DATA SET 109A-TYPE

IDENTIFICATION

CONTENTS PAGE

1. GENERAL

1.01 This section covers the general application and the physical and functional description of Data Set 109A-type. Information on the transmission loop used by Data Set 109A-type is also covered in this section.

> *Note:* For the purpose of this section, a transmission loop is a 2-wire metallic line that connects a Data Set 109A-type to a Data Set 109-type.

1.02 Data Set 109A-type is designed to provide low-speed (up to 300 bauds), half-duplex (HDX), serial data transmission over 2-wire metallic private line facilities and is intended for station arrangements. The data set is designed to use the 3-mA polar dc transmission scheme.

1.03 The Data Set 109A-type must work in conjunction with a station controller such as Data Auxiliary Set (DAS) 820-type. The data set working in conjunction with a DAS is referred to as a data station.

1.04 The Data Set 109A-type is intended to communicate with a Data Set 109-type in the following arrangements:

(a) Data station to hub operation using Data Set 109B-type at the hub

(b) Data station to data station operation using Data Set 109A-type at the distant end.

1.05 Data Set 109A-type can operate only over a closed dc loop which consists of a 2-wire metallic line. This line cannot be equipped with anything that will break the dc path of the loop.

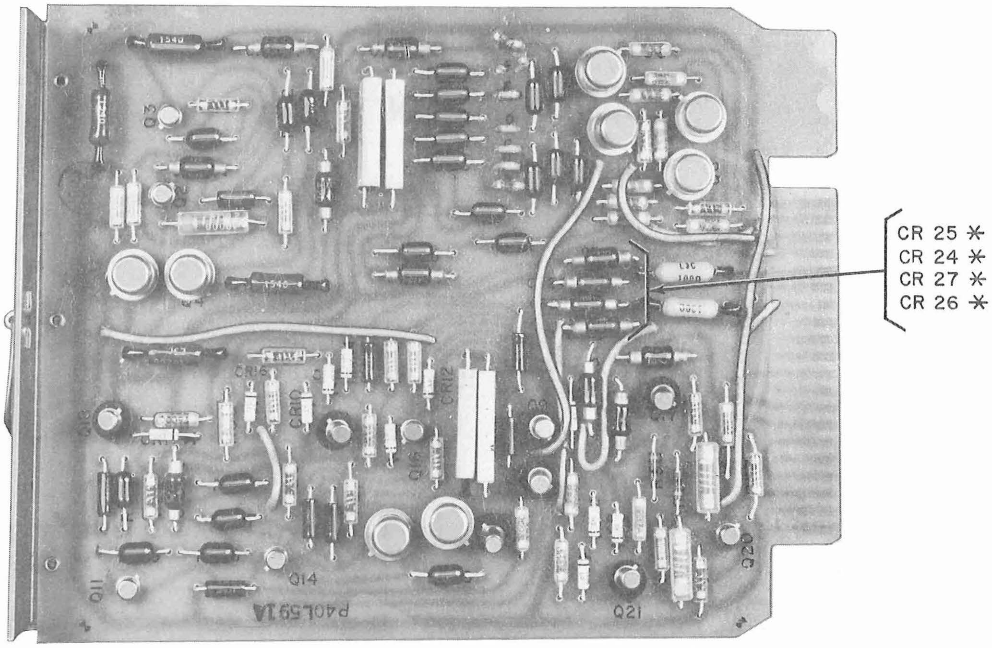
1.06 The data set is designed to operate in an ambient temperature range of 40 to 120°F and in a relative humidity range of 20 to 95 percent.

2. PHYSICAL DESCRIPTION

2.01 Data Set 109A-type consists of a single printed plug-in board as shown in Fig. 1. The dimensions of the data set are 7.1 inches long, 5.5 inches wide, and 1.4 inches high.

2.02 Data Set 109A-type has two classifications—Data Set 109A1 and Data Set 109A2. Both data sets are identical, except that Data Set 109A1 is equipped with a lightning protection network which is composed of CR24 through CR27. (See Fig. 1).

2.03 The data set requires approximately 5 watts of filtered +24 ±3 volts and −24 ±3 volts dc peak power. The power is normally supplied by the associated DAS of the data set.



✳ THESE COMPONENTS ARE USED FOR LIGHTNING PROTECTION AND ARE ONLY PROVIDED ON DATA SET 109A1.

Fig. 1—Data Set 109A-Type

2.04 Data Set 109A-type mounts in the various models of DAS 820-type including the following:

(a) Data Auxiliary Set 820D-type for single private line service

(b) Data Auxiliary Set 820E-type for multiple private line service.

2.05 The interface leads of the data set that connect to the DAS are shown in Table A. These leads meet the signal characteristics of the Electronic Industries Association (EIA) Standard RS-232-B.

TABLE A

DATA SET 109A-TYPE

FUNCTIONAL INTERFACE LEADS

DESIG	DESCRIPTION
BA	Transmitted Data
BB	Received Data
CF	Data Carrier Detector

3. FUNCTIONAL DESCRIPTION

3.01 The main function of Data Set 109A-type is to transmit data to and receive data from Data Set 109-type at a distant location. The secondary function of the data set is to provide a signal indication that the current of the transmission loop is below a satisfactory level.

3.02 The data set consists of transmitting circuits, receiving circuits, signal fail circuits, and monitor circuits as shown in Fig. 2. The monitor circuits are common to transmitter, receiver, and signal fail circuits.

TRANSMITTING CIRCUITS

3.03 The transmitting circuits convert the data from the station controller into mark and space signals which can be transmitted over the transmission loop.

3.04 The transmitting circuits consist of the transmit OR gate, the transmitter circuits, the monitor circuits, and the transmit delay circuit (Fig. 2).

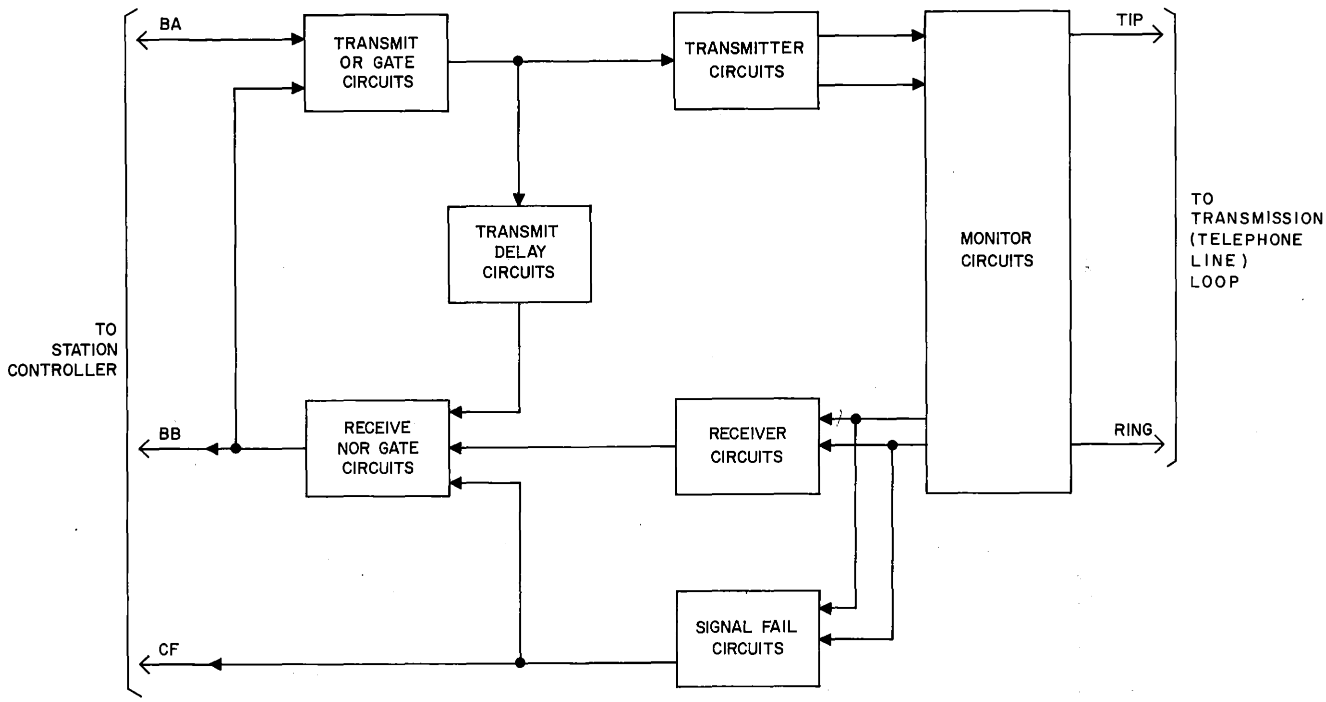


Fig. 2—Data Set 109A-Type, Block Diagram

(a) The function of the transmit OR gate is to prevent the data set transmitter from sending a spacing signal when the transmitter loop is in the spacing state due to the distant data set transmitting a break (a spacing) signal. This can be done because the output of the transmit OR gate enables the output of the receive NOR gate to interrupt the data transmission on the BA lead by clamping a marking condition to the transmitter circuit. This is done when an incoming break (a space) signal is applied to the receive NOR gate from the receiver circuit. The output of the transmit OR gate can pass data only when a steady mark condition is applied from the receive NOR gate circuit.

(b) The transmitter circuit converts the mark and space signals of the data source into +4 volt mark signals and -12 volt space signals that cause mark or space current to flow in the transmission loop.

(c) The monitor circuits apply the signals from the transmitter circuits to the transmission loop and continually sense the direction and magnitude of the current that is applied through the tip and ring leads (Fig. 2). This enables the receiver and signal fail circuits to function as required.

(d) The transmit delay circuit insures that the data being transmitted on the BA lead is not looped back to the station on the BB lead. This is required since the monitor and receiver circuits operate continuously. Assuming that a marking condition is applied to the BA lead, the receive NOR gate is held marking by the outputs of the transmit delay and the receiver circuits. When a space is applied to the BA lead, the transmit delay couples a marking condition to the input of the receive NOR gate before the output of the receiver circuit can apply a spacing condition to the input of the receive NOR gate (Fig. 2). When a mark is reapplied to the BA lead, the transmit delay holds the receive NOR gate to a marking condition for about 200 μs before the output of the receive NOR gate is allowed to follow the signals from the receiver circuit.

3.05 Data is applied to the transmit DAS via the BA lead. If a marking condition is applied to the transmit OR gate by the receive NOR gate, the transmit OR gate will pass the data on to the transmitter circuit and the transmit delay circuit. The transmitter circuit converts the mark and space signals of the data into +4 volt mark signals and -12 volt space signals. The mark and space signals are then passed to the monitor circuits which apply the signals to the transmission loop.

RECEIVING CIRCUITS

3.06 The receiving circuits receive the signals on the transmission loop, differentiate between the mark and space signals, and pass the signals on to the DAS.

> ***Note:*** The receiving circuits operate continuously, and therefore the data being transmitted is looped back to the station controller if the transmit delay does not function.

3.07 The receiving circuits consist of the receiver circuits, the receive NOR gate, and the monitor circuits.

(a) The receiver circuits accept the signals on the transmission loop from the monitor circuits and differentially detect the signals (rejecting longitudinal currents) as mark and space signals before passing the signals to the receive NOR gate.

(b) The receive NOR gate holds the BB lead to a marking condition when spacing signals are being transmitted on the BA lead and when low current in the transmission loop is detected by the signal fail circuits. It also passes signals from the receiver circuit to the DAS via the BB lead if the BA lead is marking and if a low current condition has not been detected.

(c) The monitor circuits pass the signals on the transmission loop to the receiver while performing the function outlined in 3.04 (c).

3.08 The signals on the transmission loop are passed by the monitor circuits to the receiver circuits. The receiver circuits differentially detect the signals as mark and space signals and then pass the signals to the receive NOR gate. If a low current condition has not been detected by the signal fail circuits, the receive NOR gate will pass the signals from the receiver circuits to the station via the BB lead.

SIGNAL FAIL CIRCUITS

3.09 The signal fail circuits provide an indication if the transmission loop current falls below a satisfactory level. To provide this function, the signal fail circuits consist of a bi-directional bridge circuit, an integrator circuit, and an inverter circuit.

(a) The bi-directional bridge detects current flow, regardless of the polarity, as the current level of the transmission loop exceeds a satisfactory level and conducts, producing a negative output to the integrator circuit. When the current level of the transmission loop falls below a satisfactory level, the bridge will cease conducting and pass a positive output to the integrator circuit.

(b) The integrator circuit eliminates the amplitude variations (ripples) of the negative output from the bi-directional bridge and passes the signals to the inverter. The integrator directly passes the positive signal from the bridge to the inverter.

(c) The inverter circuit clamps the CF lead to an ON condition during normal operations and to an OFF condition when a current fail condition is detected.

3.10 During normal operations, the bi-directional bridge conducts and passes a negative output to the integrator circuit. The integrator eliminates the ripples from the negative output signal and passes the negative output to the inverter circuit. The inverter clamps the CF lead to an ON condition (positive EIA voltage) which indicates normal operation.

> ***Note:*** The EIA voltages concur with RS-232-B which states that, for driver circuits, the positive voltages range between +5 and +25 volts, and the negative voltages range between -5 and -25 volts.

3.11 When the current level falls below a satisfactory level, the bridge circuit ceases to operate and applies a positive output to the inverter circuit. The inverter is turned on and applies an OFF condition (negative EIA voltage) to the CF lead.

4. TRANSMISSION INFORMATION

4.01 Data Set 109A-type employs the 3-mA polar dc transmission scheme to transmit and receive data with Data Set 109-type. The dc loop resistance to obtain 3 mA of current depends on the operational arrangement at the set.

4.02 In data station to hub operation, the design dc loop resistance to obtain the nominal 3 mA of current is 2000 ohms with a maximum capacitance of 1 μF.

(a) Loops of less than 1800 ohms must be built out to the nominal value of 2000 ohms by using a line-adjusting resistor coded J70165D-1. The line-adjusting resistor should be located in the hub office. Loops which have resistances that range between 1800 and 2000 ohms do not require the build-out unit.

(b) Loops of greater resistance than 2000 ohms may be used, up to a maximum of 2500 ohms, as long as the maximum capacitance does not exceed 1 μF.

(1) For such loops, the nominal loop current of 3 mA decreases up to 15 percent with the increasing resistance.

(2) Similarly, the distortion may increase with the increasing resistance to an additional 0.5 percent as compared to loops of nominal resistance. The increased distortion does not materially affect the quality of the transmission.

4.03 In the station-to-station operation, the design dc loop resistance to obtain the nominal 3 mA of current is 1800 ohms with a maximum capacitance of 1 μF.

(a) Loops of less than 1500 ohms must be built out to the nominal value of 1800 ohms by using a 13A1 Data Unit as a J70165D-1 Line Adjusting Resistor Unit.

(1) The build-out unit can be located at either station of the transmission loop.

(2) The build-out unit must be mounted in series with the loop and is located external to the data set.

(b) Loops which range between 1500 and 1800 ohms of resistance do not require any additional resistance in series with the loop.

(c) Loops of greater resistance than 1800 ohms may be used, up to a maximum of 2500 ohms, as long as the maximum capacitance does not exceed 1 μF.

(1) For such loops, the nominal loop current of 3 mA decreases up to 20 percent with the increasing resistance.

(2) Similarly, the distortion may increase with the increasing resistance to an additional 0.8 percent as compared to loops of nominal resistance. The increased distortion does not materially affect the quality of the transmission.

DATA SET 109A-TYPE TRANSMISSION SCHEME

4.04 The data sets at each end of the transmission loop (Fig. 3) may be considered as voltage sources from which space and mark currents are derived for use on the loop.

4.05 The signal conditions on the transmission loop are as follows.

(a) ***Idle condition:*** Both data sets are transmitting a mark condition [Fig. 3(A)].

Note: The idle condition exists only when neither of the data sets has data information to be transmitted.

(b) ***Data Set 109A-type is Transmitting:*** Data Set 109A-type transmits either a mark [Fig. 3(A)]or a space [Fig. 3(B)]while distant Data Set 109-type transmits a steady mark condition.

(c) ***Data Set 109A-type is Receiving:*** Data Set 109A-type transmits a steady mark condition while the distant Data Set 109-type is transmitting a mark [Fig. 3(A)]or a space [Fig. 3(C)].

4.06 Steps (a) through (d) explain the transmission scheme.

(a) The voltage value for transmitting a space (–12 volts) into the loop is three times that

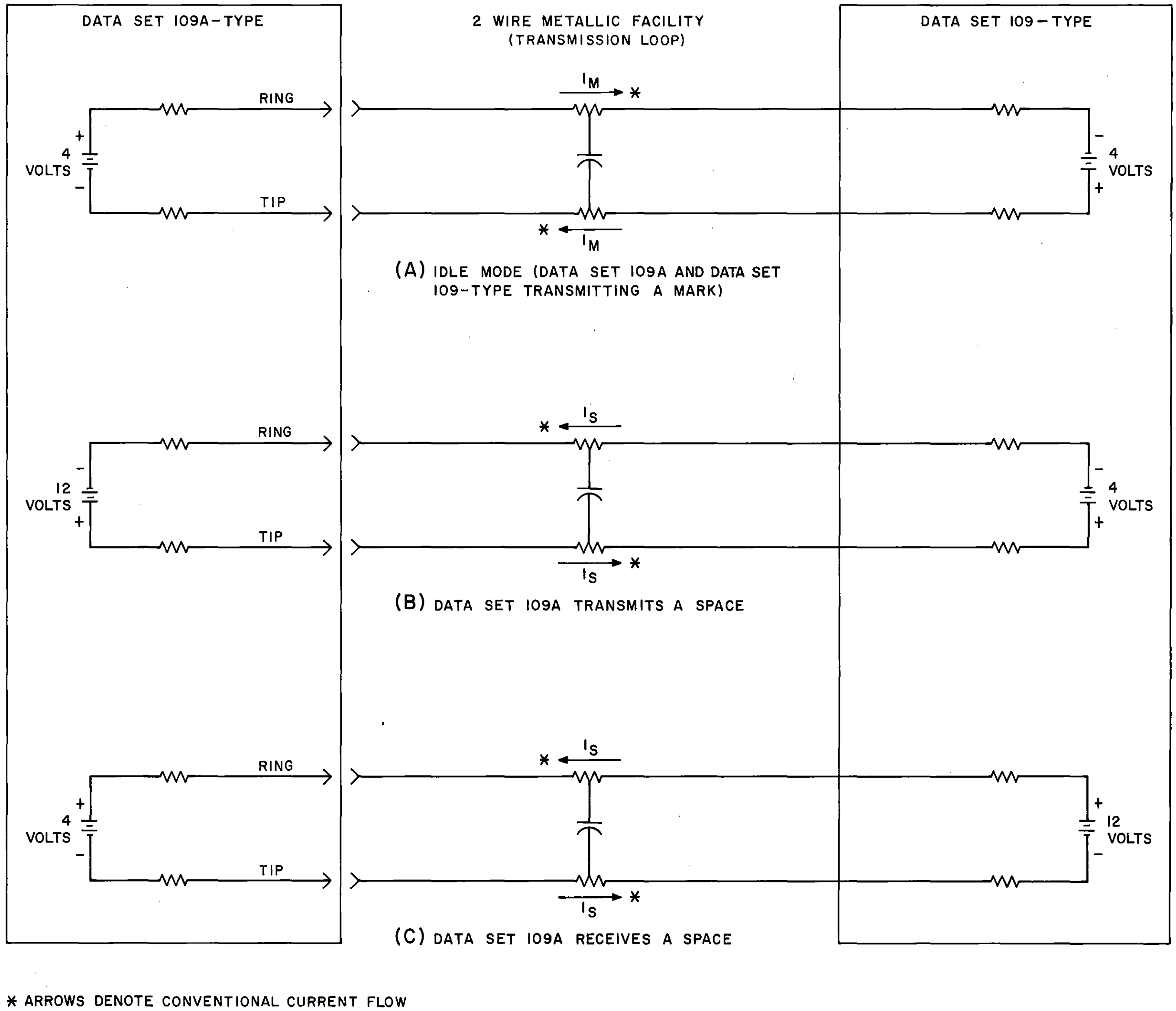


Fig. 3—Data Set 109A-Type, Transmission Scheme

for transmitting a mark (+4 volts) and is opposite in polarity to the mark.

(b) Consider Fig. 3(A) where both data sets are transmitting marks (the idle condition). The marking voltage applied to the loop algebraically adds to 8 volts. This sets up a current of 3 mA in the direction indicated by Fig. 3(A). Both data sets interpret this as marking current in the loop.

(c) Fig. 3(B) illustrates Data Set 109A-type transmitting a space (-12 volts). The sum of the Data Set 109A-type space and the Data Set 109-type mark (+4 volts) algebraically adds to 8 volts which sets up a current of 3 mA in the direction indicated in Fig. 3(B). Both data sets interpret this as spacing current in the loop.

(d) Fig. 3(C) illustrates the reception of a space by Data Set 109A-type from Data Set 109-type. The voltages produce the 3 mA of current as described above, and both data sets interpret this as spacing current in the loop.

4.07 ***Breaking Signal:*** Either station of the loop can interrupt the data transmission by transmitting a break signal (a long spacing signal). The break signal must be long enough to enable the transmitting station to recognize the signal as a break and not as a character.

4.08 ***Simultaneous Starts:*** Both stations attempting to transmit a space at the same time is uncommon. When a simultaneous start occurs, the station sending a longer spacing signal seizes control of the transmission path the instant the other station sends a marking signal.

5. REFERENCES

5.01 For more detailed information about Data Set 109A-type, refer to the following list:

(a) CD-3D025-01 (Data Set 109A-Type, Circuit Description)

(b) SD-3D025-01 (Data Set 109A-Type, Schematic Description).

5.02 For more information about Data Set 109A-type used with Data Auxiliary Set 820-type, refer to the following list of Bell System Practices:

(a) Section 591-024-101 (Data Set 109A-Type Single Private Line Station Using Data Auxiliary Set 820D-Type, Description and Operation)

(b) Section 591-024-102 (Data Set 109A-Type Multiple Private Line Station Using Data Auxiliary Set 820E-Type and KS-20018 Cabinet, Description and Operation)

(c) Section 591-024-103 (Data Set 109A-Type Multiple Private Line Station Using Data Auxiliary Set 820E-Type and KS-20093 Cabinet, Description and Operation).

5.03 For more information about Data Set 109B-type, refer to the section entitled Data Set 109B-Type, Description (312-802-100).