 (customer dial pulse) and CDP2 close upon seizure and open momentarily for each dial pulse transmitted to the customer-provided equipment while in the split mode only. After cut-through, the CDP1-CDP2 contact will open. The dial pulse rate will be in the 8 to 11 pulses per second range with 50% to 70% break when dialed by a local station. The load on CDP1 and CDP2 should be limited to 500 milliamperes.

#### 4.24 Forward Seizure (CFW, CSP)

When TSPXY is provided, the customer's equipment must seize the central office and at least obtain dial tone before releasing the split. Assuming CG is connected to CSP to perform a split, the customer's equipment seizes the central office by connecting CFW (customer forward seizure) to CSP. This causes the protective connecting arrangement to begin the ground start sequence into the central office. Since the FW relay shown in Figure 4 has

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a locking path, the CFW to CSP closure can be removed after approximately 50 milliseconds. Operation of the forward seizure also causes the voice connection (CT and CR) to transfer from the calling side to the central office side of the connection. When dial tone is returned, it will appear at CT and CR. (In most but not all cases, dial tone is concurrent with central office loop current indicated by CC01 and CC02.) The range of the CFW to CSP connection is 50 ohms.

### 4.25 Central Office Loop Current (CC01, CC02)

The existence of central office loop current is indicated by a closure between CC01 (customer central office) and CC02. Central office loop current in most, but not all, cases indicates a readiness to receive address information. Pulsing should not begin however until both dial tone (CT and CR) and loop current are present. Address information can be sent by either TOUCH-TONE (paragraph 4.19) or dial pulse sending (paragraph 4.26). The load on CC01 and CC02 should be limited to 500 milliamperes.

### 4.26 Dial Pulse Sending (CPL, CG)

Customer-provided equipment can send an address to the central office when TSPXY is provided. This information is sent by connecting CPL (customer pulsing) to CG in the idle state and opening it momentarily for each dial pulse. Limits on dial pulse signals are shown in Figure 5. The range of the CPL connection to CG is 50 ohms.

### 4.27 Cut-Through Indication (CCT1, CCT2)

To verify that the protective connecting arrangement has cut-through, CCT1 (customer cut-through) will be connected to CCT2 whenever the connecting arrangement is in a cut-through condition. The load on CCT1 and CCT2 should be limited to 500 milliamperes.

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### 4.28 High Impedance Voltage Sensing (CDPT, CDPR)

When seized by a calling party, CDPT (customer dial pulse - tip) and CDPR (customer dial pulse - ring) are connected to the tip and ring through 100k ohm resistors. This connection can be used to record dial pulses before and after cut-through. Details on the characteristics of these signals and the specifications for connecting circuits are contained in the Technical Reference for Voice Connecting Arrangement HZM (PUB 42606). If the connecting equipment is located remote to the PBX, cable capacitance may be high enough to prevent using the 100k ohm resistors in TSPXY and TSPZ1. In this case additional HZM resistors should be ordered and located near the connecting equipment. The separate HZM connection will be ordered as a separate item and connected to the tip and ring between the outgoing trunk circuit and the TSPXY or TSPZ1 equipment.

### 4.3 Grounding

Protective Connecting Arrangements TSPXY and TSPZ1 are provided with a common signal ground (a metallic cold water pipe or other approved ground) which is always bonded to the electric power ground and telephone protector ground, where present. Although the CG lead is grounded at the protective connecting arrangement, it is not permitted to use this lead to derive the main ground for the customer's equipment. The general grounding requirements for the customer-provided equipment are covered in Paragraph 5.3.

## 5. GENERAL DESIGN CONSIDERATIONS

### 5.1 Foreign and Surge Voltage Protection

Where telephone lines are exposed to power line contact, lightning exposure, power line induction or a rise in ground potential exceeding 300

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volts RMS, protective devices are installed at the central office and on the customer's premises that will provide a path to ground for foreign voltages that exceed about 600 volts peak.

The manufacturer is responsible for designing his equipment and facilities in such a way that foreign and hazardous voltages from his equipment and facilities are not applied to the protective connecting arrangement.

### 5.2 Telecommunications Network Characteristics

#### 5.21 End-to-End Electrical Loss

The end-to-end electrical loss of a connection is a function of the impedances of both end terminations and the losses of the interoffice trunks, the serving central office, and the facilities to the serving offices. The information found in the REFERENCES in Appendix B may be used to determine statistical loss distributions for different types of calling patterns on the telephone network.

#### 5.22 Nonlinearities

Nonlinearities such as compression, clipping, phase shift, and harmonic distortion can exist on the telecommunications network. Normally, these are insignificant for speech transmission. It is expected that harmonic distortions will result in single tones which are no greater than about 5% of the fundamental.

### 5.3 Grounding

It is expected that the customer's equipment, if powered from commercial power, will be grounded in accordance with applicable electrical codes e.g., National Electrical Codes (NEC), and should be bonded to the ground electrode

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to which the telephone protector is grounded but not using the telephone ground clamp. Self-powered or passive customer's equipment need not be grounded. Provisions should be made within the customer's equipment for connecting together all internal signal grounds. This connection shall be isolated from both the grounding (green) conductor run with the power supply primary conductors and the chassis or frame of the customer-provided equipment.

The customer's signal ground may be obtained with a proper connection to a metallic cold water pipe, using a single No. 14 AWG, or larger, copper conductor. The other end should be connected to the ground return terminal of the customer's equipment. Proper attention should be given to provide the lowest possible resistance connection at each end of the circuit. It is imperative that this ground be connected at the same location to the water piping system as the telephone protector or signal ground but not using the telephone ground clamp. This lead shall not be fused.

6. SERVICE RESPONSIBILITIES

6.1 Responsibility of the Manufacturer

The manufacturer of the terminal equipment is responsible for the following:

- a) Informing the purchaser as to which protective connecting arrangement his equipment has been designed to work with.
- b) Advising the purchaser to order these protective connecting arrangements by code TSPXY or TSPZ1 from the Telephone Company.

- c) Providing information to the purchaser that specifies installation, operational, routine maintenance, and repair procedures which, if properly employed by the purchaser, will assure compliance with this Technical Reference.
- d) All patent or other liability arising out of the use, offering or distribution of such equipment by or to them.

## 6.2 Responsibility of the Customer

The tariffs regulating the connection of customer-provided terminal equipment or communications systems through connecting arrangements to the telecommunications network state that the operating characteristics of such equipment or systems shall be such as not to interfere with any of the services offered by the Telephone Company. Such use is subject to the further provisions that the equipment or systems provided by a customer do not endanger the safety of Telephone Company employees or the public; damage, require change in or alteration of, the equipment or systems or other facilities of the Telephone Company; interfere with the proper functioning of such equipment or systems or facilities; impair the operation of the telecommunications network or otherwise injure the public in its use of the Telephone Company's services. Upon notice from the Telephone Company that the equipment or system provided by a customer is causing or is likely to cause such hazard or interference, the customer shall take such steps as shall be necessary to remove or prevent such hazard or interference.

The customer desiring to use customer-provided equipment is responsible for the following:

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- a) Informing the Telephone Company of his intention to use such equipment and ordering the protective connecting arrangement by code TSPXY or TSPZL.
- b) Connecting the equipment to the interface connecting block.
- c) Assuring that the equipment in use continues to comply with all the requirements of the applicable tariffs and this Technical Reference.
- d) Following the installation, operational, routine maintenance and repair procedures specified by the manufacturer.
- e) Removing the equipment from use if the customer detects that it is defective or if the Telephone Company notifies the customer that the equipment is causing a hazard or interference as specified above.

6.3 Responsibility of the Telephone Company

The Telephone Company shall not be responsible for the installation, operation, or maintenance of any customer-provided terminal equipment devices. Long distance message telecommunications service is not represented as adapted to the use of customer-provided equipment and where such equipment is connected to Telephone Company equipment or facilities, the responsibility of the Telephone Company shall be limited to the furnishing of facilities suitable for telecommunications service and to the maintenance and operation of such facilities in a manner proper for such telecommunications services. Subject

to this responsibility the Telephone Company shall not be responsible for (1) the through transmission of signals generated by the customer-provided equipment or for the quality of, or defects in, such transmission, (2) the reception of signals by customer-provided equipment, or (3) address signaling where such signaling is performed by customer-provided tone-type signaling equipment.

The Telephone Company shall not be responsible to the customer or otherwise if changes in minimum network protection criteria contained in the tariffs and the technical specifications in this Technical Reference, or in any of the facilities, operations, or procedures of the Telephone Company render any customer-provided equipment obsolete or require modification or alteration of such equipment or otherwise affect its use or performance.

7. MAINTENANCE OF SERVICE

Maintenance of equipment supplied by the Telephone Company shall be done only by the Telephone Company.

When trouble is experienced with this service, the customer should disconnect the terminal equipment to determine whether the service impairment is located in the customer-provided equipment or in the equipment provided by the Telephone Company. If the terminal equipment is determined to be defective, the customer shall immediately discontinue its use until such time as the customer has it repaired. If the tests indicate that the trouble is in the Telephone Company-provided equipment, a trouble report should be promptly referred to the Telephone Company's "Repair Service" whose number

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can be found in the front of the telephone directory. The repair attendant should be given:

- A. Customer's name
- B. Customer's address
- C. Listed telephone number
- D. Location and telephone number of the location if different
- E. Uniform Service Order Code (USOC) TSPXY or TSPZ1
- F. Nature of trouble
- G. Customer's contact for additional information

The customer shall be responsible for the payment of a service charge for visits by the Telephone Company to the customer's premises where the service difficulty or trouble report results from the use of a customer-provided equipment.

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APPENDIX A

GLOSSARY

ADDRESS SIGNALS - denotes dc dial pulses or appropriate pairs of tone signals transmitted to a central office that represent the telephone number of the distant party.

COMMUNICATIONS SYSTEM - denotes channels and other facilities which are capable, when not connected to the Long Distance Message Telecommunications Service, of communications between customer-provided terminal equipment or Telephone Company stations.

CUSTOMER - the term "Customer" denotes the person, firm or corporation which orders service and is responsible for the payment of charges and compliance with Telephone Company regulations.

CUSTOMER-PROVIDED TERMINAL EQUIPMENT - denotes devices or apparatus and their associated wiring, provided by a customer, which do not constitute a communications system and which, when connected to the communications path of the telecommunications network, are so connected either electrically, acoustically, or inductively.

DIAL PULSE RATE - repetition of pulses for switching purposes, usually expressed in pulses-per-second.

INTERDIGITAL TIMING - the minimum time required between digits for the switching equipment to respond to the last digit received and ready itself for receiving the next digit.

INTERFACE CONNECTING BLOCK - the Telephone Company-provided connecting point to which the customer brings and connects the leads of his equipment and to which the Telephone Company brings and connects leads from the protective connecting arrangement.

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NETWORK CONTROL SIGNALING - denotes the transmission of signals used in the telecommunications network which perform functions such as supervision (control, status, and charging signals), address signaling (dialing), calling and called number identification, audible tone signals (call progress signals indicating reorder or busy conditions, alerting, coin denominations, coin collect and coin return tones) to control the operation of switching machines in the telecommunications network.

NETWORK CONTROL SIGNALING UNIT - denotes the terminal equipment furnished, installed, and maintained by the Telephone Company for the performance of network control signaling. (See Note below.)

OFF-HOOK SUPERVISION - the conditioning of the interface leads by the customer-provided equipment which indicates that it is answering or originating a call.

ON-HOOK SUPERVISION - the conditioning of the interface leads by the customer-provided equipment which indicates that it has disconnected and is idle.

PERCENT BREAK - the period of time of an open interval in a dial pulse sequence compared to the total time of an open and closed interval, expressed as a percentage.

PROTECTIVE CONNECTING ARRANGEMENT - protective equipment provided by the Telephone Company to accomplish the electrical connection of customer-provided equipment with the telecommunications network. It is designed to transmit speech signals as contrasted to one designed to transmit data signals.

NOTE: Under the tariff regulations, the terms "connecting arrangement" and "network control signaling unit" are separate and distinct from each other; however, the term "connecting arrangement" is generally used to include the functions of network control signaling.

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SUPERVISORY SIGNALS - signals used to initiate a request for service by the calling party (off-hook); to notify the called party that he is being called (ringing); to indicate an answered call (off-hook); to indicate a disconnect (on-hook); and to recall an operation or distant party to a connection (switchhook flash).

TELECOMMUNICATIONS NETWORK - central office switching equipment, associated interoffice and intraoffice facilities, and terminal equipment which provide Long Distance Message Telecommunications Service or private line service.

TELEPHONE COMPANY - denotes the American Telephone and Telegraph Company, the Long Lines Department, its concurring carriers, and its connecting carriers, either individually or collectively.

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APPENDIX B

REFERENCES

Some references describing various transmission characteristics of the telecommunications network are listed below:

- \*(a) McAdoo, K. L., "Speech Volumes on Bell System Message Circuits - 1960 Survey," Bell System Technical Journal (BSTJ), Vol. 42, No. 5 (September 1963), p. 1999.
- \*(b) Gresh, P. A., "Physical and Transmission Characteristics of Customer Loop Plant," BSTJ, Vol. 48, No. 10 (December 1969), p. 3337.
- \*(c) Breen, C., and Dahlbom, C. A., "Signaling Systems for the Control of Telephone Switching," BSTJ, Vol. 39, No. 6 (November 1960), p. 1381.
- \*(d) Bodle, D. W., and Gresh, P. A., "Lightning Surges in Paired Telephone Cable Facilities," BSTJ, Vol. 40, No. 2 (March 1961), p. 547.
- \*\* (e) Bell System Data Communications Technical Reference - PUB 41007 - 1969-1970 Switched Telecommunications Network Connection Survey (Reprints of Bell System Technical Journal articles) - April, 1971.
- \*\* (f) Bell System Data Communications Technical Reference - PUB 41008 - Analog Parameters Affecting Voiceband Data Transmission - Description of Parameters - October 1971.
- \*\*\* (g) "Principles of Electricity Applied to Telephone and Telegraph Work," by American Telephone and Telegraph Company, New York, New York.

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\*\*\*(h) "Switching Systems," by American Telephone and Telegraph Company, New York, New York.

(i) "Notes on Transmission Engineering," by United States Independent Telephone Association, Washington, D. C.

\*\*\*(j) "Notes on Distance Dialing - 1975," by American Telephone and Telegraph Company, New York, New York.

\*\*\*(k) "Transmission Systems for Communications," by Bell Telephone Laboratories, Inc.

\*These journals may be purchased by writing to:

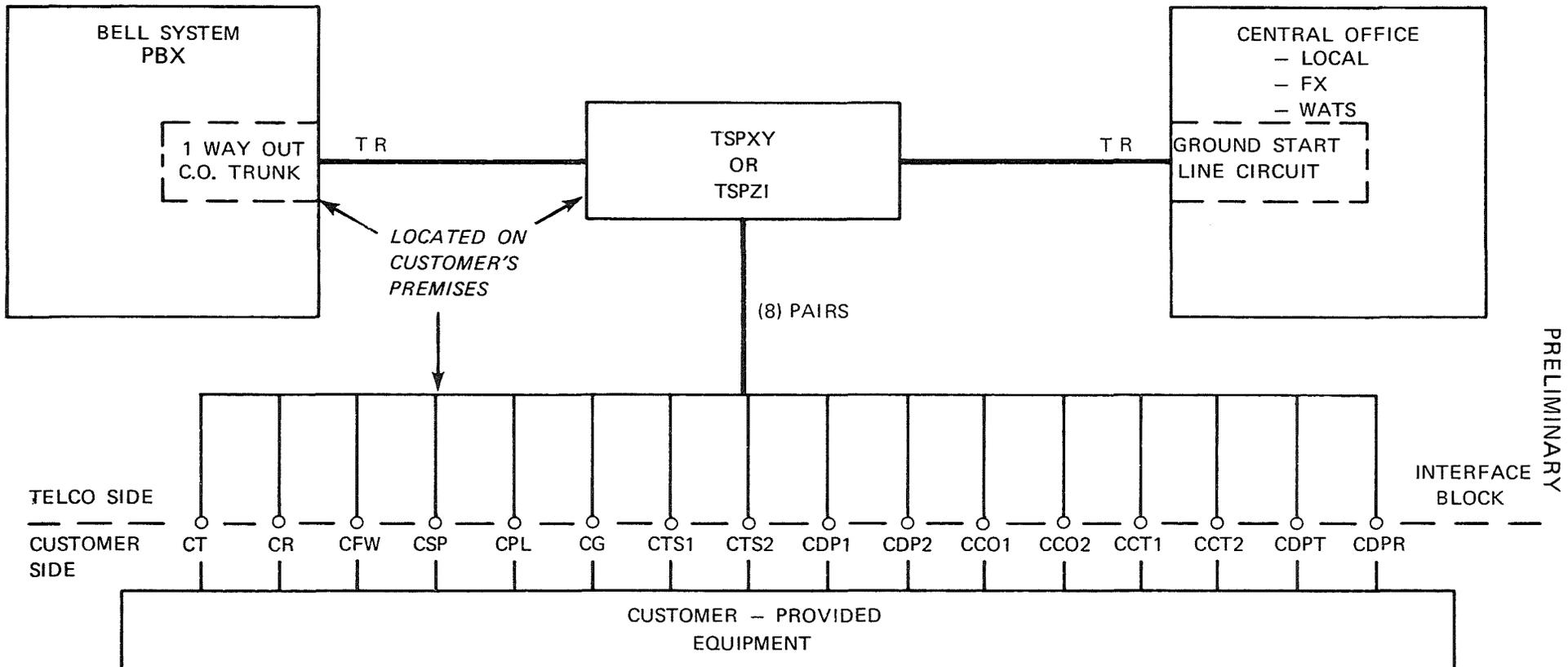
Bell Telephone Laboratories, Inc.  
Circulation Supervisor  
Mountain Avenue, Room 3C109  
Murray Hill, New Jersey 07974

\*\*These references may be purchased by writing to:

American Telephone and Telegraph Company  
Supervisor - Information Distribution Center  
195 Broadway, Room 208  
New York, New York 10007

\*\*\*These publications may be purchased by writing to:

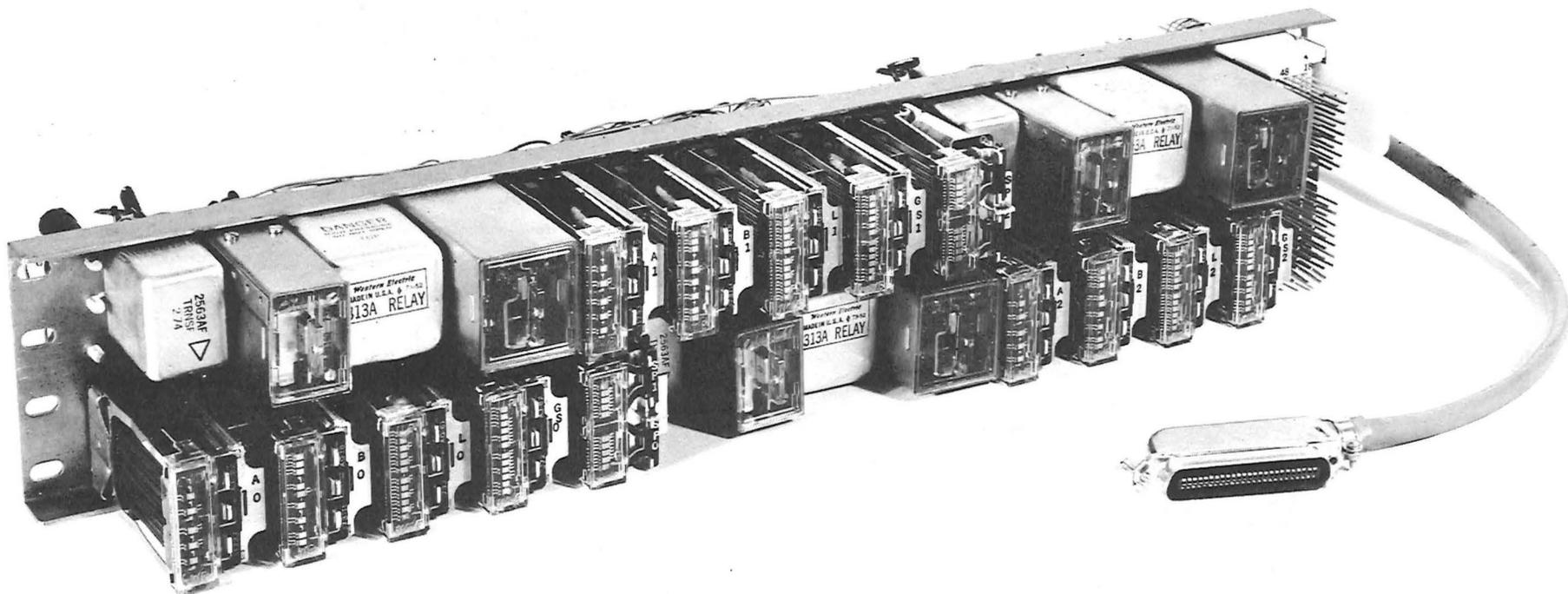
Western Electric Company, Inc.  
Commercial Relations  
P. O. Box 1579  
Newark, New Jersey 07102



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**BLOCK DIAGRAM  
PROTECTIVE CONNECTING ARRANGEMENT TSPXY OR TSPZI**

**FIGURE 1**

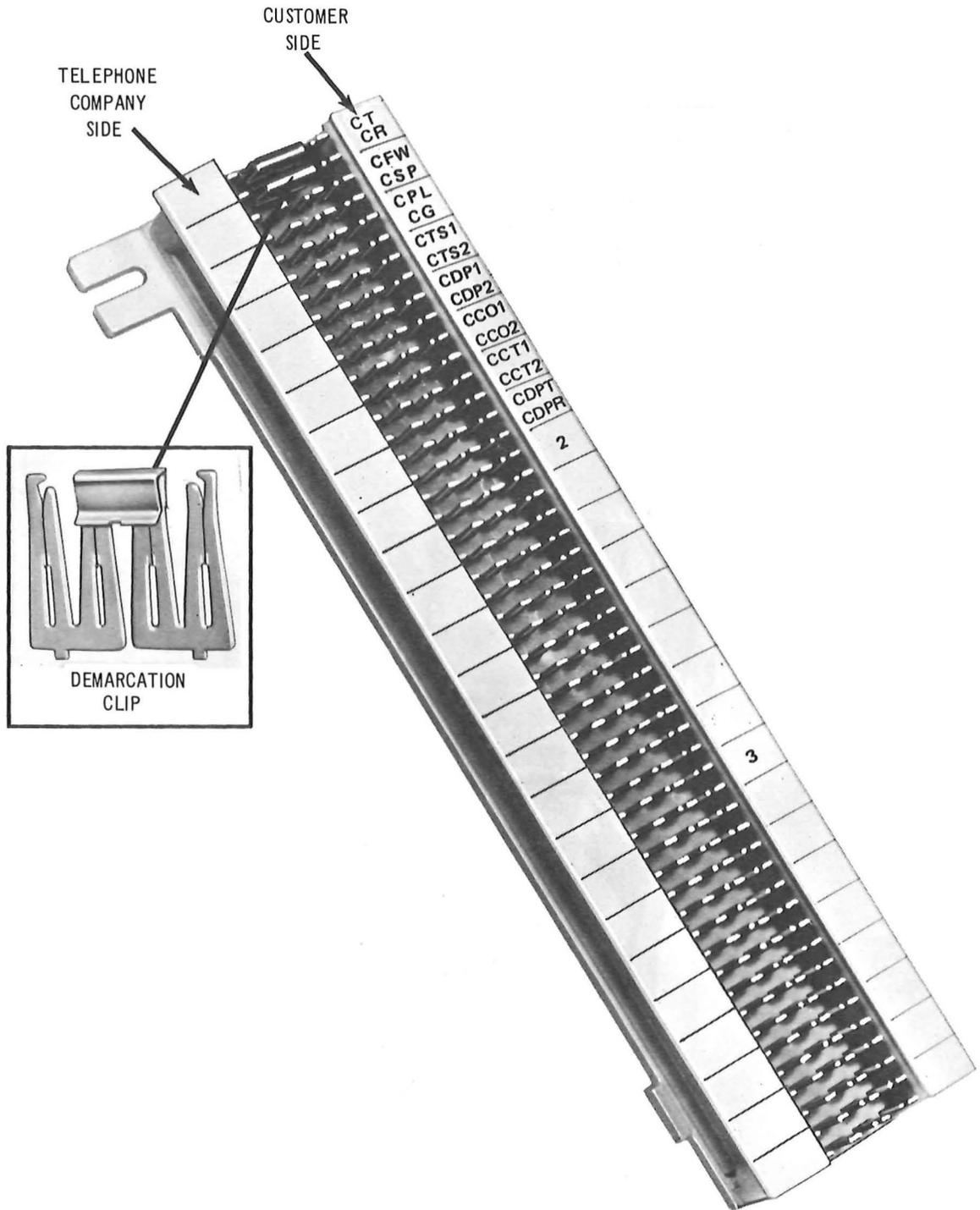


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TELEPHONE COMPANY EQUIPMENT USED TO PROVIDE  
PROTECTIVE CONNECTING ARRANGEMENT  
TSPXY OR TSPZ1  
(3 CIRCUITS SHOWN)

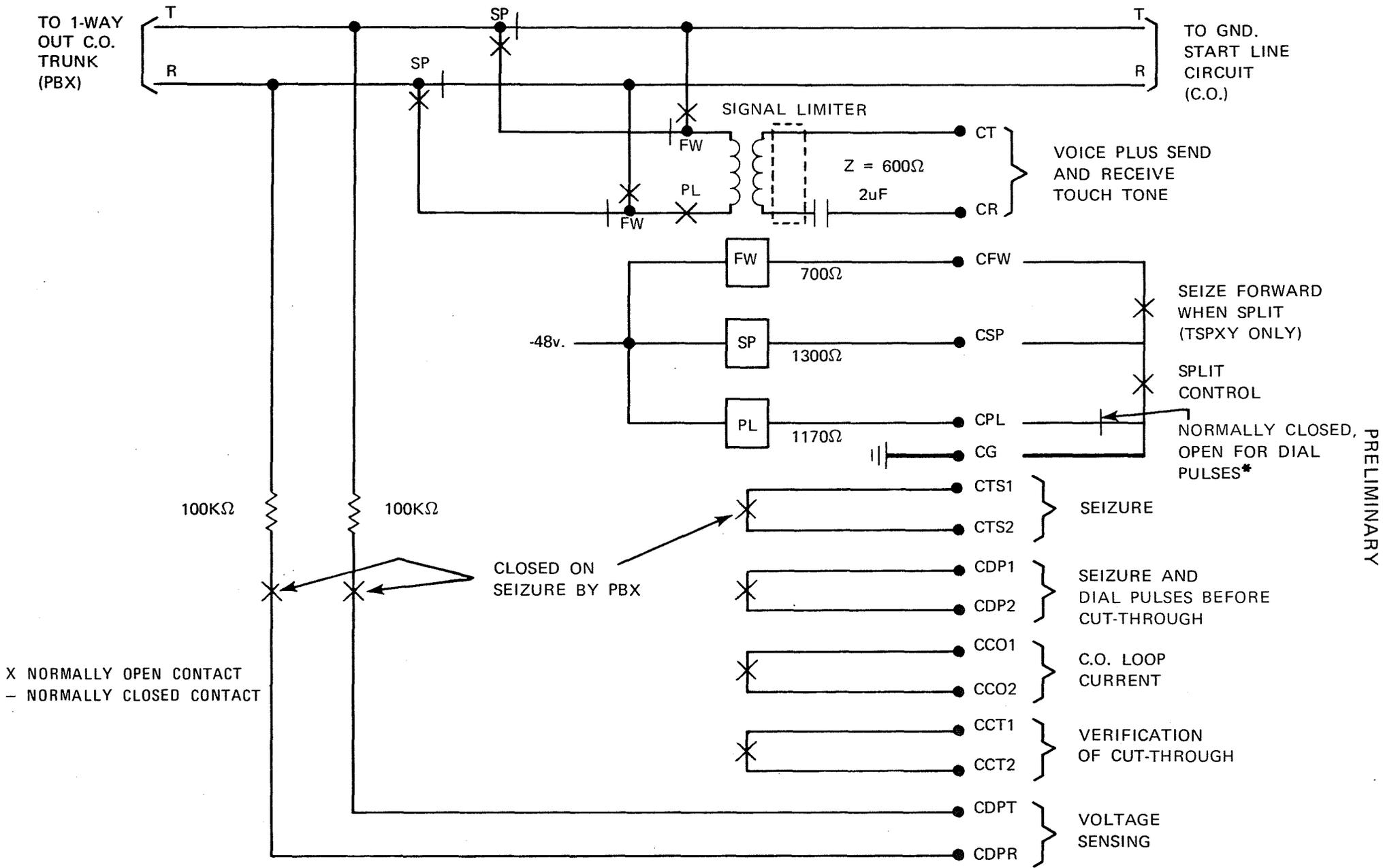
FIGURE 2

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TYPICAL INTERFACE CONNECTING BLOCK

FIG. 3

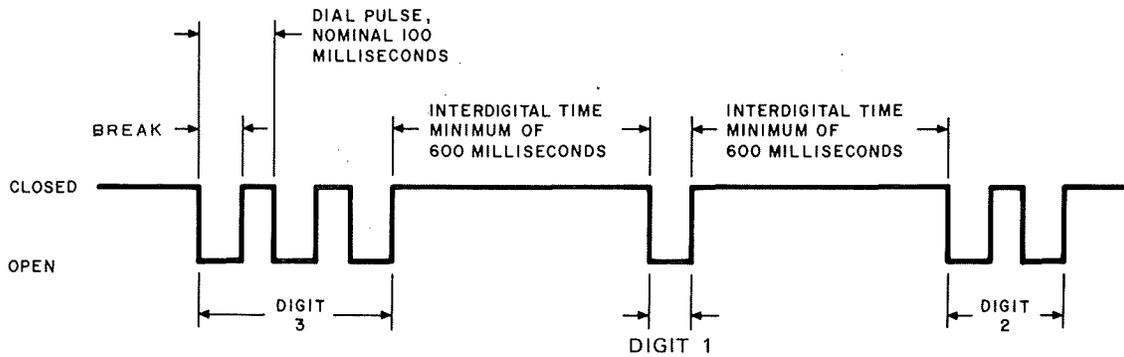


\* TSPXY ONLY (MUST BE OPEN ON TSPZ1)

**SIMPLIFIED SCHEMATIC  
PROTECTIVE CONNECTING ARRANGEMENT TSPXY OR TSPZ1  
FIGURE 4**

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TYPICAL PATTERN OF DIAL PULSES EXPECTED  
FROM CUSTOMER-PROVIDED EQUIPMENT  
OVER LEADS CS AND C6 (DIALING NUMBER 312)



DIAL PULSE RATE-NOMINAL 10 PULSES PER SECOND (8 MIN - 11 MAX.)  
PERCENT BREAK- 50 MIN - 64 MAX.  
INTERDIGITAL TIME - MINIMUM OF 600 MILLISECONDS

LIMITS FOR CUSTOMER-PROVIDED  
DIAL PULSES  
FIG. 5