

PRELIMINARY

**Bell System Voice Communications
TECHNICAL REFERENCE**

**Voice
Connecting
Arrangement
CDA (1A)
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 communication 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 as 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 telecommunication 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 local Telephone Company representative through the local business office or Marketing representative. For ready identification, the Telephone Company describes this service as Voice Connecting Arrangement 1A.

2. SYSTEM DESIGN CONSIDERATIONS

2.1 Voice Connecting Arrangement 1A

Voice Connecting Arrangement 1A provides a means for manually connecting a customer-provided communications system, equipped with a cord switchboard, which furnishes answer supervision, to the Bell System telecommunications network. It is arranged to handle voice calls in either direction. This arrangement is terminated on an interface connecting block to which the customer connects his leads from the cord switchboard. A Network Control Signaling Unit is provided which should be conveniently located adjacent

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to the cord switchboard attendant. A call to the Central Office can be originated by the switchboard attendant by inserting a cord into the jack associated with an idle circuit. When dial tone is heard, the attendant depresses the PICKUP button on the Network Control Signaling Unit associated with the Central Office trunk into which the cord was plugged, and, using the dial on the Unit, dials the desired number. After dialing, the attendant depresses the RELEASE button on the Unit, disconnecting the dial from the circuit. When the attendant receives on-hook supervision from the customer-provided station, the attendant removes the cord from its jack which releases the connecting circuit and the Central Office trunk.

On an incoming call, the Central Office ringing signal is detected by the connecting circuit which opens and closes a dedicated set of contacts to the customer-provided equipment in synchronism with the ringing. This alerts the attendant who answers by inserting a cord into the proper jack, which causes the ringing to be tripped and cuts the talking path through the protective coupler from the attendant to the Central Office trunk. The attendant may then extend the call to a customer-provided station as required. When the attendant receives on-hook supervision from the called station, the cord is removed from its jack which releases the connecting circuit and the Central Office trunk. This Unit provides for voice frequency coupling between the telecommunications network and the customer-provided switchboard for transmission purposes. A pair of conductors is used for the TRANSMISSION path. SERVICE REQUEST leads, a separate pair of conductors, provide the means for the customer-provided equipment to answer incoming calls and to initiate outgoing calls. The

third pair, SIGNAL ALERT leads, provide an isolated contact closure each time the Central Office applies ringing current during an incoming call.

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 alteration 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,

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operation or maintenance of any customer-provided terminal equipment. Long distance message telecommunications service is not represent as adapted to the use of customer-provided equipment and where such equipment is 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 equipment or for the quality of, or defect in, such transmission, or (ii) the reception of signals by customer-provided equipment.

The Telephone Company shall not be responsible to the customer or otherwise if changes in the 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 equipment 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. When this occurs the customer should perform the necessary testing to determine whether the service impairment is located in his equipment.

If a trouble exists and the customer's tests indicate the trouble is not in the customer's 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 customer's 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 surge by 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 expected to be limited to about 600 volts peak between conductors or from one conductor to ground.

2.4 Hazardous Voltage Limitations

For the purpose of providing adequate protection to personnel and plant facilities, and unless otherwise specified in Section 4.2 and 4.3 of this Technical Reference, steady-state voltages applied to conductors connected to the Voice Connecting Arrangement 1A 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 1A

3.1 Physical

Voice Connecting Arrangement 1A consists of three parts; a plug-in printed wiring board, a mounting cabinet and a Network Control Signaling Unit. The main portion of each circuit is contained on a 4 X 8 inch plug-in printed wiring board. A maximum of five printed wiring boards (5 circuits) can be mounted in a cabinet which is approximately 16-1/2 inches

high, 13-1/2 inches wide, and 10-1/2 inches deep (see Fig. 1). The cabinet, which includes a self-contained power unit, fully equipped weighs approximately 27 pounds. The cabinet will be mounted by the Telephone Company in an appropriate location in close proximity to a customer-provided 110V ac outlet (see Sec. 4.5). This voice connecting arrangement will function within a temperature range of 0° to 55°C and a humidity range of 5 to 95 percent. Five units will dissipate approximately 55 watts of heat. Leads from these circuits are brought out of the cabinet and 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 (see Fig. 2). The interface connecting block must be located within 25 feet of the cabinet.

The Network Control Signaling Unit should be located in close proximity to the attendant of the customer-provided equipment. The Unit is initially arranged to be used with 11 connecting circuits. An additional row of six buttons can be added arranging the Console for a total of 17 connecting circuits. The Unit is available in the following colors:

- a. Light Beige
- b. Light Gray
- c. Moss Green
- d. White

The Console should be located within 25 feet of the cabinet.

3.2 Functions

The major functions of this connecting arrangement 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 accepting supervisory signals from the customer-provided equipment.

3.3 Originating and Receiving a Call

3.31 Incoming Call From the Central Office

When a call arrives from the Central Office, the incoming ringing signal is detected by the Voice Connecting Arrangement 1A which opens and closes a dedicated set of contacts in synchronism with the ringing and forwards the signals over the SIGNAL ALERT leads (C1 and C2) to the customer-provided equipment. This alerts the attendant to the incoming call, who answers by inserting a cord into the proper jack which causes an off-hook signal (closure) to be sent over the SERVICE REQUEST leads (CS and CG) to operate a supervisory relay in the voice connecting arrangement. The operation of the supervisory relay disconnects the ringing detector and establishes a talking path between the attendant at the customer-provided equipment and the Central Office over the TRANSMISSION leads (CT and CR). The attendant now can complete the incoming call to a customer-provided station as required. When the attendant receives on-hook supervision from the called customer-provided station, the attendant removes the cord from its jack. This causes an on-hook signal (open) to be sent over the SERVICE REQUEST leads (CS and CG) releasing the supervisory relay and restoring the circuit to its idle condition.

3.32 Outgoing Call Towards The Central Office

When the attendant wishes to establish a call to the Central Office, the attendant selects an idle connecting circuit and inserts the plug of the cord into the associated jack which provides a closure that connects the SERVICE REQUEST leads (CS and CG) together. The supervisory relay operates and cuts through to the TRANSMISSION leads (CT and CR) establishing a talking path to the Central Office. When dial tone is returned from the Central Office, the attendant depresses the pickup button on the Network Control Signaling Unit associated with this connecting circuit. The depressed pickup button causes a relay to place the pulsing and off-normal contacts of the dial into the circuit. Then the attendant dials the appropriate digits. After completion of the dialing the release button on the Network Control Signaling Unit is depressed, which disconnects the dial from the circuit and releases the pickup button. When the established call has terminated, the attendant receives on-hook supervision from the calling party, the cords on the customer-provided switchboard are removed from the jacks. This causes an on-hook signal (open) to be sent over the SERVICE REQUEST leads (CS and CG) releasing the supervisory relay which restores the circuit to its idle condition.

3.4 Interface Leads

Six interface leads per circuit are provided from the Voice Connecting Arrangement 1A to an interface terminal block for the customer's 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 connecting arrangement. The second pair, designated

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CS and CG (SERVICE REQUEST), provides for the function of request for service of an outgoing call and answering of an incoming call. The third pair, designated C1 and C2 (SIGNAL ALERT), provides a means of alerting the attendant at the customer-provided equipment to an incoming call from the Central Office.

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

3.5 Method of Connection

The leads from the Voice Connecting Arrangement 1A will be terminated by the Telephone Company in a terminal box equipped with the interface 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*</u> <u>DESIGNATION</u>	<u>CURRENT</u> <u>DESIGNATION</u>	<u>FUNCTION</u>
T	1CT	voice transmission
R	1CR	pair
A	CS	service request
A1	CG	pair
R1	C1	signal alert
B1	C2	pair

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

4. ELECTRICAL CHARACTERISTICS

4.1 General

The maximum insertion loss of the Voice Connecting Arrangement 1A is approximately one (1) dB over the voice frequency range of 300 to 3,000 Hertz. The customer's equipment must furnish its own talk and signal battery. No voice signal amplification is provided by this arrangement. This unit requires a connection to 110 Volts 60 Hertz power source. See Section 4.5 AC Power.

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 1A provides about one to one impedance transformation. The impedance is a function of the design of the connection between the voice connecting arrangement and the Central Office. For design purposes, the impedance of the customer-provided equipment should be 600 ohms. The voice signal levels must comply with the applicable Tariffs; signal level restrictions are given in Section 5. 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 3-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 voice connecting arrangement, but in no case shall it exceed one milliwatt."

For the Voice Connecting Arrangement 1A the maximum permissible voice signal power at the interface connecting block is -9 dBm when averaged over any 3-second interval.

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 communication 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-through 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 10,000 ohms. The CG lead is grounded at the

voice connecting arrangement. See Section 4.5 Grounding. The SERVICE REQUEST pair will load the customer's supervisory contact with 0.010 ampere, maximum, inductive load. The minimum open circuit insulation resistance between the CS lead and the CG lead, and from either lead to ground, shall be 100,000 ohms. The maximum external loop resistance from the CS lead and the CG lead measured at the interface connecting block towards the customer is 1000 ohms.

4.4 Signal Alert Path - Leads designated C1 and C2

This pair of leads provides an isolated contact closure each time the Central Office rings during the incoming call. Nominally the rings will be two seconds in duration with a silent interval of four seconds. The contact and the associated internal wiring of the voice connecting arrangement exhibits a maximum of 5 ohms dc resistance measured at the interface connecting block when the contact is closed. The current must be limited to a maximum of 0.5 ampere. The contact is not equipped with an arc suppression network.

4.5 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 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 1A 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 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.

4.6 AC Power

Each group of 5 connecting circuits requires a connection to a customer furnished nominal 110 Volt 60 Hertz source. This ac circuit, which is separately fused, should not be under the control of a wall switch. Each such 15 ampere circuit is sufficient for an installation of up to 20 connecting circuits.

5. POWER AND IMPEDANCE CONSIDERATIONS 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 that when all PBX loops in the Bell System are considered, the limit of -12 dBm will be met.

5.2 Maximum Available Power

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 -9 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 1A does not exceed -9 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.

* 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.

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.

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 inband 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 -9 dBm if the maximum meter swing does not exceed 84 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 micro-farads. To do this connect the negative lead of a 150 micro-farad 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 -9 dBm if the maximum meter swing does not exceed 82 dBrn (3 kHz flat weighting). 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. TELECOMMUNICATIONS 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 3 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 per cent of the fundamental will normally be encountered.

8. 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, 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 the Long Distance Message Telecommunications Service, of communications between customer-provided terminal equipment or Telephone Company stations.

CONNECTING ARRANGEMENT - the Voice Connecting Arrangement 1A 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.

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 telecommunication 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.

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

NETWORK CONTROL SIGNALING - the transmission of signals used in the telecommunication 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 re-order or busy conditions, alerting, coin denominations, coin collect and coin return tones) to control the operation of switching machines in the telecommunication system.

NETWORK CONTROL SIGNALING UNIT - the Bell System key and dial unit furnished, installed and maintained by the Telephone Company for the provision of network control signaling used with the Voice Connecting Arrangement 1A.

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.

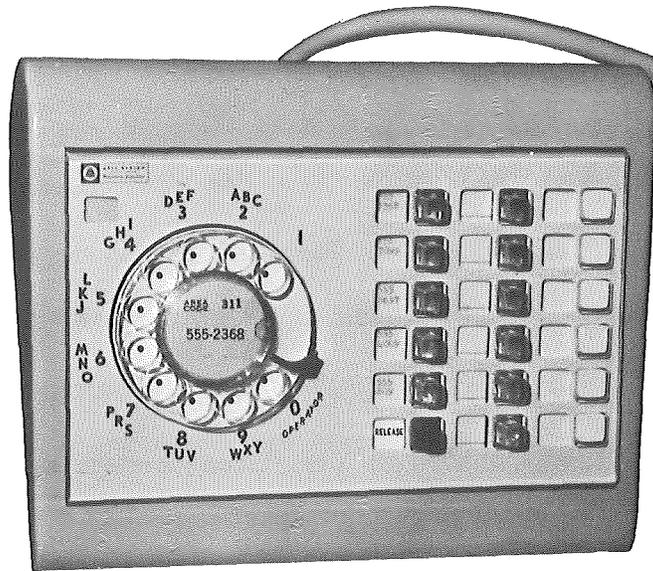
SIGNAL ALERT - the designation of the leads or function which indicates the present of an incoming call.

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

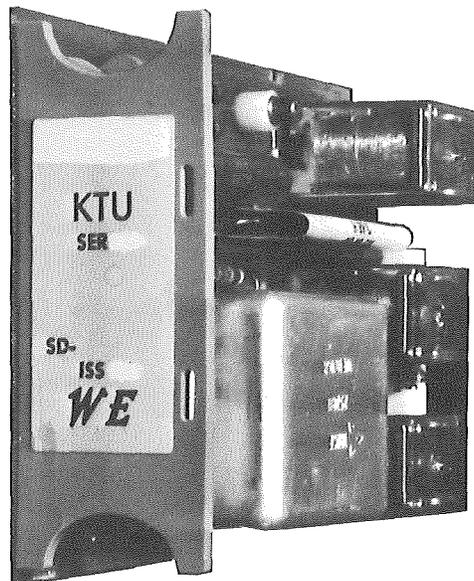
TELECOMMUNICATION NETWORK - the Bell System voice switching equipment, associated interconnecting facilities and station equipment which connects its subscribers together.

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

VOICE COUPLER - that portion of the Voice Connecting Arrangement 1A (see Fig. 4) which connects the transmission path from the customer-provided equipment to the telecommunication network.

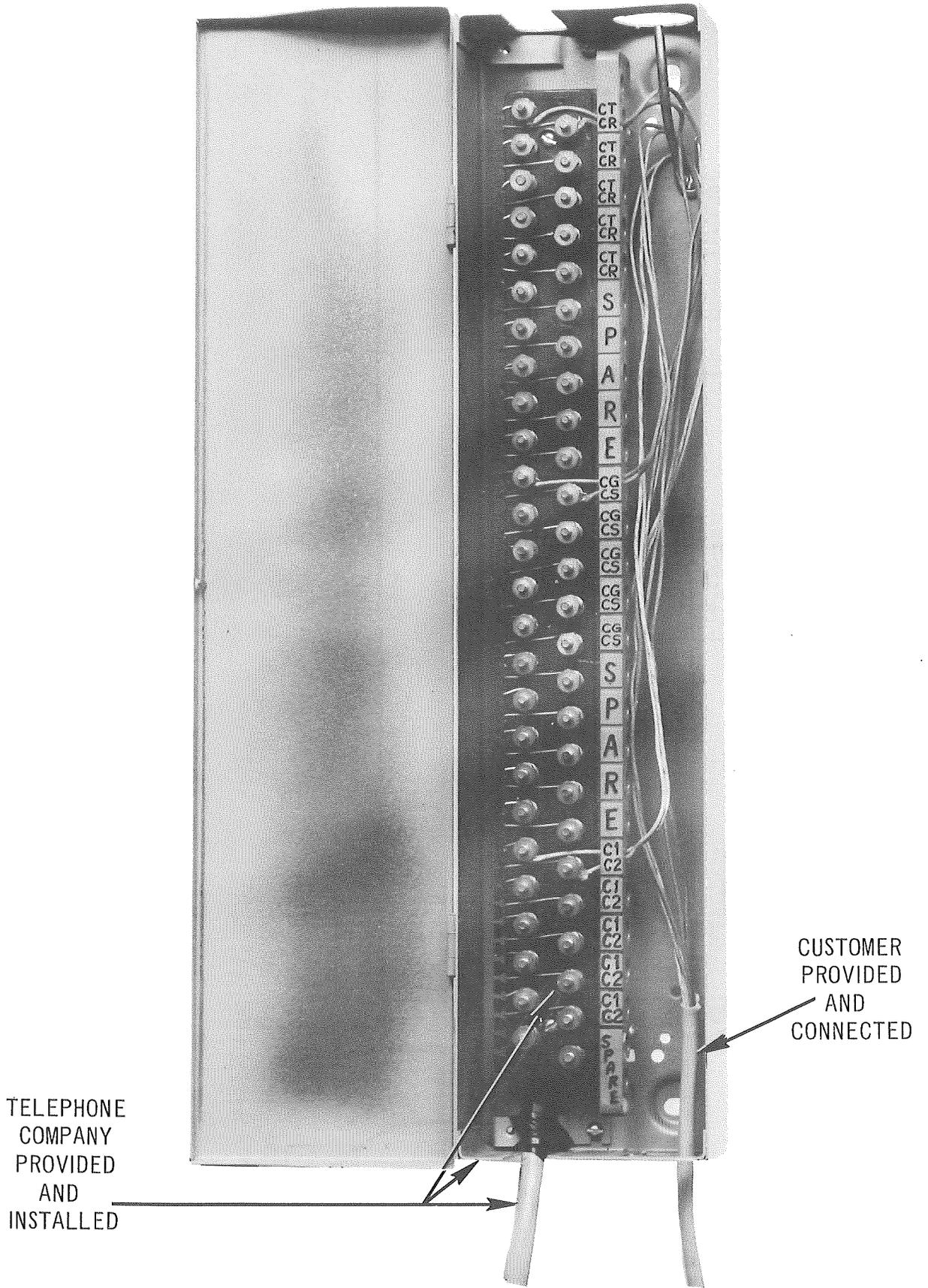


Network Control Signaling Unit
Figure 1A

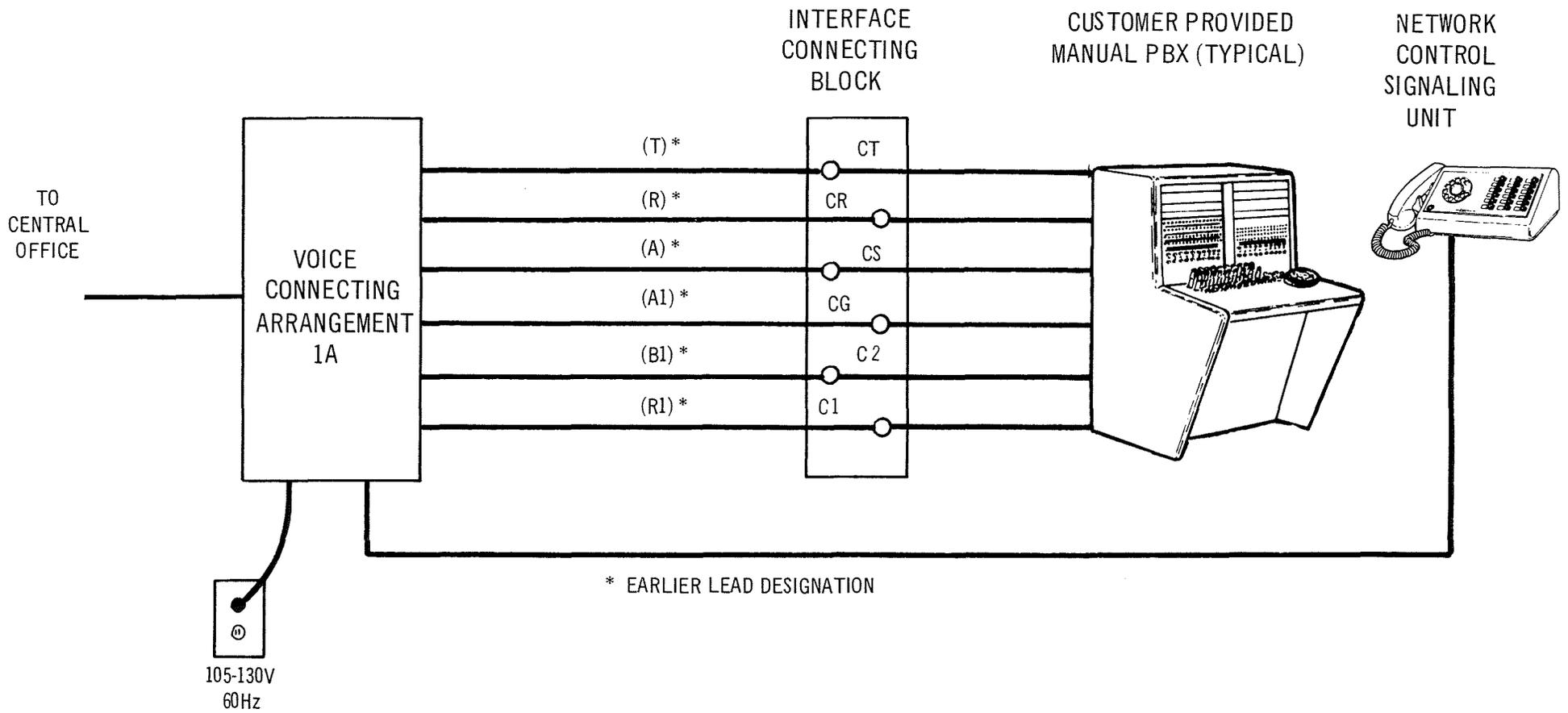


Voice Coupler Unit
Figure 1B

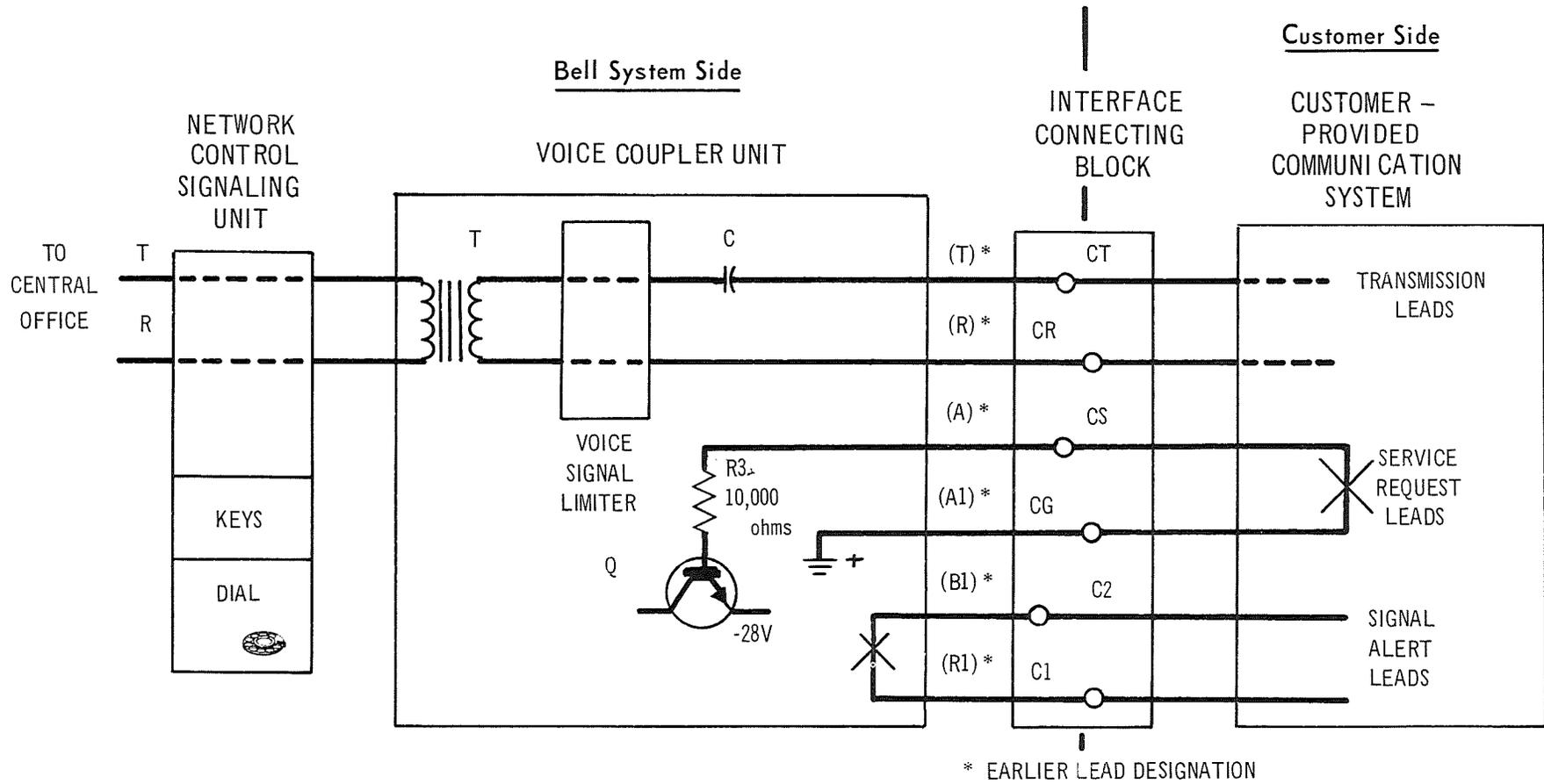
VOICE CONNECTING ARRANGEMENT 1A
Figure 1



Interface Connecting Block
Fig. 2



BLOCK DIAGRAM – VOICE CONNECTING ARRANGEMENT 1A
Figure 3



SIMPLIFIED SCHEMATIC – VOICE CONNECTING ARRANGEMENT 1A
Figure 4