PUB 42608

PRELIMINARY

Bell System Voice Communications

TECHNICAL REFERENCE

Connecting Arrangement

KTX

Interface Specification

October 1973

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 systems and equipment are set forth in the appropriate tariff regulations.

If further information is required, please contact:

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

TECHNICAL REFERENCE

CONNECTING ARRANGEMENT KTX

TABLE OF CONTENTS

LIST OF FIGURES

PRELIMINARY

CONNECTING ARRANGEMENT KTX

1. GENERAL

1.1 Introduction

F.C.C. tariffs and corresponding intrastate tariffs filed by the Bell System provide for the electrical connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to the Bell System telecommunications network. The tariffs also provide for the indirect (acoustic or inductive) connection of such equipment or systems. Both methods require compliance with network protection criteria given in the tariffs.

Electrical connection is made through a protective connecting arrangement furnished, installed, and maintained by the Telephone Company.

1.2 Application

Connecting Arrangement KTX provides a means for connecting customer-provided call restricting equipment to a central office line (e.g., local, foreign exchange or WATS line) or PBX station line terminated only in a Telephone Company-provided key telephone system (Fig. 1). The arrangement provides an indication to customer-provided equipment of the supervisory condition and address information (dial pulse and TOUCH-TONE® signaling) present on the line, and a means by which the customer-provided equipment may initiate a request to deny completion of an outgoing call from the key telephone station.

The supervisory and dialing information is provided to the customer-provided equipment through a high resistance connection to the central office or PBX station line. If a dry-contact type interface

is desired by the customer for detecting this information, the customer requires Connecting Arrangement RCX in addition to Connecting Arrangement KTX. Connecting Arrangement RCX cannot be used with TOUCH-TONE® telephone stations since no ac dialing (TOUCH-TONE®) information is available to the customer-provided equipment with that arrangement.

1.3 Ordering and Identification

The connection service described in this Technical Reference is identified by the Bell System as Connecting Arrangement KTX.

One Connecting Arrangement KTX should be ordered for each central office line or PBX station line for which call restricting capability is required. Contact your local Telephone Company business office or Marketing representative for information regarding rates for, and availability of, this connecting arrangement.

2. DESCRIPTION

2.1 Functions

The major functions of this connecting arrangement are:

(a) To protect Telephone Company personnel and facilities from potentially hazardous voltages which may be applied to the telecommunications network.

(b) To provide isolation from longitudinal imbalance.

(c) To indicate to customer-provided equipment, trunk status information, including supervisory and address (dial pulse and TOUCH-TONE signaling) information, through a high resistance connection to the line.

(d) To provide for accepting a request signal from customer-provided equipment to restrict completion of an outgoing call from the Telephone Company key telephone system.

2.2 Physical

Connecting Arrangement KTX consists of equipment mounted on one 8-inch circuit card for two connecting arrangements. The circuit card will be plugged into a panel which may be relay rack mounted with the key telephone equipment or housed in the apparatus mounting cabinet containing the key telephone equipment.# The associated -24 volt rectifier power supply is provided when the key telephone system power unit is inadequate to fill the total power requirement. The power supply requires a grounded outlet connection to a non-switched customer-furnished nominal 117 ± 12 volt, 60 ± 1 Hz source, fused at 15 amperes. The connecting arrangement will function satisfactorily within a temperature range of 0 to 55°C and a humidity range of 5 to 95 percent.

2.3 Interface Leads

Four, six or eight interface leads per circuit are provided from Connecting Arrangement KTX to the Interface Connecting Block for the customer's use (Fig. 1). Technical information pertaining to these leads is discussed in Section 4.

Pending availability of the arrangement described above an interim arrangement consisting of one 23 inch equipped mounting plate and two key telephone units mounted and powered as described for the permanent arrangement will be installed and will furnish identical service.

The leads and their functions are as follows:

Lead Designation	Function
CDPT, CDPR	Trunk status indicator to customer-provided equipment
CG, CS	Call denial request from customer-provided equipment
CTS	Customer tone signal
CTG	Customer tone ground
CBAT	Customer-provided -24 volt battery
CGRD	Customer-provided ground

Leads from this arrangement will be terminated on a Telephone Company-provided Interface Connecting Block conveniently located to permit testing, maintenance, trouble isolation, and ease of connection to the customer-provided equipment. The customer must provide and install the conductors and make the necessary connections of his equipment to the connecting arrangement at this block.

A typical Interface Connecting Block is shown in Fig. 2. This "quick connect" type "66" connecting block utilizes tinplated spring clip terminal strips which accommodate unstripped, polyethelene or polyvinyl chloride (8 mils max. thickness) insulated conductors of 20 to 26 AWG. A Reliable Electric R714B Tool or equivalent is used to press the insulated wire down into the slot. The spring pressure of the clip cuts away the insulation and makes the electrical connection. The Telephone Company will provide strapping wires or bridging clips between the second and third terminals of the block to interconnect the leads. The straps or bridging clips should be removed by

the customer's representative when it is necessary to test toward the customer-provided equipment and then replaced to restore the circuit to service.

The customer-provided equipment must be located so that the maximum external loop resistance, including contact resistance, across the call denial request leads measured at the connecting arrangement shall not exceed 50 ohms when indicating a closure. However, the distance between the connecting arrangement and the customer-provided equipment should be as short as possible to avoid interference between circuits since the terminating impedance on the CDPT and CDPR leads is high.

3. OPERATION

A simplified schematic drawing of this connecting arrangement is shown in Figure 3. Relay designations shown in parentheses are for corresponding relays provided in the interim arrangement. A station originating a call goes off-hook, placing a ground on the A lead. The A lead ground operates a relay which connects the CDPT and CDPR leads to the tip and ring of the line. The customer-provided equipment can then detect address signaling (Rotary or TOUCH-TONE®) over the high resistance bridged connection.

If the call is to be restricted, the customer-provided equipment should send a request to restrict signal by the completion of dialing of the sixth digit. To send this signal the customer-provided equipment momentarily closes CS to CG to operate the restrict relay. The restrict relay operated, opens the tip and ring to the central office, connects the

calling station to the output side of the isolating transformer and cuts through the customer-provided tone supply to the input side of the isolating transformer. The customer-provided equipment can send a distinctive restriction tone or announcement over the CTS and CTG leads or optionally over the CDPR and CDPT leads to the calling station. The call is abandoned to the central office and the line appears idle to incoming calls. When the calling station goes on-hook, the A lead ground is removed releasing the connecting arrangement. The circuit will then be in the idle state.

An incoming call occurring during the time the calling station is restricted will operate the ring detector circuit forcing release of the connecting arrangement. The incoming call will immediately terminate to the station that is off-hook.

4. SPECIFIC DESIGN CONSIDERATIONS

4.1 Line Status Indicator Path

The line status indicator path (CDPT and CDPR) provides a high resistance connection to both the ring and tip conductors of the associated central office line or PBX station line. This resistance consists of 100,000 ohms $\pm$ 3% in each interface lead of the line status indicator path and will, therefore, present a loss to voiceband and dc signals of up to 46 dB or more, depending on the impedance characteristics of the customer-provided equipment.

The line status indicator path provides a means for the customer-provided equipment to detect, through the resistors in each interface lead, the dc and ac status of the line, including supervisory and address information (dc dial pulse and TOUCH-TONE signaling) at all times while the line is in use. The supervisory signals (which consist of "on-hook", indicating an idle or disconnect condition; "off-hook", indicating a request for service by a calling party or an answered call by a called party; and "switchhook flash", indicating operator recall to a connection) and dc dial pulse address information can be detected as dc voltage level differences across the CDPT and CDPR leads. TOUCH-TONE address information consists of two voiceband frequencies for each digit, as discussed in Section 4.16. The supervisory and address signal levels become a function not only of the customer-provided equipment termination but also a function of the length of the loop from the connecting arrangement to the serving central office or PBX and the station originating the outgoing call. For this reason, details cannot be given on the exact voltage levels that will be encountered in any particular installation.

These leads are to be used by the customer-provided equipment to receive information on the status of the line being monitored and, at the customer's option to apply a distinctive call restricting tone toward the calling station when the connecting arrangement is in the restricting mode. Signal power applied to these leads must not exceed +1 dBm. If the signal power on leads CDPT and CDPR or CTG and CTS,

during the restrict mode, exceeds +1 dBm, a non-linear limiting device is shunted across these leads resulting in distortion of the signal.

Leads CTS and CTG may be used to apply the restricting tone to the station when the customer-provided equipment requires separation of the sensing and tone leads.

4.11 Call Denial Request Path

The call denial request leads (CG and CS) provide a means of initiating a request from the customer-provided equipment to deny completion of an outgoing call from the Telephone Company-provided key telephone system. The CS lead has a maximum potential of -26 volts dc through a 750 ohm relay. The CG lead is grounded at the connecting arrangement. This lead shall not be used by the customer to ground his equipment.

The call denial request pair will offer the customer-provided equipment a maximum noninductive load of 38.0 milliamperes.

The minimum open circuit insulation resistance of the customer-provided equipment between the CG and CS leads, and from either lead to ground, should be 100,000 ohms. The maximum external loop resistance including contact resistance across the CG and CS leads measured at the connecting arrangement toward the customer-provided equipment shall not exceed 50 ohms when indicating a closure.

The closure on these leads, when given, shall be provided only during the interval following the receipt of the first through sixth digits of the number dialed to insure that the call is not completed (answered) and, therefore, billed.

The closure shall not be less than one second in duration, and the minimum open interval between successive closures shall not be less than 50 milliseconds. Only one call denial request is possible with each contact closure on the CG and CS leads and, therefore, the contact closure must be opened and reclosed for each call denial request. Once the contact closure is removed for any interval of time, it shall not be reclosed except during the acceptable time interval discussed above and only on calls required to be denied completion. If provided at other times, in some instances it can result in the abandonment of a call in progress.

4.12 Battery Ground

Leads CBAT and CGND may be used, at the customer's option, to supply his own -24Vdc potential and ground to the CDPT and CDPR leads in the idle condition to simulate the on-hook line condition.

4.13 Line Conditions

The following paragraphs describe in general terms the conditions that occur on a Central Office or PBX line. This information is not intended to be all inclusive but is intended as a guide to assist designers of equipment that will be used with Connecting Arrangement KTX. In all cases the conditions described are those existing on the line side of the connecting arrangement. The degree to which the values given would be altered by the high resistance of the line status indicator path is a function of the input impedance of the customer-provided equipment.

4.14 Loop Start

This type of facility is used for all central office or PBX station lines terminated in Telephone Company-provided key telephone systems. Figure 4 shows a simplified schematic of a typical loop start line. The connecting arrangement would generally be connected into the line close to the key telephone system equipment.

The exchange loop polarity is normally negative on the ring side and positive on the tip side. However, the line may be exposed to polarity reversals during the progress of a call in some cases. Polarity reversals, if present, will appear on the CDPT and CDPR leads.

In the off-hook condition, the dc voltages applied to the line status indicator leads will be reduced by the battery feed resistance and the resistance of the line. The loop resistance of most central office lines is 1300 ohms or less. However, loop resistances of up to 2500 ohms may be encountered in some cases.

In the process of establishing a talking path, the central office or PBX circuit through which dc current is supplied changes conditions and in addition line tests are made which can interrupt or "open" the line current. The length of open intervals that a line can expect to encounter depends on the type of office, class of service, and the progress of the call. Most offices will not generate opens longer than 300 ms. In some

offices, however, the length of the open is traffic-dependent and unbounded. Consecutive switching system initiated opens longer than 100 ms, however, are not expected to occur with less than 100 ms separation.

4.15 DC Dial Pulse Signaling

In general, dc dial pulses, which also appear as open line current intervals, are generated at the telephone set at a nominal rate of 10-pulses per second, with a minimum of 8- and a maximum of 11-pulses per second. The percent break is a minimum of 58 percent and a maximum of 64 percent. The minimum interdigital time is 600 milliseconds (see Figure 5).

4.16 TOUCH-TONE Address Signaling

The signaling code for the Bell System TOUCH-TONE calling system provides for 16 distinct signals. Each signal is composed of two voice-band 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

These address signals can be expected to have the following characteristics at the originating station:

A. Frequency Deviation

Tone frequencies are within ± 1.5 percent of their nominal values.

B. Voice Energy Suppression

Voice energy from the telephone transmitter or other source is suppressed at least 45 dB below the signal power measured at the telephone set during tone signal transmission. In the case of automatic dialing, the suppression is maintained continuously until pulsing is completed.

C. Rise Time

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

D. Pulsing Rate

Minimum duration of two-frequency tone signal:	50 ms
Minimum interdigital time:	45 ms
Minimum cycle time (period):	100 ms

4.17 Longitudinal Balance

It is expected that the customer-provided detection device will present a balanced circuit to the CDPT and CDPR connecting arrangement interface leads to minimize the possibility of introducing longitudinal noise to the line facility. That is, each conductor should have equal impedance to ground. Balanced operation will also insure that the customer-provided equipment is not subject to longitudinal noise that may be present on the telephone facility.

The customer-provided device should maintain balance within 6,000 ohms.

4.2 Grounding

Connecting Arrangement KTX requires a common signal ground (a metallic cold water pipe or other ground in accordance with applicable electrical codes, such as the National Electrical Code) which is always bonded to the electric power ground and telephone protector ground, where present. Although the CG lead of the call denial request pair is grounded at the unit, it is not permitted to derive the main ground for the customer's equipment through this lead from the connecting arrangement. The general grounding requirements for the customer-provided equipment are covered in Paragraph 5.2.

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 at the PBX that will provide a path to ground for foreign voltages that exceed about 800 volts peak. Since the customer's equipment is connected to the telephone line through the connecting arrangement, the customer's equipment is isolated from longitudinal and metallic surges by the high impedance consisting of 100,000 ohms bridged separately to the tip and ring conductors while the line is in use.

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 connecting arrangement.

5.2 Grounding

It is expected that the customer's equipment, if powered from commercial power, will be grounded in accordance with applicable electrical codes, e.g., National Electrical Code (NEC) and should be bonded to the ground electrode to which the telephone protector is grounded but not using the telephone ground clamp. Self-powered or passive customer's equipment need not be grounded. Provisions should be made within the customer's equipment for connecting together all internal signal grounds. This connection shall be isolated from both the grounding (green) conductor run with the power supply primary conductors and the chassis or frame of the customer-provided equipment.

The customer's signal ground may be obtained with a proper connection to a metallic cold water pipe, using a single No. 14 AWG, or larger copper conductor. The other end should be connected to the ground return terminal of the customer's equipment. The run should be short, straight, and a continuous piece of wire. 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 or ground electrode as the telephone protector or signal ground lead but not using the Telephone Company ground clamp. This lead shall not be fused.

6. SERVICE AND MAINTENANCE CONSIDERATIONS

6.1 Responsibility of the Customer

The tariffs permitting connection of customer-provided terminal equipment or communications systems to the telecommunications network by means of a protective connecting arrangement state that where long distance message telecommunications service is available under these tariffs for use in connection with terminal equipment or communications systems provided by a customer, 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 system or facilities, or otherwise injure the public in its use of the Telephone Company's services. Upon notice from the Telephone Company that the equipment or systems 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 permitting connection of terminal equipment and communications systems provided by a customer 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 protective connecting arrangements and network control signaling units, suitable for private line or 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, or (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) Connecting arrangement service code KTX

(e) Description of the trouble

(f) Customer's contact for additional information

If a Telephone Company service call results in the location of the trouble in the customer-provided equipment, the customer will be charged for the service call. The Telephone Company does not maintain or repair the customer-provided equipment.

PRELIMINARY

APPENDIX A

GLOSSARY

ADDRESS SIGNALS - denotes dc dial pulses or appropriate pairs of TOUCH-TONE signals, transmitted to a Central Office, that represent the telephone number of the distant party.

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

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 EQUIPMENT - devices or apparatus and their associated wiring, provided by a customer, which do not constitute a communications system and which, when connected to Telephone Company equipment, are so connected either electrically, acoustically, or inductively.

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

INTERFACE CONNECTING BLOCK - the Telephone Company-provided connecting point to which the customer brings and connects the leads of his equipment and to which the Telephone Company brings and connects leads from the 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, both rotary and tone signaling), 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.

OFF-HOOK SUPERVISION - indicates that the telephone is answering or originating a call.

ON-HOOK SUPERVISION - indicates that the 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.

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).

TELECOMMUNICATIONS NETWORK - the Bell System voice switching equipment, associated interconnecting 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.

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.

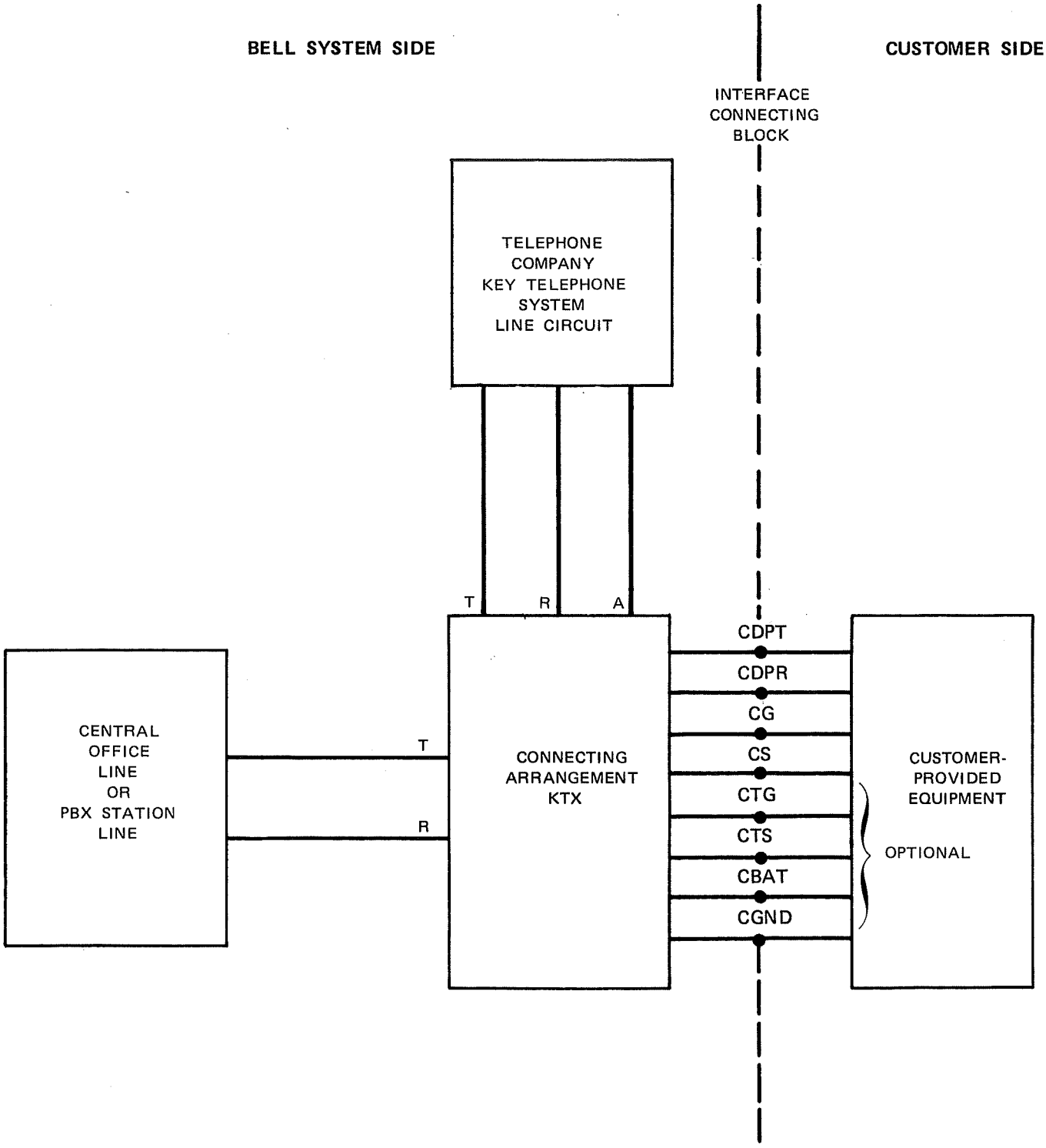
***(j) "Notes on Distance Dialing - 1968," by American Telephone and Telegraph Company, New York, New York.

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

**Available through Americal Telephone and Telegraph Company
Supervisor - Information Distribution Center
195 Broadway, Room 208
New York, New York 10007

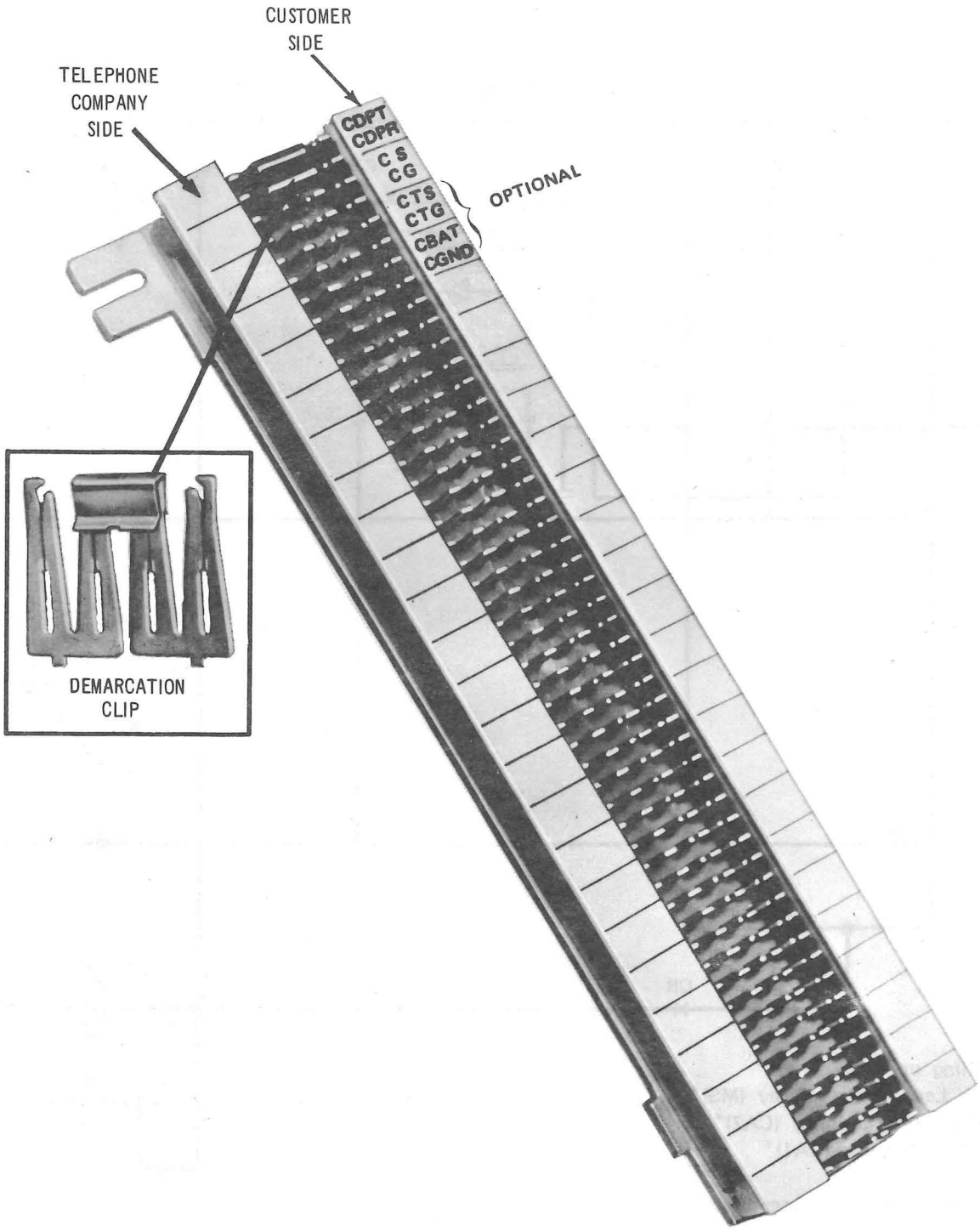
*** Available through Western Electric Company, Inc.
Commercial Relations
P.O. Box 1579
Newark, New Jersey 07102

Available through United States Independent Telephone Association
Washington, D. C.

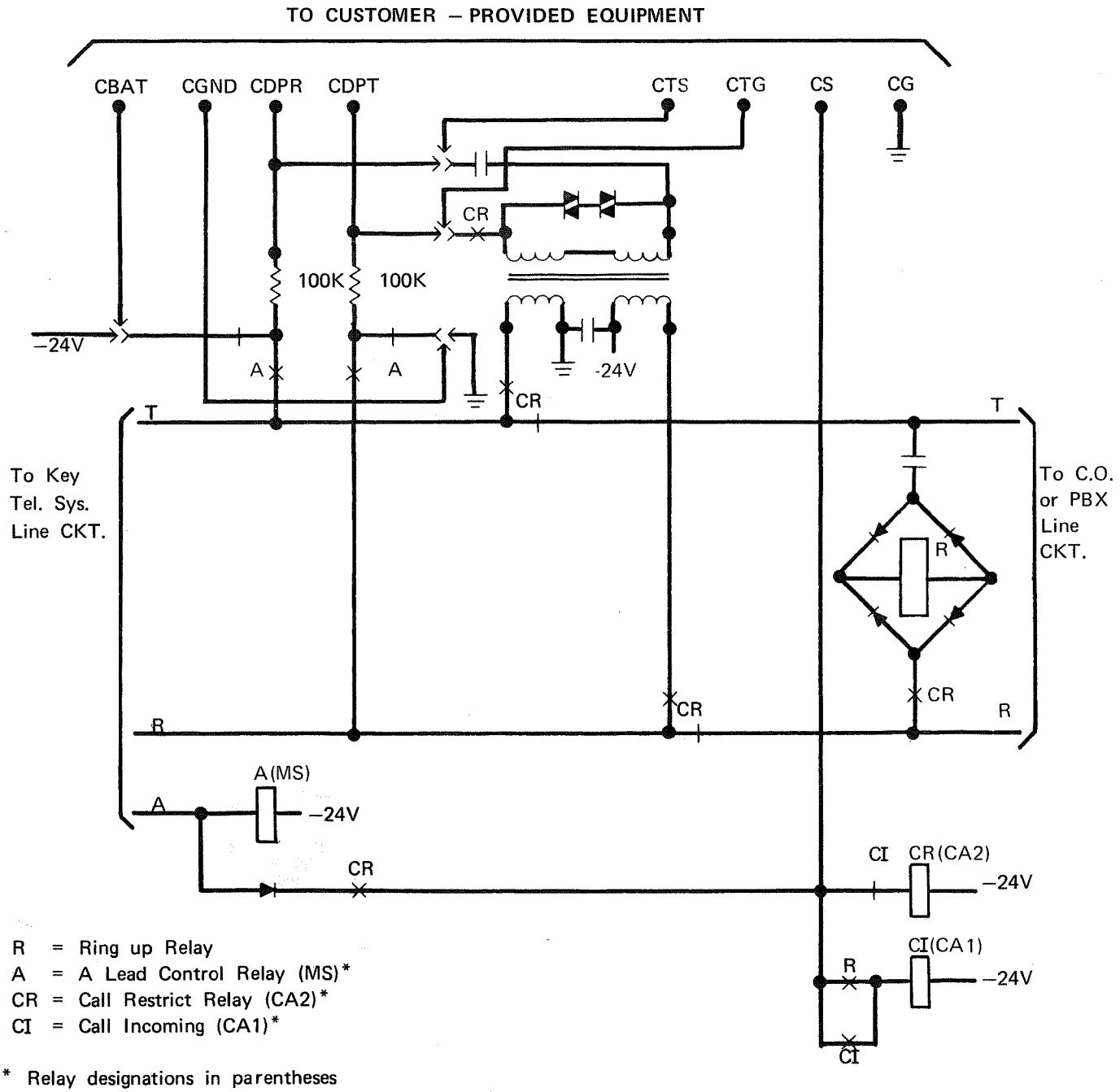


BLOCK DIAGRAM – CONNECTING ARRANGEMENT KTX

FIG. 1



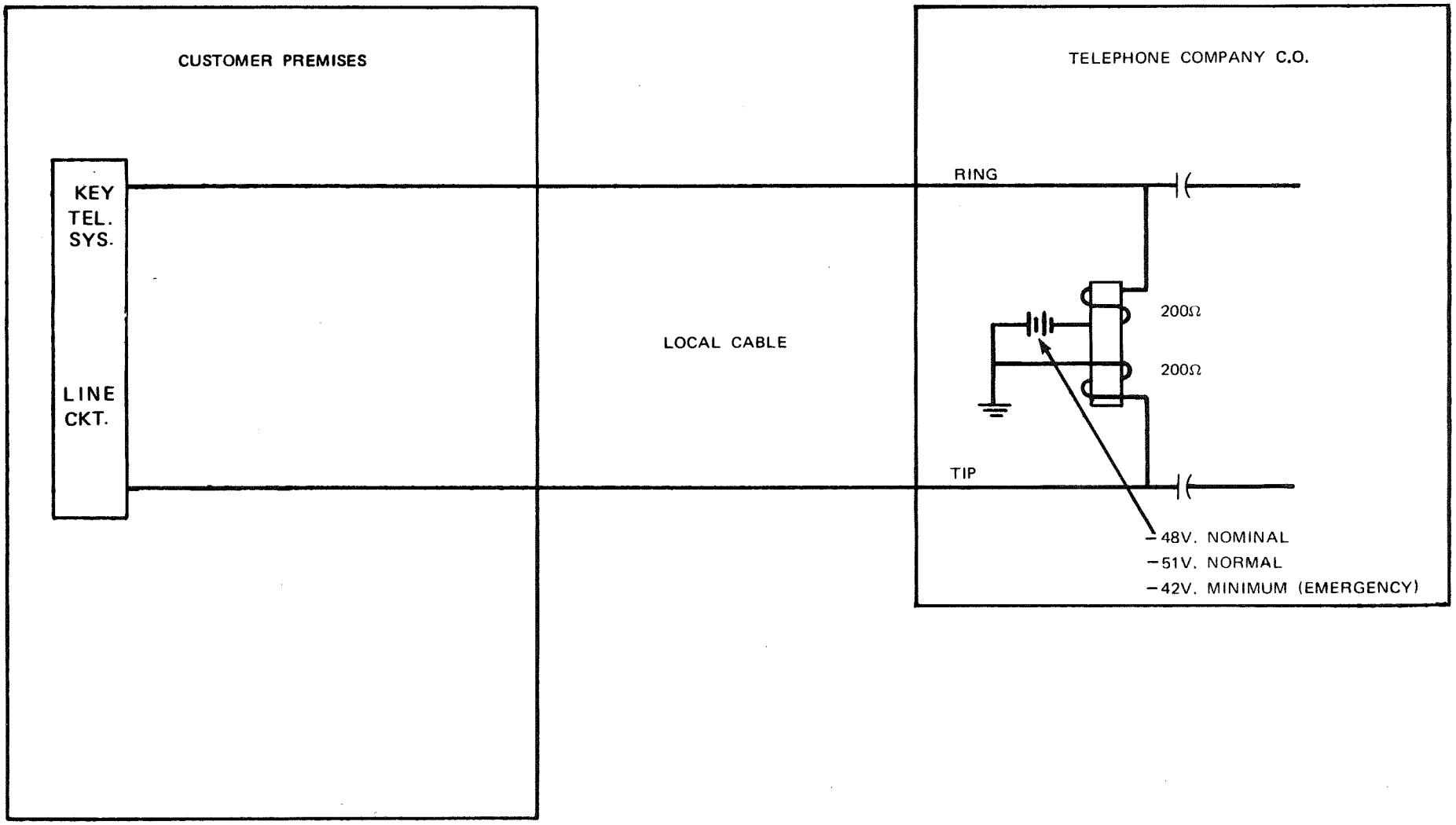
TYPICAL INTERFACE CONNECTING BLOCK
FIG. 2



R = Ring up Relay
A = A Lead Control Relay (MS)*
CR = Call Restrict Relay (CA2)*
CI = Call Incoming (CA1)*

* Relay designations in parentheses are for the interim arrangement.

SIMPLIFIED SCHEMATIC
CONNECTING ARRANGEMENT KTX
FIG. 3

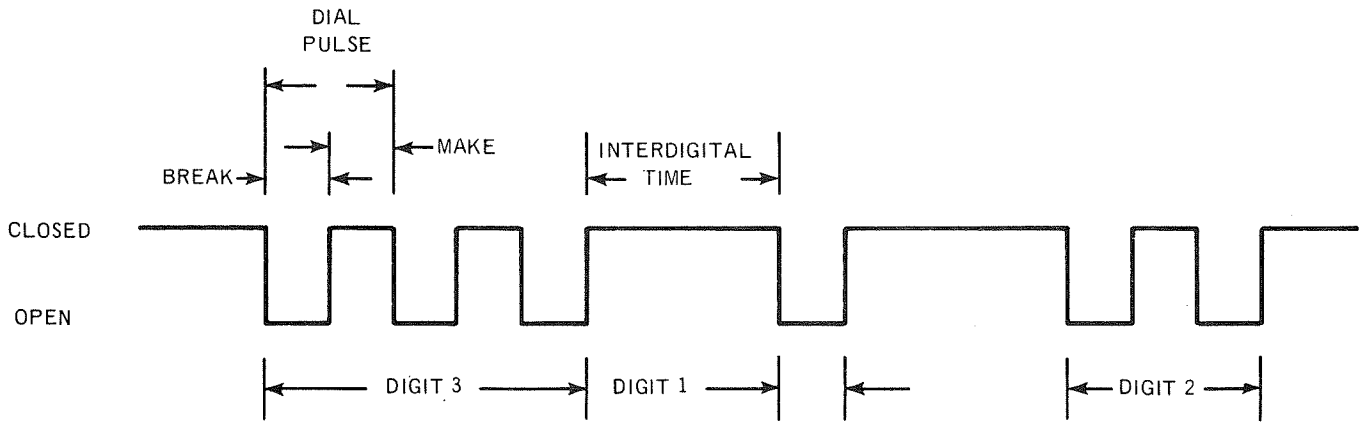


PRELIMINARY

TYPICAL CENTRAL OFFICE BATTERY FEED CIRCUIT

FIG. 4

TYPICAL PATTERN OF DIAL PULSES EXPECTED FROM CALLING STATION
OVER LEADS CDPT AND CDPR (WHEN DIALING NUMBER 312)



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

CONNECTING ARRANGEMENT KTX
DIAL PULSE CHARACTERISTICS
FIG. 5