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Bell System

TECHNICAL REFERENCE

DATA SET 401J

INTERFACE SPECIFICATION

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Bell System Data Communications

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ENGINEERING DIRECTOR - TRANSMISSION SERVICES

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1. GENERAL DESCRIPTION

1.01 The Data Set 401J is a multi-frequency data receiver intended to be used with any of the 401 type transmitters for one-way transmission of alpha-numeric information over the switched telephone network ("DATA-PHONE" Service). This set may be used on private leased lines if desired. A "TOUCH-TONE" telephone may serve as a data transmitter into the 401J receiver if the transmitter of the TT telephone is excluded during the data mode and the "C" group data contacts are ignored.

1.02 The 401J receiver will deliver contact closures electrically to the customer's apparatus at any rate up to twenty characters per second any of the 99 possible characters which may be sent from a 401 transmitter. These characters will be of the same nature as those applied to the transmitters since the 401J is an ungated receiver.

1.03 Two separate tone answer-back channels are provided on a one-way basis. This version is coded 401J2. A second version of the 401J receiver also includes the capability for providing a one-way voice answer-back channel. This version is coded 401J3. Provisions are made for remotely testing the data set from a Telephone Company data test center.

1.04 The 401J receiver is arranged to work with Automatic Calling Units. Also, it provides for attended or unattended reception of data signals. Normal voice telephone service is also available with the ability to operate the data set with certain key telephone systems.

1.05 Indication of ringing on the line, signaling an incoming call, can be given to the customer over the ring indicator interface lead. An alternate option for using this lead will allow the customer to signal the line that the station is out of service. This would generally be desirable when a number of receivers are used in a receive only group. If the customer intends to operate this way, he must order telephone line arranged for "receive only" service at the earliest possible date (special central office or PBX equipment is required).

1.1 PHYSICAL CHARACTERISTICS

1.11 The Data Set 401J consists of a data receiver and a voice telephone combined in a single unit. This unit measures 10-3/4 inches wide, 14-1/2 inches deep, and 5-1/2 inches high (with handset in place); it weighs about 22 pounds (Figure 1). The Data Set 401J must be mounted horizontally.

1.12 Keys are provided on the data set for control of the data set.

1.13 Two cords are furnished with the data set. One is a 10-foot, 3 conductor power cord for connection to a three-wire 117-volt receptacle. The other cord is used for connecting the data set to the telephone line.

1.2 CODES

1.21 The Data Set 401J provides 14 channels divided into three groups, two of which contain five channels and the third group which contains four channels. The permissible characters that may be detected by this receiver are those which operate one and only one channel from each of the three groups. Thus the receiver accepts and delivers a restricted three-out-of-fourteen code allowing a total of 100 (5 × 5 × 4) states. When used in conjunction with a 401 type data transmitter the channels A., B., and C. are used as an intercharacter separator thus allowing 99 possible characters for data information. For detail information on the 401 type data transmitter, please refer to the Bell System Data Communications Technical Reference for for the particular transmitter.

1.22 The arrangement of the data channels is as follows:

Group	Channel
A	A0
A	A1
A	A2
A	A3
A	A4
B	B0
B	B1
B	B2
B	B3
B	B4
C	C0
C	C1
C	C2
C	C3

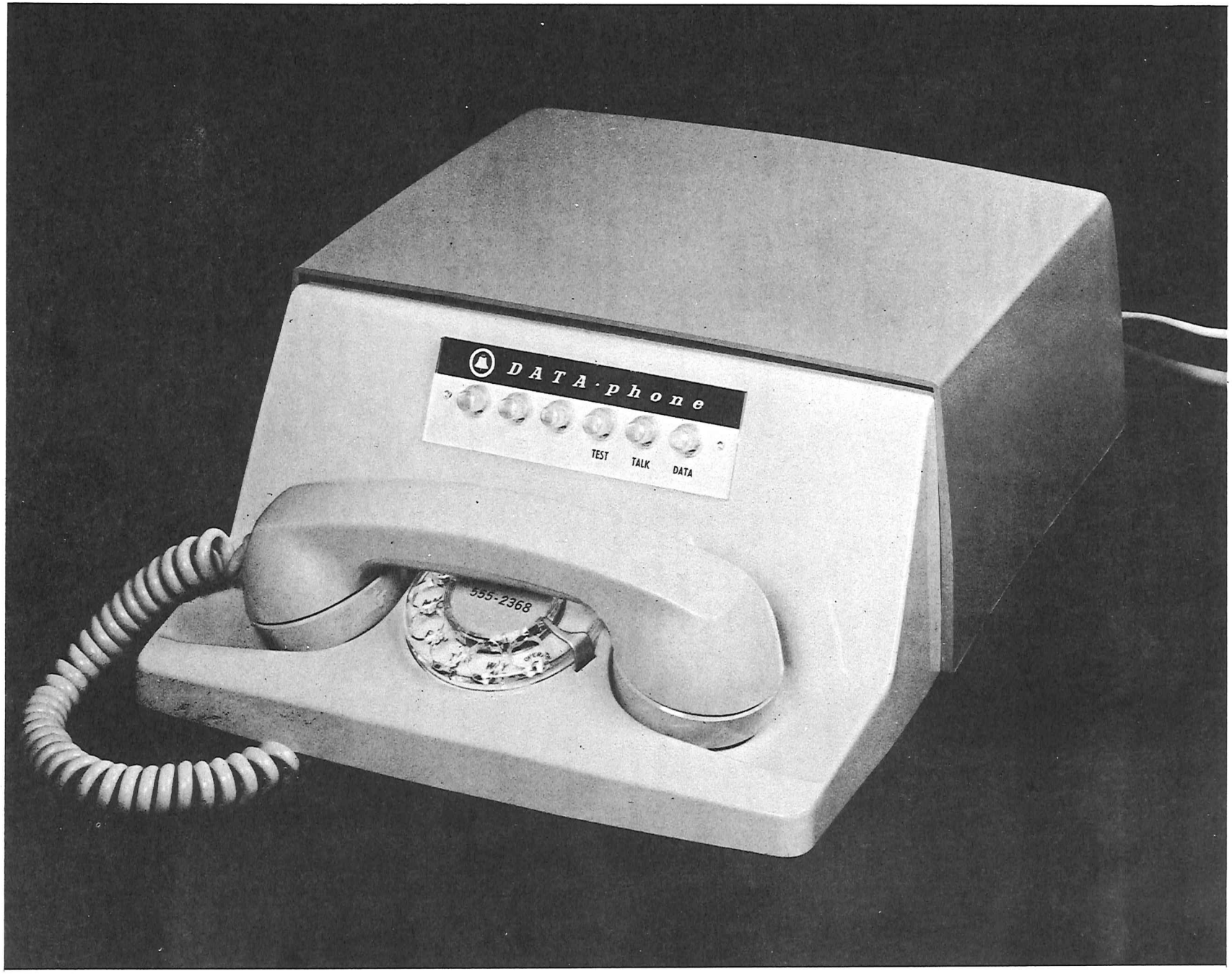

Fig. 1 Data Set 401J

1.3 POWER REQUIREMENTS

The 401J receiver requires about 10 watts of power from a 117-volt, 60 cycle a.c. source furnished locally by the customer. Connection to the power source is made by means of the power cord previously described.

1.4 ENVIRONMENT

This set will operate satisfactorily over most of the circuits in the switched telephone network. It will operate over a temperature range of 40° F to 120° F and a relative humidity range of 20% to 95%.

1.5 TEST FEATURE

A TEST key is provided to permit the customer to enable test circuits within the data set, thereby allowing the remote testing of the data set from a Telephone Company test center. A lamp under the TEST key indicates when the data set is in the test mode. The data set is automatically released from the test mode by the Telephone Company test center upon completion of the tests. The customer may release the data set from the test mode should it inadvertently be placed in the test mode by depressing the DATA key.

1.6 TONE ANSWER-BACK

1.61 The 401J receiver is capable of transmitting two audible tones of 1017 and 1785 cycles per second. One or the other of these may be transmitted by means of contact closures in the customer's equipment, but not both at the same time. These signals are delivered to the customer at the transmitter location through the interface of the transmitting data set as tones or electrical contacts, depending upon the transmitting data set.

1.62 The 401J3 receiver can be arranged to transmit voice answer-back signals on a one-way basis towards the data transmitting location. Voice answer-back signals are accepted from the customer at a connecting block interface. The customer should arrange to run his voice answer-back leads to the connecting block

1.7 UNATTENDED ANSWERING

The 401J receiver may be arranged through an installer wiring option to automatically answer incoming calls. With this option the data set will automatically answer an incoming call any time the Data Terminal Ready lead is grounded in the customer's equipment and the set has power. The data set will trip ringing from the central office and then automatically return about three seconds of tone to the transmitting station. About 30 milliseconds after this tone is removed the Data Set Ready indication is given to the customer equipment. The 401J receiver is now ready to receive data providing that the customer equipment has placed a ground on the "Data Receive" lead.

2. ELECTRICAL INTERFACE

2.1 RECEIVER INTERFACE

The Data Set 401J receives data from the telephone line and delivers it to the customer's Data-Handling Equipment.

2.11 Connector

2.111 To connect to the data set interface connector, the customer's equipment should be equipped with a cable not exceeding approximately 50 feet in length (capacitance between any signal interchange lead and its signal ground must not exceed 2500 picafarads) fitted with a Cinch or Cannon Type DB-19604-432 connector, or equivalent, fitted with a Cinch DB-51226-1 hood assembly.

2.112 The maximum current through any interconnecting lead shall be 100 milliamps steady state with 500 milliamps permissible on a surge. On open, the maximum potential between any two pins in the connector shall be 50 volts with 200 volts permissible on a surge less than 10 ms in duration.

2.113 Contact protection shall be provided for all relay contacts involved in the receiver interface by the unit furnishing those contacts.

2.114 Signal Ground is tied to the frame of the 401J, which is in turn grounded through the power cord. The frame of the Customer's Equipment must also be grounded. If the circuit so requires, Signal Ground may be tied to the frame of the Customer's Equipment, but it must not be used to derive the main ground for the frame of the Customer's Equipment.

The allocation of pins in the connector on the 401J is shown in Table 1 and Figure 2.

TABLE 1

Allocation of Pins in the 401J Receiver Connector

Pin	Function	Pin	Function
1	Frame Ground	14	Data Channel C1
2	Data Channel A0	15	Data Channel C2
3	Data Channel A1	16	Data Channel C3
4	Data Channel A2	17	Data Channel C0
5	Data Channel A3	18	Data Group C Common
6	Data Channel A4	19	Answer-back 1 (1017 cps)
7	Data Group A Common	20	Answer-back 2 (1785 cps)
8	Data Channel B0	21	Data Receive
9	Data Channel B1	22	Data Terminal Ready
10	Data Channel B2	23	Data Set Ready
11	Data Channel B3	24	Signal Ground
12	Data Channel B4	25	Ring Indicator or Out of Service
13	Data Group B Common		

2.115 The Frame Ground lead may be used to tie the frame of the data set to the frame of the Customer's Equipment. It must not be used to derive the main ground for the frame of the Customer's Equipment. With the power cords (data set and data terminal) removed the resistance between the ground terminals of the two power outlets must be less than 1 ohm when measured by a typical commercial volt-ohmmeter

2.12 Data Contacts

2.121 Data is delivered to the Customer's Equipment by the appropriate closures of the data relay contacts. Table 2 indicates the possible closures.

TABLE 2

Data Closures for the 401J Receiver

Group	Group Common Pin	Closure between Group Common and One of Following Leads Per Group
A	7	A0, A1, A2, A3, A4
B	13	B0, B1, B2, B3, B4
C	18	C0, C1, C2, C3

"Rest" Channels – A0, B0, C0

Intercharacter Separator – A0, B0, and C0 simultaneously.

2.122 Each group of data contacts are electrically isolated from each other and the rest of the circuits of the 401J receiver.

2.123 The data contacts are protected by a series RC network consisting of about 470 ohms resistance and 0.5 microfarads capacitance connected in parallel with each pair of contacts.

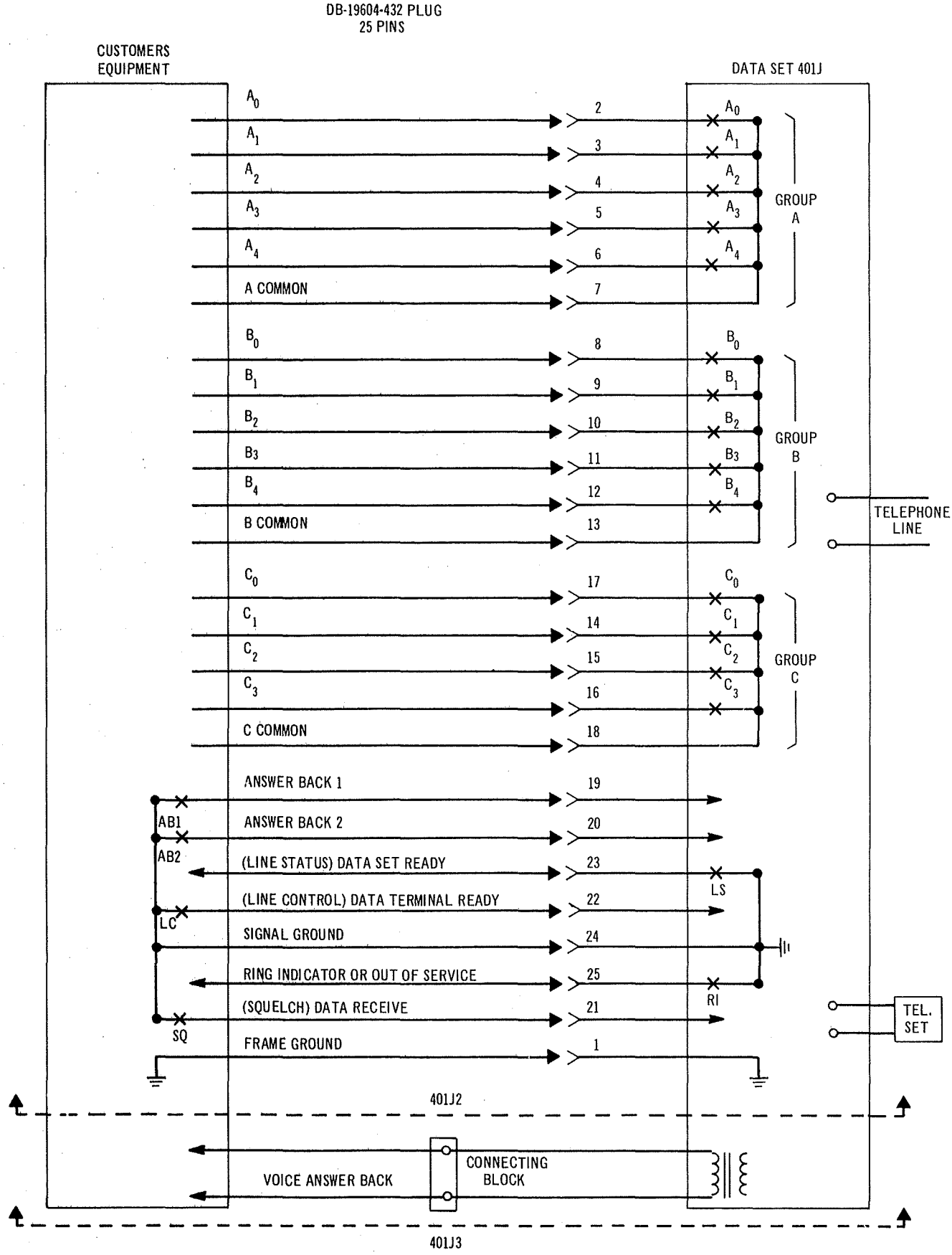

FIG. 2 DATA SET 401J RECEIVER INTERFACE SIGNALS

2.124 When a TOUCH-TONE telephone or a Data Set 401A serves as a transmitting input to the 401J receiver, the data terminal equipment (business machine) should be arranged to ignore any "C" group data contacts.

2.13 Data Timing Characteristics

If simultaneous signals are presented to the 401J receiver input a maximum skew of 4 milliseconds can be expected in the contact closures. The nominal receiver integrate (absolute delay) time is 13 milliseconds. It is possible for the pulse width at the output to vary up to ± 5 milliseconds.

2.14 Performance in the Presence of Improper Characters or Transmission Interference.

2.141 Because the 401J is an ungated receiver, skew in the input signals will not impair the operation of the 401J.

2.142 If a proper character is sent from the transmitter and noise with appropriate characteristics should happen to be introduced in the system the character could be affected in the following ways:

(a) It could appear to the 401J receiver as the operation of a different channel resulting in the operation of an undesired data contact.

(b) The noise could cancel the energy in any or all of the legitimate data channels, thus preventing legitimate data contacts from closing.

2.143 If the transmitting data contacts of the 401 type transmitter are held closed after the transmitter keying contacts are opened, interference caused by transmission echoes may occur. This will usually appear in the form of a repeated or an additional character at the 401J receiver output.

2.144 If the keying contacts at the transmitting data set (401 type) are opened between characters a potential error condition is established, if the Customer's Equipment presents a character on the transmitting data contacts during the 50 to 100 millisecond hangover interval of the previous character without first reclosing the transmitter keying contacts.

2.15 Data Receive Lead

2.151 The Data Receive Lead (pin 21) must be connected to Signal ground (pin 24) at all times when the Customer's Equipment is ready to receive data.

2.152 The Data Receive Lead should be held open when the Customer's Equipment is not ready to receive data and must be held open when answer-back signals are being generated.

2.16 Answer-back

2.161 Two answer-back signals of 1017 and 1785 cycles per second may be generated by the 401J receiver.

2.162 The 1017 cycles per second answer-back signal is initiated by opening the Data Receive Lead and making a contact closure between pin 19 (Answer-back 1) and pin 24 (Signal Ground) of the 401J connector.

2.163 The 1785 cycles per second answer-back signal is initiated by opening the Data Receive Lead and making a contact closure between pin 20 (Answer-back 2) and pin 24 (Signal Ground) of the 401J connector.

2.164 The voice answer-back leads are terminated within the data set in 600 ohms balanced equally with respect to ground. Voice signals should be delivered from the Customer's Equipment at-7VU into 600 ohms. Volume Units is a measurement of an audio signal on a specified volume indicator called the VU meter. Any direct current present must be less than 5 milliamperes. An internal limiter will clip any peaks above 0VU. The Data Receive Lead (pin 21) must be opened when voice signals are being transmitted. The impedance of the Customer's Equipment furnishing the voice signals should be balanced with respect to ground to prevent unwanted noise transmission.

2.17 Supervisory Controls

2.171 The operation of the Data Set 401J as an unattended station is covered in Section 3. The Data Terminal Ready Lead (pin 22) and the Data Set Ready Lead (pin 23) are used in the supervision of the telephone line.

2.172 The Data Terminal Ready Lead (pin 22) must be held closed to Signal Ground (pin 24) whenever the Customer's Equipment requires the station to accept an incoming call or main-

tain an existing call. The closure between pins 22 and 24 should be removed whenever the Customer's Equipment requires the station to end an existing call or whenever the Customer's Equipment requires the station to ignore an incoming call.

2.173 The Data Set Ready Lead (pin 23) is closed to Signal Ground (pin 24) by the 401J receiver whenever a connection has been established and the receiver is ready to proceed with data reception. If the call is answered manually, as would be the case if the Data Terminal Ready Lead were open, the station will be held initially in the voice mode. In this case, pin 23 is open and will be closed only after the DATA key on the 401J receiver is operated to place the station in the data mode. Data Set Ready Lead will be open when the data set is in the talk mode.

2.174 When the Data Terminal Ready Lead (pin 22) is opened to initiate a disconnect, it must be held open until after the Data Set Ready closure to Signal Ground has been removed by the 401J receiver. Alternatively, the Data Terminal Ready Lead can be held open for a timed period of at least 50 milliseconds to initiate a disconnect.

3. SYSTEM OPERATION

The Data Set 401J may be arranged to function either attended or unattended. This arrangement will be established in accordance with the customer's order when the station is installed. Attended operation requires that each call be answered manually. Unattended operation allows these functions to be handled automatically by controls incorporated in the 401J receiver and the Customer's Equipment.

3.1 ATTENDED OPERATION

3.11 A call may be placed by a person at either the transmitting station or the receiving station in the same manner as a voice call. It is answered by lifting the telephone handset at the called station.

3.12 When both parties are ready to commence data transmission, they so signify by voice and operate the DATA button on their sets to transfer them to the data mode. The telephone set handset may be replaced in its cradle when the 401J receiver is in the data mode.

3.13 When the data transmission is completed, the call may either be terminated or the the parties may return to the voice mode. Return to the voice mode is accomplished by depressing the TALK button and lifting the telephone handset.

3.14 The call may be terminated in either of two ways. If voice communication is not desired after reception of data, the call is terminated by lifting the handset, depressing the TALK button, and returning the handset to its cradle. An alternate method is to open the Data Terminal Ready Lead from Signal Ground as described earlier in Section 2 with the handset in the on-hook position.

3.2 UNATTENDED ANSWERING

3.21 If the 401J receiver is arranged for automatic answer, incoming calls will be handled automatically when the Customer's Equipment provides a contact closure between the Data Terminal Ready Lead and Signal Ground.

3.22 When the call is answered by the unattended receiver, a 1.1 second quiet period is provided to allow proper operation of the telephone network control circuits. Then an answer-back tone is automatically initiated for a period of about 3 seconds. This answer-back signal notifies both the calling station and any telephone operators involved that the call has been answered.

3.23 Approximately 30 milliseconds after the completion of the answer-back tone transmission, the Customer's Equipment is notified that a data call has been set up by a contact closure between the Data Set Ready Lead and Signal Ground. Data transmission may then commence providing the Customer's Equipment provides a contact closure between the Data Receive Lead and Signal Ground.

3.24 The DATA lamp is lighted when the 401J receiver is in the data mode. Transfer to the voice mode can be accomplished by depressing the TALK button and lifting the handset. The DATA lamp is extinguished while the receiver is in the talk mode.

3.25 Return to the data mode can be accomplished at any time by depressing the DATA button. The handset may then be returned to its cradle.

3.26 Termination of a call that has been answered automatically may be accomplished by removing the closure between the Data Terminal Ready Lead and Signal Ground as described earlier. The 401J receiver is then ready to accept another incoming call.

3.27 In either the unattended mode or the attended mode, if the receiver is not powered or the Data Terminal Ready Lead is not closed to Signal Ground, the receiver may not be transferred to the data mode. Depressing the DATA button will not cause the Data lamp to light, and upon release of the DATA button, unless the TALK button is held depressed, the connection will be dropped.

3.28 In either attended or unattended operation, an indication is given to the Customer's Equipment that the line is being rung by a contact closure between the Ring Indicator Lead (pin 25) and Signal Ground. An alternate use of this lead or pin 25 is for providing an Out-of-Service indication from the Customer's Equipment to the data set. This feature may be used with certain receive only lines. Either of these options may be selected by the customers and will be provided when the data set is installed.

3.3 UNATTENDED ORIGINATING

3.31 The 401J receiver is arranged to operate with an 801 Automatic Calling Unit for unattended origination of data calls.

3.32 After completion of the dialing operation, the Automatic Calling Unit will, by recognition of an answer signal from the called station transfer the 401J to the data mode and present Data Set Ready to the business machine. (Refer to technical reference for ACU for details.)

3.33 Independent of how the call was placed, there are two ways to end the call. In both ways, the attendant at the transmitting station hangs up by placing the telephone handset in its cradle. If an attendant is at the 401J receiving station, he may end the call by removing and then replacing the handset with the TALK button operated. If no attendant is at the 401J receiving station, the Customer's Equipment at the transmitting station must send an end-of-call data code before the station hangs up. This code is used to signal the Customer's Equipment at the receiving terminal to open the Data Terminal Ready Lead and thus order the receiving data set to disconnect. In the event that this signal is not sent before the transmitting station hangs up, the central office may eventually recognize that the call has ended and disconnect the receiving station. However, the customer may be annoyed by the unnecessary delay, and by interference caused by the presence of transient noise on the line.

FIGURE 3
DATA SET 401J