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PRELIMINARY

Bell System Voice Communications
TECHNICAL REFERENCE

Connecting Arrangement

AD1

Interface Specification

October 1974

ENGINEERING DIRECTOR – CUSTOMER EQUIPMENT SYSTEMS

PRELIMINARY

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TECHNICAL REFERENCE

CONNECTING ARRANGEMENT AD1

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CONNECTING ARRANGEMENT AD1

1. GENERAL

1.1 Introduction

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

1.2 Application

Connecting Arrangement AD1 provides the means for automatically connecting a customer-provided dc dial pulse repertory dialer, which requires no voice transmission path, to the telecommunications network via a station line to a local, foreign exchange, or WATS central office or PBX/Centrex station line. An associated Telephone Company - provided telephone set performs all of the other normal telephone station functions, e.g., voice transmission, switchhook, manual dialing, and ringing.

Connecting Arrangement AD1 supplements Voice Connecting Arrangement SU7QW which is described in Technical Reference - Voice Connecting Arrangement SU7QW. Connecting Arrangement AD1 provides the basic features required for connection of customer-provided dialers but does not provide auxiliary features such as receiver muting during dial pulsing or the option of a customer-provided source of power to operate the connecting arrangement. Where these features are required, Voice Connecting Arrangement SU7QW should be specified.

1.3 Ordering and Identification

The protective connection service described in this Technical Reference is identified by the Bell System as Uniform Service Order Code (USOC) AD1. When ordering this service, the customer should specify this code. One connecting arrangement should be ordered for each telephone set which is to be connected to the customer-provided equipment. The local Telephone Company business office or Marketing representative will provide information regarding availability and rates for this service.

2. DESCRIPTION

2.1 Functions

The major functions of this connecting arrangement are:

(a) To protect Telephone Company personnel and facilities from hazardous voltages which may be applied at the interface.

(b) To provide isolation against longitudinal imbalance.

(c) To provide for network control signaling to the telecommunications network, e.g., dc dial pulses, on-hook and off-hook signals.

(d) To provide fail-safe protection in case of failure of dialer or loss of power.

2.2 Physical

Connecting Arrangement AD1 consists of a coupler which is a printed circuit board assembly contained in an apparatus box measuring approximately 4 inches high, 2-3/4 inches wide, and 1-7/8 inches deep (Figure 1). The coupler, which weighs about eight ounces, has a metal base and a molded

plastic cover. Since it contains a mercury relay it must be mounted on a stable flat surface in a vertical position.

External screw terminals are provided for connection of the leads from the customer-provided dialer. Internal screw terminals are provided for the Telephone Company installer to make connections to the telephone line, associated telephone set, and the power transformer which plugs into a 110V ac outlet.

2.3 Interface Leads

Two interface leads, A and B, (Fig. 2) are terminated externally on screw terminals and are to be used by the customer to terminate the pulsing leads from his dc dial pulse dialing equipment.

3. OPERATION

3.1 Incoming Call from the Central Office

The coupler does not respond to nor affect incoming calls from the central office. Incoming calls are handled using the associated Telephone Company-provided telephone set in the normal manner.

3.2 Outgoing Call to the Central Office

To make an outgoing call with the customer-provided repertory dialer (assuming power has been applied to the connecting arrangement, and leads A and B are closed), the customer removes the handset of the associated Telephone Company telephone set and, after receiving dial tone, operates the dialer to outpulse the desired telephone number. The dialer pulsing contacts open and close leads A and B causing relay D (Fig. 2) to open and close the pulse leads G and G1 connected to the telephone line.

To prevent a false dial pulse, power must be applied to the connecting arrangement and leads A and B must be closed before the associated telephone set goes off-hook. If a power failure occurs, or if the customer's dialing contacts fail to close, or if the customer-provided dialer is disconnected, the D relay will release, if operated, and close the line to the associated telephone set permitting manual dialing. Thus, the customer, even under these conditions, has full use of his normal telephone service.

3.3 Disconnect

To disconnect a call established using Connecting Arrangement ADl, the customer replaces the handset of the associated telephone set.

4. SPECIFIC DESIGN CONSIDERATIONS

4.1 Transmission Path

No voice transmission or tone address signaling path is provided by the coupler. All transmission functions are provided by the associated Telephone Company-provided telephone set.

4.2 DC Signaling Paths

4.21 Dial Pulse (Leads A and B)

Leads A and B should be normally closed and are used to provide a path for customer-provided dial pulses which, in order to register properly in any type of Bell System switching equipment, must meet the following criteria (see Fig. 3):

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

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

(c) Minimum make: 34 milliseconds*

(d) Minimum break: 55 milliseconds*

*Minimum make and minimum break shall not occur in the same pulse.

(e) Interdigital time: 600 milliseconds minimum

(f) Contact bounce: 1 millisecond maximum total interval on make or break. Since the response time of the connecting unit is very short, any improper break or chatter by the customer's dialing contacts will be repeated on the telephone line.

Customer-provided connecting leads and contacts (or transistor switches) across leads A and B should have a maximum total resistance (closed circuit) of 50 ohms maximum and a minimum insulation resistance (open circuit) of 500k ohms. The open circuit voltage across leads A and B is 35 volts maximum and the short circuit current is 10 milliamperes maximum.

4.3 Power Supply

Power for the coupler is furnished and installed by the Telephone Company. It is provided by a low voltage, current-limited transformer plugged into a 60 Hz, 117 volt ac outlet provided by the customer. The outlet should not be under the control of a switch. The transformer output is connected by the Telephone Company installer to the terminals in the coupler.

4.4 Grounding

Connnecting Arrangement AD1 is normally ungrounded and customer-provided signaling and power supply ground connections to the protective connecting arrangement should be isolated from ground. It is expected that the customer's equipment where required will comply with applicable electrical codes, e.g., National Electrical Code (NEC).

5. GENERAL DESIGN CONSIDERATIONS

5.1 Foreign and Surge Voltage Protection

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

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

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

6. SERVICE AND MAINTENANCE CONSIDERATIONS

6.1 Responsibility of the Customer

The tariffs which provide for the connection of customer-provided equipment state that where long distance message telecommunications service is available under these tariffs for use in connection with customer-provided equipment, 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 customer-provided equipment does 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 equipment 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.

6.2 Responsibility of the Telephone Company

The Telephone Company shall not be responsible for the installation, operation or maintenance of any customer-provided terminal equipment. Long distance message telecommunications service is not represented as adapted to the use of customer-provided equipment and where such equipment is connected to Telephone Company 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 defects in such transmission, (ii) the reception of signals by customer-provided equipment, 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 or otherwise 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 equipment obsolete or require modification or alteration of such equipment or otherwise affect its use or performance.

6.3 Trouble Reporting Procedure

Maintenance of equipment supplied by the Telephone Company shall be done only by the Telephone Company. When trouble is experienced with this service, the customer should disconnect the dialer to determine whether the

service impairment is located in the customer-provided equipment or in the equipment provided by the Telephone Company. If the dialer is determined to be defective, the customer shall immediately discontinue its use until such time as the customer has it repaired. If the tests indicate that the trouble is in the Telephone Company-provided equipment, a trouble report should be promptly referred to the Telephone Company "Repair Service" whose number can be found in the front of the telephone directory. The repair attendant should be given:

(a) Customer's name

(b) Customer's address

(c) Listed telephone number

(d) Description of the trouble

(e) Uniform Service Order Code (USOC) AD1

(f) Customer's contact for additional information

If a Telephone Company premises visit results in a finding that the reported location of the trouble is not caused by Telephone Company equipment or facilities, the customer will be so notified and will be responsible for the payment of a service charge for the visit as stated in the applicable tariffs.

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APPENDIX A

GLOSSARY

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

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

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

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

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

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

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

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

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

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

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 or rering); 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 central office switching equipment, associated interoffice and intraoffice facilities, and terminal equipment which provide Long Distance Message Telecommuncation Service or private line service.

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

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

PRELIMINARY

APPENDIX B

REFERENCES

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

*(a) Gresh, P. A., "Physical and Transmission Characteristics of Customer Loop Plant," Bell System Technical Journal (BSTJ), Vol. 48, No. 10 (December 1969), p. 3337.

*(b) Breen, C., and Dahlbom, C. A., "Signaling Systems for the Control of Telephone Switching," BSTJ, Vol. 39, No. 6 (November 1960), p. 1381.

*(c) Bodle, D. W., and Gresh, P. A., "Lightning Surges in Paired Telephone Cable Facilities," BSTJ, Vol. 40, No. 2 (March 1961), p. 547.

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

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

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

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

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

*These journals may be purchased by writing to:

Bell Telephone Laboratories, Inc.
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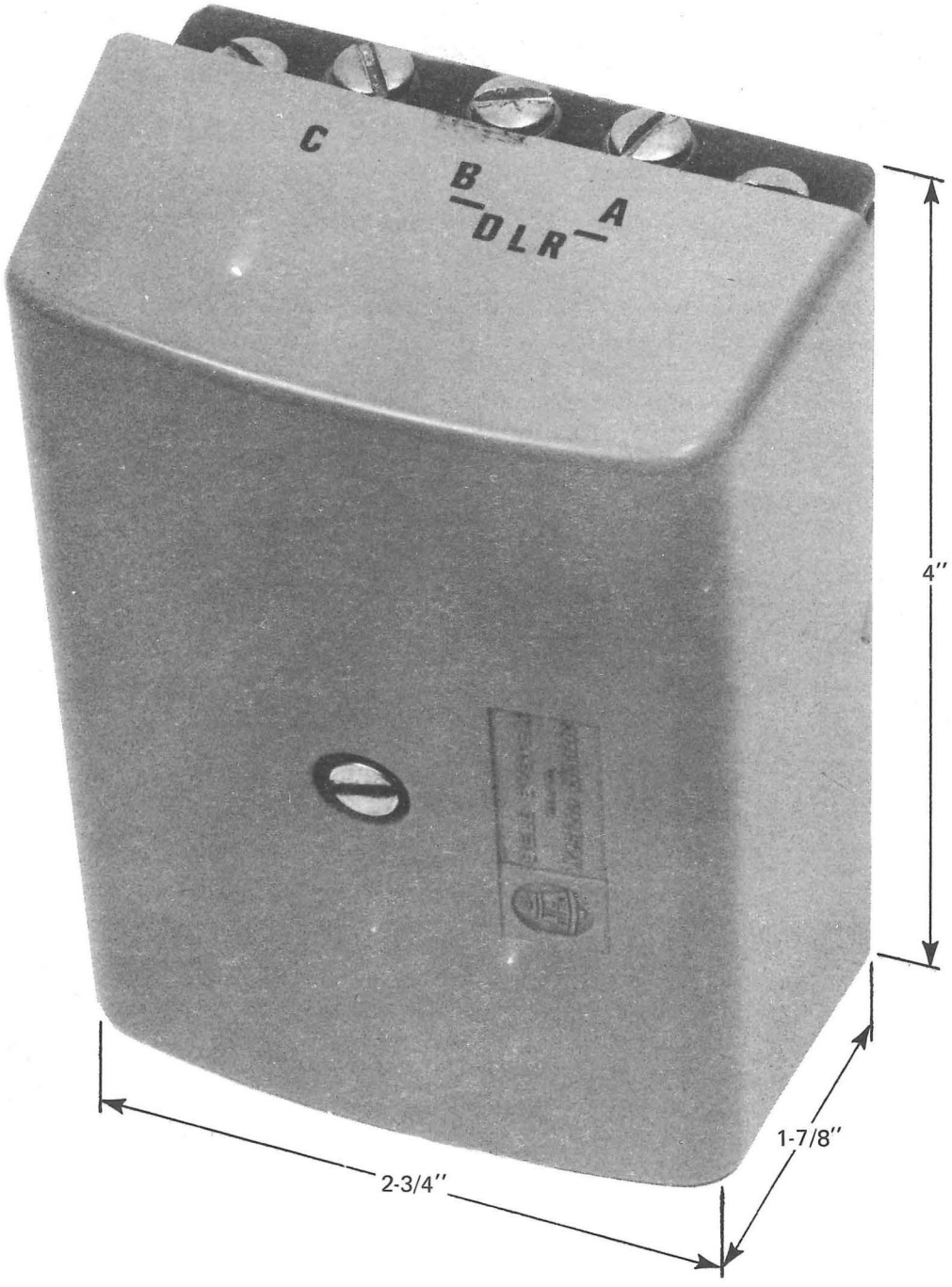
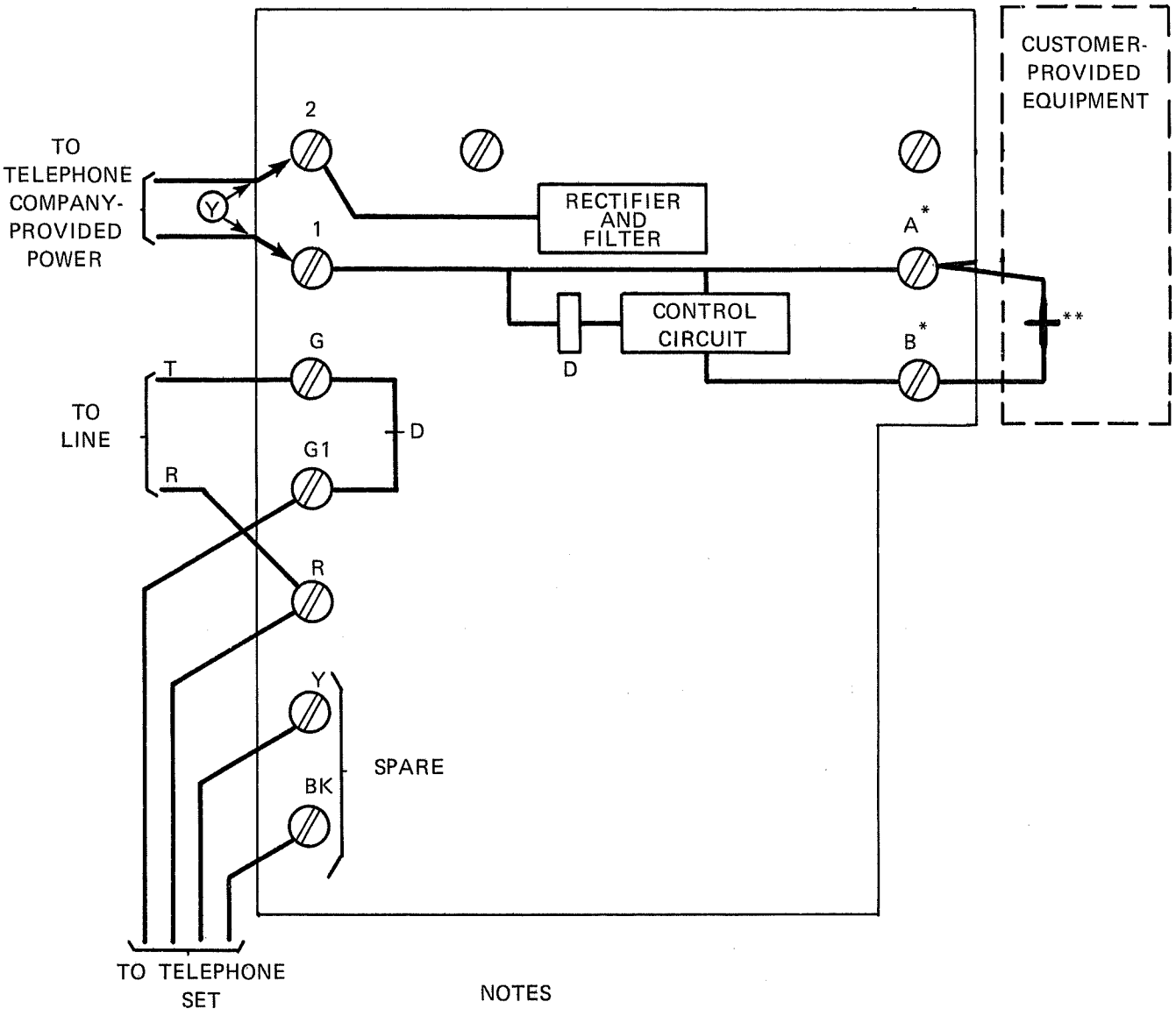
New York, New York 10007



CONNECTING ARRANGEMENT AD1
FIG. 1



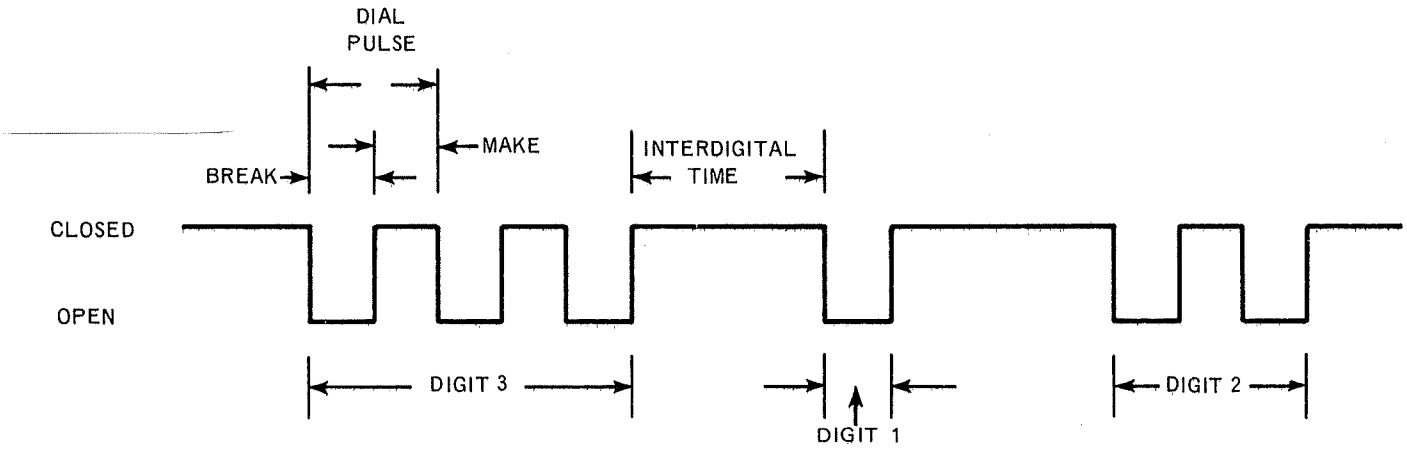
NOTES

* DENOTES CUSTOMER INTERFACE TERMINALS ON CONNECTING ARRANGEMENT.

**NORMALLY CLOSED CONTACT.

BLOCK DIAGRAM AND SIMPLIFIED SCHEMATIC
CONNECTING ARRANGEMENT AD1
FIG. 2

TYPICAL PATTERN OF DIAL PULSES EXPECTED FROM CUSTOMER – PROVIDED EQUIPMENT
OVER LEADS A AND B (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 AD1
DIAL PULSE CHARACTERISTICS
FIG. 3