

PRELIMINARY

**Bell System Voice Communications
TECHNICAL REFERENCE**

**Voice
Connecting
Arrangement
3A**

**Interface
Specification**

June 1969

ENGINEERING DIRECTOR - CUSTOMER TELEPHONE SYSTEMS



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NOTICE

This Technical Reference is specifically intended for the developers and designers of telephone voice communications systems and equipment which interface with the Bell System telecommunications network and for technical consultants to use in designing communications systems and arrangements requiring connections to the Bell System telecommunications network. The right to revise this Technical Reference for any reason, including conformity with USASI, EIA, CCITT or other standards, to utilize new advances in the state of the technical arts, or to reflect changes in the design of the equipment and/or service described herein is expressly reserved.

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PREFACE

The material in this Technical Reference is intended for use by designers and manufacturers of telephone equipment who expect to connect their communication equipment to the Bell System telecommunications network. This material covers guides which, if followed, should permit the transmission and reception of voice signals without interference to other Telephone Company services.

The responsibility of the Bell System with respect to the use of customer-provided equipment is set forth in the appropriate tariff regulations.

In furnishing this material, the Bell System Telephone Companies make no claims or representations and assume no responsibility, beyond that set forth in the tariff regulations, for the suitability of the transmission path or the performance of the telecommunications system. The Bell System is in no way responsible for the design, performance, installation, operation or maintenance of the communications systems or equipment provided by others which are connected to the telecommunications network and does not endorse or approve any such system or equipment. The material in this Technical Reference is furnished in the interest of preventing interference to other Telephone Company services and users, and is not furnished with the intent to provide complete design specifications or parameters, or to assure the quality or performance of customer-provided telephone systems and equipment.

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1. GENERAL

F.C.C. Tariff No. 263 and corresponding intrastate tariffs filed by the Bell System provide for the direct connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to the Bell System telecommunications network. Direct electrical connection is made through a voice connecting arrangement furnished, installed, and maintained by the Telephone Company. They also provide for the indirect (acoustic or inductive) connection of such equipment or systems.

In addition, the Bell System retains responsibility for network control signaling. This includes the switchhook, dialing and control functions, as well as the protective function of voice signal limiting and isolation of Central Office battery from the customer-provided equipment.

For new or additional service, contact your Telephone Company representative through the local business office or Marketing representative. For ready identification, the Telephone Company describes this service as Voice Connecting Arrangement 3A.

2. SYSTEM DESIGN CONSIDERATIONS

2.1 Voice Connecting Arrangement 3A

The Voice Connecting Arrangement 3A provides a means for manually connecting a customer-provided dial intercom or communications system that furnishes answer supervision to the Bell System telecommunications network through a Bell System provided key telephone set. It is arranged to handle voice calls in either direction. This arrangement is terminated at the key telephone set on three pick-up keys; a trunk key (the listed dedicated telephone number), a station key (the customer-provided switching system terminal)

and a transfer key (connects the listed telephone trunk to the customer-provided switching system terminal). This arrangement provides voice coupling only, between the voice connecting arrangement and the communications system for transmission purposes. A dc circuit is established between the voice connecting arrangement and the communications systems via the TRANSMISSION leads, a pair of conductors, for holding and dialing the station users. SERVICE REQUEST leads, a separate pair of conductors, provide the means for the customer's equipment to supply answer supervision for incoming calls and to initiate outgoing calls.

2.2 Service and Maintenance Considerations

2.21 Responsibility of the Customer

The Tariffs permitting direct electrical connection of customer-provided communications systems state that:

Where long distance message telecommunications service is available under this tariff for use in connection with customer-provided communications systems the operating characteristics of such 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 customer-provided systems do not endanger the safety of Telephone Company employees or the public; damage, require change in or alternation of, the equipment or other facilities of the Telephone Company; interfere with the proper functioning of such equipment or facilities; impair the operation of the telecommunications system or otherwise injure the public in its use of the Telephone Company's services. Upon notice from the Telephone Company that the customer-provided system

is causing, or is likely to cause such hazard or interference, the customer shall make such change as shall be necessary to remove or prevent such hazard or interference.

2.22 Responsibility of the Telephone Company

The Tariffs permitting direct electrical connection of customer-provided communications systems state that:

The Telephone Company shall not be responsible for the installation, operation or maintenance of any customer-provided communications systems. Long distance message telecommunications service is not represented as adapted to the use of customer-provided systems and where such systems are connected to Telephone Company facilities the responsibility of the Telephone Company shall be limited to the furnishing of facilities suitable for long distance message telecommunications service and to the maintenance and operation of such facilities in a manner proper for such telecommunications service; subject to this responsibility the Telephone Company shall not be responsible for (i) the through transmission of signals generated by the customer-provided systems or for the quality of, or defect in, such transmission, or (ii) the reception of signals by customer-provided systems.

The Telephone Company shall not be responsible to the customer or otherwise if changes in minimum network protection criteria contained in the Tariffs and Section 5 of 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 otherwise affect its use or performance.

2.23 Trouble Reporting Procedure

Even though there is an adequate maintenance operation for this service, there will be occasions when trouble is experienced with this service. When this occurs, the customer should perform the necessary testing to determine whether the service impairment is located in his equipment. If the tests indicate the trouble is in the Telephone Company-provided equipment, it should be promptly reported to the Telephone Company. Trouble reports should be called to 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. Customer contact for additional information.

2.3 Foreign and Surge Voltage Protection

Where telephone lines are exposed to lightning, power circuit contact, or induction, there are protective devices located at the Central Office and on the subscriber premises that will provide a path to ground for foreign voltages that exceed 600 volts peak. Since the customer's equipment is connected to the telephone line through the voice connecting arrangement, the customer's equipment is protected from longitudinal lightning surges by trans-

transformer isolation. The maximum surge between conductors CT and CR (see Fig. 4) due to foreign potential that the customer's equipment will encounter is 30 volts. The surge potentials on the other conductors of the voice connecting arrangement will not exceed about 600 volts peak.

The customer is responsible for providing protection, internal to his equipment and facilities, against surge and hazardous voltages from his equipment and facilities being applied to the voice connecting arrangement. The surge potential on the conductors CT and CR is expected to be limited to 30 volts. The surge potential on conductors CS and CG is expected to be limited to about 600 volts peak between conductors or from one conductor to ground.

2.4 Hazardous Voltage Limitations

When it is necessary for the customer to apply an operational voltage to facilities interconnected with telephone facilities, certain voltage limitations shall be observed. These limitations are for the purpose of providing adequate protection to personnel and plant facilities, unless otherwise specified in Section 4.2 and 4.3 of the Technical Reference, steady-state voltages applied to conductors connected to the Voice Connecting Arrangement 3A should not exceed the following:

	<u>dc</u>	<u>ac (RMS)</u>
Maximum voltage, any conductor to ground	135	50
Maximum voltage, conductor to conductor	(135 (270*)	(50 (100*)

* Permitted only if voltage source is center-tapped to ground.

The power supplies and wiring methods used in the customer-provided equipment should meet the provisions of the National Electric Code (NEC), Article 725, for Class 2 remote control and signal circuits.

3. DESCRIPTION OF VOICE CONNECTING ARRANGEMENT 3A

3.1 Physical

The Voice Connecting Arrangement 3A consists of two standard Key Telephone System line circuits and a voice coupler circuit. Each circuit is contained on a 4 x 8 inch, plug-in, printed wiring board. This arrangement will be mounted by the Telephone Company in an appropriate Telephone Company provided mounting. This arrangement will function satisfactorily within a temperature range of 0° to 55°C and a humidity range from 5 to 95 percent. Each arrangement dissipates approximately 3 watts of heat. Leads from this arrangement are terminated on a Telephone Company-provided interface connecting block conveniently located to permit testing, maintenance, trouble isolation, and ease of connection to the customer's equipment. The interface connecting block (see Fig. 2) must be located within 25 feet of the voice connecting arrangement.

3.2 Functions

The major functions of this voice connecting arrangement and its associated Bell System Key Telephone Set are:

- a. To provide voice frequency access to and from the telecommunications network.
- b. To provide network control signaling to the network.
- c. To limit abnormally high voice signal voltages.
- d. To isolate hazardous voltages and currents.
- e. To provide for dialing into the customer-provided equipment.
- f. To provide for accepting supervisory signals from the customer-provided equipment.

3.3 Originating and Receiving a Call

3.31 Incoming Call from the Central Office

When call is received at the Bell System Key Telephone Set from the serving Central Office, the voice connecting arrangement is seized and the ringing voltage activates the trunk circuit portion of the arrangement. An audible signal will be heard and a flashing lamp will appear on the "trunk" pick-up key of the Bell System Key Set. The attendant answers the incoming call by first depressing the associated trunk pick-up key and then taking the receiver off-hook. This retires the audible signal and the flashing lamp signal changes to a steady lamp signal. The attendant determines which customer-provided station is desired, then places the Central Office trunk on hold by depressing the common "hold" button. The steady lamp under the "trunk" key now flashes at the wink-hold rate. If the customer-provided communications systems have an idle path, the attendant then depresses the pick-up button designated "station". A steady lamp appears under the button and dial tone, if present, is heard. The desired communications system station is then dialed. When the station user answers, the contact closure from the communications system equipment connects the SERVICE REQUEST leads (CS and CG) together which prepares the operate path to connect the voice coupler. The attendant advises the station user that he has a call. The attendant now depresses the non-locking "connect" key button which completes the operate path for supervisory relays. These relays, in turn, are locked operated under control of the other SERVICE REQUEST leads. This causes the removal of the holding bridge, placed previously on the incoming trunk, and completes the voice path between the Central Office trunk and the

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customer-provided communications system station. The attendant may now go on-hook. The lamps under the "station" and "trunk" pick-up keys remain lighted steadily. When the customer-provided station goes on-hook, the relay contacts open the SERVICE REQUEST leads and release the entire connection without any further effort by the attendant. All lamps are extinguished at that time.

3.32 Outgoing Call to the Central Office

When the customer-provided communications system station user dials the proper code for the attendant station (Telephone Company Key Set), ringing voltage from the customer-provided equipment over the TRANSMISSION path (CT and CR) will activate the "station" line circuit. An audible signal will be heard and a flashing lamp will appear at the pick-up button assigned "station". In addition to activating the Telephone Company line circuit, the customer-provided equipment must provide a contact closure which connects the SERVICE REQUEST leads (CS and CG) together. The attendant answers the call by first depressing the flashing "station" pick-up button and then going off-hook. This retires the audible signal and the flashing lamp signal changes to steady. The attendant determines what number is desired, then places the communications system station user on hold by depressing the common "hold" button. The "station" lamp now flashes at the wink-hold rate. The attendant now depresses the "trunk" pick-up button, waits for dial tone, then dials the requested telephone number. A steady lamp appears under the "trunk" pick-up button. When the connection is completed to the desired telephone number, the attendant depresses the nonlocking "connect" button associated with this connecting arrangement. This completes a path over the

SERVICE REQUEST leads (CS and CG) to operate the supervisory relays which lock under control of the SERVICE REQUEST leads. The supervisory relays transfer the holding bridge, placed previously on the "station" line, to the coupler circuit and completes the voice circuit from the communications system station and the Telephone Company Central Office trunk. The "trunk" and "station" lamps remain lighted steady. The attendant may now go on-hook. When the customer-provided station goes on-hook, the relay contacts of the communications system open the SERVICE REQUEST leads and release the entire connection without any further effort by the attendant. All lamps are extinguished at this time.

3.4 Interface Leads

Four interface leads per circuit are provided from the Voice Connecting Arrangement 3A to an interface terminal block (see Fig. 2) for the customers' use. Technical information pertaining to these leads is discussed in Section 4.

The first pair, designated CT and CR, provides the two-way voice transmission path from the voice connecting arrangement and a dialing path to the customer's equipment. The second pair, designated CS and CG, provides for the function of request for service of an outgoing call and the answer of an incoming call.

The customer must provide and install the conductors from the customer-provided communications system to the interface connecting block. This block will accept leads up to 18 gauge.

3.5 Method of Connection

The leads from the Voice Connecting Arrangement 3A will be terminated by the Telephone Company in a terminal box equipped with the interface

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connecting block (Fig. 2). The customer or his representative will make the necessary connections to associate his equipment with the voice connecting arrangement at this terminal box. The leads from the voice connecting arrangement will be terminated by the Telephone Company on studs under washers secured by nuts on an interface connecting block mounted in the box. Separate nuts and washers on the same studs will be provided for the customer's connections. These will be designated as follows:

<u>EARLIER DESIGNATION*</u>	<u>CURRENT DESIGNATION</u>	<u>FUNCTION</u>
1T	1CT	voice transmission
1R	1CR	pair
OH	CS	service request
OH1	CG	pair
2	2	designates second circuit
3	3	designates third circuit

*A small quantity of initially provided units will have this designation.

4. ELECTRICAL CHARACTERISTICS

4.1 General

The Bell System Key Telephone Set will generate dial pulses over the interface leads CT and CR towards the customer-provided equipment at the rate of 8 to 11 pulses per second with a percent break of 58 to 64 percent. The insertion loss of the Voice Connecting Arrangement 3A is approximately

five (5) dB over the voice frequency range of 300 to 3000 Hertz. The customer's equipment must furnish its own talk and signal battery, and ringing supply. No voice signal amplification is provided by this arrangement.

4.2 Transmission Path - Leads designated CT and CR

4.21 Voice Signal Limiter

A voice signal limiter is incorporated in the transmission path to protect the Bell System telecommunications network from applications of abnormally high signal levels. This has no effect on normal voice signal levels.

This limiter does not remove the customer's responsibility to meet the network protection criteria as prescribed in the Tariffs and as outlined in Section 5 of this Technical Reference.

4.22 Transmission Parameters

The Voice Connecting Arrangement 3A provides about one-to-one impedance transformation. For design purposes, the impedance of the customer-provided equipment should be 600 ohms. The voice signal levels must comply with the applicable Tariffs. The Tariffs permitting electrical connection of customer-provided communications systems state: "To prevent excessive noise and cross-talk in the network, it is necessary that the power of the signal at the Central Office not exceed 12 dB below one milliwatt when averaged over any three second interval. To insure that this limit is not exceeded, the power of the signal which may be applied by the customer-provided equipment to the Telephone Company interface located on the customer's premises will be specified for each type of connecting arrangement, but in no case shall it exceed one milliwatt."

For the Voice Connecting Arrangement 3A the maximum permissible voice signal power at the interface connecting block is -4 dBm when averaged over any 3-second interval.

4.23 Signaling Parameters

Talking and dialing battery must be furnished by the customer-provided communications system to the Bell System Key Telephone Station when a call is initiated to or received by this station from a customer-provided station. The dc current flow measured in the leads CT-CR in the talking, dialing and holding mode should be a minimum of 0.023 ampere and a maximum of 0.065 ampere. The minimum value of 0.023 ampere insures that the Key Telephone Station transmitter operates properly. The maximum value of 0.065 ampere is to limit the current flow in the holding bridge (590 ohm resistor) during an established call.

The customer-provided equipment must be capable of supplying 20-30 Hertz ringing at 55 volts ac, minimum, and a maximum of 130 volts ac. The ringing generator current must flow into the loop CT-CR, when applied, so that the ringing can be tripped on a loop basis in this arrangement. The customer's tripping circuit shall be capable of limiting the peak current through the voice connecting arrangement to 0.035 ampere maximum. The ringing voltage supply shall be grounded. See Section 4.4 Grounding. The voice connecting arrangement does not supply battery or ground over the CT or CR leads.

4.3 Service Request Path - Leads designated CS and CG

This pair of leads, which must be a dedicated pair, provides the means of answering an incoming call and initiating an outgoing call from the customer's communications system. The customer's equipment must (dedicated for

this purpose only) provide a closure to answer an incoming call, continue that closure throughout the duration of the call, open these leads when the customer's equipment disconnects at the completion of the call, and maintain the open until the next call is handled. When a call is initiated, the customer's equipment is expected to provide and maintain a closure throughout the duration of the call, open these leads at the completion of the call, and maintain the open until the next call is handled. The transmission path will be cut-thru after a closure of the SERVICE REQUEST leads (CS and CG) and the transmission path will remain connected until the SERVICE REQUEST leads are opened. The CS lead of the SERVICE REQUEST pair has a maximum of -28 volts dc through 375 ohms. The CG lead is grounded at the voice connecting arrangement. See Section 4.4 Grounding. The SERVICE REQUEST pair will load the customer's supervisory contact with 0.07 ampere, maximum, inductive load. The minimum open circuit insulation resistance between the CS lead and the CG lead, and from either lead to ground, will be 15,000 ohms. The maximum external loop resistance from the CS lead to the CG lead measured at the interface connecting block towards the customer is 50 ohms.

4.4 Grounding

In general, it is desirable that circuits in the customer's equipment which connect to the voice connecting arrangement have some path to ground. A direct or resistive ground on one side of the power supply would be an example of such a path. This practice avoids the possibility of the entire circuit involved being at an indeterminate potential with respect to ground. Such a potential, perhaps as a result of electrostatic induction, could result in an insulation breakdown in the arrangement. It is expected

that the customer's equipment, if powered from commercial power, will be grounded in accordance with applicable electrical codes (NEC) and should be bonded to the telephone protector ground electrode when available. Self-powered or passive customer's equipment need not be grounded. One side of the customer's ringing generator supply, when provided, should be grounded.

Voice Connecting Arrangement 3A is provided with a common signal ground (a cold water pipe or other ground approved by the NEC) which is always bonded to the electric power ground and telephone protector ground, where present. The CG lead of the SERVICE REQUEST pair is grounded at the unit. If necessary, this SERVICE REQUEST ground lead may be connected to the frame ground of the customer's equipment. It is not permitted to derive the main ground for the customer's equipment through this lead from the voice connecting arrangement.

As an example, a good ground may be obtained with a proper connection to a metallic cold water pipe, using a single No. 6 AWG copper conductor. The other end should be connected to the ground return terminal of the customer's equipment. Proper attention should be given to providing 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. This connecting conductor should be short, straight and if possible a continuous piece of wire. This lead shall not be fused.

5. POWER AND IMPEDANCE CONSIDERATION FOR CUSTOMER-PROVIDED EQUIPMENT

5.1 Average Power at the Central Office

The average power (in any 3-second interval) delivered to a 900 ohm resistive load at the Central Office should not exceed -12 dBm. The

limitations described in 5.2 below, on power at the customer's location have been set so, when all business telephone loops in the Bell System are considered, the limit of -12 dBm will be met.

5.2 Maximum Power Available

The Central Office power criterion, in 5.1 above, can be satisfied by limiting the maximum available power* from a customer-provided 600 ohm source to -4 dBm when averaged over any 3-second interval. The customer-provided communications system should be so designed that the average power over any 3-second interval applied to the interface block associated with a Voice Connecting Arrangement 3A does not exceed -4 dBm. The recommended procedure for estimating the power is given in Section 6.

5.3 Signaling Considerations

The telecommunications network incorporates tone signaling devices that are used for network control functions. These devices, connected at all times to the telephone circuit, are designed to be sensitive to single frequency tones at 2600 Hz. They are, however, relatively insensitive to energy at this frequency if sufficient energy is present at the same time as 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 voice connecting

* The available power of a source is the maximum power that the source can deliver to a load. Maximum power transfer occurs when the load and source impedances are matched.

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 2,450 Hz band.

5.4 Out-of-Band 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 Hertz to 4005 Hertz shall be at least 18 dB below the power of the signal as specified in Section 5.2 above.
- b. The power in the band from 4000 Hertz to 10,000 Hertz shall not exceed 16 dB below one milliwatt.
- c. The power in the band from 10,000 Hertz to 25,000 Hertz shall not exceed 24 dB below one milliwatt.
- d. The power in the band from 25,000 Hertz to 40,000 Hertz shall not exceed 36 dB below one milliwatt.
- e. The power in the band above 40,000 Hertz shall not exceed 50 dB below one milliwatt.

5.5 Internal Impedance

The internal impedance of the customer's equipment should be approximately 600 ohms.

6. TESTING AND MEASURING METHODS

6.1 Measuring Maximum Available Power

The following measuring method is satisfactory for estimating the maximum power averaged over a 3-second interval to determine that the in-band criterion is being met:

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 Telephone Test Meter 3555B, a Western Electric 3C (3A) Noise Measuring Set, or the equivalent.* The meter FUNCTION switch should be in the BRIDGE position, the slide switch marked DAMP/NORM in the DAMP position, and 3 kHz flat weighting should be used. In almost all cases the speech power averaged over any 3-second interval will not exceed -4 dBm if the maximum meter swing does not exceed 79 dBrn.

The accuracy of this method can be somewhat improved by increasing the size of the damping capacitance in the Western Electric 3C or 3A 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 noise meters other than the Western Electric 3C and 3A.) With the additional damping the power averaged over any 3-second interval will not exceed -5dBm (3 kHz Flat) if the maximum meter swing does not exceed 77 dBrn. The use of meters with shorter time constants, such as a VU meter or a standard voltmeter, is not recommended.

* 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.

7. TELECOMMUNICATION NETWORK CHARACTERISTICS

7.1 Transmission Parameters

Information describing the component parts and operating characteristics of the Bell System telecommunications network has been published. Various articles have discussed statistical information on talker volumes (a), end-office losses and noise (b-d), loop characteristics (e), and other characteristics (f-h). These articles are listed in Section 8. In addition, five general information texts are listed.

The 1000 Hz insertion loss for this voice connecting arrangement (with a customer's communication device having a 600 ohm source impedance) and its associated loop will average about 8 dB with a standard deviation of about 1 dB.

7.2 End-to-End Electrical Loss

The end-to-end electrical loss of a connection is a function of the impedances of both end terminations, the losses of the loops at both ends, and the end-office loss. The information given in the references in Section 8 may be used to determine statistical loss distributions for different types of calling patterns on the telephone network.

7.3 Bandwidth and Frequency Response

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 with increasing frequency. This voice connecting arrangement does not limit this bandwidth.

7.4 Nonlinearities

Nonlinearities such as compression, clipping, and harmonic distortion can exist on the telecommunications network. Normally, these are low enough to be ignored. It is expected that total harmonic distortions no greater than about 5 percent of the fundamental will normally be encountered.

8. REFERENCES

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

- a. McAdoo, K.L., "Speech Volumes on Bell System Message Circuits-1960 Survey", Bell System Technical Journal 42 No. 5 (September 1963), p. 1999.
- b. Nasell, I., "The 1962 Survey of Noise and Loss on Toll Connections", BSTJ, 43, No. 2 (March 1964), p. 697.
- c. Nasell, I., "Some Transmission Characteristics of Bell System Toll Connections", BSTJ, 47, No. 6 (July-August 1968), p. 1001.
- d. Nasell, I., Ellison, C.R., and Homstrom, R., "The Transmission Performance of Bell System Intertoll Trunks", BSTJ, 47, No. 8 (October 1968), p. 1561.
- e. Hinderliter, R.G., "Transmission Characteristics of Bell System Subscriber Loop Plant", IEEE Transactions, Communications and Electronics, September 1963, p. 464.
- f. Alexander, A.A., Gryb, R.M., and Nast, D.N., "Capabilities of the Telephone Network for Data Transmission", BSTJ, 39, No. 3 (May 1960), p. 431.
- g. Breen, C., and Dahlbom, C.A., "Signaling Systems for the Control of Telephone Switching", BSTJ, 39, No. 6 (November 1960), p. 1381.

- h. Bodle, D.W. and Gresh, P.A., "Lightning Surges in Paired Telephone Cable Facilities", BSTJ, 40, No. 2 (March 1961), p. 547.
- * i. Principles of Electricity applied to Telephone and Telegraph Work by American Telephone and Telegraph Company, New York, New York.
- * j. Switching Systems by American Telephone and Telegraph Company, New York, New York.
- k. Notes on Transmission Engineering by United States Independent Telephone Association, Washington, D.C.
- * l. Notes on Distance Dialing - 1968 by American Telephone and Telegraph Company, New York, New York.
- * m. Transmission Systems for Communications by Bell Telephone Laboratories.

* Available through Graybar Electric Company.

9. GLOSSARY#

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

CONNECTING ARRANGEMENT - the Voice Connecting Arrangement 3A provided by the Telephone Company to accomplish the direct electrical connection of customer-provided facilities with the facilities of the Telephone Company and to connect the transmission path from the customer-provided equipment to the telecommunications system.

May differ in letter from exact wording as used in the Tariffs.

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 system, are so connected either electrically, acoustically or inductively.

END-OFFICE - the last serving Central Office in the switching hierarchy of the telecommunications network.

INTERFACE CONNECTING BLOCK - the Telephone Company furnished 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 voice connecting arrangement.

NETWORK CONTROL SIGNALING - the transmission of signals used in the telecommunications system 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 system.

NETWORK CONTROL SIGNALING UNIT - the Bell System Key Telephone Station furnished, installed and maintained by the Telephone Company for the provision of network control signaling used with the Voice Connecting Arrangement 3A.

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OFF-HOOK SUPERVISION - the conditioning of the SERVICE REQUEST 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 SERVICE REQUEST leads by the customer-provided equipment which indicates that the customer's telephone has disconnected, or that the equipment is idle.

SERVICE REQUEST - the designation of the leads or function which accepts supervision from the customer's equipment.

SUPERVISORY SIGNALS - see off-hook and on-hook supervision.

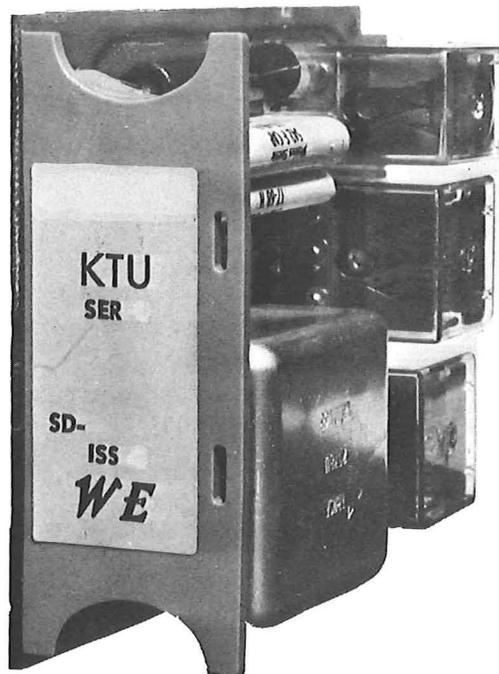
TELECOMMUNICATION NETWORK - the Bell System voice switching equipment, associated interconnecting facilities and station equipment which connects its subscribers together.

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

VOICE COUPLER - that portion of the Voice Connecting Arrangement 3A (see Fig. 4) transmission path from the customer-provided equipment to the telecommunications network.

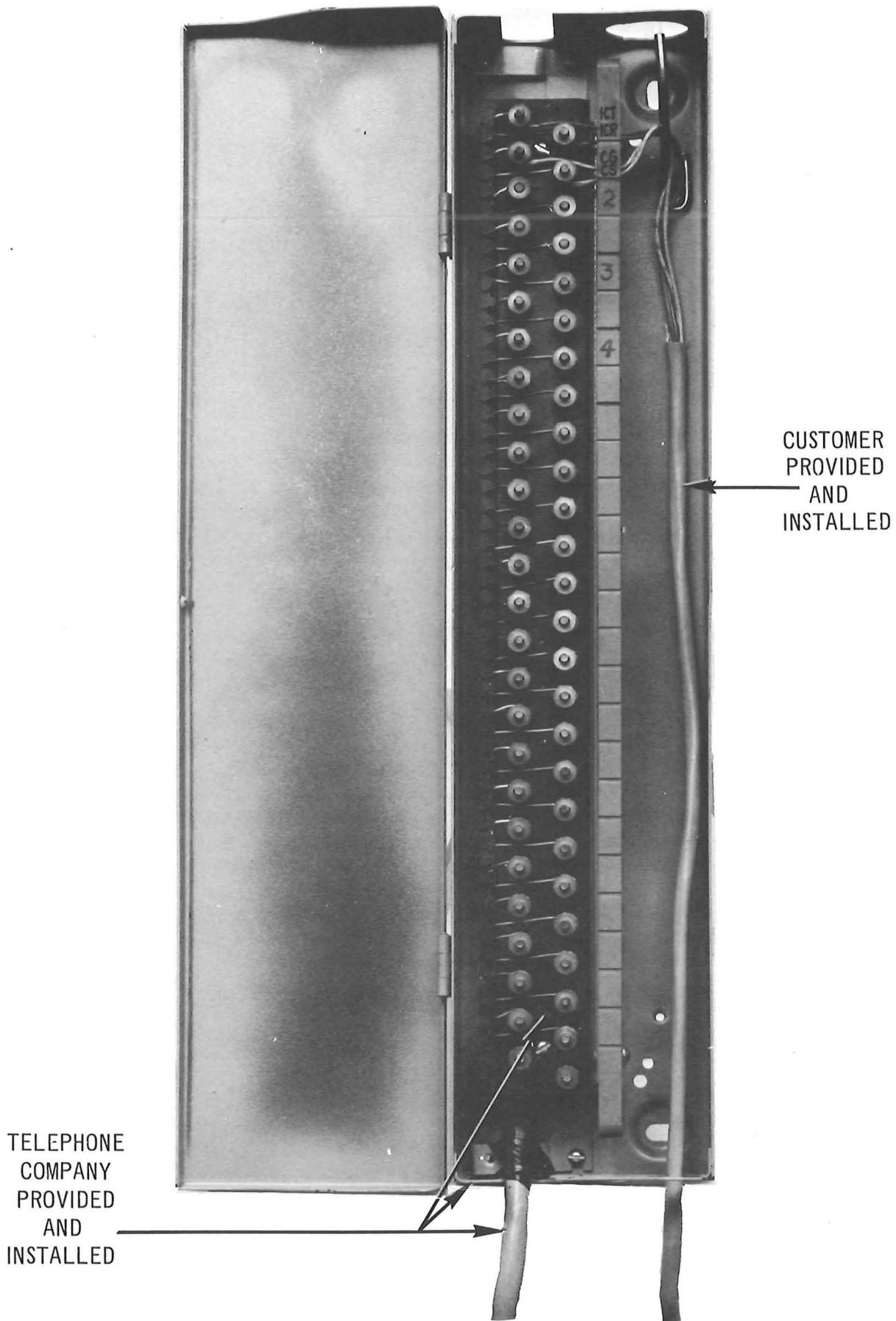


Typical Bell System Key Telephone Set
Network Control Signaling Unit
Figure 1A

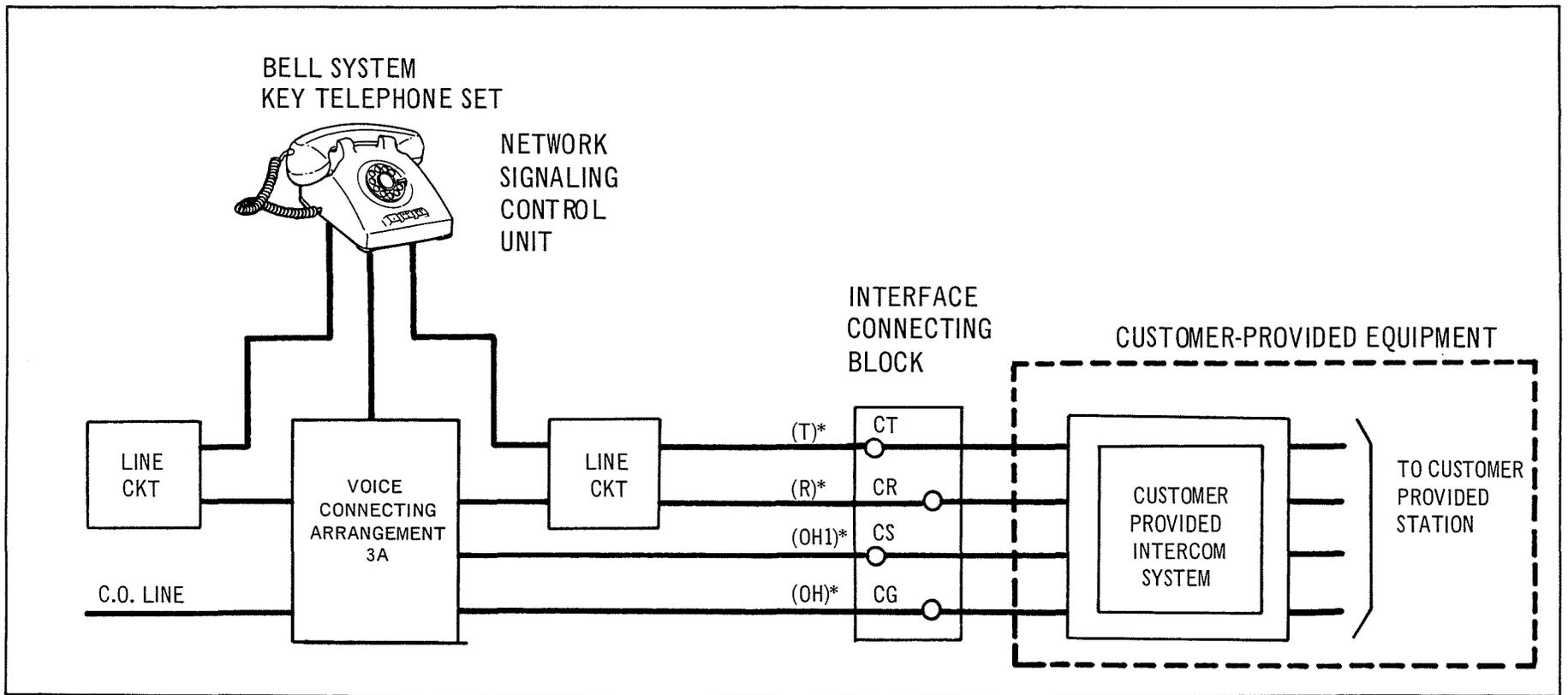


Voice Coupler Unit
Figure 1B

VOICE CONNECTING ARRANGEMENT 3A
Figure 1

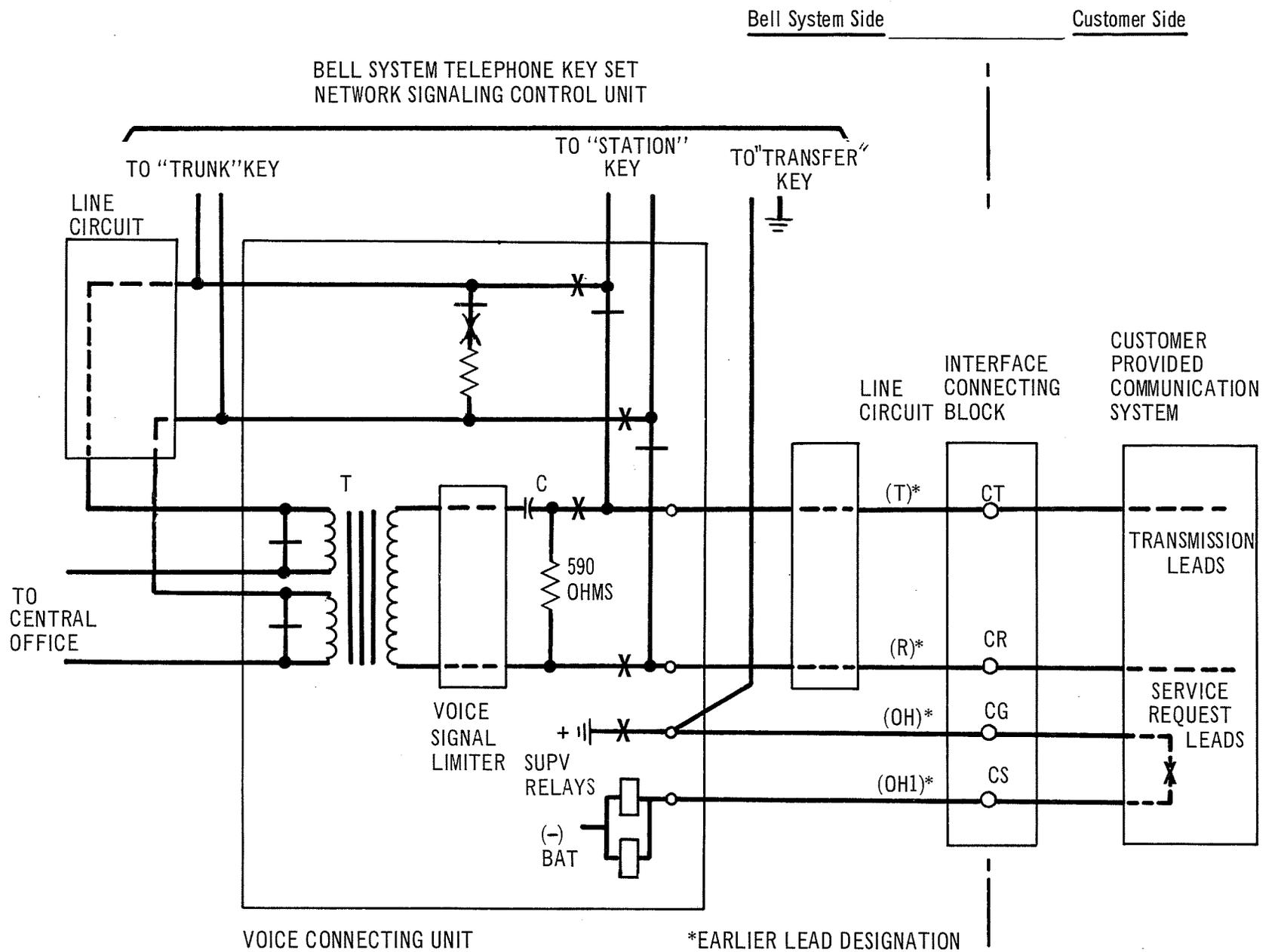


Interface Connecting Block
Fig. 2



*EARLIER LEAD DESIGNATION

BLOCK DIAGRAM – VOICE CONNECTING ARRANGEMENT 3A
Figure 3



VOICE CONNECTING ARRANGEMENT 3A

Figure 4