PUB 42208

PRELIMINARY

Bell System Voice Communications
TECHNICAL REFERENCE

Voice Connecting Arrangement

STC

Interface Specification

REVISED

February 1974

ENGINEERING DIRECTOR - CUSTOMER TELEPHONE SYSTEMS

PRELIMINARY

NOTICE

This Technical Reference is published by American Telephone and Telegraph Company as a guide for the designers, manufacturers, and consultants of customer-provided systems and equipment which connect with Bell System communications systems or equipment. American Telephone and Telegraph Company reserves the right to revise this Technical Reference for any reason, including, but not limited to, conformity with standards promulgated by ANSI, EIA, CCITT, or similar agencies; utilization of new advances in the state of the technical arts; or to reflect changes in the design of equipment or services described therein. The limits of responsibility and liability of the Bell System with respect to the use of customer-provided equipment and systems are set forth in the appropriate tariff regulations.

This Technical Reference supersedes and replaces Bell System Voice Communications Technical Reference for Voice Connecting Arrangement STC dated April 1972.

If further information is required, please contact:

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New York, New York 10007

TECHNICAL REFERENCE

VOICE CONNECTING ARRANGEMENT STC

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PRELIMINARY

VOICE CONNECTING ARRANGEMENT STC

1. GENERAL

* 1.1 Introduction

F.C.C. tariffs and corresponding intrastate tariffs filed by the Bell System provided for the electrical connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to Bell System telecommunications network by means of a connecting arrangement. The connecting arrangement includes circuit elements to provide network control signaling unit functions as well as certain 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 certain network protection criteria specified therein.

This Technical Reference is revised to clarify the specification involving application of the connecting arrangement and to include general revisions in the text. Paragraphs which have specific changes in content or wording are indicated by an asterisk (*).

* 1.2 Application

Voice Connecting Arrangement STC provides a means for automatically connecting customer-provided voice terminal equipment (typically, single line telephones) to the telecommunications network via a central office local exchange, foreign exchange or WATS line. This protective connecting arrangement is not intended for the connection of a customer-provided multi-button set to a Bell System key system; is not intended for the connection of a customer-provided key telephone system to a central office line, nor is it intended for data transmission. This arrangement provides local talking

battery and dial service using customer-provided dc dial pulse or tone address signaling (where the customer has subscribed to Bell System TOUCH-TONE® service) and a locally generated 20 Hz ringing signal over a third lead.

The arrangement cannot be used on a bridged ringer basis, and therefore, the ringing bridge (ringer) in the customer-provided equipment may have to be rewired to provide for three-wire operation. This connecting arrangement is designed for single line applications and may not provide satisfactory service when used in multiple line applications such as key telephone systems. Voice Connecting Arrangement STP provides for connection of customer-provided key telephone systems.

Local power to operate Voice Connecting Arrangement STC may be furnished by the Telephone Company or by the customer at his option. Power for talking and signaling purposes is provided via the connecting arrangement to the customer-provided equipment.

A Telephone Company-provided telephone set is normally included with the telephone line but may be optionally excluded by the customer.

1.3 Ordering and Identification

The protective connection service described in this Technical Reference is identified by the Bell System as Voice Connecting Arrangement STC. One connecting arrangement should be ordered for each telephone line to which customer-provided equipment is to be connected. The local Telephone Company business office or Marketing representative will provide information regarding availability and rates for this service. When ordering, the customer should specify whether the associated Telephone Company-provided telephone set and/or power source will be required.

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2. DESCRIPTION

2.1 Functions

The major functions of this connecting arrangement 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 limit abnormally high speech and tone address signal levels from the customer-provided equipment.

(d) To provide speech transmission to and from the telecommunications network.

(e) To provide network control signaling to the network, including dc dial pulses, on-hook, off-hook, etc.

(f) To provide for ringing signals using a third lead (STC does not provide for bridged ringing across transmission leads).

(g) To provide local dc battery for talking and signaling.

* 2.2 Physical

Voice Connecting Arrangement STC consists of printed circuit boards housed in an apparatus box measuring approximately 9 inches square and 3 inches deep and is intended for either shelf or wall mounting. It weighs approximately 4 pounds, has an aluminum base and a molded plastic cover with a light olive gray textured finish (Fig. 1).

A 15-pin female receptacle is provided on the arrangement to connect the transmission, signaling, and power leads to the customer-provided equipment by means of a mating plug and cable to be furnished by the

customer (e.g., ITT-Cannon Electric or Cinch No. DA-19603-403 equipped with a Hood No. DA-51225-1). The Telephone Company installer will make connections to the telephone line and to the Telephone Company power transformer, if provided (see Fig. 2.).

* 2.3 Interface Leads

Typically, only three leads are required to connect with Voice Connecting Arrangement STC for transmission and signaling purposes (see Fig. 3). Two additional leads are provided for connection to customer-provided dc power when the customer elects to provide power to the connecting arrangement.

Transmission, Switchhook, Dialing (Leads CT and CR)

Leads CT and CR provide a two-way voice transmission path for speech and tone address signaling. They also provide local direct current from the connecting arrangement to the customer-provided equipment to be used as talking battery (typically used to provide dc power to transmitters and/or tone address dials in telephone sets) and signaling battery (typically used for switchhook and rotary dial signaling in the telephone sets).

Ringing (Leads RU1 and CR)

Lead RU1 with lead CR provides a locally generated 20 Hz ringing signal to be used to operate up to three customer-provided conventional high-impedance ringers on a third wire (non-bridged) basis.

Battery (Leads B1+ and B2-)

Leads B1+ and B2- provide for a connection of an optional customer-provided dc power source to provide power to the connecting arrangement. The Telephone Company (at the customer's option) may provide a power source

for the connecting arrangement. In this case, a low voltage ac transformer is plugged into a customer-provided 60 Hz, 117 volt ac outlet and connected to Telephone Company terminals in the connecting arrangement. This ac power, which is current-limited, is converted to dc power in the connecting arrangement where it is used to operate the connecting arrangement. When the Telephone Company transformer is used as the primary power source, a customer-provided rechargeable battery may be "floated" across leads B1+ and B2- to provide emergency power during failure of commercial ac power.

3. OPERATION

In the following paragraphs, the operation of Voice Connecting Arrangement STC is described and reference is made to the circuits shown in the Block Diagram (Fig. 2).

* 3.1 Incoming Call from the Central Office

When 20 Hz ringing on the line is detected by the RING DETECTOR circuit (Fig. 2), a current-limited, local 20 Hz ringing signal is generated by the RING SUPPLY circuit and is applied between leads CR and RU1 to the customer-provided equipment to operate up to three conventional high impedance ringers. The RING DETECTOR circuit also causes relay PR to operate which enables the ring trip circuit. The customer-provided equipment answers the call by closing leads CT and CR through a resistive termination. This operates relay TR causing the connecting arrangement to seize the line, trip ringing and establish a two-way transmission path between the customer-provided equipment and the telecommunications network. The voice connecting arrangement does not exchange busy supervision with the associated Telephone Company telephone set (if provided).

* 3.2 Outgoing Call to the Central Office

When the customer goes off-hook to originate a call, the customer-provided equipment shall provide a resistive termination across leads CT and CR. This will cause relays TR and PR to operate and the connecting arrangement will seize the telephone line and establish the two-way transmission path. The voice connecting arrangement does not exchange busy supervision with the associated Telephone Company telephone set (if provided). After receipt of dial tone, the customer may then dial the desired number either by periodically interrupting the dc termination across leads CT and CR (dial pulse) or by transmitting tone address signals over the same leads (if the customer has ordered TOUCH-TONE service). Since two-way transmission has been established, call progress signals from the telecommunications network (e.g., dial tone, audible ring or busy-tone) can be heard and conversation can begin as soon as the distant party answers.

* 3.3 Disconnect

When the customer's station goes on-hook, the customer-provided equipment must remove the resistive termination across leads CT and CR causing relays PR and TR to release, thus releasing the line. Distant party disconnects are not detected or indicated by the connecting arrangement.

3.4 Power Failure

In those situations where the customer does not provide standby power, the Telephone Company telephone set normally associated with the line (if provided) can be used to provide emergency service during commercial power failure.

4. SPECIFIC DESIGN CONSIDERATIONS

4.1 Transmission Path (Leads CT and CR)

4.11 Insertion Loss

The insertion loss of Voice Connecting Arrangement STC is a nominal 3 dB at 250 Hz and 1 dB over the voice-frequency range of 300 to 3000 Hz. No voice signal amplification is provided.

4.12 Impedance

Voice Connecting Arrangement STC provides about a one-to-one impedance transformation on the CT and CR leads. The input impedance is a function of the voice connecting arrangement impedance and the impedance of the station loop. For design purposes, the input impedance of this arrangement should be considered to be 600 ohms. Therefore, the impedance of the customer-provided equipment likewise should be 600 ohms for optimum speech transmission performance.

4.13 Bandwidth

The nominal voice-frequency bandwidth of the telecommunications network extends from about 300 to 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 connecting arrangement does not limit this 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 specfication, 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) at the CT and CR leads should not exceed -8 dBm. This limit has been set so that when the average loss of loops in the Bell System are considered (including the insertion loss of the voice connecting arrangement), the limit of -12 dBm at the local central office will be met.

Using measuring Method A (see Paragraph 4.15), the mmaximum power averaged over any 3-second interval will, in almost all cases, not exceed -8 dBm if the maximum meter swing does not exceed 85 dBrn (93 dB correction factor). With the additional damping of measuring Method B, the power averaged over any 3-second interval will not exceed -8 dBm if the maximum meter swing does not exceed 83 dBrn (91 dB correction factor).

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 is 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.

Western Electric 3-Type Noise Measuring Set	
Control	Setting
FUNCTION (Switch)	BRDG
NORM/DAMP (Switch)	DAMP
WTG (Plug-in Network)	3Kc FLAT

Hewlett-Packard Transmission and Noise Measuring Set Model 3555B	
Control	Setting
INPUT (Switch)	NOISE/BRDG
FUNCTION (Pushbutton)	VF/Nm-600 BAL
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 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 interoffice 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.

#These meters do not have a 3-second averaging time but, when used on 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.

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 voice 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 not exceed 26 dB below one milliwatt (18 dB below the signal level specified in Paragraph 4.14).

(b) The power in the band from 4000 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 Tone Address Signaling

When TOUCH-TONE service has been ordered by the customer, Voice Connecting Arrangement STC permits customer-provided tone address signals to be transmitted over leads CT and CR to a central office TOUCH-TONE

receiver for the purpose of network address signaling. The signaling code for the Bell System TOUCH-TONE signaling 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:

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

   Max. difference in levels between frequencies: 4 dB

   Max. 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 of automatic dialing, the suppression should be maintained continuously until pulsing is completed.

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.

4.19 Signal Limiting

A voice signal limiter is incorporated in the transmission path to protect the telecommunications network from applications of abnormally high signal levels. This has no effect on normal voice or normal tone address signal levels. This limiter does not abrogate the customer's responsibility to meet the network protection criteria as prescribed in the tariffs and as outlined in Paragraph 4.14.

4.2 DC Signaling Paths

4.21 Switchhook, Dial Pulse, and Talk Battery (Leads CT and CR)

In addition to being used for speech and tone-address transmission, leads CT and CR are also used to supply talking and signaling (switchhook and dial pulse) battery to the customer-provided equipment. The connecting arrangement supplies 22 volts dc maximum and 50 milliamperes maximum to these leads. The total resistive termination across these leads by the customer-provided equipment should range from 130 to 600 ohms resistive (at 130 ohms the current is 50 milliamperes, at 600 ohms it is 23 milliamperes). This allows for more than one customer-provided telephone set to be connected to the connecting arrangement. Lead CR is positive with respect to lead CT.

In order to register properly in any type of Bell System switching equipment, dial pulses generated by customer-provided equipment shall have the following characteristics (see Fig. 4):

(a) Rate: 8 to 11 pulses-per-second (10 pps nominal)

(b) Break: 58 to 64 percent of total make-plus-break duration (61% nominal)

(c) Minimum make: 34 milliseconds

(d) Minimum break: 55 milliseconds

(e) Interdigital time: 600 milliseconds minimum

(f) Contact bounce: 1 millisecond maximum of total interval on make or break.

4.3 Ringing Path (Leads RU1 and CR)

A path for supplying a ringing signal to customer-provided equipment is established over leads RU1 and CR. The customer-provided equip-

ment should present a total dc impedance of 125 ohms minimum across these leads. The ringing circuit will generate a signal of 85V RMS (open circuit) as measured with an RMS calibrated ac voltmeter. This is derived from a 120V dc voltage pulsed at a 20 Hz rate beginning at 0.7 second after the start of the ringing burst received from the serving central office. The circuit is designed to supply approximately 45 volts RMS to up to three conventional high impedance ringers (minimum total ac impedance of 4700 ohms at 20 Hz). The maximum current (short circuit) between leads RU1 and CR is about 13 milliamperes. Lead CR is positive with respect to lead RU1. The connecting arrangement does not permit bridged ringing operations across CT and CR. Lead RU1 must not be connected to CT by the customer's equipment.

4.4 Battery Leads (Leads B1+ and B2-)

Leads B1+ and B2- may be used by the customer-provided equipment to supply dc power to the connecting arrangement. The customer-provided supply may have the B2- lead grounded. The power requirements are as follows:

(a) Voltage: 21 ±5 volts dc (ripple must fall within these limits)

(b) Operating Current: 140 milliamperes maximum

(c) Standby Current: 12 milliamperes

(d) Initial Surge: 1 ampere

As a customer option, the Telephone Company may provide an ac power transformer which is to be plugged into a customer-provided 60 ±1 Hz, 117 ±12 volt ac power outlet. A customer-provided rechargeable battery (18 volt, 150-500 milliampere hour) may be floated across

leads B1+ and B2- to provide emergency power. A charging current of 2.5 milliamperes is available to keep the battery charged under normal standby conditions.

4.5 Grounding

Voice Connecting Arrangement STC is normally floating (ungrounded). However, the B2- lead may be used as a signal reference ground. It is expected that if the customer's equipment is grounded that it will comply with applicable electrical codes, e.g., the National Electrical Code (NEC).

5. GENERAL DESIGN CONSIDERATIONS

5.1 Foreign and Surge Voltage Protection

Where telephone lines are exposed to foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protective devices are installed at the central office and on the customer's premises. Typically, these devices will provide a path to ground for foreign voltages that exceed about 600 volts peak. Since the customer's equipment is connected to the telephone line through the connecting arrangement, the customer's equipment is protected from any resulting longitudinal surges. Residual metallic surges on the transmission leads due to foreign potentials will be limited by the protective connecting arrangement to no greater than 30 volts.

The customer is responsible for providing protection, internal to his equipment and facilities, against foreign and hazardous voltages from his equipment and facilities being applied to the voice 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 inter-office trunks, the serving central offices 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.

6. SERVICE AND MAINTENANCE CONSIDERATIONS

6.1 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 where long distance message tele-communications service is available under these tariffs for use in connection with customer-provided terminal equipment or communications systems, 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 or make such change as shall be necessary to remove or prevent such hazard or interference.

6.2 Responsibility of the Telephone Company

The tariffs regulating the connection of customer-provided terminal equipment and communications systems through connecting arrangements to the telecommunications network state that the Telephone Company shall not be responsible for the installation, operation or maintenance of said terminal equipment or communications systems. Long distance message telecommunications service is not represented as adapted to the use of customer-provided equipment or systems and where such equipment or systems are connected to Telephone Company facilities, the responsibility of the Telephone Company shall be limited to the furnishing of facilities, including the connecting arrangements and network control signaling units, suitable for long distance message telecommunications service and to the maintenance and operation of such facilities in a manner proper for such services. Subject to this responsibility the Telephone Company shall not be responsible for (i) the through transmission of signals generated by the customer-provided equipment or systems or for the quality of, or defects

in, such transmission, (ii) the reception of signals by customer-provided equipment or systems, or (iii) address signaling where such signaling is performed by customer-provided tone-type signaling equipment. The Telephone Company shall not be responsible to the customer if changes in minimum network protection criteria contained in the tariffs (and in this Technical Reference) or in any of the facilities, operations or procedures of the Telephone Company render any customer-provided facilities obsolete or require modification or alteration of such equipment or systems or otherwise affect its use or performance.

6.3 Trouble Reporting Procedure

When trouble is experienced with this service, the customer should perform the necessary testing at the interface to sectionalize the difficulty, i.e., determine whether the service impairment is located in the customer-provided equipment or in the equipment provided by the Telephone Company. If the tests indicate that the trouble is in the Telephone Company-provided equipment, it should be promptly reported to the Telephone Company. Trouble reports should be called into the listed "Repair Service" number which 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) Description of the trouble

(e) Uniform Service Order Code (USOC) STC

(f) Customer's contact for additional information

If a Telephone Company service call to the customer's premises results in the location of the trouble in the customer-provided equipment, the customer will be charged for the service call.

PRELIMINARY

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.

CONNECTING ARRANGEMENT - protective equipment provided by the Telephone Company to accomplish the electrical connection of customer-provided equipment with the telecommunications network.

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 CONNECTOR - the Telephone Company-provided connecting point to which the customer brings and connects the mating plug and cable of his equipment to the protective voice connecting arrangement.

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)

OFF-HOOK SUPERVISION - the conditioning of the CT and CR leads by the customer provided equipment which indicates a customer's telephone is answering or originating a call.

ON-HOOK SUPERVISION - the conditioning of the CT and CR leads by the customer-provided equipment which indicates that the customer's telephone has disconnected or that the equipment 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.

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.

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 operator or distant party to a connection (switchhook flash).

TALKING BATTERY - direct current supply typically used to energize carbon transmitters in telephone sets.

TELECOMMUNICATIONS NETWORK - the 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.

TONE ADDRESS SIGNALS - signals generated by customer-provided equipment for dialing into Bell System TOUCH-TONE equipped switching equipment.

VOICE CONNECTING ARRANGEMENT - a protective connecting arrangement designed to transmit speech signals as contrasted to one designed to transmit data signals.

PRELIMINARY

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) "Principles of Electricity Applied to Telephone and Telegraph Work," by American Telephone and Telegraph Company, New York, New York.

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

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

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

***(j) "Notes on Distance Dialing - 1968," by American Telephone and Telegraph Company.

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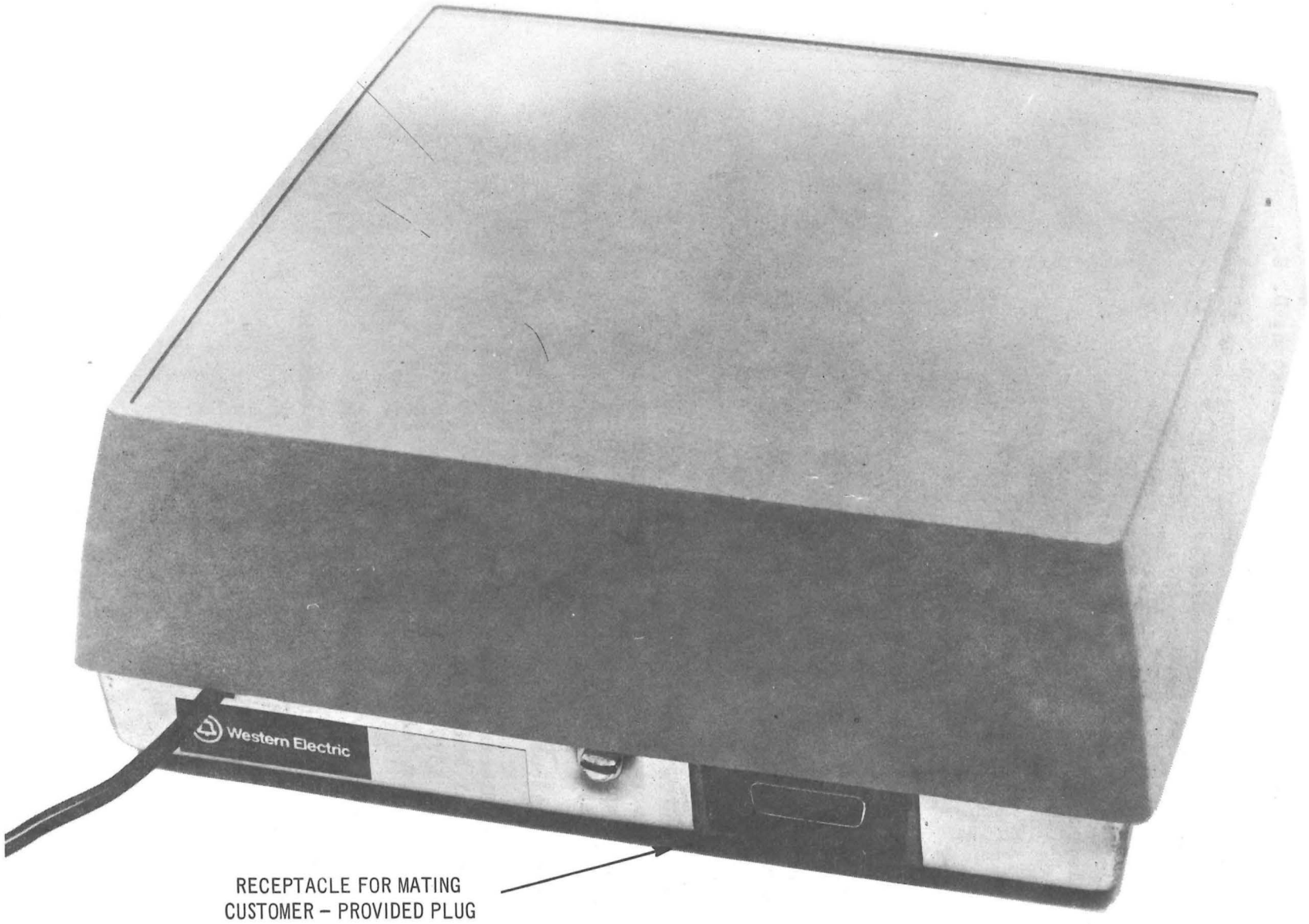
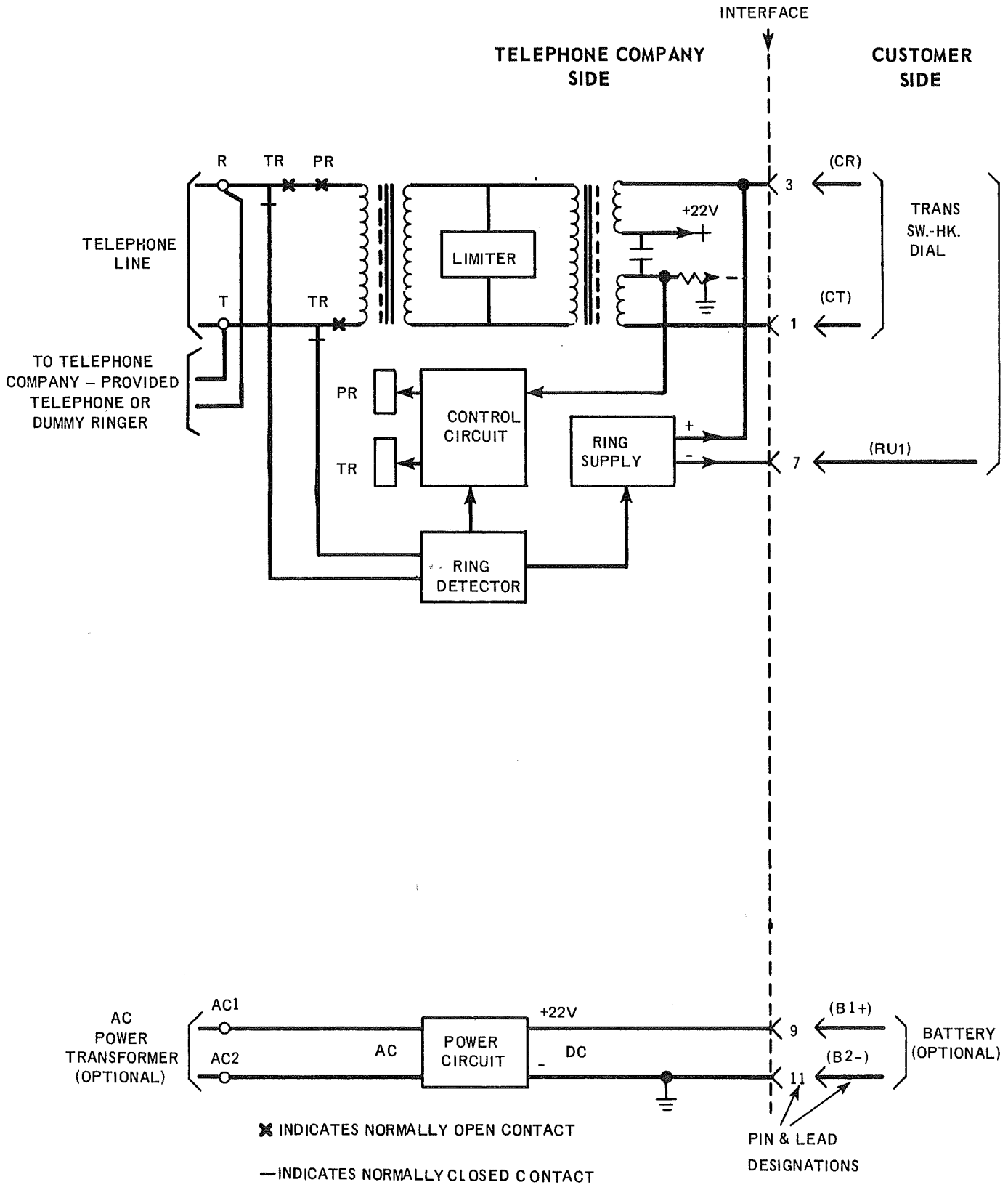
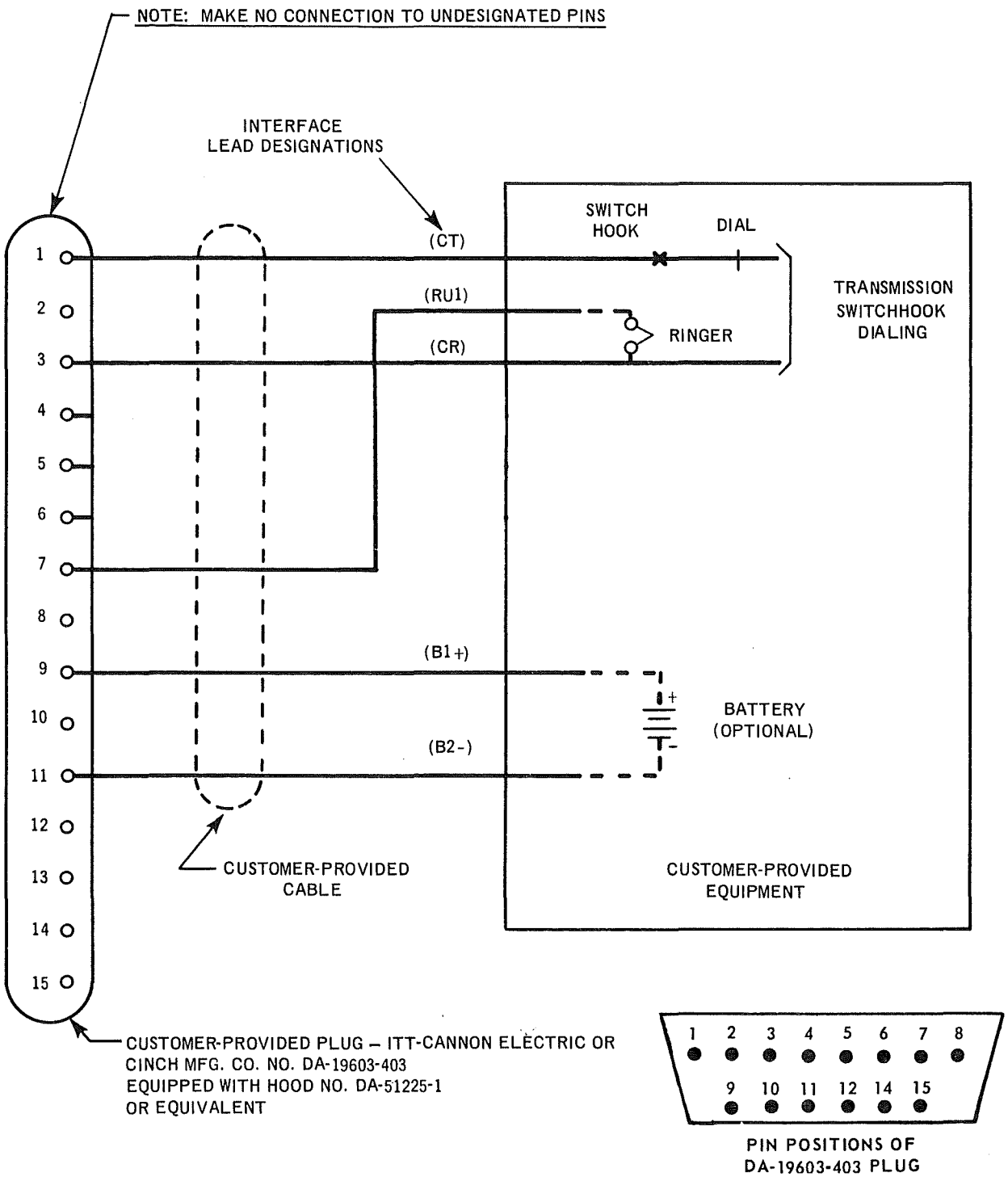


VOICE CONNECTING ARRANGEMENT STC

FIG. 1

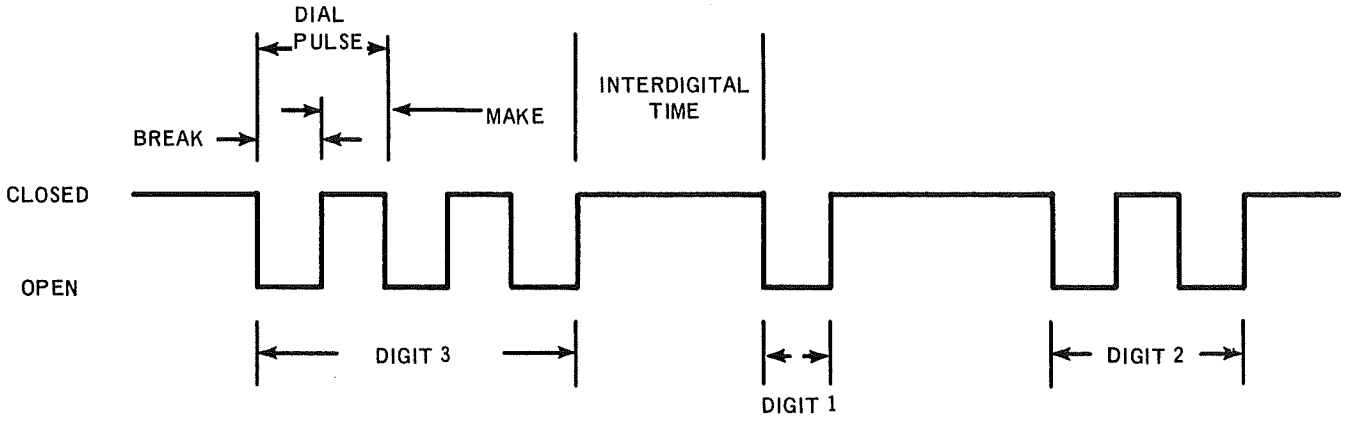


VOICE CONNECTING ARRANGEMENT STC
BLOCK DIAGRAM
FIG 2



VOICE CONNECTING ARRANGEMENT STC
TYPICAL CONNECTIONS TO BE PROVIDED BY THE CUSTOMER
FIG. 3*

TYPICAL PATTERN OF DIAL PULSES EXPECTED
FROM CUSTOMER-PROVIDED EQUIPMENT OVER
LEADS CT AND CR (e.g., WHEN DIALING NUMBER 312)



DIAL PULSE RATE: 8-11 PULSES PER SECOND (10 NOMINAL)
PERCENT BREAK: 58-64 PERCENT OF TOTAL MAKE-PLUS-BREAK INTERVAL (61% NOMINAL)
INTERDIGITAL TIME: 600 MILLISECONDS MINIMUM

VOICE CONNECTING ARRANGEMENT STC
DIAL PULSE CHARACTERISTICS
FIG. 4