

PRELIMINARY

Bell System Data Communications

TECHNICAL REFERENCE

801C - LI/2 Data Auxiliary Set Interface Specification

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DIRECTOR – DATA AND SPECIAL SERVICES



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1. GENERAL DESCRIPTION

1.1 Data Auxiliary Set 801C-L1/2

Data Auxiliary Set 801C-L1/2 is an Automatic Calling Unit (ACU) which permits a customer-owned data terminal, such as a computer, to originate DATAPHONE® calls automatically in areas where TOUCH-TONE calling is available. Dialing instructions and the telephone number of the called station are passed between the data terminal and the ACU in the form of parallel binary signals. The digits of the called telephone number are transmitted one at a time from the data terminal to the ACU. The ACU transmits each digit by TOUCH-TONE signals to the telephone central office. After each digit has been transmitted, the ACU requests the next digit from the data terminal. The ACU also has the capability of recognizing an answering tone from the called station as an indication that the called station has answered. The major advantage of TOUCH-TONE calling compared to rotary dialing is the shorter dialing time. For machine dialing, the comparison for a ten-digit number is about one second for TOUCH-TONE dialing to about ten seconds on the average for rotary dialing.

1.2 Physical Description

A pictorial view of Data Auxiliary Set 801C-L1/2 is shown in Figure 1. The set in its housing measures 5.8 inches wide, 2.2 inches high, and 10.8 inches deep, and will operate normally over a temperature range from 40° to 120°F with relative humidity in the range from 20 to 95 percent. Its weight is approximately four pounds.

1.3 Power Requirements

Power is supplied by an external transformer which mounts on the customer-provided 105 to 129 volt, 60 \pm 3 Hertz nonswitched three-prong wall outlet. The size of this transformer is approximately 2.2 inches wide, 1.9 inches deep, and 1.9 inches high and weighs approximately one pound. The power required is approximately ten watts.

1.4 Grounding

Grounding of the ACU set housing and chassis to the local building power ground is established through the ground wire of the power cord. The Signal Ground circuit on the interface is the common reference potential for all other circuits on the interface. The normally supplied option connects Signal Ground to Frame Ground. However, before connecting to the data set, the installer must provide the proper option so that the ground connection option of the ACU is similar to the one used in the associated data set (that is with the Signal Ground connected to Frame Ground or with the Signal Ground not connected to Frame Ground).

1.5 Location of the Data Auxiliary Set

Data Auxiliary Set 801C-L1/2 should be located in the vicinity of the data terminal equipment and of the associated data set to meet the recommendations of EIA Standard RS-366 that the customer-provided interface cable from the data terminal should not exceed 50 feet in length.

1.6 Interface with Data Terminal

The ACU interface circuits between the data terminal and the Data Auxiliary Set conform to the Electronics Industries Association Standard RS-366 when operated without manual intervention via the test keys or telephone set. For proper operation, the data terminal should also conform to these standards.

1.7 Operation with Customer Terminal Equipment

For descriptive purposes the 801C-L1/2 can be considered to comprise four functional circuits as shown on Figure 2. These four functional circuits are:

- (1) The Interface circuitry
- (2) The Telephone Line circuitry
- (3) The Answer Detection circuitry
- (4) The Test circuitry

Interface Circuitry

These circuits provide for the interchange of information between the data terminal and the ACU and for the necessary controls and timing with the ACU.

The timing circuits make certain that each TOUCH-TONE signal is sent toward the telephone central office long enough to be assured recognition. These circuits also assure sufficient time between transmission of tone pairs to permit differentiation between successive digits. They provide "time-out" features to tell the data terminal when no proper answer has been received from the called party, after an appropriate waiting interval (Abandon Call and Retry or ACR signal). They also prevent a new call from being attempted before the telephone switching equipment has had time to recognize the end of the previous call.

Telephone Line Circuitry

These circuits comprise the necessary devices to switch the telephone line from the associated data set to the ACU and to detect the central office signal that dialing may begin. They also include the TOUCHTONE generator used to forward the desired number information to the telephone central office and a circuit to detect and to notify the data terminal

(via the interface circuitry) whenever the telephone line is in use (Data Line Occupied or DLO signal).

On some calls, the dialing of an access code is required which - after a possible delay - is followed by a second dial tone. A feature, called second dial tone detection, of the DAS 801C-L1/2 avoids (in most applications) the need for the data terminal equipment to time an arbitrary interval between access code and further digits. This feature works as follows. After dialing the access code, the data terminal equipment presents binary "13" on the digit signal circuits causing the ACU to revert to the dial tone detection mode. After receiving and detecting the second dial tone, the ACU will proceed to give the data terminal equipment the signal to continue dialing.

Note: Certain station arrangements do not permit second dial tone detection. It cannot be provided when the second dial tone is received at an insufficient level from a remote telephone central office or when the option "Data Set Answer Detection Without End of Number" is provided. The local telephone sales representative should be consulted to determine if second dial tone detection can be used.

Answer Detection Circuitry

When a call is placed to a data set arranged to automatically answer an incoming call, the called data set responds by transmitting a single frequency tone. In manually answered calls, this tone is transmitted when the called set is put in the data mode. At this point, one of three answer detection action modes, depending upon the particular capabilities of the data set associated with the ACU and upon the particular type of operation agreed to with the local telephone sales representative, is as follows:

- (1) The calling ACU may be arranged by an option, "ACU Answer Detection or End-of-Number" option, to recognize this answer tone as the indication that the called station has answered. If the ACU has been arranged to provide for this option, then, after each digit dialed, the answer detection circuitry of the ACU monitors the line for the answer tone until another digit is presented. Then after the last telephone digit has been dialed, and if the data terminal does not provide a supplementary "End-of-Number" digit, the answer tone detection circuitry of the ACU will monitor the line until it receives an answer tone from the called station.
- (2) With the same option as previously described, "ACU Answer Detection or End-of-Number" option, if the data terminal after transmitting the last telephone digit transmits an "End-of-Number" digit, the answer tone detection circuitry will be bypassed and control transferred to the data set without the ACU answer tone detection circuitry monitoring for the tone. In this case, the answer tone is expected to be detected by the data set which must have this capability.

- (3) If, instead of being provided with the option "ACU Answer Detection or End-of-Number", the ACU is provided with the option "Data Set Answer Detection Without End of Number", then the answer tone is expected to be detected by the data set without the need for the data terminal to transmit an "End-of-Number" digit. The data set is placed off-hook when the first digit is dialed. Thereafter, the data set monitors the line for answer tone.

The local telephone company representative should be consulted as to which of these answer tone detection action modes can or should be provided. It will depend upon the capabilities of the particular data set to be associated with the ACU and, in some cases, where more than one mode is possible, upon the customer's desires.

For operation with some called data sets, the ACU will be arranged by an option to transfer the line back to its associated data set shortly after the end of the tone is detected. For other data sets, however, transfer will occur just after the beginning of the answer tone in order that data set hand shaking can take place when the ACU transfers the calling station to the data mode. Whether the ACU transfers at the beginning or the end of the received tone depends on the option connected at the time the ACU is installed. This option is determined by the type of data set associated with the ACU.

Test Circuitry

These circuits are used to check if the ACU is operating properly. They comprise three pushbutton test switches and four lamps located on the front of the ACU (Figure 1) and the necessary associated circuitry. A list of these test switches, lamps and their functions are described in Section 1.8.

1.8 Test Switches and Lamp Indications

Data Auxiliary Set 801C-L1/2 is equipped with three test switches which are accessible at the front cover which permit testing of the ACU. The functions of these test switches are discussed in detail in Section 5, and are summarized below:

- (1) SD (Slow Dialing) - While this switch is held depressed, the dial sequence with the data terminal is slowed sufficiently so that a count of the number of digits sent by the data terminal can be made.
- (2) TR (Test Receive circuits) - When this switch is held depressed, the operation of the dial tone detection and answer tone detection circuits are tested.
- (3) TT (Test Transmit circuits) - When this switch is held depressed, the TOUCHTONE generating circuit and dial sequence timers are tested.

The 801C-L1/2 is provided with four LED status lamps on the front cover. The lamp names and their functions are described below:

- (1) ON (Power On) - Indicates that power is applied to the ACU.
- (2) CR (Call Request) - Indicates the status of the Call Request (CRQ) signal from the customer data terminal interface. A signal on this circuit is generated by the data terminal to request the ACU to originate a call.
- (3) PD (Present Next Digit) - Indicates the status of the Present Next Digit (PND) signal from the ACU to the data terminal interface. In normal operation, the lamp will light after dial tone is detected, will blink off once for each digit received from the data terminal, and will then stay lit until the end of the data call.
- (4) AR (Abandon Call and Retry) - Indicates the status of the Abandon Call and Retry (ACR) signal from the ACU to the data set interface. When lit, it indicates excessive time has elapsed in the call set-up sequence.

These signals on the data terminal interface circuits are described in more detail in Sections 3, 4 and 5.

2. OPTIONAL CUSTOMER FEATURES

Data Auxiliary Set 801C-L1/2 is provided with several optional features which must be specified by the customer when the ACU is ordered. These are listed on Figure 3 and are as follows:

(1) Abandon Call and Retry (ACR) Timer Control Options

The operation of the ACR Timer when occurring during the process of call origination indicates that there is a high probability that the connection to the called data station cannot be successfully established. One of the most likely reasons for this is that the called station is busy. The operation of the ACR Timer in the ACU does not initiate any ACU action to abandon the call but merely turns ON the interface circuit ACR to the data terminal. The data terminal then may initiate any action it considers necessary.

Unless otherwise requested by the customer, the ACR Timer control option "Stop ACR Timer When DSS Goes On" is supplied. This option provides for disabling the ACR Timer after the ACU has completed its call origination functions (as indicated by the interface circuit COS from the ACU being turned-on). For the mode of operation where the ACU is detecting answer tone from the called station, completion of its call origination functions includes an assurance that a DDD connection has been made to the called station. However, for the mode of operation

where the data set is detecting answer tone, this includes only an assurance that the called number has been transmitted from the ACU to its central office.

Note: In previous ACU's, circuit COS was designated DSS.

If the customer desires, he may select the ACR Timer control option which does not disable the ACR Timer as previously described (option "Do Not Stop ACR Timer When DSS Goes On"). In this case, the ACR Timer will continue to time until its time-out interval expires or until the interface circuit CRQ from the data terminal is turned OFF. The ACR Timer will time-out on every call unless circuit CRQ is turned OFF before time out occurs. This option may be useful to a customer's data terminal when operating with a data set which is detecting answer tone instead of the ACU. In this case, the data terminal may use an ON signal of interface circuit ACR in conjunction with an OFF signal on the data set interface circuit CB to indicate to the data terminal that a connection has not been made to the called station and that it should abandon the call.

(2) Abandon Call and Retry (ACR) Timer Timing Options

Unless otherwise requested by the customer, an ACR Timer timing option is supplied which provides for the maximum interval of 56 seconds. However, since one of the most frequent uses of this function is to time-out for a call to a busy station, the customer may be interested in using a shorter time-out interval to provide a faster response to his data terminal (computer). Other options provide 7, 14 and 28 seconds but the customer should discuss these with the Telephone Company representative to insure that he does not select an option which results in premature operation of the ACR Timer before all types of normal calls are completed.

(3) Call Termination Control Options

There are two methods by which a call may be terminated automatically when transmission of data has been completed. In one method the data terminal signals the ACU to terminate the call (by turning OFF the interface circuit CRQ from the data terminal). In the second method the data terminal signals the associated data set to "hang-up", that is, terminate the call (by turning OFF the associated data set interface circuit CD from the data terminal). These are described in more detail in Section 4.2.

Unless otherwise requested by the customer, the call termination control option "Terminate Call via ACU After DSS ON" is supplied. This option requires the data terminal to turn OFF the ACU interface circuit CRQ to signal the ACU to terminate the call.

(4) Signal Ground Option

Unless otherwise requested by the customer, the Signal Ground option "Signal Ground Connected to Frame Ground" is supplied. This option provides for connecting signal ground to frame ground. When this option is provided, the data set must use a similar option.

The other Signal Ground option which provides for not connecting signal ground to frame ground should only be provided when the customer's data terminal cannot permit the connecting of signal ground to frame ground in the data sets. Since some types of telephone central office arrangements (ground start) require the ACU connection of signal ground to frame ground, the use of this option should be discussed with the Telephone Company representative to insure that a compatible type of telephone central office arrangement is provided.

3. CUSTOMER INTERFACE DESCRIPTION

The interface is the point of connection between the ACU and the data terminal. The ACU is equipped with a 25-pin, female connector. The user must supply the plug and necessary cable to connect his terminal to the ACU. For the male connector, a plug such as the DB-19604-432 plug manufactured by Cannon* or Cinch+ (or equivalent) is required. This type plug provides a reliable, low-resistance contact. In addition, a DB-51226-1 Hood Manufactured by Cinch (or equivalent) is recommended to protect the connections, anchor the cable to the plug, provide a finger grip for easy insertion or removal, and provide a positive screw-in locking arrangement to prevent the connector from being pulled out inadvertently.

3.1 Electrical Considerations

The ACU follows the standards set forth in Electronic Industries Association Standard RS-366 when operated without manual intervention via the test keys or telephone set, which are not covered in RS-366. For proper operation, the station terminal equipment should also adhere to these recommendations. The following paragraphs give some of the highlights of the above document.

* ITT - Cannon Electric, Division of IT&T Corporation, 3208 Humboldt Street, Los Angeles, California 90031.

+ Cinch Manufacturing Company, 1026 S. Homan Avenue, Chicago, Illinois 60624

3.1.1 Signal States

The Digit Signal Circuits are considered in the "one" condition when the voltage on the circuit is more negative than minus three volts with respect to Signal Ground, and in the "zero" condition when the voltage on the circuit is more positive than plus three volts with respect to Signal Ground.

All control functions are considered ON when the voltage on the circuit is more positive than plus three volts with respect to Signal Ground, and are considered OFF when the voltage on the circuit is more negative than minus three volts with respect to Signal Ground. The Call-Request (CRQ) and Power Indication (PWI) circuits are "Fail Safe" in that a power-off condition or a disconnection of the interconnecting cable shall be interpreted as an OFF condition.

The data and control circuit interface functional states are defined below:

<u>Notation</u>	<u>Negative Voltage</u>	<u>Positive Voltage</u>
Binary State	ONE	ZERO
Digit Signal Condition	ONE	ZERO
Control Function	OFF	ON

3.1.2 Impedances of Terminator

The terminating impedance of the receiving end of interchange circuits shall have a dc resistance of not less than 3000 ohms nor more than 7000 ohms over the range of voltages for which the signal is defined. When the interface plug is disconnected, the interface voltage on terminator circuits shall be less than ± 2 volts.

3.1.3 Driver Voltages

The open circuit driver voltage with respect to Signal Ground on any interchange circuit shall not exceed ± 25 volts. When the terminating impedance is in the proper range (3000 ohms to 7000 ohms) and the terminator open circuit voltage is zero, the potential at the point of interface shall be neither less than ± 5 volts nor more than ± 15 volts in magnitude. The terminator on an interchange circuit shall withstand any input signal within the ± 25 volt limit.

3.1.4 Rise and Fall Times

The operation of the circuitry that receives signals from an interchange circuit shall be dependent only on the signal voltage. For Control Interchange circuits, the time required for the signal to pass through the transition region (-3 volts to $+3$ volts) during a change in state shall not exceed one millisecond.

3.2 Purpose and Use of Interface Circuits

The ACU is provided with interface circuits shown in Figure 4 for connections to the customer's data terminal. Circuit names and their designations are in accordance with EIA Standard RS-366 except as noted. Circuit numbers correspond to pin assignment on the 25-pin receptacle. A description of the operation of each circuit and the signals appearing on them follows.

3.2.1 Protective Ground (AA) - Circuit 1

This conductor is electrically bonded to the ACU equipment frame. It is further connected to external ground through the third wire of the power cord. Circuit AA is accessible on a screw terminal, but does not appear on the ACU interface plug.

3.2.2 Digit Present (DPR) - Circuit 2

Direction: To the ACU

Signals on this circuit are generated by the data terminal to indicate that the ACU may read the code combination presented on the Digit Signal Circuits N1, N2, N4, N8, Circuits 14 through 17.

The OFF to ON transition indicates that the data terminal has set the states of the Digit Signal Circuits for the next digit. Circuit DPR must not be turned ON before Circuit PND (Present Next Digit), Circuit 5, is turned ON, and when turned ON, should remain ON until Circuit PND is turned OFF. Circuit DPR should then be turned OFF, and when turned OFF, should be held OFF until Circuit PND is turned ON again.

THE STATES OF THE DIGIT SIGNAL CIRCUITS MUST NOT CHANGE WHEN CIRCUIT DPR IS ON.

After the last digit (including EON if used) has been presented and Circuit PND turned OFF, Circuit DPR must be turned OFF and held OFF even though Circuit PND turns ON again.

3.2.3 Abandon Call - Retry (ACR) - Circuit 3

Direction: From ACU

Signals on this circuit are used to indicate the probability of unsuccessful completion of the call attempt.

The ON condition, when presented during the process of call origination, (i.e., before Circuit COS turns ON) indicates that there is a high probability that the connection to a remote data station cannot be successfully established and is a suggestion to the data terminal to abandon the call and to reinitiate the call at a later time. The OFF condition indicates that there is no reason to believe that the call cannot be successfully completed.

When the option "Stop ACR Timer When DSS Goes ON" is provided, if Circuit ACR has not turned ON before Circuit COS (Call Origination Status) is turned ON, then it will remain in the OFF condition. However, if Circuit ACR has turned ON before Circuit COS is turned ON, then when Circuit COS turns ON, Circuit ACR will turn OFF. When the option "Do Not Stop ACR Timer When DSS Goes ON" is provided, Circuit ACR will continue to function after Circuit COS is turned ON. This permits the data terminal to use the ACR timer in the ACU even though the ACU has completed all its functions.

3.2.4 Call Request (CRQ) - Circuit 4

Direction: To ACU

Signals on this circuit are generated by the data terminal to request the ACU to originate a call.

The ON condition indicates a request to originate a call and must be maintained during call origination, until Circuit COS (Call Origination Status) is turned ON, in order to hold the connection to the communication channel (remain "OFF-HOOK"). The call will usually be terminated if Circuit CRQ is turned OFF before Circuit COS turns ON. However, there is a short period of time just before Circuit COS is turned ON during which turning OFF Circuit CRQ may not terminate the call. Therefore, it is recommended, as specified in the EIA RS-366 Standard, that the data terminal should turn OFF Circuit DC in the associated data set interface as well as Circuit CRQ whenever a call is to be terminated before Circuit COS has turned ON. The OFF condition indicates that the data terminal has completed its use of the ACU. After the ACU has turned ON Circuit COS, the data terminal may turn Circuit CRQ OFF without causing a disconnect if the option "Terminate Call via Data Set After DSS ON" is provided. However, if the option "Terminate Call via ACU After DSS ON" is provided, then the ACU retains control of the connection to the communication channel after Circuit COS is turned ON, thereby enabling a Circuit CRQ disconnection function like that of Circuit CD (Data Terminal Ready) in the associated data set interface. In this case, Circuit CRQ must be maintained in the ON condition until the call is to be disconnected. When this option is used, there is no requirement to turn OFF Circuit CD in the data set interface to either abort a call attempt or to disconnect an established call. Circuit CRQ must be turned OFF between calls or call attempts and should not be turned ON unless Circuit DLO (Data Line Occupied) is in the OFF condition. The terminator for Circuit CRQ interprets a power OFF condition or the disconnection of the interconnecting cable as an OFF state.

3.2.5 Present Next Digit (PND) - Circuit 5

Direction: From ACU

Signals on this circuit are generated by the ACU to control the presentation of digits on the Digit Signal Circuits.

The ON condition indicates that the ACU is ready to accept the next digit indicated on Circuits NBl, NB2, NB4 and NB8 (Digit Signal Circuits). Circuit PND will be turned ON by the ACU only after the data terminal turns Circuit DPR (Digit Present) OFF. The OFF condition indicates that the data terminal should turn OFF Circuit DPR. After turning Circuit DPR OFF, the data terminal may set Circuits NBl, 2, 4 and 8 (Digit Signal Circuits) to indicate the next digit to be dialed.

3.2.6 Power Indication (PWI) - Circuit 6

Direction: From ACU

Signals on this circuit are generated by the ACU to indicate whether power is available within the ACU. The ON condition indicates that power is available in the ACU.

When the power in the ACU is OFF, the source impedance of the driver side of this circuit will not be less than 300 ohms, measured with an applied voltage not greater than 2 volts in magnitude referenced to Circuit SGD (Signal Ground). The terminator for this circuit shall interpret this power OFF condition or the disconnection of the interconnecting cable as an OFF state.

3.2.7 Signal Ground (AB) - Circuit 7

This conductor establishes the common ground reference potential for all interface circuits except Protective Ground (AA).

3.2.8 Circuits 9 and 10

These circuits are used for the purpose of testing by Telephone Company personnel. The data terminal must not connect to them.

3.2.9 Call Origination Status (COS) - Circuit 13

Direction: From ACU

In previous Automatic Calling Units, this circuit was designated DSS (Data Set Status). The new designation of COS is in accordance with EIA RS-366 Standards. Signals on this circuit are generated by the ACU to indicate the status of automatic call origination. The ON condition during a call originated by the ACU indicates to the data terminal that the ACU has completed its call origination functions. If the option "Terminate Call via Data Set After DSS ON" is provided, the data terminal may turn OFF Circuit CRQ after Circuit COS has been turned ON without prematurely disconnecting the call. In this case, disconnection of the call by the data terminal is possible only through the data set interface. However, if the option "Terminate Call via ACU After DSS ON" is provided, then after Circuit COS has been turned ON, Circuit CRQ should be turned OFF by the data terminal only when it wishes to disconnect the call.

Once Circuit Cos is turned ON, it will remain ON at least until either Circuit CRQ is turned OFF by the data terminal or the data set is taken out of the data mode. Circuit COS may come ON at other times, e.g., during an incoming call or a manually originated call, but any ON condition appearing at a time other than during automatic call origination by the ACU should be disregarded.

This circuit should not be interpreted to convey information regarding the operational status or state of preparedness of the associated data set.

3.2.10 Digit Signal Circuits (NB1, 2, 4, 8) - Circuits 14, 15, 16, 17

Direction: To ACU

- Circuit NB1 (14) - Digit Signal Circuit - Low Order Bit (Value 1)
- Circuit NB2 (15) - Digit Signal Circuit - Second Order Bit (Value 2)
- Circuit NB4 (16) - Digit Signal Circuit - Third Order Bit (Value 4)
- Circuit NB8 (17) - Digit Signal Circuit - High Order Bit (Value 8)

Parallel binary signals on these circuits are generated by the data terminal.

The information presented on these interchange circuits may be transmitted by the ACU to the telephone line (digits of the called number) or may be used locally as a control signal. An example of the use of these interchange circuits for control purposes is the passing of the EON (end of number) code combination to the ACU after the last digit of the called number has been passed.

The states of the Digit Signal Circuits must not change when Circuit CPR is ON. The states may be changed at any time while DPR is OFF. To maintain the maximum dial speed, this change should be completed within 50 milliseconds.

The following table shows the combinations to achieve digit values from 0 to 9 and other signals.

<u>Digit Value</u>	<u>Digit NB8</u> [Value 8]	<u>Signal NB4</u> [Value 4]	<u>Circuit NB2</u> [Value 2]	<u>States NB1</u> [Value 1]
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1

<u>Digit Value</u>	<u>Digit NB8</u>	<u>Signal NB4</u>	<u>Circuit NB2</u>	<u>States NB1</u>
8	1	0	0	0
9	1	0	0	1
10* (Note 1)	1	0	1	0
11# (Note 1)	1	0	1	1
12 EON	1	1	0	0
13 Second Dial Tone	1	1	0	1
14 Not Valid				
15 Not Valid				

Note 1: These correspond to the 11th and 12th pushbuttons on a 12-button TOUCH-TONE telephone set.

3.2.11 Data Line Occupied (DLO) - Circuit 22

Direction: From ACU

Signals on this circuit are used to indicate when the communication channel is in use for automatic calling, data communication, voice communication or for testing of the automatic calling or data communication equipment.

The ON condition indicates that the communication channel is in use.

The OFF condition indicates that the data terminal may originate a call provided that Circuit PWI (Power Indication) is ON. The OFF condition is not presented until all of the other interchange circuits from the ACU are returned to their proper idle conditions.

3.3 Interface Circuit Conditions in TEST Mode

In the TEST mode, the circuits directed from the data terminal are disabled within the ACU. Circuit PWI is not affected. Circuits PND, COS and ACR are turned OFF and Circuit DLO is turned ON.

4. OPERATION WITH DATA TERMINAL EQUIPMENT

4.1 Originating a Call Automatically

To originate a call, the data terminal presents a call request signal to the ACU by turning On Circuit CRQ (Call Request). If the telephone line is not in use, (Circuit DLO OFF) the ACU takes the line from the data set and signals the telephone central office that a call is waiting. If Circuit CRQ from the data terminal is turned ON while Circuit DLO to the data terminal is already ON, the ACU will not respond to the call request until the telephone line becomes idle, as indicated by Circuit DLO being turned OFF.

4.1.1 Start Dialing Indication

Circuit PND (Present Next Digit) to the data terminal is turned ON when the ACU is ready to receive the first digit to be dialed.

4.1.2 Dialing the First Digit

When the data terminal detects Circuit PND ON, it should present the first digit to be dialed on Circuits NB1, NB2, NB4, and NB8. Digit information is presented to the ACU in binary-coded-decimal (BCD) form with the NB1 lead having a value of 1, NB2 a value of 2, NB4 a value of 4, and NB8 a value of 8. When these Digit Signal Circuits have been set, the data terminal should turn ON Circuit DPR (Digit Present) to tell the ACU to dial the first digit.

4.1.3 Dialing of Subsequent Digits

After the first digit has been dialed, the ACU turns OFF Circuit PND to the data terminal. At this time, the data terminal should turn OFF Circuit DPR and then reset Circuits NB1, NB2, NB4 and NB8 for the next digit to be dialed. Any delay greater than 50 milliseconds in turning OFF Circuit DPR after Circuit PND turns OFF will slow down the dialing rate and increase the time required to place a call. If, for some reason, Circuit DPR is not turned OFF, Circuit PND will not be turned ON. After the data terminal has turned OFF Circuit DPR, the ACU will again turn ON Circuit PND. Assuming that the data terminal has previously reset Circuits NB1, NB2, NB4 and NB8 for the next digit to be dialed, the data terminal should now turn ON the Circuit DPR after which the ACU will out-dial this digit. This sequence of Circuit PND OFF, Circuit DPR OFF, Circuit PND ON, Circuit DPR ON is repeated for each digit to be dialed. The states of the digit leads may be changed only after Circuit DPR is turned OFF. Long delays between presentation of successive digits may result in a central office timeout or in an ACR timeout.

4.1.4 Second Dial Tone Detection

After dialing a digit (such as an access code) which will cause a second dial tone to be sent from the central office, the data terminal should present the binary digits 1101 (digit value 13) on Circuits NB8, NB4, NB2 and NB1. After the ACU has received and detected the second dial tone, it will turn Circuit PND ON as a go-ahead signal for the data terminal to present the remaining digits to be dialed.

4.1.5 Completing Dialing

After the complete number has been dialed, Circuit PND will again turn ON. At this point, one of three answer detection actions as explained in 1.7 takes place, as described below.

EITHER

4.1.6 ACU Answer-Tone Detection

Following presentation of the last digit, the data terminal must hold Circuit DPR OFF. When the called data set answers, it sends out the answer tone mentioned in 1.7, which is recognized by the ACU as a legitimate answer. The ACU signals the data set to hold the line and then gives the line back to the data set. Circuit COS (Call Origination Status) turns ON indicating that the data set is holding the line.

OR

4.1.7 Data Set Answer Detection With End-of-Number Signal

This mode can be used only with data sets capable of answer-tone detection, as described in Section 1.7.

Following presentation of the last digit of the called number, the binary digits 1100 (digit value 12) are set on Circuits NB8, NB4, NB2 and NBI respectively by the data terminal and Circuit DPR is turned ON. The ACU reacts by immediately signaling the data set to "hold" the line and then giving the telephone line back to the data set. When Circuit PND goes OFF, Circuit DPR must be turned OFF and left OFF even though Circuit PND turns ON again. Circuit COS then turns ON indicating that the data set is holding the line.

OR

4.1.8 Data Set Answer Detection Without End-of-Number Signal

Some types of the data sets are capable of detecting answer tone without requiring the EON signal as described in Section 1.7. In these data sets, the monitoring of the line for answer tone is started after the first digit has been dialed. Detection of answer tone by the data set results in the data set going to the data mode and Circuit COS turning ON. For these types of data sets, it is not necessary for the data terminal to transmit an "End-of-Number" digit to the ACU.

4.1.9 Abandon Call and Retry (ACR)

For a variety of reasons, there may be some calls which are not completed to the called station. For example, calls may be made where the called station, or all paths to it, may be busy. Also, central offices are normally arranged to "time-out" and ignore further dialing by the subscriber if too much time elapses between digits (5 seconds or so depending on the office). To help prevent inordinately long and useless waiting periods on such calls, the ACR (Abandon Call and Retry) timing circuitry has been incorporated.

The ACR timer starts when Circuit CRQ (Call Request) is turned ON assuming that Circuit DLO is turned OFF (indicating that the telephone line is idle). If Circuit DLO is turned ON when Circuit CRQ is turned ON, then the ACR timer will not start timing until the telephone line becomes idle and Circuit DLO is turned OFF. As described in Section 2, the time-out interval normally supplied is set by the installer for a nominal period of 56 seconds unless otherwise agreed to between the customer and Telephone Company representative.

The ACR timer is reset to zero and restarted each time the data terminal presents a digit including the "End-of-Number" digit. Any time the data terminal, the ACU or the telephone network takes more than the preset timing interval, Circuit ACR is turned ON to tell the data terminal that too much time has passed with no apparent action. The decision to act on or ignore the ACR indication is left to the data terminal.

As described in Section 2, an option selected at the time of installation either stops the ACR timer when Circuit COS turns ON (this is the normal option) or lets the timer run until the timing interval expires or Circuit CRQ is turned OFF. In the former case, if Circuit COS turns ON after Circuit ACR has already turned ON, Circuit ACR will then turn OFF. In the latter case, the ACR timer will time-out on every call unless Circuit CRQ is turned OFF before time-out occurs.

Under normal operating conditions, a high percentage of calls should be completed without encountering an abandon call indication. However, the possibility exists of a trouble in the data terminal, ACU or telephone network causing repeated misdials. This would be annoying to the called party. It is therefore recommended that data terminal be arranged to limit successive retries (to, say, three or so).

4.2 Terminating a Call Automatically

4.2.1 Call Termination Methods

As described in Section 2, a customer option permits a call, originated as outlined above, to be terminated automatically when transmission of data has been completed in either of two methods. In one method, the data terminal signals the ACU (by turning Circuit CRQ OFF) to terminate the call. In the other method, the data terminal signals the associated data set (by turning OFF the data set Circuit CD) to terminate the call. Also, calls may be terminated manually following the usual method of call termination for the data set used.

4.2.2 Call Termination Via ACU With Call Request (CRQ) Circuit Control

The option normally provided (option "Terminate Call via ACU After DSS ON") is that of call termination via ACU with the data terminal signaling the ACU to "hang-up" by turning OFF the Call Request (CRQ) Circuit. Circuit CRQ is turned ON by the data terminal to originate the call and then must be held ON until the call is to be terminated. When data transmission is completed, and, after signaling the called end to hang

up by means of the transmitted data signal, the data terminal signals the ACU by turning OFF Circuit CRQ to terminate the call. Then, when Circuit DLO (Data Line Occupied) goes OFF, the data set and ACU are ready for the next call. Turning OFF Circuit CRQ at any time during the call will end the call and cause the line to go "on-hook".

4.2.3 Call Termination Via the Associated Data Set

If the option provided (option "Terminate Call Via Data Set After DSS ON") is selected, then the call termination is via the associated data set rather than via the ACU and the call is terminated in a somewhat different manner. Circuit CRQ is turned ON to originate the call and must be held ON until Circuit COS (Call Origination Status) turns ON. The call will usually be terminated if Circuit CRQ is turned OFF before Circuit COS turns ON. However, there is a short period of time just before Circuit COS turns ON, during which turning OFF Circuit CRQ may not terminate the call. Therefore, it is recommended, as specified in the EIA RS-366 Standard, that the data terminals should turn OFF Circuit CD in the data set interface as well as Circuit CRQ whenever a call is to be terminated before Circuit COS has turned ON. When Circuit COS is ON, however, control is at the data set and the condition of Circuit CRQ will not affect operation in any way. To terminate the call, when data transmission is completed, the data set is "hung up" in its normal manner. Please note that Circuit CRQ should be turned OFF at some time between Circuit COS turning ON and the data set "hanging up". Then when Circuit DLO goes OFF, both the data set and ACU are ready for the next call.

4.3 Manually Originated Calls

Calls may be originated in the normal way using the telephone of the data set associated with the ACU. During the interval that the telephone set is "off-hook", the ACU is prevented from attempting to originate a call. At the same time, Circuit DLO is turned ON indicating that the line is in use. Circuit PND remains OFF during this call. After manual origination, if the data set is manually transferred to the data mode, Circuit COS turns ON.

Any calls not originated by the ACU cannot be terminated by the ACU. A manually originated call must be terminated either by turning OFF Circuit CD in the data set interface or manually, following the procedure for the data set used. When the call has terminated, Circuits COS and DLO turn OFF and the data set and ACU are ready for the next call.

4.4 Incoming Calls

When the data set and the data terminal are arranged to automatically answer incoming calls, the ACU does not interfere. Similarly, calls may be manually answered. Circuit DLO turns ON to indicate that the line is in use, and the ACU will not respond to a subsequent Circuit CRQ ON condition until the line is idle. When the data set goes into the data mode, Circuit COS turns ON. Throughout the data transmission interval, Circuit PND remains OFF.

4.5 Intercall Timing

The ACU is arranged to inhibit origination of a new call on a line before a previous call has been completely disconnected. An intercall timer in the ACU is set at an interval that assures disconnect when the ACU station goes "on-hook" after a call originated by the ACU station or when a station that called the ACU station is already "on-hook" when the ACU station goes "on-hook". The intercall timer interval may not be long enough to take care of the case in which the ACU goes "on-hook" but the connection is still held by the distant station. In this case, the line is not ready for a new call until the calling line goes "on-hook" or for an interval considerably longer than the ACU intercall timer interval, whichever occurs first. If circuit CRQ is turned ON before a previous call is completely disconnected, the ACR timer will eventually time out and Circuit ACR will turn ON.

4.6 Sequence of Interface Circuit Operations

Figure 5 presents a sequence of operations of the interface circuits during the set up of a call, during data transmission and during clearing of the call. The top of the chart represents the idle condition of the data station when a call may be placed. At the bottom of the chart, the station is idle again.

5. CUSTOMER TEST AND SUPERVISION FEATURES

5.1 General

The Data Auxiliary Set 801C-11/2 has a number of self-test and monitoring features which can readily be used by a customer's attendant to check the operation of the ACU.

The ACU is equipped with four status lamps on the front panel. These lamps can be observed to check the operation of the ACU during calls, and to check the results of tests conducted as described below. Three test keys are accessible through a cutout in the front panel. These keys can be operated by the user for tests as described below. An optional loudspeaker can be provided external to the ACU to permit audible checks during normal operation and tests. This speaker functions only during call set up periods of the ACU and does not operate during data or telephone calls.

5.2 Supervision During Normal Operation

Lamp ON will light as soon as power is applied to the ACU. If the lamp is extinguished, the ac power supplied by the customer may be off. Interface Circuit PWI (Power Indication) provides a similar function on the interface.

Lamp CR is lit when Circuit CRQ (Call Request) is ON. The lamp will always be lit during call set up and may be ON during data transmission, depending on the option selected (see Section 3.2.4).

Lamp PD is lit when Circuit PND (Present Next Digit) is ON. In normal operation, the lamp will light after dial tone is detected, will blink off once for each digit received from the data terminal, and will then stay lit until the end of the data call.

Lamp AR is lit when Circuit ACR (Abandon Call and Retry) is ON. When lit, it indicates that excessive time has elapsed in the call set up sequence or that the ACR timer interval has elapsed, depending upon the option selected as described in Section 3.2.3.

If the optional loudspeaker is provided, dial tone will be heard when first lamp PD lights, soon after lamp CR lights. Just prior to lamp PD blinking off, a TOUCH-TONE frequency combination can be heard. Following the completion of the dialing, and where the ACU is providing answer tone detection, as described in Section 4.1.6, any call progress tones present on the line, such as ring-back, will be heard, followed (on successful calls) by the answer tone from the called data set. As soon as the ACU transfers the call to its associated data set, the loudspeaker is muted.

5.3. Tests

Lamp ON should always be lit. No test need be attempted if this lamp is extinguished, as this indicates that no ac power is available to the ACU.

5.3.1 Slowed-down Operation of Dial Sequence

In normal operation, the dial sequence is so fast (10 digits a second for fast acting data terminals), that it is not possible to count the number of times lamp PD blinks, or the number tone combinations heard in the loudspeaker.

When nonlocking button SD (Slow Dialing) is held depressed, the dial sequence is sufficiently slowed to make a count possible. In this way, the number of digits sent by the data terminal can be checked, e.g., for a ten-digit DDD call, lamp PD is extinguished ten times.

5.3.2 Test of ACU Dial Tone Detection Circuit and ACR Timer

This test can only be carried out while the station is idle, i.e., the telephone set is on-hook, the data set idle and CRQ is OFF. To test the operation of the dial tone detection circuit, the nonlocking button TR (Test Receive circuits) is held depressed. Lamp CR should light immediately. When dial tone is received (and heard in the optional loudspeaker), lamp PD should light, indicating proper operation of the dial tone detection circuit. If the button is held depressed for an interval longer than the one selected for the ACR timer, lamp AR will light, indicating proper operation of the timer. Release of button TR will restore all circuits.

The same button is used to test the answer tone detection circuitry in conjunction with and under the guidance of the telephone company test center.

5.3.3 Test of TOUCH-TONE Generator and BCD Translation

The nonlocking button TT (Test Transmit Circuits) is used to test the TOUCH-TONE generating circuitry and the dial sequence timers. In conjunction with and under instructions of the Telephone Company testboard, the proper translation of the binary-coded decimal input signals to the TOUCH-TONE combinations can be checked as well as the accuracy of tone frequencies and levels.

After a local call is established from the telephone set associated with the data set, the dial sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 is automatically generated when button TT is held depressed. The proper operation of the timing circuits can be checked by observing the blinking of lamp PD. The generation of tones can be monitored in the optional loudspeaker, or in the earphone of the called telephone set. Simultaneous depression of button SD slows down the sequence and facilitates the checking of the operation.



FIGURE 1 – DATA AUXILIARY SET 801C-L1/2

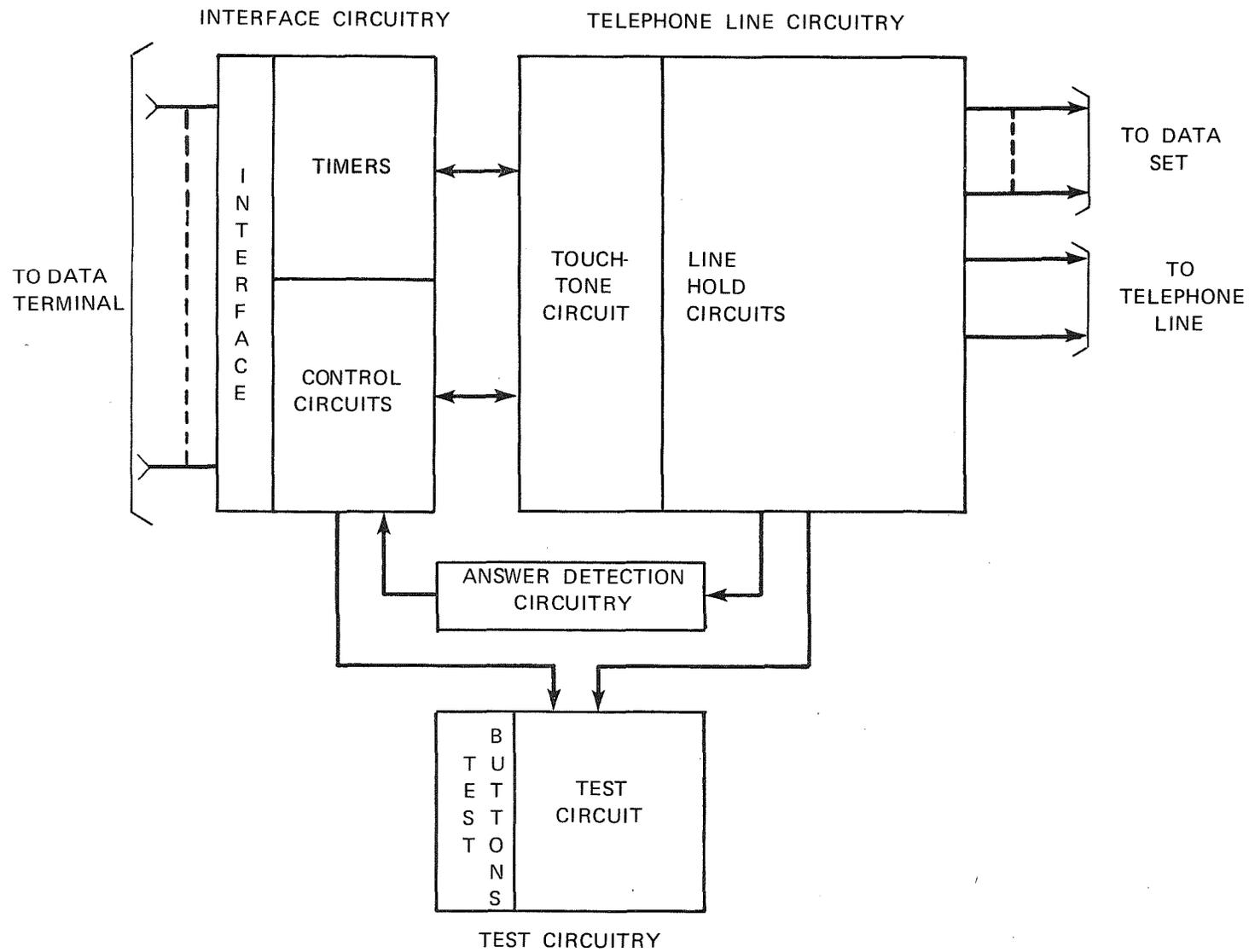
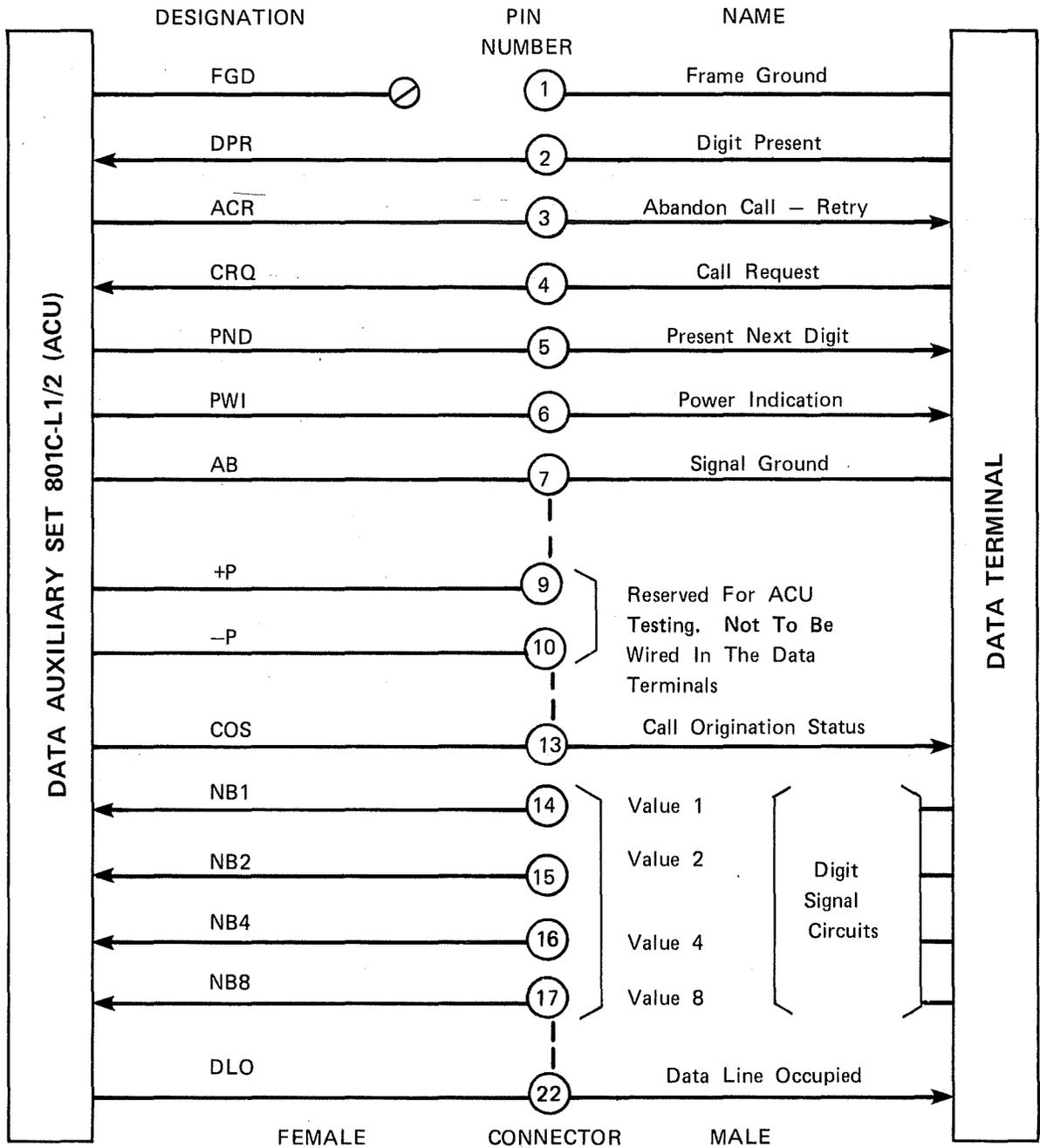


FIGURE 2
 DATA AUXILIARY SET 801C
 FUNCTIONAL BLOCK DIAGRAM

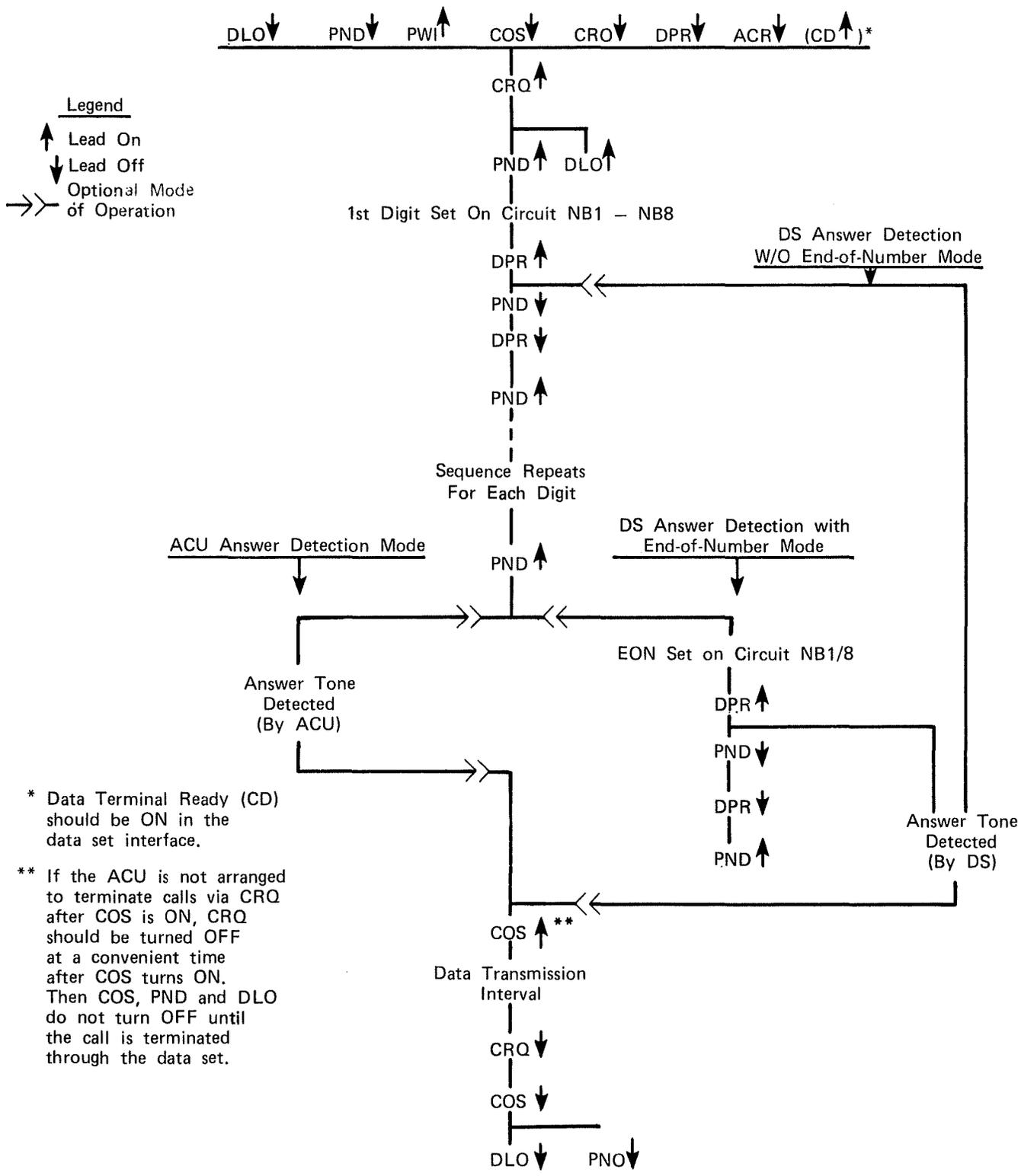
Name	Choices	Section Referenced
1. Abandon Call and Retry (ACR) Timer Control	<ul style="list-style-type: none"> -Stop ACR Timer When DSS Goes On -Do Not Stop ACR Timer When DSS Goes On 	2.(1)
2. Abandon Call and Retry (ACR) Timer Timing Options	<ul style="list-style-type: none"> -ACR Timing Interval, 7 sec. -ACR Timing Interval, 14 sec. -ACR Timing Interval, 28 sec. -ACR Timing Interval, 56 sec. 	2.(2)
3. Call Termination Control Options	<ul style="list-style-type: none"> -Terminate Call via ACU After DSS On -Terminate Call via Data Set After DSS On 	2.(3)
4. Signal Ground Option	<ul style="list-style-type: none"> -Signal Ground Connected to Frame Ground -Signal Ground Not Connected to Frame Ground 	2.(4)
5. Speaker	<ul style="list-style-type: none"> -Required -Not Required 	5.1

FIGURE 3
OPTIONAL CUSTOMER-SPECIFIED FEATURES OF
DATA AUXILIARY SET 801C-L1/2



- Note 1: Pins not shown are unassigned and should not be used.
- Note 2: Frame ground of the data terminal may be connected to Pin 1 but does not appear in the ACU connector.
- Note 3: In previous ACU's, circuit COS was designated DSS.

FIGURE 4
DATA AUXILIARY SET 801C-L1/2
INTERFACE CONNECTOR PIN ASSIGNMENTS



* Data Terminal Ready (CD) should be ON in the data set interface.

** If the ACU is not arranged to terminate calls via CRQ after COS is ON, CRQ should be turned OFF at a convenient time after COS turns ON. Then COS, PND and DLO do not turn OFF until the call is terminated through the data set.

FIGURE 5
Data Auxiliary Set 801C - L1/2
Interface Circuit Sequence Diagram

