DATA-PHONE® INTERCONNECTION ARRANGEMENT FOR TRUNK SIDE OF 10B DATA LINE CONCENTRATOR (DLCS*) DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains descriptive and functional information for the trunk side DATA-PHONE interconnection arrangement of a 10B Data Line Concentrator. The arrangement provides a means by which a local DLCS station can be interconnected through the DDD network to stations equipped with DATA-PHONE service. The arrangement interconnects DLCS and the telephone network through the trunk side of the dual-access concentrator. The local DLCS station must be equipped with an optional rotary dial or TOUCH-TONE® signaling device and a listen-only handset.

* Data Line Concentrator Service, formerly known as DATREX

1.02 A block diagram illustrating the interconnection arrangement being used in a system is shown in Fig. 1. The local station operates over 2-wire DLCS metallic loops to gain access to a local computer port. When the local station is arranged for alternate access to DATA-PHONE, the selection of the alternate access line will be recognized by the concentrator, and the station will be connected to the alternate access trunk group (Trunk Group B). Trunk group B is associated with the DATA-PHONE interconnection arrangement. The local station can now dial out onto the DDD facility because the interconnection arrangement has provided a communication link between a local DLCS station and the telephone network.

> ***Note:*** Any particular concentrator may be arranged for only one type of dial signaling, ie, either rotary dial or TOUCH-TONE but not both.

1.03 The interconnection arrangement operates with appropriate data sets and control logic circuits to convert the dc data set signals into ac signals compatible with DATA-PHONE service. The arrangement is compatible with either half-duplex (HDX) service or full-duplex (FDX) service.

1.04 A block diagram of the interconnection arrangement is shown in Fig. 2. The

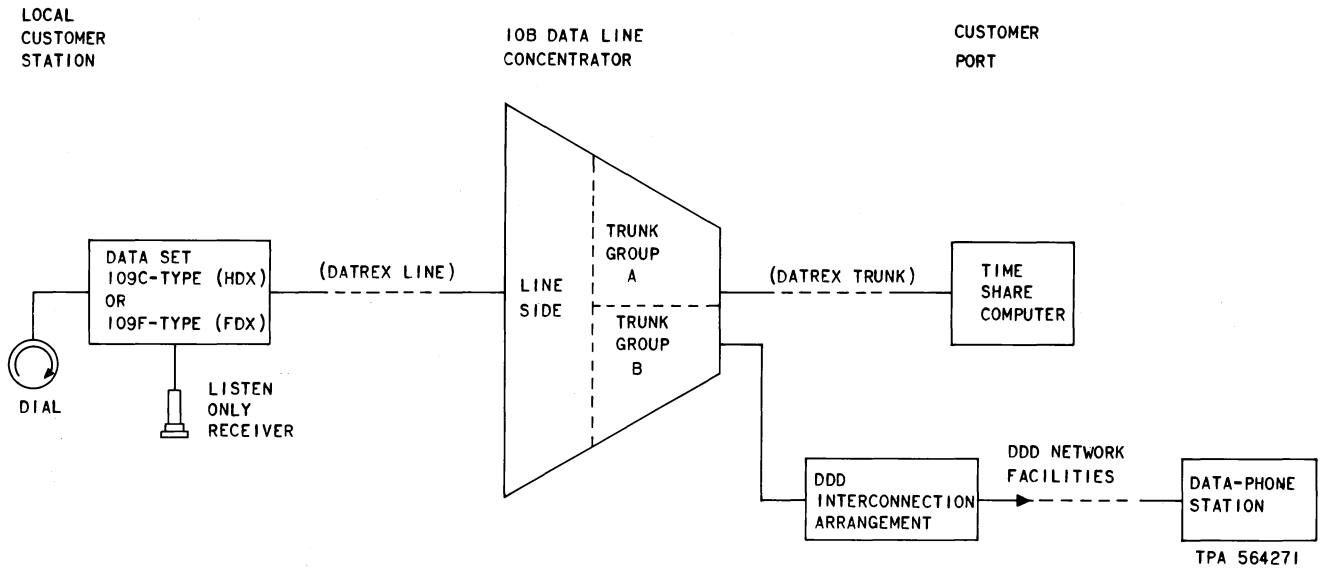

Fig. 1—System Arrangement, Block Diagram

arrangement consists of two separate data sets (each one being contained on a single plug-in circuit pack), one logic circuit pack, and one interface circuit pack. All four circuit packs for one interconnection arrangement are mounted in a 28A1 Data Mounting as shown in Fig. 3. The 28A1 Data Mounting has slot provisions to accommodate two separate interconnection arrangements.

1.05 Each interconnection arrangement requires a Data Set 108D-L1 and a logic circuit pack AR72. If the local customer is operating half-duplex, the interconnection arrangement can use a Data Set 109D-L1 or a Data Set 109E-L1 to interface with the concentrator trunk group B. Full-duplex operation requires a Data Set 109E-L1 to interface with the concentrator trunk group B. If the local customer is provided with rotary dial signaling, the interconnection arrangement requires the interface circuit pack AR73 (option Z). TOUCH-TONE signaling requires the interface circuit pack AR74 (option Y).

1.06 Circuit functions of the four circuit packs are completely interconnected by using the special 10-inch long 209A adapter cord (see Fig. 4). This cord is capable of serving two separate interconnection arrangements when both are contained in one 28A1 Data Mounting.

1.07 All interconnection arrangements serving one 10B Data Line Concentrator must be

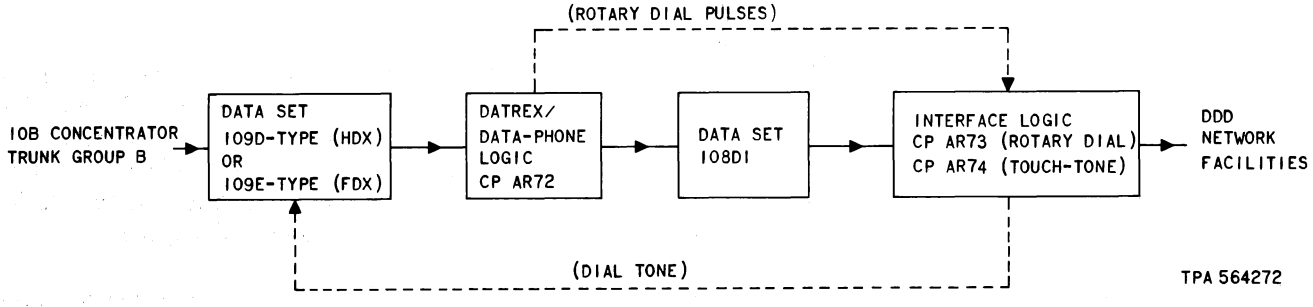

Fig. 2—Interconnection Arrangement, Block Diagram

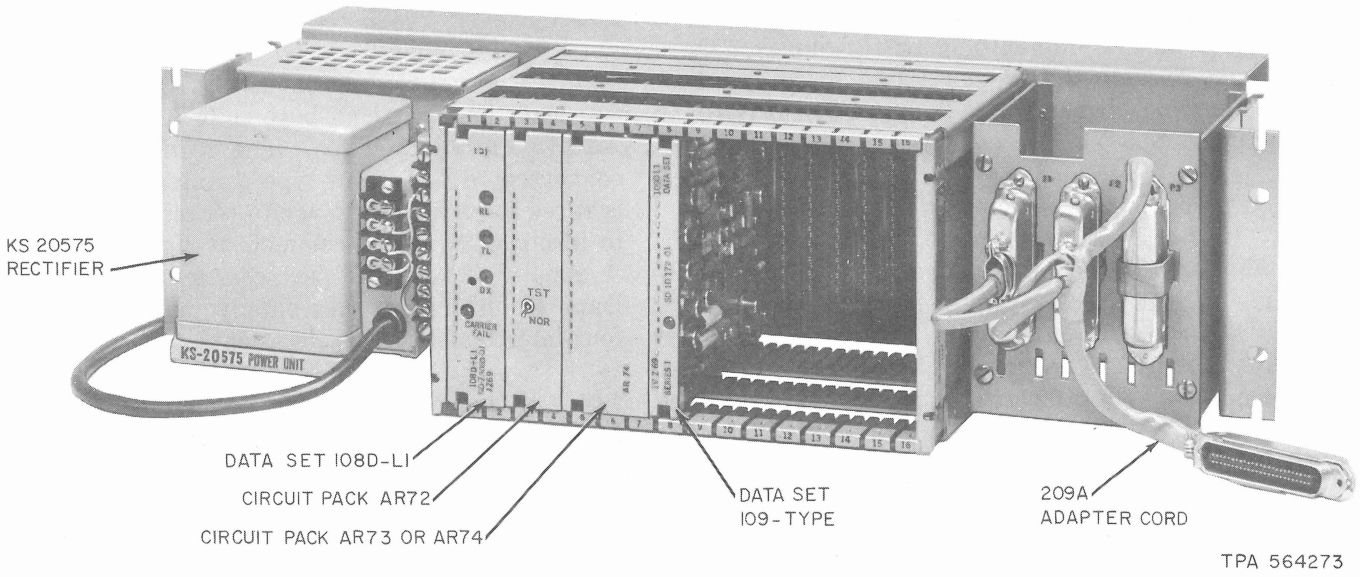

Fig. 3—28A1 Data Mounting With One Interconnection Arrangement

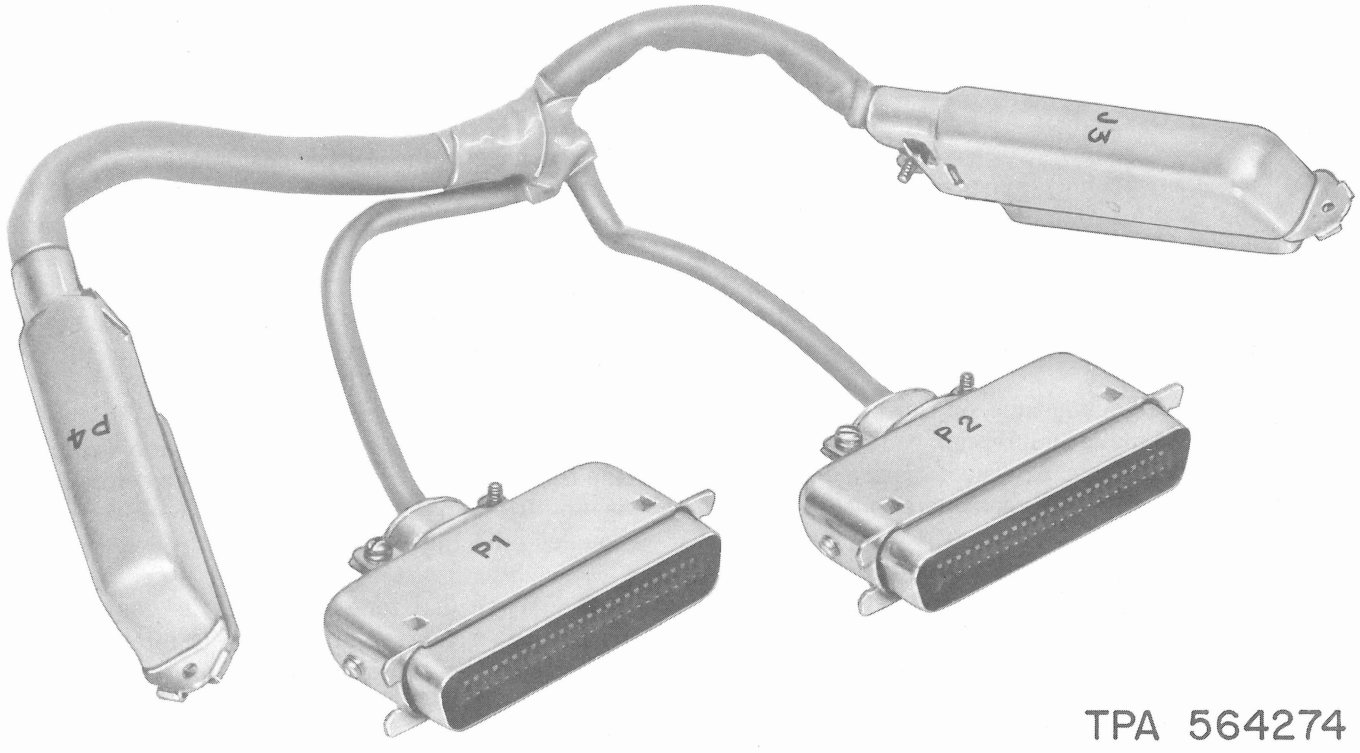

Fig. 4—209A Adapter Cable

equipped with identical options. The arrangement will either be half-duplex only or full-duplex only and must provide the proper option to recognize either rotary dial signaling (option Z) or TOUCH-TONE signaling (option Y).

1.08 An optional common key telephone set or a CALL DIRECTOR® set can be associated with the interconnection arrangement. These units provide such features as intercepting the telephone line (DDD) and/or making the associated trunk circuit appear as "not ready for service" to the concentrator. The associated key telephone set or CALL DIRECTOR set can be placed on a shelf within the equipment cabinet containing the interconnection arrangement. These telephone sets are useful as aids to maintenance service and testing.

1.09 A TEST switch is provided on circuit pack AR72 to allow loop-around testing on the DATA-PHONE line side while at the same time providing a "not ready" appearance toward the concentrator.

2. DESCRIPTION

A. Physical Description

2.01 The interconnection arrangement is housed in a 28A1 Data Mounting which measures 10 inches high, 25 inches wide, and 6 inches deep. The data mounting can be used in either 23- or 25-inch racks and can contain two complete interconnection arrangements.

2.02 Physical dimensions of the units which are used to make an interconnection arrangement are provided in Table A. The sizes are approximate for estimating mounting considerations.

2.03 The interconnection arrangement is designed to operate in an ambient temperature range of +40°F to +120°F with relative humidity up to 95 percent.

B. Power Requirements

2.04 When a KS-20575 rectifier is used to supply the operating voltages, it is secured on the 28A1 Data Mounting to the left of the 59C Apparatus Mounting using predrilled mounting holes. The rectifier outputs are terminated on the 28A1 Data Mounting terminal strip. The terminal strip is prewired to the circuit pack connectors.

2.05 The KS-20575 rectifier is a ferro-resonant device which accepts 105 to 129 volts at 60 (±3) Hz, generates approximately 120 watts under full load, and provides both +24 (±3.0) vdc and −24 (±3.0) vdc sources. The rectifier output is connected to the screw-type terminal strip which is wired to provide +24 vdc to terminal 1, −24 vdc to terminal 20, and a common or signal ground to terminal 8 of all circuit pack connectors in the 28A1 Data Mounting. It can supply power for up to four interconnection arrangements.

2.06 If the interconnecting arrangement is to be powered from a source other than a KS-20575 rectifier, the voltage, current, and wattage requirments are provided in Table B for reference.

3. FUNCTIONAL DESCRIPTION

GENERAL

3.01 The sequence of operation which enables a DLCS customer to connect to DATA-PHONE facilities is shown in Fig. 5. The customer presses LINE 2 key (or key designated for DDD access) which is recognized by the concentrator as a request for DATA-PHONE facility service. The concentrator cross-connects the DLCS customer to an available interconnection arrangement, and the normal DLCS loop current is established between the station data set and the Data Set 109-type in the arrangement.

3.02 Data Set 109-type can now provide the Receive Supervision signal to circuit pack AR72 which enables logic circuits to energize the line relay on circuit pack AR73 or AR74. Line relay contacts seize and hold the line facility to the central office. Dial tone from the central office is amplified by circuits on AR73 or AR74 and coupled onto the DLCS facility.

3.03 When dial tone is heard, the customer can dial a far-end station. The interconnection arrangement is equipped to accept rotary dial pulses (AR73) or TOUCH-TONE signaling (AR74).

3.04 Call progress tones and ringing can be monitored by the customer. When the far-end station answers by going off-hook, an F2M signal is returned to the arrangement to unsquelch Data Set 108D. A short duration of F2M tone is heard at the DLCS station to signal that a DATA-PHONE connection is being established. The station will receive an acknowledgment from

TABLE A

PHYSICAL DIMENSIONS OF THE INTERCONNECTING ARRANGEMENT UNITS

UNIT	HEIGHT (INCHES)	WIDTH (INCHES)	DEPTH (INCHES)	WEIGHT	
				POUNDS	OUNCES
28A Data Mounting	6	25	10-1/2	15	—
KS-20575 Rectifier	5-1/4	6	6-1/2	12	8
Data Set 108D1	5-1/2	1-1/8	7	1	4
Data Set 109D	5-1/2	1/2	7	—	8
Data Set 109E	5-1/2	1/2	7	—	8
CP AR72	5-1/2	1/2	7	—	6
CP AR73	5-1/2	1/2	7	1	—
CP AR74	5-1/2	1/2	7	1	—

TABLE B

INTERCONNECTION ARRANGEMENT POWER REQUIREMENTS

UNIT	VOLTAGE SOURCE (See Note)	CURRENT DRAIN	WATTAGE	VOLTAGE SOURCE (See Note)	CURRENT DRAIN	WATTAGE
Data Set 108D	+24 (±2)	62 mA	1.5	−24 (±2)	95 mA	2.3
Data Set 109D	+24 (±2)	70 mA	1.7	−24 (±2)	70 mA	1.7
Data Set 109E	+24 (±2)	110 mA	2.6	−24 (±2)	95 mA	2.3
CP AR72	+24 (±2)	60 mA	1.5	−24 (±2)	12 mA	0.3
CP AR73	+24 (±2)	50 mA	1.2	−24 (±2)	8 mA	0.2
CP AR74	+24 (±2)	66 mA	1.6	−24 (±2)	11 mA	0.3

Note: The two voltage sources must track within ±2.0 volts.

the called station upon completion of the DATA-PHONE connection.

3.05 The F2M tone is also monitored by the Data Set 108D in the arrangement. When the F2M tone is recognized as valid (approximately 0.5 second), logic circuits will inhibit the dialing and the call progress circuits in AR73 or AR74.

3.06 At the end of data transmission, if the far-end (DATA-PHONE) station goes on-hook first, a space signal monitor will, after 1.5 seconds, cause the concentrator to open the connection between the DLCS station and the arrangement. The arrangement will appear "not ready" to the concentrator for an additional 2.0 seconds to assure proper disconnection by the central office of the previous call. After the 2.0-second intercall timing

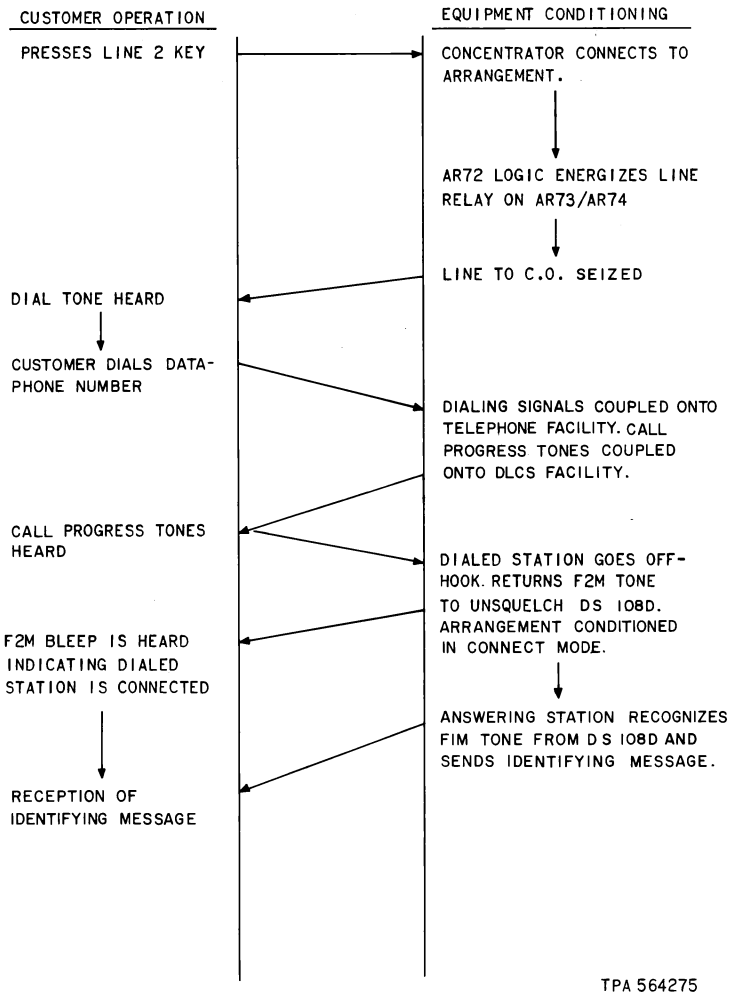

Fig. 5—Sequence of Operation When Connecting Through 10B Data Concentrator and Interconnection Arrangement to DATA-PHONE Facilities

delay, the arrangement presents an "idle" condition to the concentrator. If the DLCS station goes on-hook first, the arrangement is conditioned to appear "not ready" to the concentrator for approximately 5.0 seconds. A 3.0-second space signal is forced on-line toward the far-end station after which the 2.0-second intercall timing is started. Once the intercall timing is complete, an "idle" condition signal is again sent to the concentrator to indicate preparation for the next call.

ARRANGEMENT FEATURES

3.07 The interconnection arrangement can be equipped to recognize and accept either rotary dial pulses by using circuit pack AR73 (option Z) or TOUCH-TONE signaling using circuit pack AR74 (option Y).

A. Rotary Dial (Option Z)

3.08 Rotary dial pulses are transmitted from the DLCS station as MARK and SPACE data signals. A logic circuit on circuit pack AR72 monitors the output of the Data Set 109-type and causes a relay on circuit pack AR73 to repeat the dialing pulses onto the telephone loop.

B. TOUCH-TONE (Option Y)

3.09 Off-normal contacts of the TOUCH-TONE dial are arranged to key the transmitter of

the local station data set to transmit a SPACE signal. TOUCH-TONE signals are superimposed on the spacing data signal. The spacing data signals are used by logic circuits of circuit pack AR72 to control directional audio amplifiers contained on circuit pack AR74.

C. Data Set 109-Type Interface

3.10 A Data Set 109-type is used in the interconnection arrangement to interface with the local station through the concentrator trunk circuits. Signal exchange at the data set interface consists of the following:

- Receive Data
- Send Data
- Receive Supervision
- Current Squelch
- 2-wire line arrangement.

D. Data Set 108D-L1 Interface

3.11 A Data Set 108D-L1 is used in the interconnection arrangement to interface with the telephone loop through interface circuit pack AR73 or AR74. Signal exchange at the data set interface consists of the following:

- Received Data
- Transmitted Data
- Received Line Signal Detector
- Carrier Squelch
- 4-wire input arrangement.

E. Data Set 108D-L1 Sensitivity

3.12 The sensitivity of Data Set 108D-L1 in the arrangement has been increased for DATA-PHONE service. The data set has a sensitivity requirement of −40 dBm. When the data set is used in the interconnection arrangement, the amplifiers and filters of either circuit pack AR73 or AR74 working in tandem with the data set extend the sensitivity to −50 dBm.

F. 3-Second Disconnect Signal

3.13 The 3-second disconnect logic is part of circuit pack AR72. This circuit is enabled whenever the local DLCS station terminates the call or upon detection of a loss of carrier tone from the DATA-PHONE terminal. The 3-second disconnect circuit controls the Transmitted Data lead input to Data Set 108D-L1 to generate an F1S tone (1070 Hz) to assure the disconnection of the DATA-PHONE terminal.

G. Send Break Timer

3.14 The Send Break Timer is contained on circuit pack AR72. The timer prevents a DATA-PHONE disconnect signal from being falsely generated by the local DLCS station equipment BREAK key. A spacing signal from the local station is restricted to approximately 0.5-second duration.

H. Intercall Timing

3.15 An intercall timing delay of approximately 2.0 seconds is required to assure proper disconnection by the central office of a previous call before reseizing the line circuit of the office. The intercall timer, contained on circuit pack AR72, causes the line voltage to the concentrator to go to zero through the Current Squelch lead of Data Set 109-type. This condition provides a "not ready" appearance toward the concentrator until the interconnection arrangement is ready to accept a new call request.

I. TEST Switch

3.16 The TEST switch is located on the faceplate of circuit pack AR72. The TEST switch is provided to allow loop-back testing on the DATA-PHONE line side while providing a "not ready" appearance toward the concentrator. For normal operation, the switch handle is down. When a test mode is desired, the switch handle is up.

DETAILED DESCRIPTION

3.17 A block diagram of an interconnection arrangement is shown in Fig. 6. The local station selects alternate access through trunk group B of the dual-access concentrator to the interconnection arrangement. The current loop is completed through a winding of transformer T2 on interface circuit pack AR73 or AR74 before reaching the line pad

of Data Set 109-type. The transformer winding couples both dial tone and call progress tones from the telephone loop onto the dc DLCS loop. When the arrangement is equipped for TOUCH-TONE operation, transformer T2 also couples the TOUCH-TONE signals from the dc DLCS loop through circuitry on circuit pack AR74 onto the telephone loop.

3.18 The resistance of the line pad in Data Set 109-type is adjusted to provide a similar appearance as if the concentrator had connected to a computer port data set through trunk group A. The overall operation of Data Set 109D-type is described in Section 591-029-100. The overall operation of Data Set 109E-type is described in Section 591-036-100. Once the current loop is established through the dual-access concentrator, the Data Set 109-type enables the Receive Supervision (RS) signal lead to be ON. Detection of the RS-ON signal causes the line control circuit (on circuit pack AR72) to operate the line relay on circuit pack AR73 or AR74. The energized relay causes an off-hook indication to the central office equipment.

3.19 Dial tone from the central office equipment is coupled through hybrid transformer T1, a receive amplifier, a dial tone amplifier, and transformer T2 to the DLCS loop. The local station operator monitors dial tone through a listen-only handset. The operator then dials the DDD number using rotary dial or TOUCH-TONE signaling.

Rotary Dialing Using Circuit Packs AR72 and AR73

3.20 Rotary dial pulses are received at the interconnection arrangement as MARK and SPACE dc data signals. Option Z (screw switch S1 closed) on circuit pack AR72 must be installed to establish connection with the line control circuit. The pulses are repeated by controlling line relay K1 on circuit pack AR73 (option Z). The relay contact on output terminal 15 repeats the dial pulses under control of the line control circuit on circuit pack AR72. The dial pulses appear on the Receive Data (BB) lead of Data Set 109-type and couple to the line control circuit through the send break timer on circuit pack AR72. After Data Set 108D-L1 recognizes the incoming carrier, its Received Line Signal Detector (CF) lead disables the line control circuit through the CON control logic to prevent data originated by the local station from appearing as dialing pulses after the DATA-PHONE connection has been established.

TOUCH-TONE Dialing Using Circuit Packs AR72 and AR74

3.21 At the local DLCS station, the off-normal contacts of the TOUCH-TONE dial are conditioned to key the station data set transmitter to send a spacing signal on the line. The TOUCH-TONE signals are superimposed on the spacing signal when received at the interconnection arrangement. Option Y (screw switch S1 open) on circuit pack AR72 must be installed to prevent the line relay from falsely operating when receiving TOUCH-TONE signals.

3.22 Circuit pack AR74 (option Y) contains the same circuitry as circuit pack AR73 plus additional circuitry for TOUCH-TONE operation. The send amplifier on circuit pack AR74 contains a summing stage to amplify either the Data Set 108D-L1 tone or the TOUCH-TONE signal. Only one signal is applied to this amplifier at any time by control logic.

3.23 Before the Data Set 108D-L1 recognizes an incoming F2M tone (2225 Hz), spacing dc signals on the DLCS loop control the TOUCH-TONE logic on circuit pack AR72 from the Receive Data (RD) lead of Data Set 109-type and the send break timer on AR72. The output of the TOUCH-TONE logic circuit operates the TOUCH-TONE control circuit on circuit pack AR74. The TOUCH-TONE logic circuit on circuit pack AR72 also enables the Receive Channel Blind function which clamps the input lead to Data Set 108D-L1 through circuit pack AR74 to prevent false operation. The TOUCH-TONE amplifier on circuit pack AR74 can now permit TOUCH-TONE signals to be coupled to the telephone network through the send amplifier. The TOUCH-TONE control also changes the normal low impedance of the transformer T2 winding to a high impedance which allows a stronger TOUCH-TONE signal to be coupled to the TOUCH-TONE amplifier.

3.24 The dial tone amplifier is clamped after the DATA-PHONE connection is established through the Carrier Squelch (CS) lead of Data Set 108D-L1 to prevent interference to data in the DLCS loop.

3.25 Line signals are coupled from the telephone loop through hybrid transformer T1, a receive

amplifier, a high-pass filter, and an impedance-matching amplifier to Data Set 108D-L1. The Data Set 108D-L1 is optioned to interface with circuit pack AR73 or AR74 on a 4-wire basis. The circuitry on either circuit pack provides additional filtering and gain to permit Data Set 108D-L1 to operate with line signals as low as −50 dBm at the input to the interconnection arrangement.

3.26 Tone from the Data Set 108D-L1 oscillator is coupled through a pad, a low-pass filter, a send amplifier, and hybrid transformer T1 on circuit pack AR73 or AR74 to the telephone network. The overall operation of Data Set 108D-L1 is described in Section 591-028-100.

3.27 On circuit pack AR72, the CON flip-flop provides a memory state that a complete DLCS/DATA-PHONE connection has been established. The CON control logic switches the CON flip-flop to the SET state when both the Receive Supervision (RS) of the Data Set 109-type and the Line Signal Detector (CF) of the Data Set 108D-L1 are turned ON. This SET state of the CON flip-flop also disables the TOUCH-TONE logic circuit. The CON control logic resets the CON flip-flop to the CLEAR state only when both the Receive Supervision (RS) and the Received Line Signal Detector (CF) of each data set are turned OFF. The "0" output lead of the CON flip-flop controls the Current Squelch (CSQ) lead of Data Set 109-type through the CSQ logic circuits.

3.28 The disconnect spacing signal provided for DATA-PHONE stations is generated by the SEND SPACE—3 SECONDS circuitry. This circuit is activated when the Receive Supervision (RS) lead or the Receive Line Signal Detector (CF) of either data set is turned OFF after a complete data connection has been established. If the carrier applied to Data Set 108D-L1 falls below the −50 dBm sensitivity level of the arrangement, or the Receive Supervision (RS) function of Data Set 109-type falls below its threshold, the SEND SPACE—3 SECONDS circuitry is triggered. The SEND SPACE—3 SECONDS circuit also prevents the Data Set 108D-L1 oscillator from being clamped OFF until after the disconnect spacing signal has been transmitted.

3.29 The SEND SPACE—3 SECONDS circuit also controls the SEND BREAK TIMER circuits. During the 3-second time period, a spacing signal is forced on the output of the SEND BREAK TIMER. The function of the SEND BREAK TIMER during transmission is to prevent untimed break signals originated by the local DLCS station from disconnecting the DATA-PHONE terminal.

3.30 A MONITOR SPACE—1.5 SECOND circuit monitors the Receive Data (BB) from Data Set 108D-L1 to detect a DATA-PHONE disconnect signal. When a 1.5-second receive spacing signal is detected, the MONITOR SPACE circuit applies a signal through the CSQ logic circuit and an EIA amplifier to turn ON the Current Squelch lead to Data Set 109-type. Approximately 15 milliseconds later (the delay of a Data Set 109-type), the Receive Supervision (RS) lead of the data set is turned OFF. The Receive Supervision (RS) lead of the data set turning OFF activates the Receive Channel Blind function on circuit pack AR72 which blinds the receive channel of Data Set 108D-L1. By blinding the receive channel, the Data Set 108D-L1 will detect loss of carrier in approximately 180 milliseconds and turn its Received Line Signal Detector (CF) lead OFF. This resets the CON flip-flop to the CLEAR state. The MONITOR SPACE circuit will inhibit the SEND SPACE—3 SECONDS to provide a faster disconnect of the DATA-PHONE connection upon detecting a DATA-PHONE disconnect signal.

3.31 The arrangement facing the trunk side of a dual-access concentrator is conditioned "not ready" through the combination of CSQ logic, an EIA amplifier, and the INTERCALL TIMER—2 SECONDS circuit. After a connection has been established between a DLCS station and a DATA-PHONE terminal, a loss of Receive Supervision (RS) or Received Line Signal Detector (CF) by either data set in the interconnection arrangement causes the CSQ logic to activate the Carrier Squelch (CSQ) lead to Data Set 109-type while a 3-second SEND SPACE signal is transmitted to the DATA-PHONE terminal. At the end of the 3-second timer interval, the CON flip-flop is reset and the INTERCALL TIMER—2 SECONDS circuit is activated. At the end of the 2-second interval, the Carrier Squelch (CSQ) lead is turned OFF and the arrangement appears "idle" and ready for service to the dual-access concentrator.

4. REFERENCES

4.01 The following circuit descriptions (CDs), schematic drawings (SDs), and Bell System

Practices (BSPs) pertain to the DLCS/DATA-PHONE Interconnection Arrangement (Trunk Side):

CD & SD-1D201-01	Data System Station, DATREX /DATA-PHONE Interconnection Circuit (Trunk Side)
CD & SD-73060-01	Data Systems, Central Office and Station, Data Set 108D-Type
CD & SD-1D172-01	Data Systems, Station Data Set 109D-Type
CD & SD-1D198-01	Data Systems, Station Data Set 109E-L1
SD-1D176-01	28A-Type Data Mounting
590-102-124	28A1 Data Mounting, Identification
591-036-100	Data Set 109E-L1, Description
591-810-100	10-Type Data Line Concentrator System (DLCS), Description
591-811-101	10B Data Line Concentrator (DLCS), Description
591-811-184	DATA-PHONE® Interconnection Arrangement for Trunk Side of 10-Type Data Line Concentrator System (DATREX*), Summarizing Specification

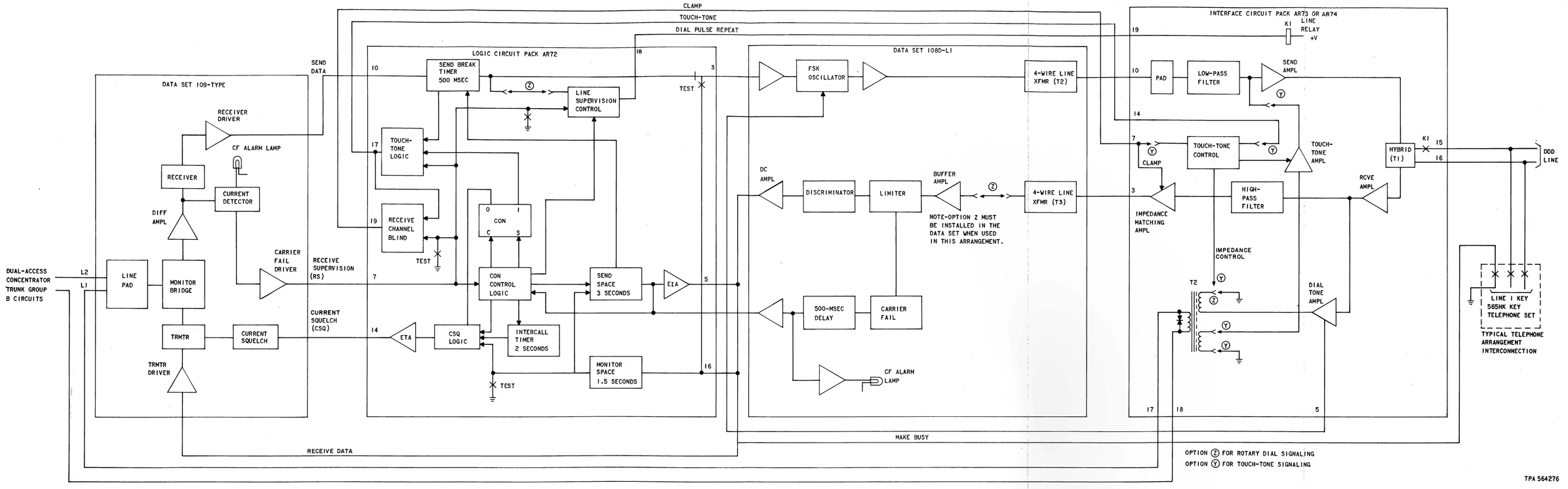

Fig. 6—Block Diagram of the Interconnection Arrangement