

**DATA SET 303-TYPE  
DESCRIPTION**

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## SECTION 593-012-100

### 1. GENERAL

**1.01** This section contains a description of Data Set (DS) 303-type and information pertinent to its operation. Information concerning the business machine equipment associated with the data set is not included.

**1.02** This section is reissued to add information concerning:

- (a) DS 303-type with PICTUREPHONE® loop line interface
- (b) Manufacture Discontinue (MD) of DS 303 codes that contain 50 percent roll-off or no transmit clock circuit and some codes with no scrambler
- (c) PICTUREPHONE loop line interface circuit pack AR513
- (d) Replacement of DS 303 circuit packs AR133, AR143, and AR220 with circuit packs AR579, AR550, and AR552, respectively
- (e) Replacement of 9A2-type data mounting with 9A3-type data mounting.

**1.03** The DS 303-type uses plug-in circuit packs extensively to offer a wide variety of features that are listed in this section.

**1.04** The normal applications of DS 303-type are at synchronous speeds of 19.2, 50.0, 230.4, and 460.8 kilobits per second (kbps). Speeds of 18.75, 40.8, and 200 kbps are available for special applications. Minimum signal element duration for nonsynchronous transmission over half-group, group, and supergroup facilities are 52, 20, and 4.3  $\mu$ sec, respectively. For nonsynchronous transmission using dc-coupled balanced line signals over digital facilities, the minimum duration is 2.0  $\mu$ sec.

**1.05** The data set employs one of three types of line signals:

- Restored polar type line signals. The other two types of line signals are intended for special applications while the restored polar type line signal is for general use.

- DC-coupled balanced line signals for operation with a T1WM-4 wideband modem and T1 line facilities

- Balanced line signals for use over PICTUREPHONE line facilities.◆

**1.06** The DS 303 accepts high-speed ON-OFF baseband signals from the customer's business machine and conditions these signals for optimum transmission performance over the facility. In the transmitter of the restored polar sets, the dc component from the signal is removed and the low frequencies are attenuated. In the receiver, the low-frequency and dc components are reinserted. The restored polar type data set is used except where it is desirable to extend a T1 line facility to the customer's premises and locate a T1WM-4 modem within 1000 feet of the data set. Where the T1WM-4 is used in such a configuration, the restored polar type line signal is not required. A simpler version of the data set is used where the restored polar circuitry is not used and the dc component is transmitted. The line signal is referred to as a dc-coupled balanced line signal. ◆Operation of the PICTUREPHONE type line sets is the same as the operation of the dc-coupled balanced line sets except the PICTUREPHONE loop line interface card CP AR513 is added so that the data set can transmit and receive over the PICTUREPHONE line facilities.◆

**1.07** Data Set 303 provides either of two customer interfaces: balanced or unbalanced. The unbalanced customer interface is used in commercial service application, while the balanced customer interface is for use in special government applications. The unbalanced customer interface provides signal leads for transmitting and receiving data plus control leads which indicate the status of the station and the customer equipment. The balanced customer interface provides only signal leads.

**1.08** For group and supergroup operation of restored polar-type data sets, data is transmitted by the data set at baseband frequencies. Wideband modems may be located at an intermediate office to translate the wideband data into the group and supergroup range. For half-group operation, an additional modulation step may be performed in the data station by a separate vestigial sideband unit, Data Auxiliary Set (DAS) 809. Refer to Section 598-034-100 for a description of DAS 809.

## 2. PHYSICAL DESCRIPTION

**2.01** The DS 303-type weighs approximately 23 pounds and has external dimensions of 17 inches wide, 6 inches high, and 10 inches deep (Fig. 1).

**2.02** The data set is of modular construction and consists of two nests for mounting plug-in circuit packs and a 26A power unit mounted on a 9A-type data mounting. Slots for mounting the circuit packs run from front to rear in the nests. Each circuit pack has a faceplate with numbered test points and a code number stenciled on it. A card-retainer bar is provided to secure the circuit packs in the data set. This bar can be removed for maintenance.

**2.03** The rear of DS 303-type (Fig. 2) has coverplates covering the wiring. These plates are removable to enable the installer to install the set or to change the strapping options. Refer to Section 593-800-200.

**2.04** Connection to the customer-provided cable is made at the J10 interface (connector KS-19401-L1) for the high-speed NONSYNC cable and at the J11 interface (connector KS-19401-L1) for the high-speed SYNC cable.

**2.05** Coded 87-type brackets are used to mount the data set in a KS-20018-type cabinet or on 19-, 23-, or 25-inch Bell System relay racks.

**2.06** When DS 303-type is mounted in a data station cabinet, the options wired into the data set and associated apparatus should be recorded on the label provided in the cabinet. If circuit packs are changed, this should be noted on the label. This will aid in identifying options and changes on subsequent repair visits.

## 3. FUNCTIONAL DESCRIPTION

**3.01** For purposes of this description, DS 303 can be subdivided into three categories of signal format, ie, restored polar, dc-coupled balanced and PICTUREPHONE type line signals. Data sets of each category can operate either synchronously or nonsynchronously. Data sets with restored polar or dc-coupled balanced line signals can have unbalanced or balanced customer interface. Data sets with PICTUREPHONE type line signals are available only with unbalanced customer interface.

**3.02** Although the different line signal type data sets use some circuit packs in common, the systems are functionally different. The restored polar system is described first, followed by the dc-coupled balanced line signal description and then the PICTUREPHONE type line signal description.

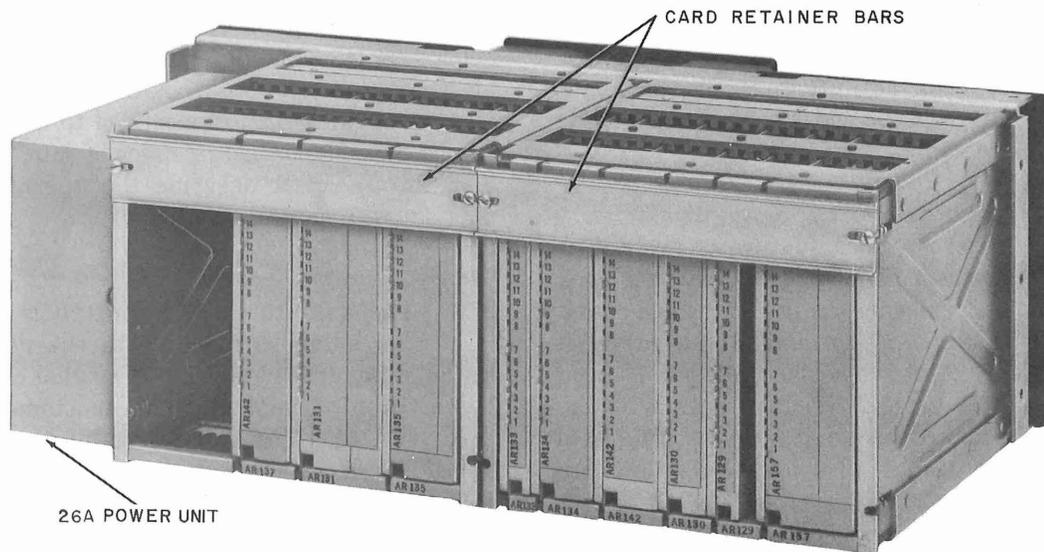


Fig. 1—Data Set 303-Type—Front View

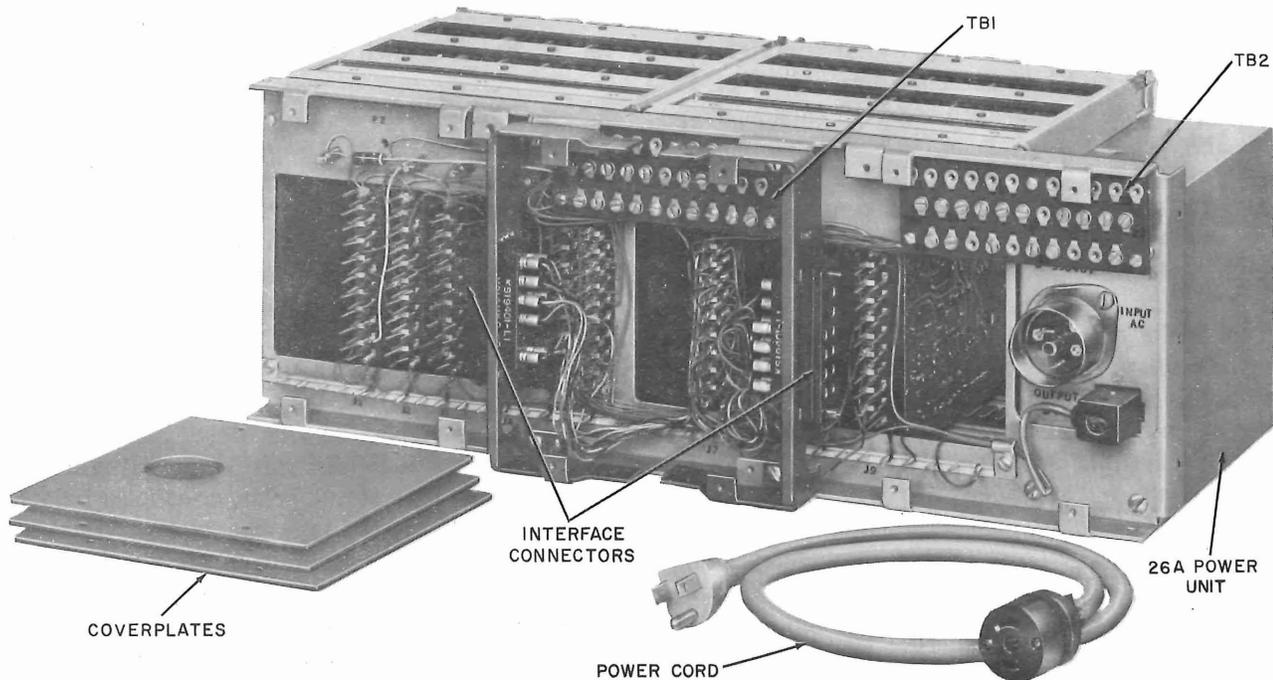


Fig. 2—Data Set 303-Type—Rear View

Where the dc-coupled balanced line signal operation and the PICTUREPHONE type line signal operation are the same as the restored polar operation, a reference is made to the restored polar description.

**3.03** The DS 303-type codes that contain the external clock feature, the 50 percent roll-off feature, or some codes that do not contain a scrambler have been Manufacture Discontinued. Table A lists DS 303-type codes that are rated MD and their replacements.

**3.04** If the external clock feature is desired, it can be furnished by using the external clock wiring option and removing the transmit clock circuit pack. The scrambler is normally required in all data set codes except when the data set is used in special applications. If data sets without scrambler are desired, existing codes of data sets with scramblers can be used and the scramblers removed.

**3.05** A functional description of each system is given first, followed by a description of the circuit packs which make up the data set configuration.

## RESTORED POLAR—NONSYNCHRONOUS OPERATION WITH UNBALANCED CUSTOMER INTERFACE

### A. General

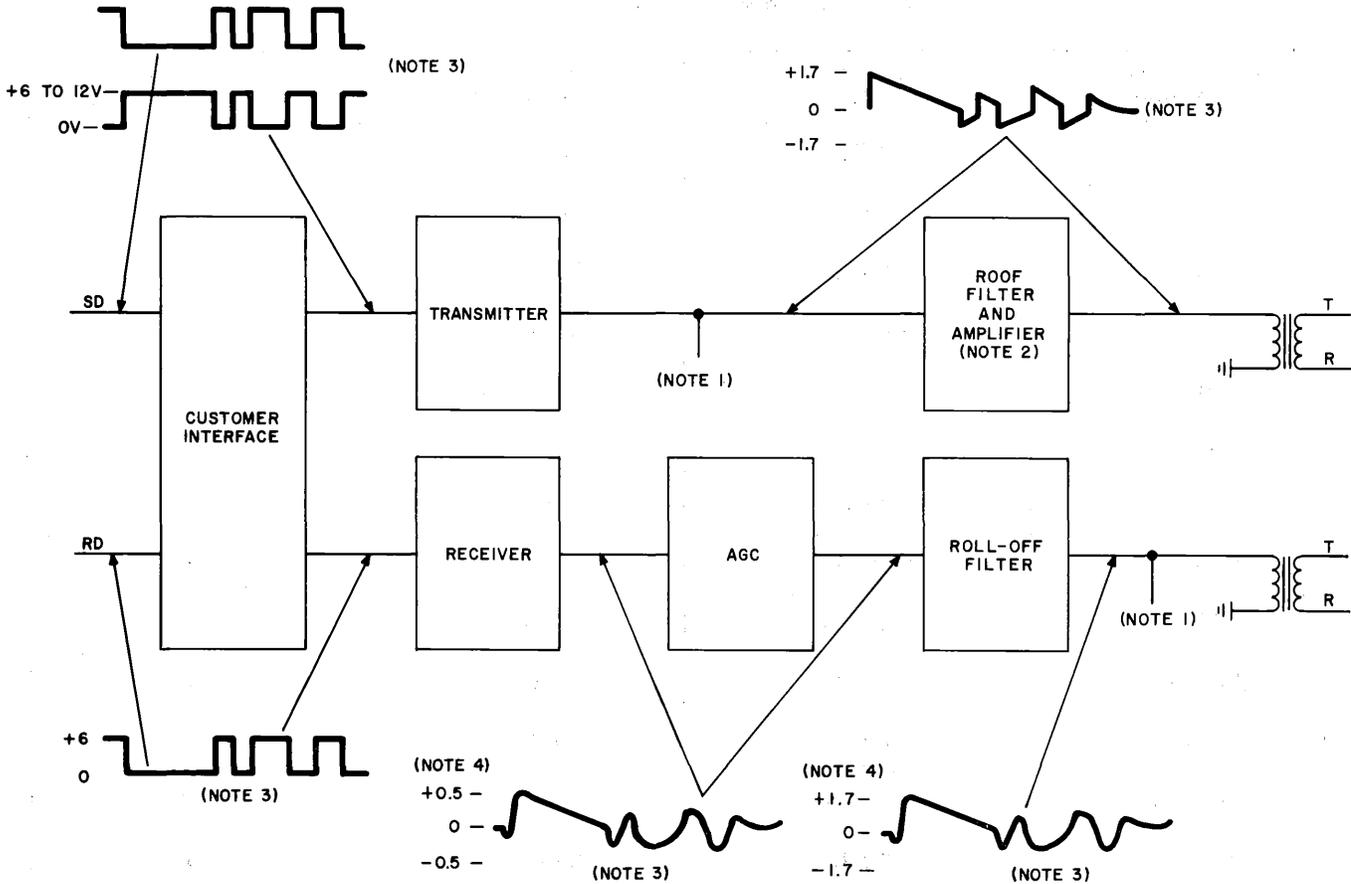
**3.06** The unbalanced customer interface is the most common configuration of a restored polar type DS 303. Refer to Fig. 3 for a simplified block diagram. For purposes of this description, all control functions are assumed to be conditioned for the transmission and reception of data. Paragraphs 3.16 through 3.21 describe the operation of the data set with control functions.

**3.07** The data to be transmitted is sent from the business machine to the data set via the Send Data (SD) lead. The SD signal is terminated by the cable terminator on the customer interface card (Fig. 3). The cable terminator blocks the signal unless certain control functions are activated. When the control functions are conditioned for transmitting data, the signal is inverted and the output of the cable terminator is applied to the transmitter card. The transmitter card converts the signal into a restored polar type signal at a 600-ohm impedance level.

## → TABLE A ←

## DATA SET 303-TYPE REPLACEMENTS

MANUFACTURE DISCONTINUED	REPLACED BY	MANUFACTURE DISCONTINUED	REPLACED BY
303B1	303B2	303H11	303H8
303C1	303C2	303B13A	303B6
303D1	303D2	303C13A	303C6A
303B3	303B4	303D13A	303D6A
303C3	303C4	303E13A	303E6A
303B5A	303B6	303G13A	303G6A
303C5A	303C6A	303C14A	303C6A
303D5A	303D6A	303D14A	303D6A
303E5A	303E6A	303E14A	303E6A
303G5A	303G6A	303G14A	303G6A
303B7A	303B8	303B17	303B6
303C7A	303C8A	303C17	303C6A
303H7A	303H8	303D17	303D6A
303B9	303B6	303E17	303E6A
303C9	303C6A	303G17	303G6A
303D9	303D6A	303C18	303C6A
303E9	303E6A	303D18	303D6A
303G9	303G6A	303E18	303E6A
303B10	303B6	303G18	303G6A
303C10	303C6A	303B29	303B25
303D10	303D6A	303C29	303C25
303E10	303E6A	303D29	303D25
303G10	303G6A	303E29	303E25
303B11	303B8	303G29	303G25
303C11	303C8A	303J29	303J25



- NOTES:
1. CONNECTION TO DAS 809 FOR HALF-GROUP OPERATION REFER TO BSP 593-800-ZZZ FOR DESCRIPTION OF RELATIONSHIP BETWEEN DS 303 AND DAS 809.
  2. ROOF FILTER AND BUFFER AMPLIFIER USED FOR HALF-GROUP AND GROUP FREQUENCIES ONLY.
  3. ALL WAVEFORMS ARE IDEALIZED.
  4. DUE TO TRANSMISSION VARIATION IN THE FACILITY, THE AMPLITUDE OF THE WAVEFORMS MAY VARY MORE OR LESS BY A FACTOR OF 2.

**Fig. 3** Restored Polar—Nonsynchronous Operation With Unbalanced Customer Interface, Simplified Block Diagram

**3.08** In data sets equipped for supergroup speeds, the signals are passed through an impedance-matching transformer (600 to 135 ohms) which results in a 135-ohm balanced signal suitable for connection to the telephone lines.

**3.09** In data sets equipped for group-band speeds, the output of the transmitter is passed through a roof filter and amplifier to reduce out-of-band signal energy. The output of the roof filter and amplifier is applied to the impedance-matching transformer as described in 3.08.

**3.10** In data sets equipped for half-group speeds, the output of the transmitter is normally applied to DAS 809 for further conditioning (Fig. 3,

Note 1) and is then returned to DS 303 to be passed through the roof filter before transmission.

**3.11** The 135-ohm received signal is passed through the impedance-matching transformer where it is transformed into 600 ohms for application to the roll-off filter.

**3.12** For group and supergroup signals, the output of the receiver-line impedance-matching transformer is applied to the roll-off filter. For half-group signals, the output of the receiver-line impedance-matching transformer may be strapped through DAS 809 before being applied to the roll-off filter.

**3.13** The purpose of the roll-off filter is to eliminate out-of-band noise while shaping the signal to reduce intersymbol interference.

**3.14** The output of the roll-off filter is applied to the automatic gain control (AGC) circuit which passes the signal on to the receiver. The AGC circuit works in conjunction with the receiver on a closed-loop basis to regulate the peak signal swing at the receiver input. The receiver is essentially a dc restorer which reinserts the dc and low-frequency components removed by the transmitter. The receiver output is connected to the Received Data (RD) cable driver on the customer interface card. The output of the RD cable driver (received data) is passed to the customer via the RD lead.

#### B. Detailed Description

**3.15** Paragraphs 3.16 through 3.21 describe the control functions and signal flow associated with a restored polar nonsynchronous data set with an unbalanced customer interface. A description is also included for the circuit packs which make up this type of data set (Fig. 4).

**3.16** Connections between the customer and the data set with an unbalanced interface are made over coaxial lines. These lines connect to either the SYNC or NONSYNC connector on the rear of the data set. Data sets arranged for nonsynchronous operation can be operated in the nonsynchronous mode only; however, data sets arranged for synchronous operation can be operated in either the synchronous or nonsynchronous mode. Nonsynchronous data sets can be connected to either the SYNC or NONSYNC connector. Synchronous data sets can be operated synchronously only through the SYNC connector or nonsynchronously through the NONSYNC connector. The synchronous connector is usually activated. To operate DS 303 through the NONSYNC connector, the customer must supply an ON signal on the ALT lead, or option A must be installed. If the customer has two nonsynchronous business machines and a nonsynchronous data set, he can connect one machine to the SYNC connector and the other to the NONSYNC connector then switch the data set between the two machines by means of the ALT signal.

**3.17** The interface is provided on a current-switching basis with the exception of the Data Terminal

Ready (DTR) and Ring Indicator (RI) functions. The DTR and RI are Electronic Industries Association (EIA) voltage interface leads. For standard interface signals, a current greater than 23 mA constitutes an ON signal, while a current less than 5 mA constitutes an OFF signal. The DTR and RI signals are transmitted between the customer and the data set over the shields of the coaxial cables. These signals are passed through the data set but do not directly affect it. For a description of these leads, refer to Section 593-800-100.

**3.18** The SD signal from the customer passes through the SD gate function, when enabled, and is applied to the transmitter via the NSD lead and transmitter gate function. The other transmitter gate function inputs (NDC, NRC, and SSD) are open. The SD gate function is enabled in either of two ways: (1) when a CS signal is being transmitted to the customer, or (2) when the data set is placed in remote test (RTN lead open). The output of the transmitter gate is applied to the restored polar transmitter where the dc component is removed and the low frequencies are suppressed in the transmitted signal. In some cases, half-group speeds may be supplied to DAS 809 for further modulation into passband-type signals before being returned to the roof filter in DS 303. Section 593-800-100 describes a wideband station arrangement that includes DAS 809. When DAS 809 is not required and the signal speed is half-group or groupband, the signal is applied to the roof filter through option V, from the roof filter to the impedance-matching transformer, and then to the wideband line. If the signal is supergroup, the roof filter is not included, and the signal is applied directly from the transmitter via option V to the impedance-matching transformer, and then to the wideband line.

**3.19** The RD signal is applied to the impedance-matching transformer in the receiving path on the transmitter and line interface card. If no vestigial sideband modulation (DAS 809) is used, the RD line signal reaches the roll-off filter through option V. The signal goes through the roll-off filter to the AGC and receiver circuits. The output of the receiver is applied to the RD gate function on the unbalanced customer interface card via the NRD lead and is sent to the customer when the RD gate function is enabled.

**3.20** The RD function is enabled by the RD control logic (RDC). The RD gate function inputs,

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NRC and SRD, are open. The RDC enables the RD gate function when either of the following conditions exists:

- (a) A DSR signal is being transmitted to the customer.
- (b) The data set is in the remote test mode (RTN lead open).
- (c) The data set is in the local test mode (LTC lead open).

**3.21** In the Remote Test 2 (RT2) mode, the RD and SD leads are looped, the SD lead is terminated in 100 ohms, and the RD lead is opened. Refer to Section 593-800-100 for a description of the remote test feature.

### C. Unbalanced Customer Interface

**3.22** The unbalanced customer interface circuit pack provides appropriate terminators and drivers for the reception and transmission of data. The control signals between the customer and the data set are passed through this circuit pack.

**3.23** The unbalanced customer interface circuit pack (AR135) is used in commercial service application. Refer to Fig. 5 for a simplified block diagram. The balanced customer interface circuit pack (AR136) is available for special government applications (refer to 3.48 through 3.54).

**3.24** The following describes the control functions exchanged with the customer:

- **DSR**—Data Set Ready—A DSR ON signal is delivered to the customer when there is an ON signal on the LS lead and the data set is not in either local test or remote test mode (LTC and RTN both at ground). These conditions can be achieved without DAS 806B or DAS 806D1 by installing options K and W.
  - **CS**—Clear-to-Send—A CS ON signal is delivered to the customer when DSR is ON and the customer supplies a Request-to-Send (RS) signal (permanent RS may be applied by option T). A CS ON signal is also supplied to the customer when there is an RS ON signal and the data set is in the local test mode.
  - **ALT**—Alternate Use—The ALT feature provides a means for switching between the synchronous connector and the nonsynchronous connector. Normally the synchronous connector is activated. Supplying an ON signal to the ALT lead operates relays which switch the data set over to the nonsynchronous connector. The ALT feature can also be controlled by the A option. These leads change state as follows. For ALT ON (nonsynchronous operation), there is a positive signal on the A lead, and the B lead is at ground potential. For ALT OFF (synchronous operation), there is an ON signal on the B lead, and the A lead is floating.
  - **LT**—Local Test—An LT ON signal from the customer operates the relay drivers which control the local test relays in the associated DAS 806 over the LTA lead.
  - **AGC**—Automatic Gain Control—An AGC ON signal is delivered to the customer when a satisfactory data signal is being received.
- 3.25** In addition to the leads between the customer interface circuit pack and the customer, the following leads connect the customer interface circuit to the terminal board or other circuit packs:
- **LS**—Line Status—A positive voltage which indicates that DAS 804 is in the data mode. This signal originates from DAS 804 through DAS 806.
  - **LTC**—Local Test Control—DAS 806 supplies ground on this lead when the station is not in the local test mode.
  - **RTN**—Remote Test Normal—DAS 806 supplies ground on this lead when the station is not in the remote test mode.
  - **LTA**—Local Test A—This originates in DS 303. An ON signal on the LT lead from the customer causes ground to be applied to the LTA lead. This ground is used to operate the local test relays in DAS 806.
  - **NSD**—Nonsynchronous Send Data—Binary SD signals are applied to the Send Data gate from the business machine. When the SD gate is unblocked, the data signal is

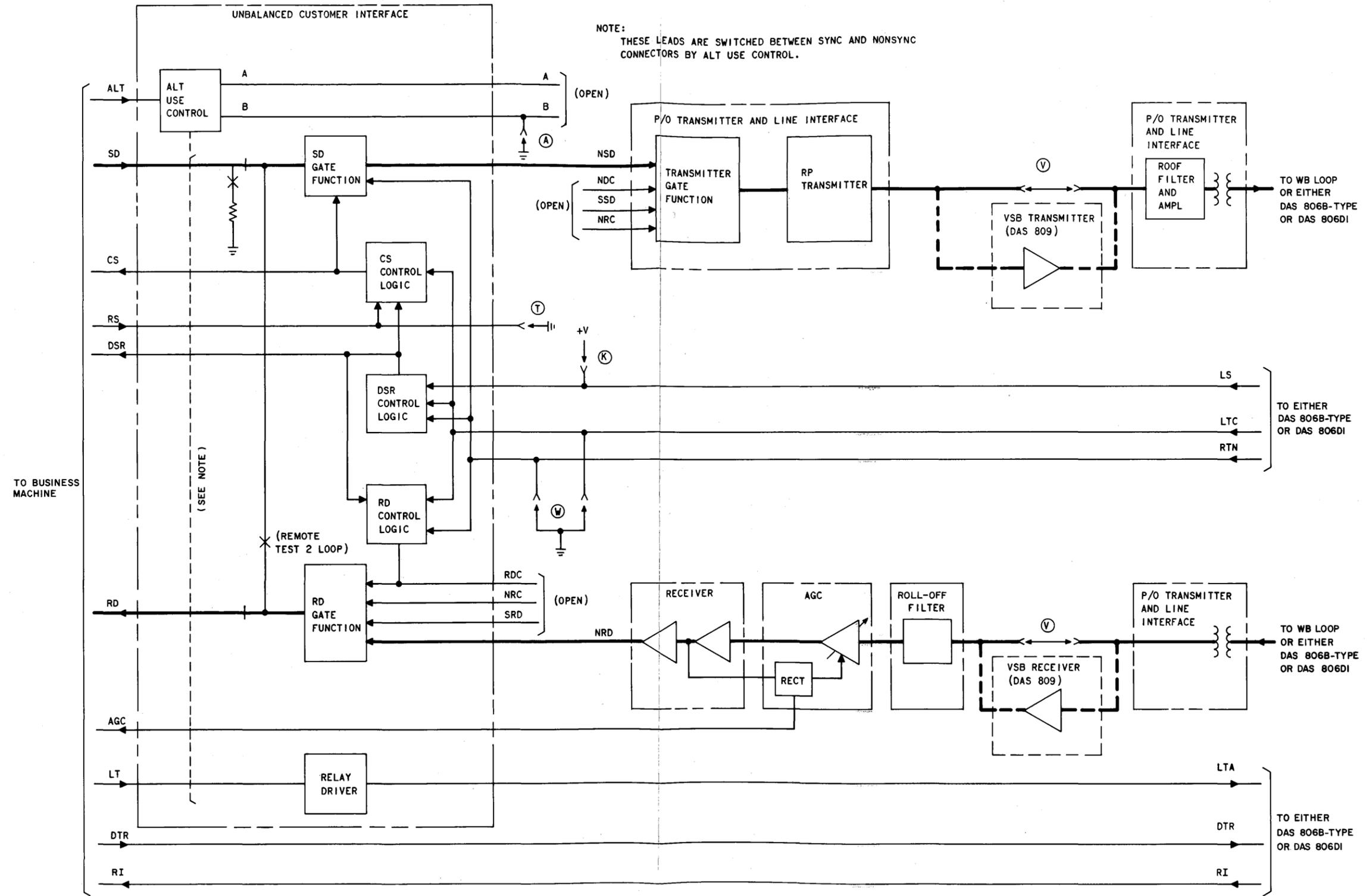


Fig. 4 Restored Polar-Nonsynchronous Operation With Unbalanced Customer Interface, Functional Block Diagram

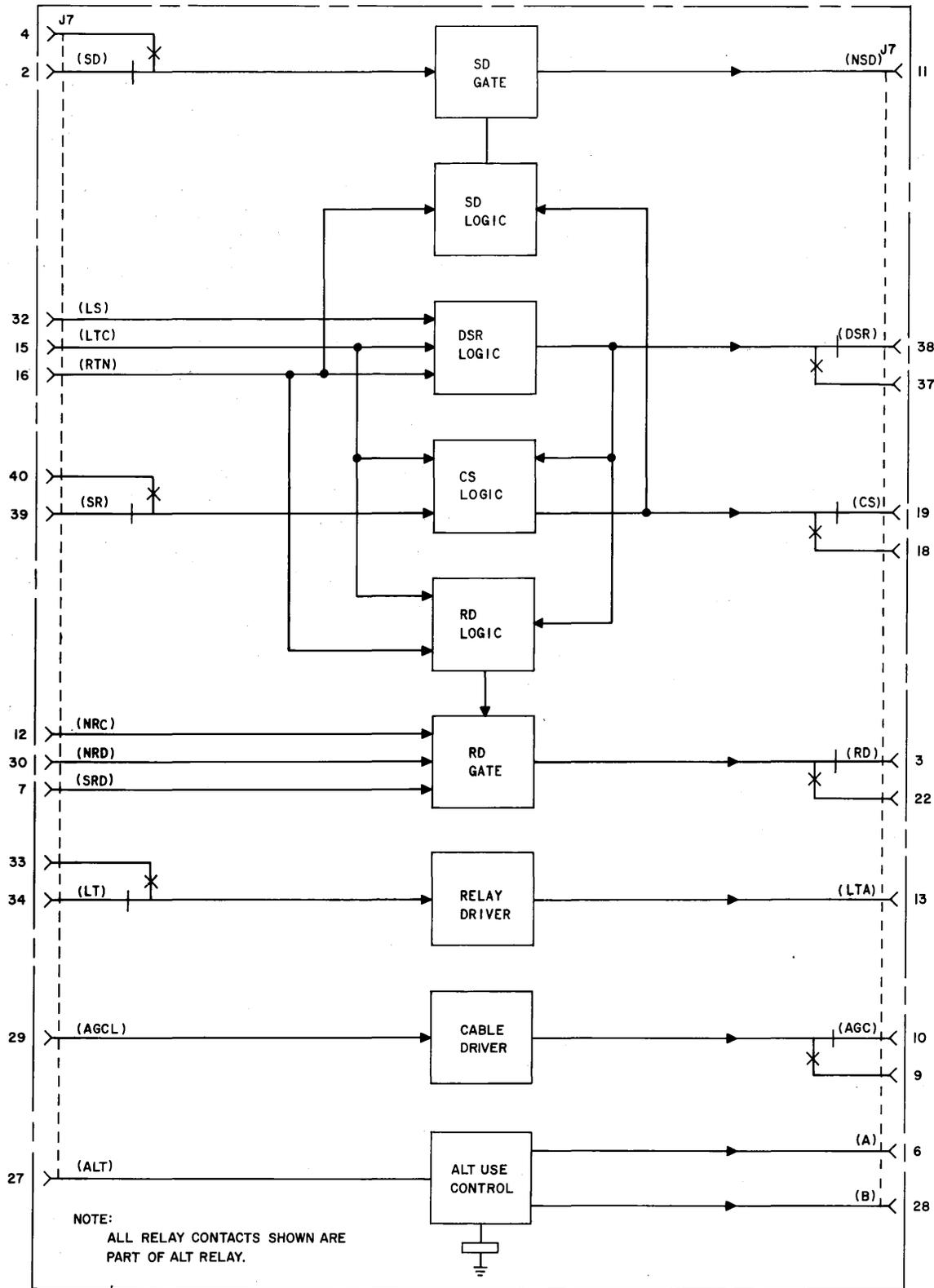


Fig. 5—Unbalanced Customer Interface—Block Diagram

applied to the transmitter and line interface circuit pack via the NSD lead.

- **NRC**—Nonsynchronous Receiver Control—This lead is not functional during nonsynchronous operation; however, when the signal control circuit pack is plugged in, the positive drive on the NRC lead prevents the nonsynchronous received data on the NRD lead from reaching the customer.
- **NRD**—Nonsynchronous Receive Data—The RD signal is applied to the customer interface from the receiver via the NRD lead.
- **SRD**—Synchronous Receive Data—In the nonsynchronous mode, the SRD lead is floating. In the synchronous mode, the synchronous receive data is applied directly to the RD cable driver via the SRD lead.

#### D. Line Interface and Transmitter (Restored Polar)

- 3.26** This circuit pack provides input logic, a restored polar transmitter, transmit band-limiting filter (roof filter and amplifier), line transformers, and line surge protection (Fig. 6).
- 3.27** The input logic circuit allows either synchronous or nonsynchronous data to pass depending on the mode of operation. Different line signal rates are used, depending on the application. The half-group sets, group sets, and supergroup sets transmit and receive baseband restored polar type line signals. The half-group sets may be used with a DAS 809 vestigial sideband unit to transmit and receive passband restored polar type line signals.
- 3.28** The transmit restored polar signal is applied to the transmitter and line interface card to make it suitable for transmission. The transmitter is essentially an RC high-pass filter followed by an amplifier circuit. The restored polar transmitter removes the dc component and attenuates the low frequencies of the binary signal.
- 3.29** The time constant used in the filter circuit depends on whether the set is to be used at half-group, group, or supergroup data speeds. Circuit pack AR131 is used for half-group and group speeds. A strapping arrangement is provided for the factory to select half-group or group operation. Circuit pack AR132 is used for supergroup data speeds only.
- 3.30** The transmitter output is applied directly to a 600- to 135-ohm impedance-matching transformer for supergroup sets. For half-group and group sets with restored polar baseband signals, the transmitter output is applied first to a roof filter and then to a 600- to 135-ohm impedance-matching line transformer. For half-group sets using DAS 809, the transmitter output is applied to DAS 809. The output of DAS 809 is then applied to the roof filter and line transformer.
- 3.31** The received restored polar signal is passed through the impedance-matching line transformer but is not changed by the transmitter and line interface card.
- 3.32** When the data set is operating at half-group speeds, DAS 809 may be used. In this case, the transmitted data is applied to DAS 809 before being applied to the roof filter and/or impedance-matching line transformer. If DAS 809 is used, the transmitter output reaches DAS 809 via lead VT1, and the DAS 809 output is applied back to the transmitter and line interface card via VT2. When DAS 809 is not used, the baseband transmitter output is strapped by option V toward the roof filter and/or line transformer via leads VT1 and VT2.
- 3.33** The following leads connect to the transmitter and line interface card:
- **T and R**—Tip and Ring of transmit pair
  - **T1 and R1**—Tip and Ring of the receive pair
  - **VT1 and VT2**—Vestigial Transmit 1 and 2
  - **VR1**—Vestigial Receive 1 (The received data is applied to TB1 via VR1.)

#### E. Roll-Off Filter

- 3.34** The roll-off filter is the receive filter of the data set. Its purpose is to eliminate out-of-band noise while shaping the signal to reduce intersymbol interference. A 100 percent roll-off filter is available for each data speed. All data set codes with 50 percent roll-off have been rated MD. ♦The data sets containing 100 percent roll-off filters are compatible with the data sets containing 50 percent roll-off filters.♦

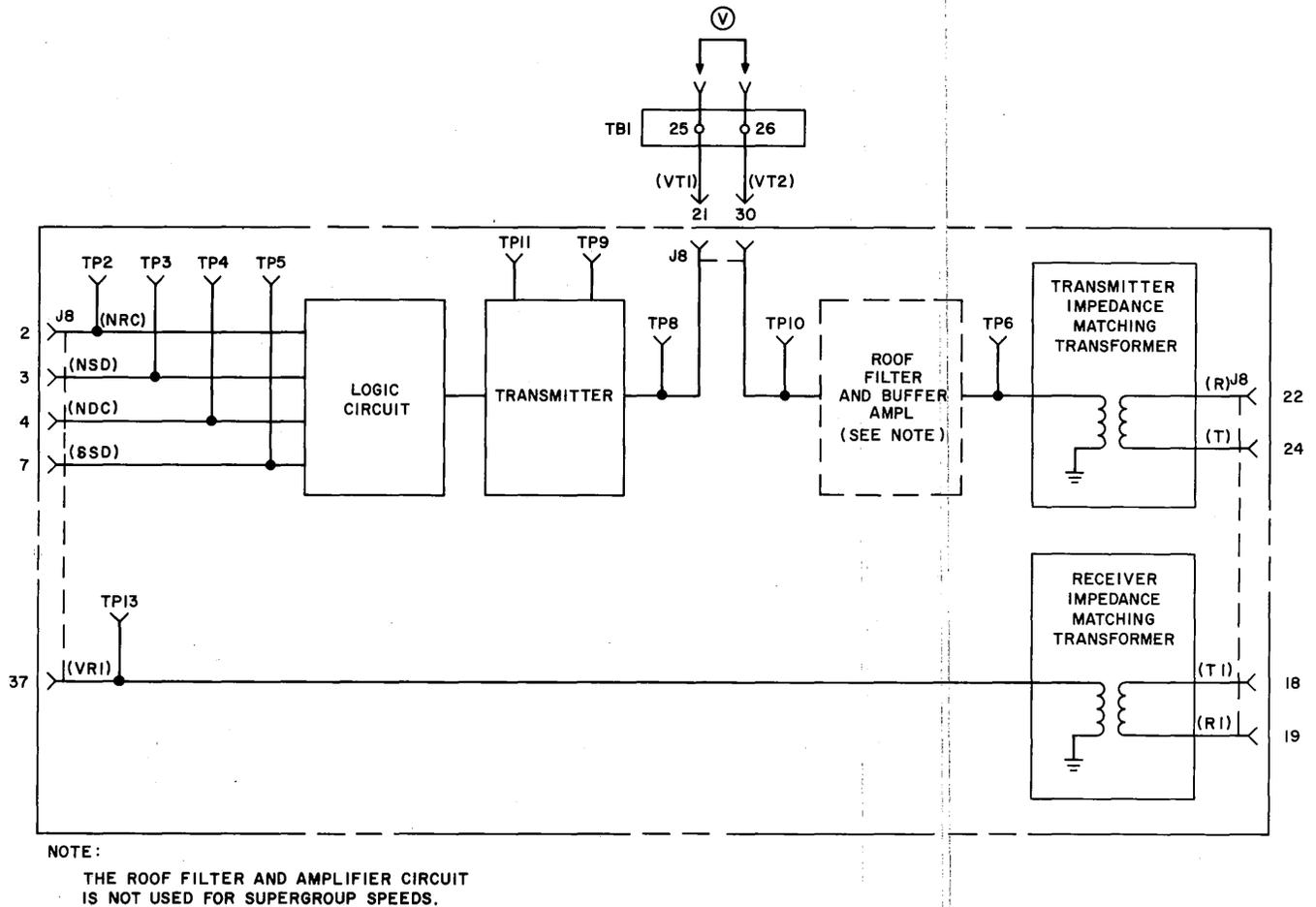


Fig. 6—Restored Polar—Line Interface and Transmitter, Block Diagram

3.35 There are different roll-off filter card codes for different bit rates and band-shaping. Each card consists of an input pad, roll-off filter, power supply access points, and AGC threshold control (Fig. 7).

3.36 There are six roll-off filter circuit packs in existence, but three of these have been rated MD. Table B lists the three 100 percent roll-off filters that are still being manufactured and the three 50 percent roll-off filters that are rated MD.

3.37 The input to the roll-off filter is via the Vestigial Receive 2 (VR2) lead. The input pad buffers the impedances of the line and filter. The pad is chosen to make the input amplitude of the received data to the AGC circuit such that the receiver-AGC combination operates over the proper part of its range. The output of the filter

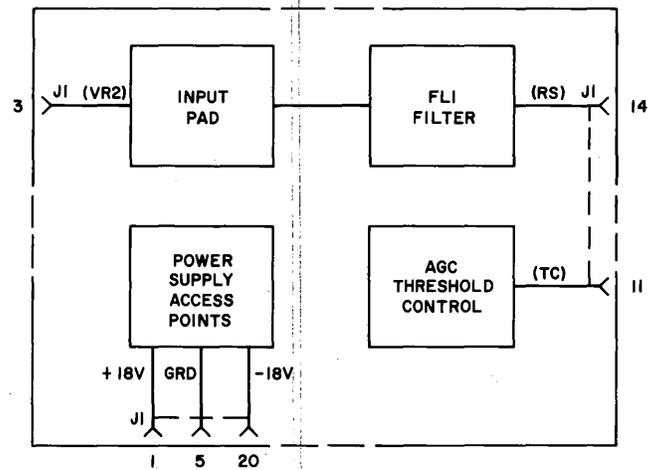


Fig. 7—Typical Roll-Off Filter—Block Diagram

→ TABLE B ←

ROLL-OFF FILTER APPLICATIONS

DATA RATE (KBPS)	ROLL-OFF	CIRCUIT PACK NUMBER	FACILITY
18.75 19.2	50%*	AR157	Half-group
18.75 19.2	100%	AR413	Half-group
50.0 40.8	50%*	AR125	Group
50.0 40.8	100%	AR126	Group
200.0 230.4	50%*	AR127	Supergroup
200.0 230.4	100%	AR128	Supergroup

\* Data sets with 50% roll-off are MD.

is applied to the AGC circuit via the Receive Signal (RS) lead.

3.38 There are test points on the front of the roll-off filter card for the +18 volt and -18 volt supplies. This makes these voltages available

on the same side of the equipment as the other test points.

3.39 The AGC is affected differently by 50 percent and 100 percent roll-off filtering; therefore, the AGC threshold must be changed depending on the roll-off used. The AGC is also affected by different bit rates. A resistor on the roll-off filter circuit pack is provided to set the AGC threshold to compensate for the differences in the AGC operation. This connection is made via the Threshold Control (TC) lead.

F. Automatic Gain Control

3.40 The AGC circuit (Fig. 8) consists of a variable loss network (varioloesser) and an amplifier in the received data signal path with a control circuit and AGC lock circuit in the feedback loop. The AGC circuit works in conjunction with the receiver on a closed-loop basis and regulates the peak signal swing at the receiver input. The receiver is basically a dc restorer followed by a slicer circuit. The AGC monitors the dc restorer output and regulates the magnitude of the signal transitions at the receiver input. Due to the nature of a restored polar data signal with which this circuit is designed to work, the AGC output cannot be fed back directly to the control circuit. Instead, the feedback is taken from the output of the summing amplifier in the receiver.

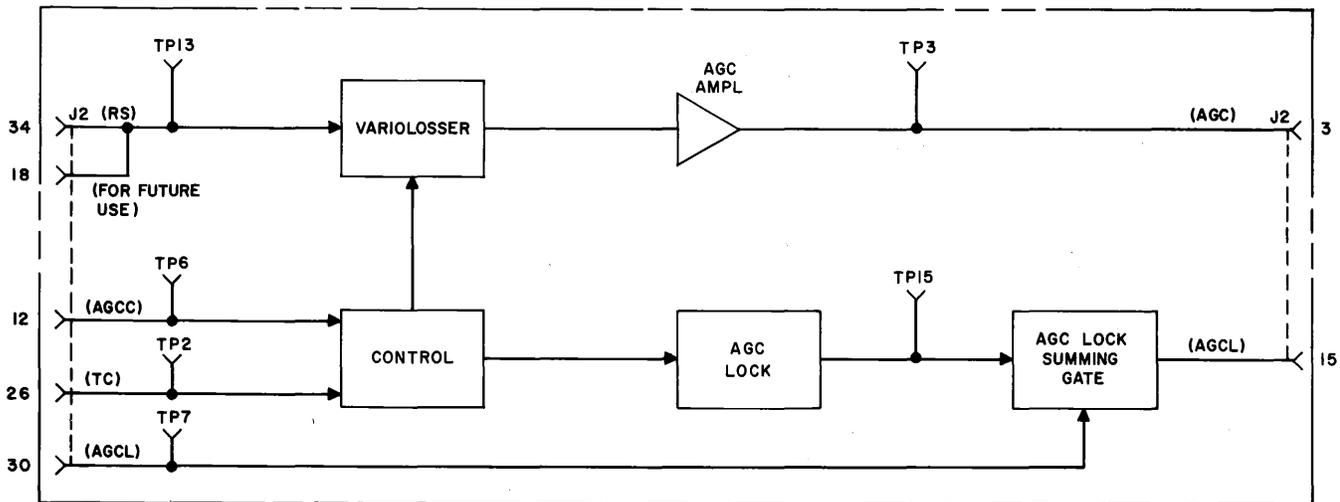


Fig. 8—Automatic Gain Control—Block Diagram

**3.41** The variollosser functions as a shunt variable attenuator. The variollosser, in conjunction with the amplifier, sets the proper signal level at the input to the receiver. The control circuit establishes the reference level at which the variollosser operates. The automatic gain control lock (AGCL) circuit monitors the control circuit and gives an indication when the AGC circuit goes into operation.

**3.42** The following leads connect to the AGC circuit pack:

- The incoming data is applied to the AGC circuit pack via the Receive Signal (RS) lead.
- The output of the AGC circuit is via the AGC lead.
- The feedback signal from the receiver is applied to the AGC circuit via Automatic Gain Control Control (AGCC) lead.
- When DS 303 is used in conjunction with DAS 809, a signal is applied to the AGC circuit via the AGCL lead (J2-30) which indicates that DAS 809 has detected the carrier.

- The AGCL indication to the customer leaves the AGC circuit pack via the AGCL lead (J2-15).

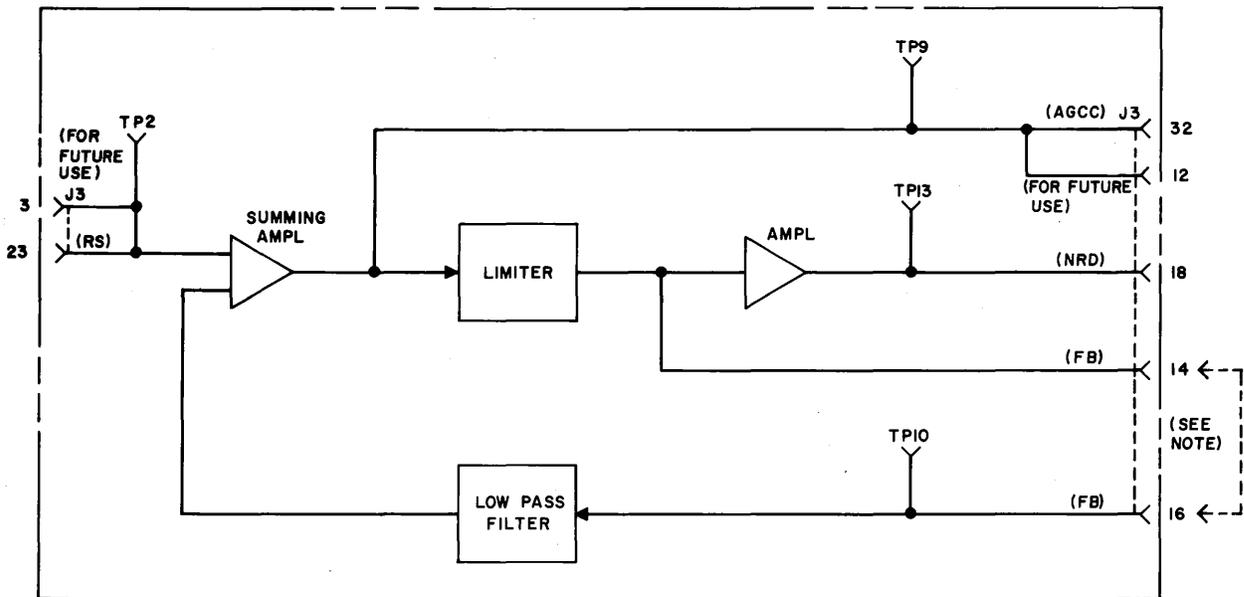
- The AGC threshold is established via the TC lead.

### G. Receiver

**3.43** The restored polar receiver consists of an input-summing amplifier, a limiter, an inverter amplifier, and a low-pass filter (Fig. 9). The dc-coupled balanced line signal sets do not require a receiver card.

**3.44** All receiver circuit packs are coded CP AR130; however, some are strapped differently. The factory provides different strapping for different speeds. The dc restoral amplitude can also be reduced, by changing the strapping on the receiver circuit pack, to achieve better performance in some cases of excessive line distortion. Refer to Table C for strapping information on the receiver circuit pack.

**3.45** The receiver is essentially a dc restorer which reinserts the dc and low-frequency components removed by the transmitter high-pass filter.



NOTE:  
THIS STRAP IS PROVIDED BY CHASSIS WIRING.

**Fig. 9—Receiver—Block Diagram**

TABLE C  
RECEIVER STRAPPING

FEATURE		STRAP
Bandwidth	Supergroup	None
	Group	7-9, 10-11
	Half-group	7-8, 10-11
DC Restorer Amplifier	Normal	1-2, 4-5
	Reduced	1-3, 4-6

**3.46** The received data signal is a differentiated signal representing the transmitted data bit pattern. The output of the limiter provides feedback through an external strap and low-pass filter. The feedback is added to the input signal. The sum of the two signals forms the input to the summing amplifier. The output of the summing amplifier is applied to the limiter. The output of the limiter is either 0 or +6 volts. This output is divided into one leg as the output of the receiver and the other leg as the feedback sample which is returned to the summing amplifier input through the low-pass filter. (Pins J3-14 and J3-16 are strapped together outside the circuit pack.) The inverter amplifier reverses the logic state of the receiver output (0 becomes +6 volts and vice versa). The time constant of the low-pass filter is the same as the time constant of the filter in the transmitter circuit. ♦The amplitude of the feedback signal may be reduced, with engineering guidance, in some exceptional applications.♦

**3.47** The following leads connect to the receiver card:

- The receiver output is binary and is applied to the RD cable driver in the customer interface card via the NRD lead.
- The received data is applied to the receiver circuit pack via the Receive Signal (RS) lead.
- The AGC sample from the summing amplifier leaves the receiver circuit pack via the AGCC lead.

## RESTORED POLAR—NONSYNCHRONOUS OPERATION WITH BALANCED CUSTOMER INTERFACE

### A. General



*Do not confuse balanced customer interface with balanced line signals.*

**3.48** There are two types of customer interface, ie, balanced and unbalanced. The unbalanced customer interface is used in all cases except for special government applications.

**3.49** Operation of nonsynchronous data sets equipped with a balanced interface is similar to that of nonsynchronous data sets equipped with an unbalanced interface (3.16 through 3.21). The differences are that control logic is not used and the data set is always functional. Refer to Fig. 10.

### B. Balanced Customer Interface

**3.50** The balanced customer interface is provided in sets designed for special uses where data between the customer and the data set is over balanced lines. Refer to Fig. 11.

**3.51** This circuit pack provides the cable terminators and drivers necessary for the reception and transmission of data. The control signals between the customer and data set are not provided with the balanced customer interface.

**3.52** The customer's SD signal is passed through the 135- to 600-ohm transformer and is squared up before being sent to the transmitter and line interface circuit packs via the NRC lead.

**3.53** Receive data (Fig. 10) reaches the balanced customer interface circuit pack via the NRD lead (nonsynchronous) or SRD lead (synchronous). In the nonsynchronous mode, option A must be supplied (via the B lead) to enable the INH gate to pass NRD data. The SRD is then floating. In the synchronous mode, option A should not be used; the nonsynchronous data on the NRD lead is then blocked in the INH gate. Synchronous data is not inhibited and reaches the amplifier via the SRD lead. The output of the cable driver is applied to the customer via the 600- to 135-ohm transformer.



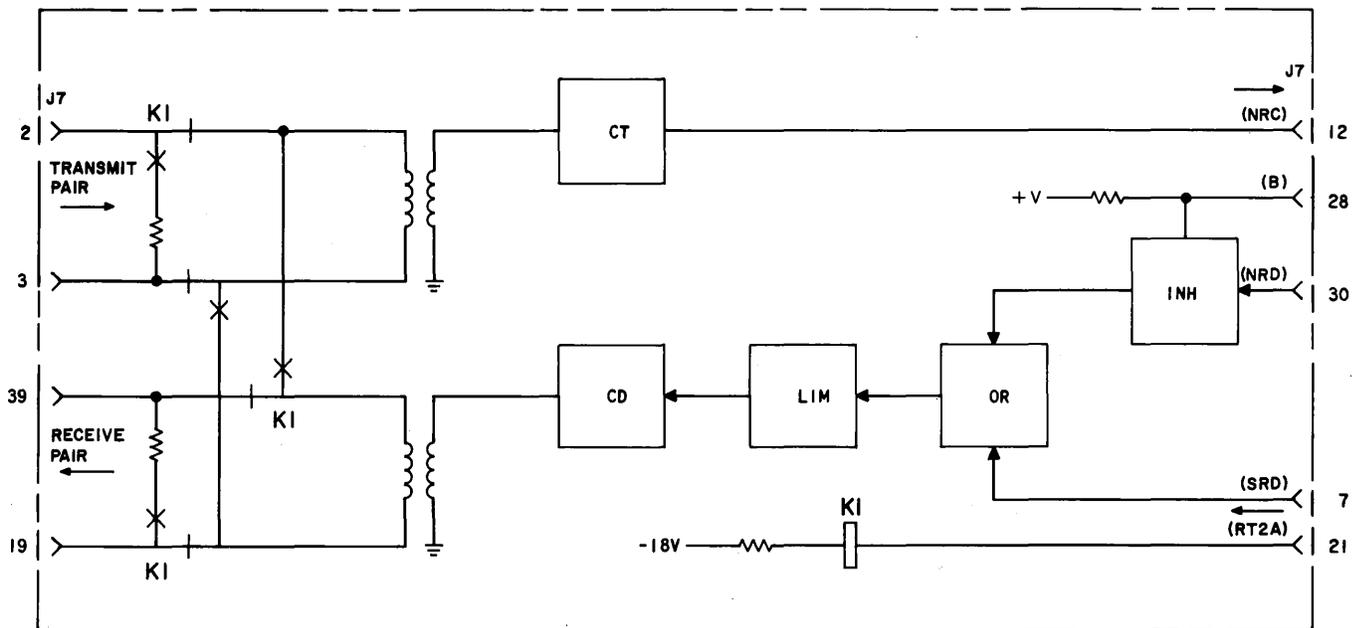


Fig. 11—Balanced Customer Interface—Block Diagram

**3.54** Data sets equipped with a balanced customer interface can be placed in the remote test condition by applying positive voltage to the RT2A lead. Local test under control of the customer's LT lead is not provided.

#### RESTORED POLAR—SYNCHRONOUS OPERATION WITH UNBALANCED CUSTOMER INTERFACE

##### A. General

**3.55** Synchronous operation with unbalanced customer interface requires two additional control signals which are clocks for the transmitter and receiver. The synchronous set usually includes a transmitting clock; however, the transmitting clock is omitted in some sets that have been rated MD, and, in this case, the clock signals are supplied by the customer. If the external clock feature is desired, it can be furnished by using the external clock wiring option and removing the transmit clock circuit pack. In the receiving side, the sets include a received clock recovery circuit and a sampler for regeneration of clock data.

**3.56** A synchronous set can operate in either the synchronous or nonsynchronous mode under control of the customer. The capacity of the data set to operate either synchronously or nonsynchronously

permits the transmission of either facsimile-type signals or computer-type signals.

**3.57** The scrambler serves to randomize the customer's binary signal train and thus prevents application of a strong single-frequency signal on the line, such as would occur if a dotting signal were transmitted. The scrambler breaks up the transmitted signal into a quasi-random pattern and spreads the signal energy uniformly over the passband. The descrambler at the receiving end restores the original data pattern. The scrambler also provides a repetitive idle code for retaining bit synchronization in the absence of customer-applied data.

##### B. Detailed Description

**3.58** Synchronous sets use all nonsynchronous circuits described in 3.06 through 3.47 in addition to the synchronous circuits which are added (Fig. 12).

**3.59** In the synchronous mode, the customer is connected to the SYNC connector (ALT signal is OFF). All interface leads are switched to the synchronous connector.

**3.60** When the SD gate function is enabled, the SD signal from the customer passes through the SD gate function and enters the signal control circuit pack over the NSD lead. If the data set is operating nonsynchronously (A lead positive and B lead at ground), the signal bypasses the sampler and is applied through the selector logic gate to the transmitter and line interface circuit pack via the SSD lead. If the data set is operated synchronously, the scrambler-descrambler feature may or may not be provided. All data sets without the scrambler-descrambler feature are rated MD. When operating in the synchronous mode with scrambler-descrambler, the SD signal is applied to the sampler (A lead floating and B lead positive) where it is compared with a clock (for timing the scrambler). The clock is obtained from either the customer via the Serial Clock Transmit External (SCTE) lead (option E) or the clock generator circuit pack via option Z. The SD signal passes from the sampler to the scrambler via the SI1 and SI2 leads and from the scrambler to the selector logic gate via the SO1 and SO2 leads. If the scrambler is not used, an alternate path is automatically made when the scrambler/decrambler card is removed. The proper signal is passed from the sampler to the selector logic gate. The path from the selector logic gate to the transmitter and line interface circuit pack is via the SSD lead. The remaining transmission functions are the same as those for nonsynchronous transmission.

**3.61** The SD gate function is enabled in either of two ways:

- (a) When a CS signal is being transmitted to the customer, or
- (b) When the data set is placed in Remote Test. The remote test mode is indicated by the RTN lead being open.

**3.62** The received signal passes through the restored polar receiving circuitry (described for nonsynchronous operation) and is applied to the sync recovery and signal regenerator circuit pack over the NRD lead from the receiver. In the synchronous mode, the signal is regenerated by the regenerator circuit and passed to the descrambler via the DI1 and DI2 leads. From the descrambler, the signal passes via the DO lead to the gate on the signal control circuit pack, and then to the RD gate function on the customer interface circuit pack via the SRD lead. The

regenerator circuit is timed by a clock signal recovered from the received signal by the sync recovery circuit. This recovered clock is also passed to the customer over the Serial Clock Receive (SCR) lead. If the synchronous mode is with the scrambler and descrambler removed, the regenerated signal passes through the selector logic gate on the signal control circuit pack and directly on to the SRD lead. The path of the received signal from the regenerator is controlled by the state of the A and B leads (in synchronous operation: A lead floating, B lead positive). Timing for the descrambler is derived from the received signal by the sync recovery circuit.

**3.63** The RD gate function is enabled from the RD control logic when one of the three following conditions exists:

- A DSR signal is being transmitted to the customer.
- The data set is in the remote test mode.
- The data set is in the local test mode.

**C. Unbalanced Customer Interface**

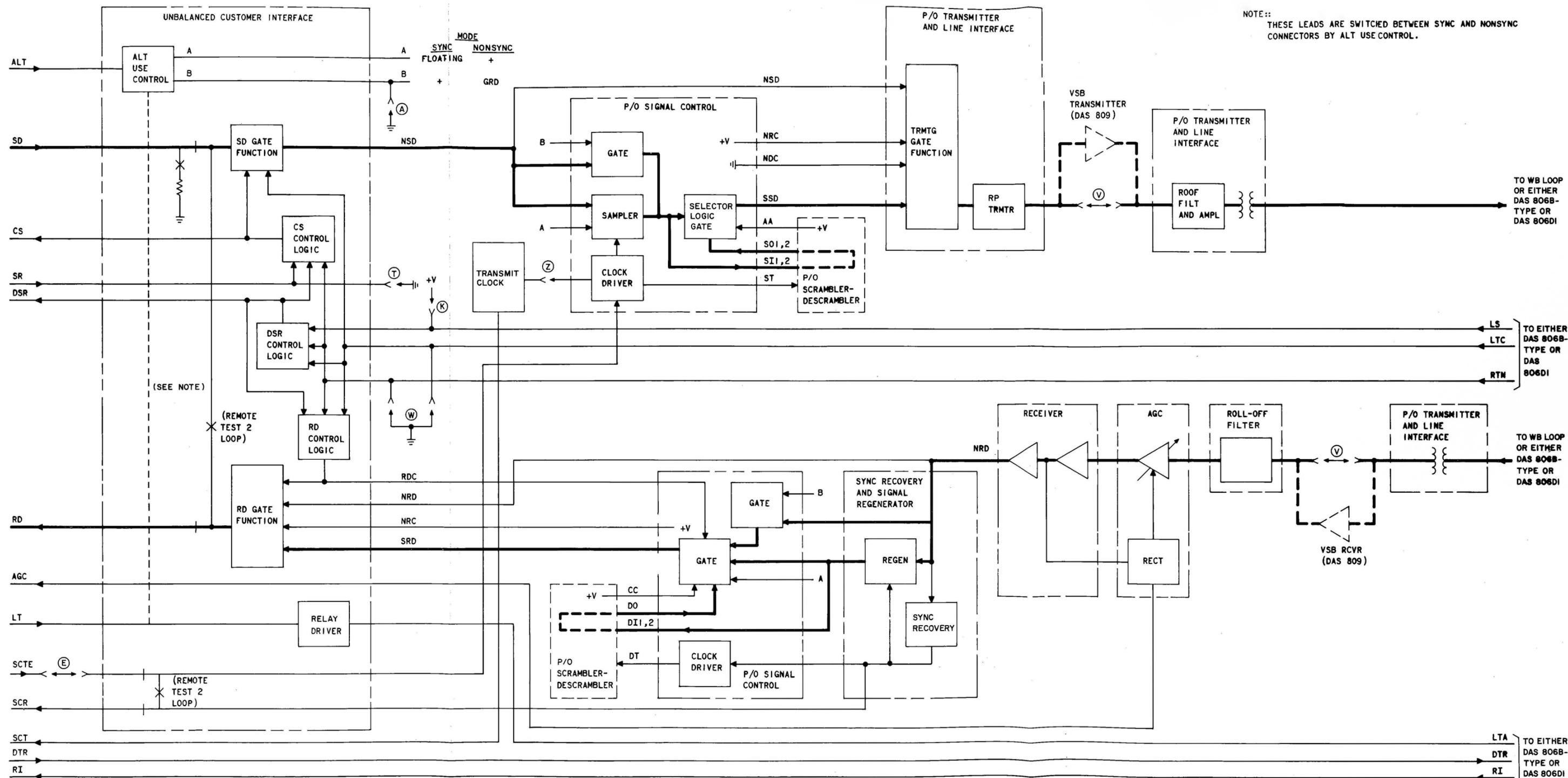
**3.64** Operation of the unbalanced customer interface circuit pack in the synchronous mode is the same as that for nonsynchronous operation. Refer to 3.22 through 3.25.

**D. Signal Control**

**3.65** The primary function of this circuit pack is to provide switching for the synchronous data set (Fig. 13). For continuity, refer to Fig. 12 which provides a functional representation of the signal and control paths. There are three basic switching operations involved:

- (a) Synchronous set operating nonsynchronously
- (b) Synchronous set operating synchronously
- (c) Synchronous set operating synchronously with scrambler-descrambler removed.

**3.66** When the data set is operating nonsynchronously, the clock signal is not needed. The transmitted data is switched around the regenerator to the selector logic circuit. From the selector logic circuit, the transmitted data is sent to the



NOTE:: THESE LEADS ARE SWITCHED BETWEEN SYNC AND NONSYNC CONNECTORS BY ALT USE CONTROL.

(SEE NOTE)

(REMOTE TEST 2 LOOP)

(REMOTE TEST 2 LOOP)

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Fig. 12—Restored Polar—Synchronous/Nonsynchronous Operation With Unbalanced Customer Interface, Functional Block Diagram

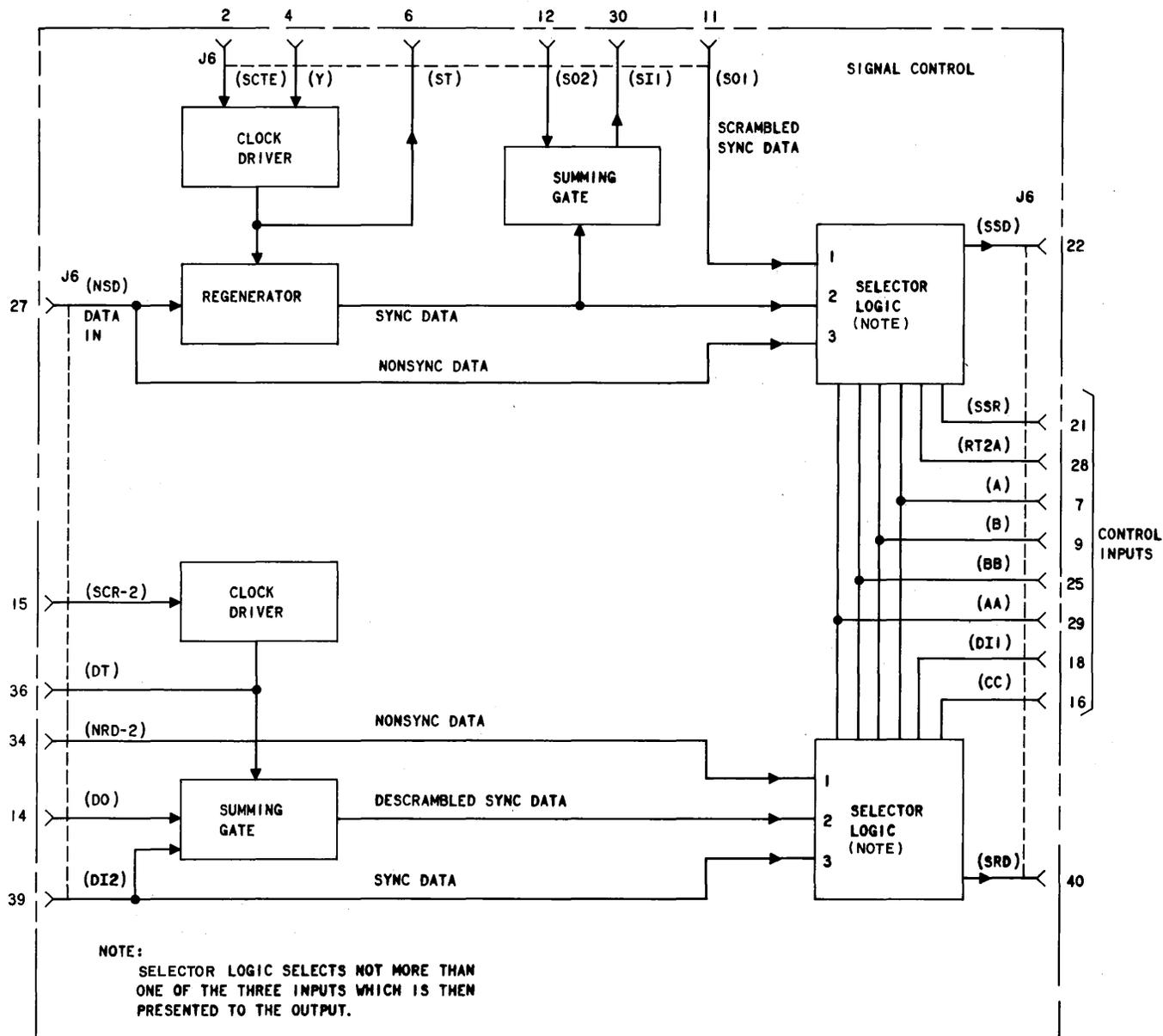


Fig. 13—Signal Control—Block Diagram

transmitter and line interface circuit pack. When the data set is operating synchronously, the transmitted signal is applied to the regenerator where it is compared with a clock signal. If the scrambler-descrambler is removed, the transmitted data from the regenerator is applied directly to the selector logic circuit and then to the transmitter and line interface circuit pack. If the scrambler-descrambler is not removed, the transmitted data from the regenerator is sent through a summing gate to the scrambler. The

output of the scrambler is applied to selector logic circuit and then to the transmitter and line interface circuit pack. The signal control circuit pack performs the same switch function in reverse for received data.

**E. Clock Generator**

**3.67** The circuit pack provides the clock signal for synchronous operation (Fig. 14). The transmitting clock circuit consists of a crystal

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oscillator, an amplifier-slicer circuit, and a cable driver. A divider circuit is also used at half-group and group data speeds.

**3.68** There are six clock generator circuit packs at the present time. Refer to Table D for their applications.

**3.69** All the clock generators utilize the same basic crystal oscillator circuit with the appropriate crystal selected to give the required frequency. In the 19.2-, 40.8-, and 50.0-kbps circuits, the crystal oscillator frequency is divided by four to give the output frequency so that more stable crystals can be used. The supergroup circuits do not use the dividing circuits.

**3.70** The oscillator output is applied to the amplifier-slicer circuit for amplification and signal-shaping. In group and half-group applications, the output of the amplifier-slicer is used to drive a 2-stage binary counter. The counter divides the frequency by four. The output of the counter is applied to the Y lead and the cable driver. The output on the Y lead is for use by the data set. The cable driver provides impedance-matching and isolation so that the signal on the SCT lead is suitable for use by the business machine.

**3.71** For supergroup frequencies, the output of the amplifier-slicer is applied to terminal 19 and the cable driver. The divider circuit is not required.

**3.72** The RT2A lead provides a means for disabling the clock during the remote test 2 mode.

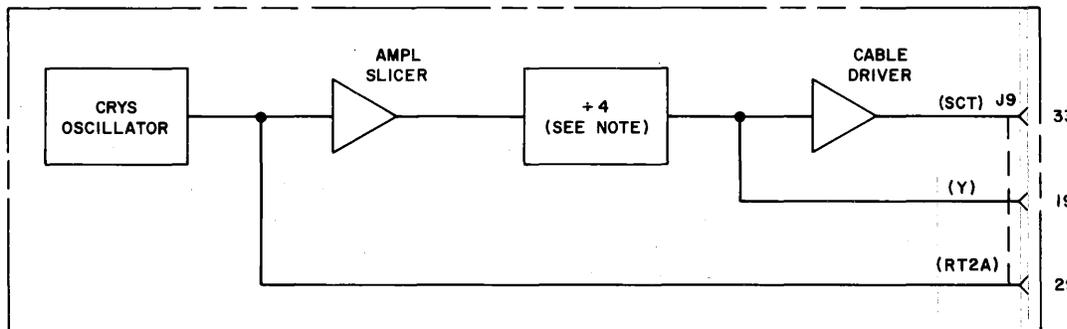
This is necessary so that recovered clock can be substituted for the transmitted clock.

**F. Scrambler-Descrambler**

**3.73** The scrambler is used to randomize the customer data sequence and prevent strong single-frequency components in the line signal which would exist with repetitive short words. It also provides a repetitive idle code which can be used as a synchronizing signal at the far end in the absence of customer-applied data. The descrambler reconstructs the original data sequence.

**3.74** Data set codes for synchronous data sets are normally equipped with a scrambler-descrambler. All synchronous sets with unbalanced customer interface are equipped with scrambler-descrambler. The synchronous sets with balanced customer interface are available either with or without scrambler-descrambler. The scrambler and descrambler are mounted on the same plug-in unit. The scrambling function with no descrambling can be provided by option X. The descrambling function with no scrambling can be provided by option Y. The scrambler-descrambler function can be eliminated by removing circuit pack AR134 or the 16A1 Data Unit; only one is supplied with each data set.

**3.75** The transmitted signal enters the scrambler-descrambler over the S11 lead (Fig. 15). In the shift register, the signal is scrambled and leaves the scrambler via the SO1 and SO2 leads. The ST lead supplies the clock to the scrambler. In the receiving path, the received



**NOTE:**  
THIS CIRCUIT NOT REQUIRED FOR  
SUPERGROUP OR 460.8 KBPS OPERATION.

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**Fig. 14—Clock Generator—Block Diagram**

TABLE D

## CLOCK GENERATOR CIRCUIT PACK APPLICATION

DATA RATE (KBPS)	CIRCUIT PACK NUMBER
19.2	AR137
40.8	AR219
50.0	AR138
200.0	AR139
230.4	AR140
460.8	AR406

signal is applied to the shift register over the DI1 lead where it is descrambled. The descrambled signal leaves the scrambler-descrambler via the DO lead. The DT lead supplies the clock to the descrambler.

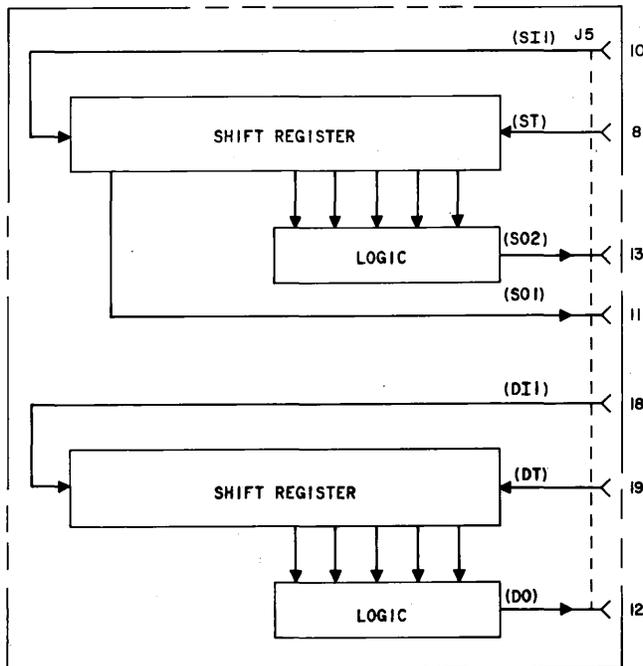


Fig. 15—Scrambler-Descrambler, Block Diagram

**G. Roll-Off Filter**

**3.76** Operation of the roll-off filter circuit pack in the synchronous mode is the same as that for nonsynchronous operation. Refer to 3.34 through 3.39.

**H. Automatic Gain Control**

**3.77** Operation of the automatic gain control (AGC) circuit pack in the synchronous mode is the same as that for nonsynchronous operation. Refer to 3.40 through 3.42.

**I. Receiver**

**3.78** Operation of the receiver circuit pack in the synchronous mode is the same as that for nonsynchronous operation. Refer to 3.43 through 3.47.

**J. Sync Recovery and Signal Regenerator**

**3.79** The sync recovery and signal regenerator circuit pack contains circuitry for deriving a clock signal from the received data. This recovered clock signal is used by the regenerator circuit to regenerate the signal.

**3.80** There is a variety of sync recovery and signal regenerator circuit packs at the present time. Refer to Table E for their applications. The sync recovery circuit packs AR143 (option ZF) and AR220 (option ZH) are rated MD and are replaced with circuit packs AR550 (option ZG) and AR552 (option ZI), respectively. Circuit packs AR550 and AR552 must be used in DS 303C-type and DS 303G-type, respectively, when these data sets are used with more than three WRR-1 regenerative repeaters in tandem. The circuit packs AR550 and AR552 are less sensitive to low-frequency modulation present in some L-carrier systems.

**3.81** All circuits have the same input-output connections and utilize the same synchronizing mechanism (Fig. 16). The synchronizing mechanism is essentially a crystal oscillator capable of being frequency- and phase-adjusted automatically to lock into the transitions of the received data.

**3.82** The signal regeneration part of the circuit uses the recovered clock signal in such a way that the positive-going transition samples the incoming data and sets or resets a flip-flop in

→ TABLE E ←

**SYNCHRONIZATION RECOVERY AND SIGNAL REGENERATOR CIRCUIT PACK APPLICATIONS**

DATA RATE (KBPS)	CIRCUIT PACK NUMBER
18.75	AR241
19.2	AR142
40.8	AR552*
50.0	AR550†
200.0	AR144
230.4	AR145
460.8	AR407

\* Replaces AR220 (MD)

† Replaces AR143 (MD)

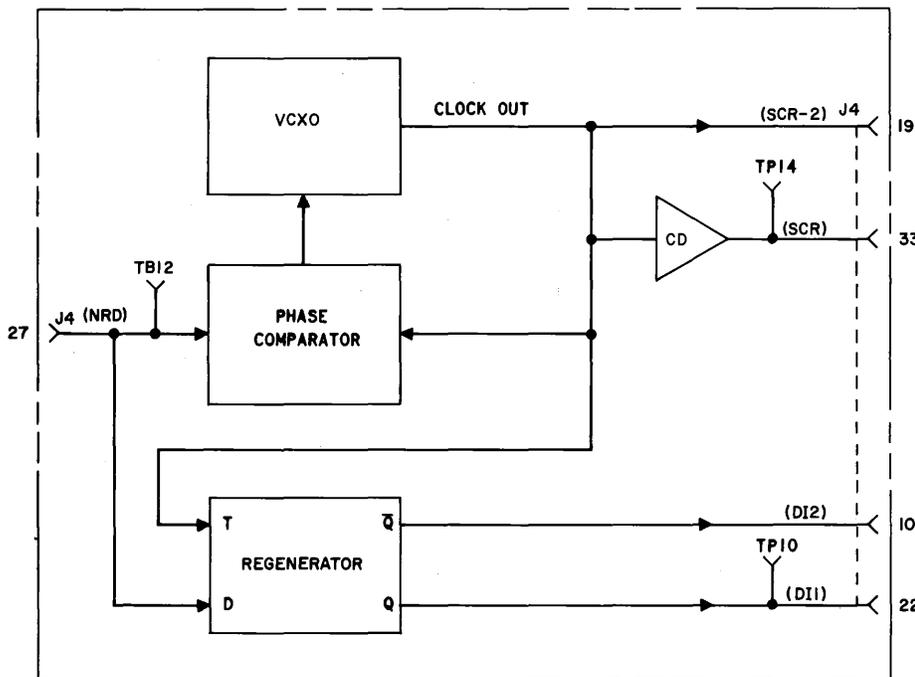
accordance with the data state that exists during the sample.

**RESTORED POLAR—SYNCHRONOUS OPERATION WITH BALANCED CUSTOMER INTERFACE**

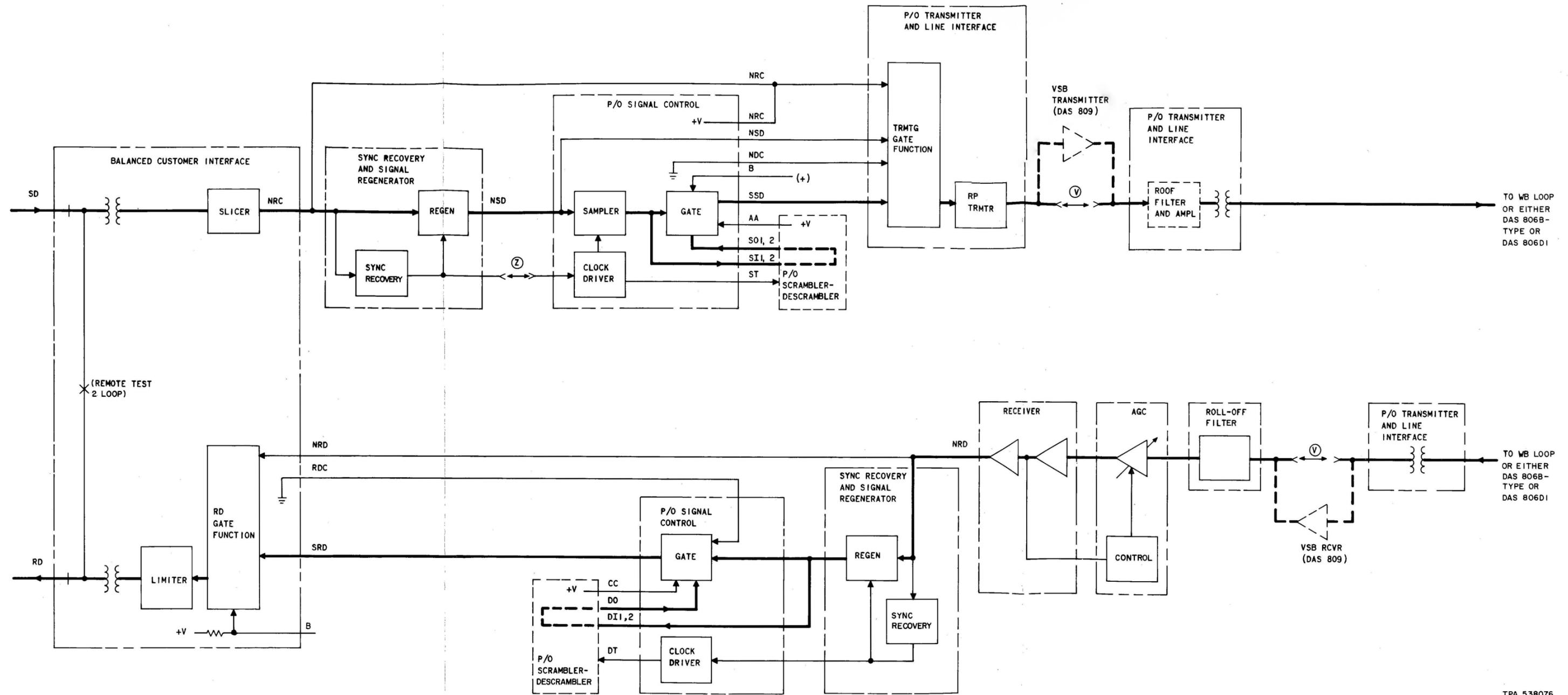
**3.83** Operation of a synchronous data set equipped with a balanced customer interface is similar to that of a synchronous data set equipped with an unbalanced customer interface. Refer to 3.55 through 3.82 for a description of synchronous unbalanced interface operation. Figure 17 shows a block diagram of this operation.

**3.84** Sets equipped with a balanced customer interface differ from the unbalanced sets in two ways:

- Control logic is not used, and the data set is always functional.



**Fig. 16—Sync Recovery and Signal Regenerator—Block Diagram**



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Fig. 17—Restored Polar—Synchronous Operation With Balanced Customer Interface, Block Diagram

- The data set is used as a regenerative repeater by inserting a second sync recovery and signal regenerator circuit pack in place of the clock generator circuit pack. In this manner, the customer's send data is regenerated before reaching the signal control circuit pack.

### **DC-COUPLED LINE SIGNAL—NONSYNCHRONOUS OPERATION WITH UNBALANCED CUSTOMER INTERFACE**

#### **A. General**

**3.85** Data Sets 303-type using dc-coupled balanced line signals are available at all the data rates for restored polar type data sets plus 460.8 kbps.

**3.86** The nonsynchronous dc-coupled balanced line signal type data set does not use the transmitter, roll-off filter, automatic gain control, or receiver circuit packs required in the restored polar type data set (Fig. 18).

**3.87** With minor exceptions, the signal flow for a dc-coupled nonsynchronous-type DS 303 is similar to that for a restored polar nonsynchronous type DS 303. Refer to 3.06 through 3.14. The restored polar transmitter and line interface is replaced by the dc-coupled balanced line interface, and DAS 809 is never used.

#### **B. Unbalanced Customer Interface**

**3.88** The unbalanced customer interface circuit pack functions the same in this application as in restored polar operation. Refer to 3.22 through 3.25.

#### **C. DC-Coupled Balanced Line Interface**

**3.89** This description covers the operation of circuit pack AR361. The circuit pack contains input logic circuit, a dc-coupled balanced line driver, balanced line terminator, and received signal indicator (Fig. 19).

**3.90** The logic circuit passes either synchronous or nonsynchronous data depending on the mode in which the data set is operating.

**3.91** The balanced line driver produces a 1.0-volt peak-to-peak balanced signal across a 100-ohm balanced cable. The line driver is capable of driving as much as 1000 feet of 761A cable.

**3.92** Circuit pack AR361 should be strapped A1-B1, A2-B2, D1-E1, and D2-E2 in all dc-coupled balanced line interface data sets.

**3.93** The balanced line terminator accepts the balanced input data signal and converts it into a single-ended binary signal. The received signal indicator recognizes the presence of incoming data and indicates this to the customer via the AGCL lead.

### **DC-COUPLED LINE SIGNAL—NONSYNCHRONOUS OPERATION WITH BALANCED CUSTOMER INTERFACE**

**3.94** Operation of a nonsynchronous data set equipped with a balanced customer interface is similar to that of a nonsynchronous data set equipped with an unbalanced customer interface (3.85 through 3.93). The differences are that (1) control logic is not used, (2) the data set is always functional, and (3) option A must be installed. Figure 20 shows a functional block diagram of a dc-coupled balanced line data set operating nonsynchronously with balanced customer interface. Refer to 3.50 through 3.54 for a description of the balanced customer interface.

### **DC-COUPLED LINE SIGNAL—SYNCHRONOUS OPERATION WITH UNBALANCED OR BALANCED CUSTOMER INTERFACE**

**3.95** The dc-coupled balanced line signal type data sets do not use the transmitter, roll-off filter, automatic gain control, and receiver circuit packs required for restored polar type data sets. Circuit packs common to both restored polar and dc-coupled line signal sets function the same way in both types of data transmission. Refer to Fig. 21 for the circuit pack arrangement in a synchronous set and to the appropriate preceding paragraphs for an operation description. Figure 22 shows a functional block diagram of a dc-coupled balanced line signal data set operating synchronously with balanced customer interface. The dc-coupled balanced line interface circuit pack provides the same function in synchronous operation as in nonsynchronous operation. Figure 23 shows a functional block diagram of a dc-coupled balanced line signal data set operating synchronously/nonsynchronously with unbalanced customer interface. Refer to 3.89 through 3.94.

**PICTUREPHONE LINE SIGNAL—SYNCHRONOUS OPERATION WITH UNBALANCED CUSTOMER INTERFACE**

**3.96** The DS 303J26 uses PICTUREPHONE-type line signals and is available at the data rate of 460.8 kbps. A functional block diagram of a PICTUREPHONE-type line signal data set operating synchronously/nonsynchronously with unbalanced customer interface is shown in Fig. 24. The operation of the data sets with PICTUREPHONE line interface is similar to the operation of the data sets with dc-coupled balanced line interface with the addition of the PICTUREPHONE loop line interface circuit pack AR513.

**3.97** The PICTUREPHONE loop line interface circuit pack AR513 (Fig. 25) in DS 303J26 contains control logic, a receiving filter, a low-pass filter, a 3-dB attenuator in the receive circuit, and a 3-dB attenuator in the transmit circuit.

**3.98** The transmit signal is applied to terminals 10 and 12 on CP AR513. The signal is passed through a low-pass filter and a 3-dB pad providing the proper signal at terminals 6 and 8 for transmission over the PICTUREPHONE line facilities. The receive signal is applied to terminals 16 and 18 and passes through a 3-dB attenuator and a low-pass receiving filter. The nominal received power will be within 6 dB of the nominal transmitted power. Also in the receive path is a control circuit to force the output of the receive path to be a steady mark whenever the line signal is looped back by the PICTUREPHONE line interconnecting unit and the data station is not in local test. The steady mark is also forced whenever the station is in the remote test 1 (RT1) mode. This forcing of a steady mark prevents a false received signal indication on the AGC lead to the customer. The remaining operation of this data set is the same as that described for synchronous data sets with dc-coupled balanced line interface. Refer to 3.95.

**3.99** Circuit pack AR361 in DS 303J26 should be strapped as follows: C1-B1, C2-B2, F1-E1, and F2-E2.⚡

**4. OPTIONS**

**4.01** Certain options are required due to the type of service and station arrangement. Other options and features are determined by the customer.

Options available for DS 303 are described as follows.

**Note:** The terminal board connection for a particular option is designated immediately following the option designation.

- **A Option**—Permanent Nonsync (TB1: 17-18)—This is required in all nonsynchronous data sets equipped with a balanced customer interface and is factory-furnished in these sets. It may be used in nonsynchronous data sets equipped with an unbalanced customer interface rather than requiring a customer-supplied ON signal on the Alternate Use (ALT) lead.
- **E Option**—External Transmit Clock (TB1: 7-8)—This is factory-furnished in data sets with suffixes 13, 14, 17, and 18, which are rated MD. It must be supplied in synchronous unbalanced interface data sets when the customer supplies the transmitting clock. In this case, the transmit clock circuit pack must be removed. Do not use option Z when option E is provided.
- **J Option** (TB1: 4-13)—This is a factory-furnished option which provides for noise margin in the logic circuitry of synchronous sets when option Y is not used. Options Y and J should never be supplied simultaneously.
- **K Option** (TB2: 17-28)—This option, which is not factory-furnished, provides permanent line status indication to DS 303. It must be used when DAS 804A-type is not used.
- **M Option** (TB1: 16-19)—When this is furnished, the scrambler idle code is not transmitted until request-to-send signal is ON. This option is factory-furnished in unbalanced interface data sets with scramblers. Either option M or Q must be supplied in all synchronous sets even if the scrambler is not used. Do not use option Q when option M is provided.
- **N Option** (TB2: 5-15)—When this is installed, DS 303 is in the data mode when ALT is OFF, thus permitting simultaneous talk and synchronous wideband data. When

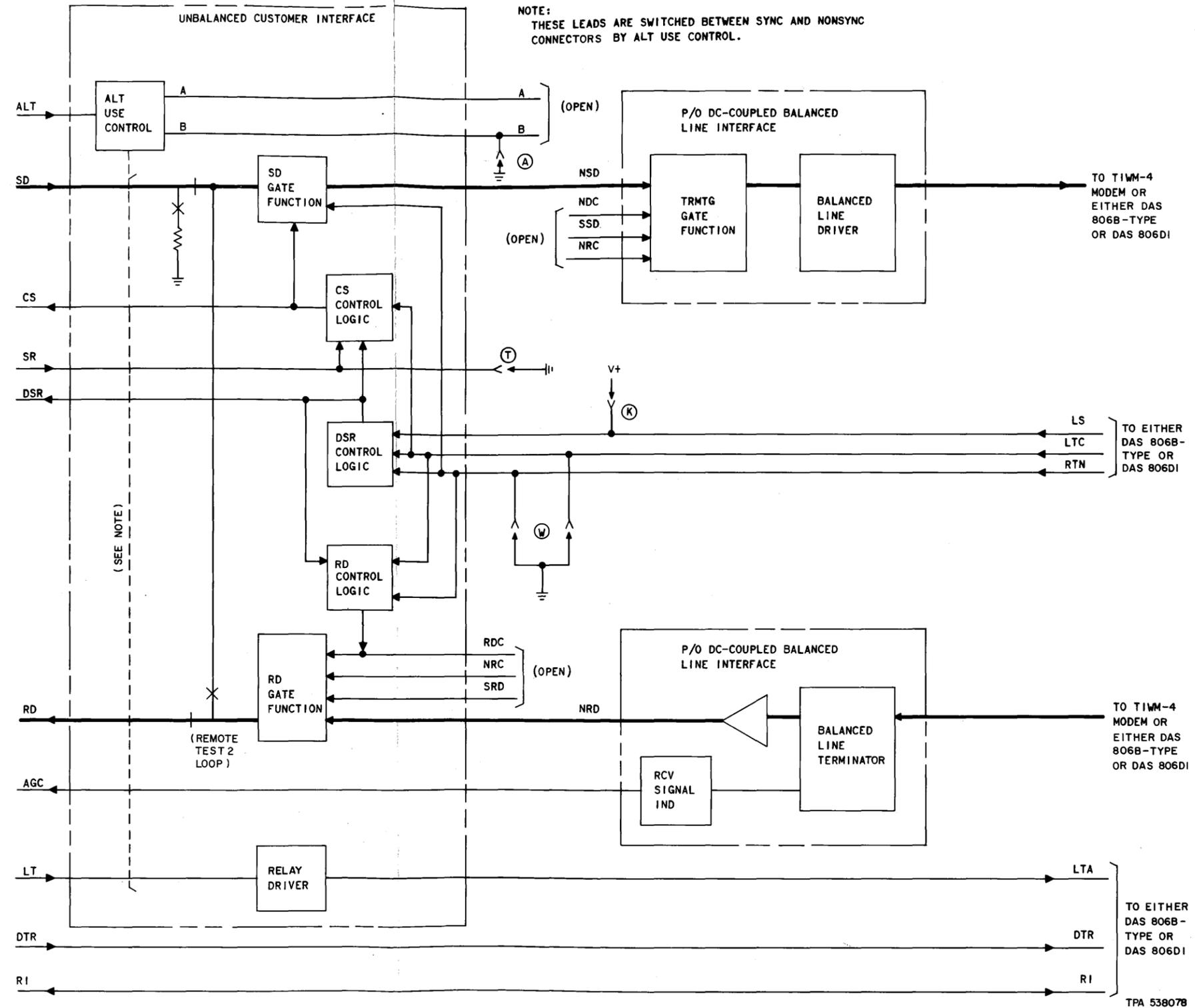
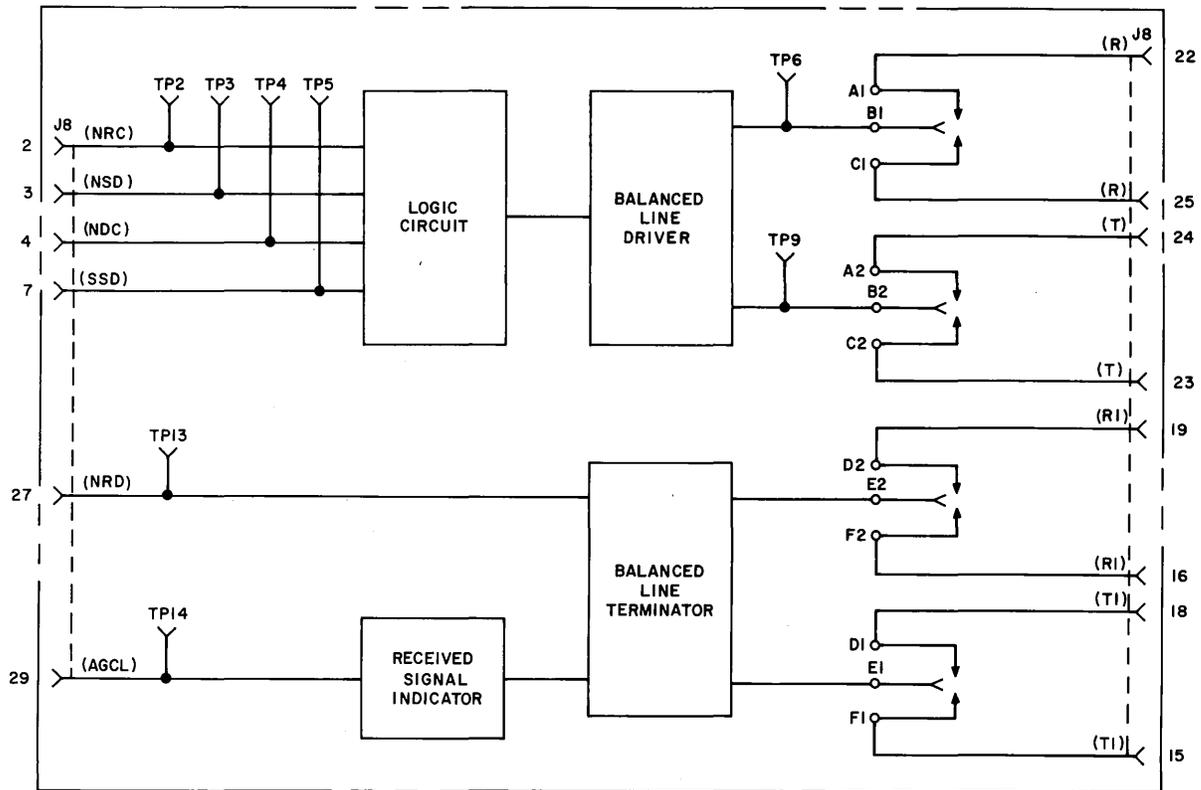


Fig. 18—DC-Coupled Line Signal—Nonsynchronous Operation With Unbalanced Customer Interface, Block Diagram



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Fig. 19—DC-Coupled Balanced Line Interface, Block Diagram

ALT is ON, DAS 804A-type must be in the data mode to transmit wideband data.

- **Q Option** (TB1: 17-19)—When this is installed, the scrambler idle code is transmitted when the scrambler is receiving a transmit clock signal. Either option Q or M must be furnished in all synchronous sets. Option Q is factory-furnished in all synchronous data sets with a balanced interface. Option M must not be supplied when option Q is installed.
- **R Option** (TB1: 15-16)—This option, which is not factory-furnished, applies only to half-group data sets. When option R is installed, the vestigial sideband (VSB) carrier is turned OFF when request-to-send signal is OFF. This option is necessary on multipoint nonswitched networks.
- **S Option** (TB2: 4-15)—This option is the inverse of option N and permits simultaneous talk and nonsynchronous wideband data when ALT is ON. When ALT is OFF, DAS 804A-type must be in the data mode to transmit wideband data.
- **S and N Options** (S—TB2: 4-15, N—TB2: 5-15)—When options S and N are installed, DS 303 can transmit either synchronous or nonsynchronous data regardless of whether DAS 804A-type is in the talk or data mode. When neither option N nor S is supplied, DAS 804A-type must be in the data mode to transmit wideband data. When DAS

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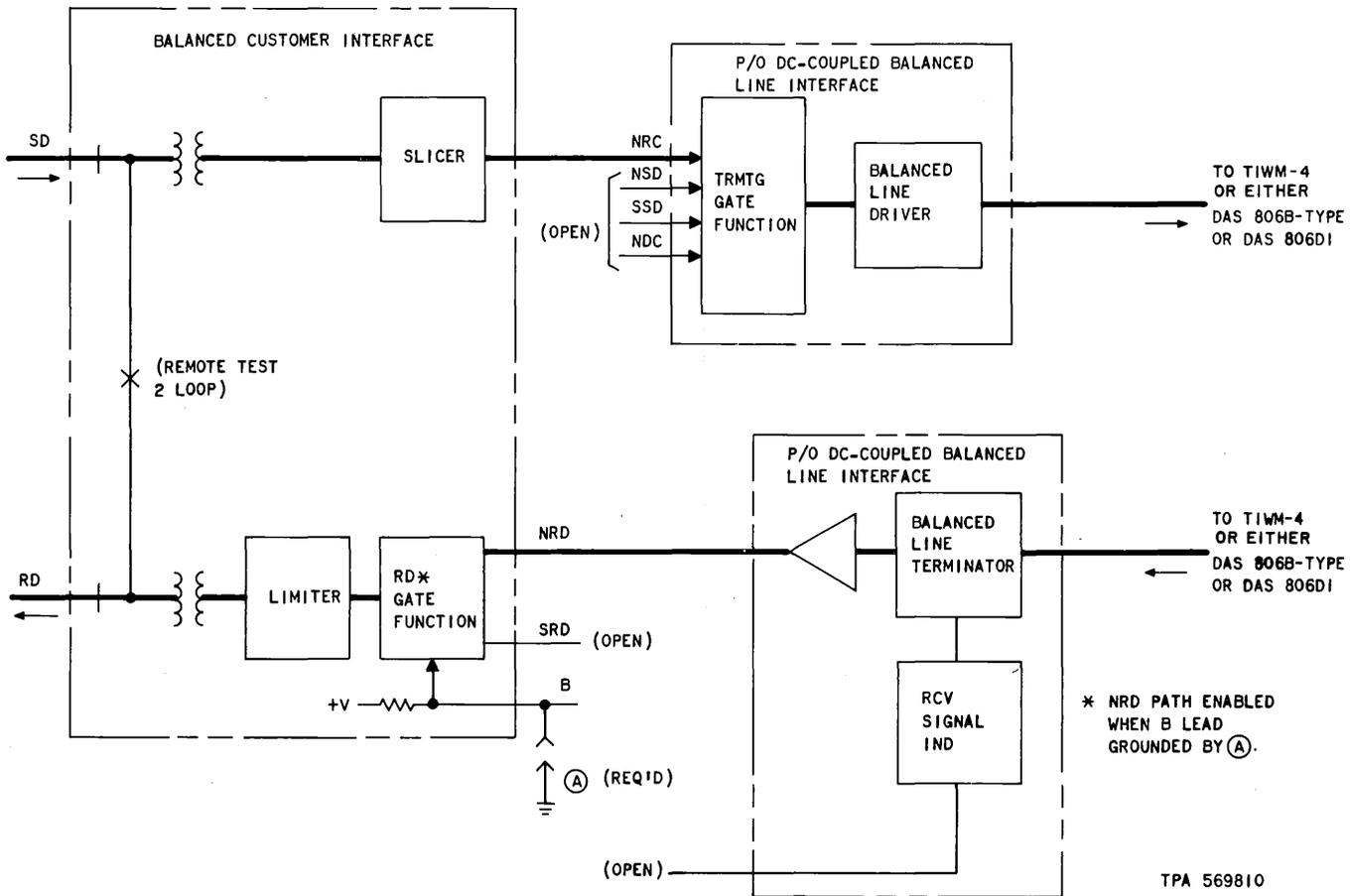


Fig. 20—DC-Coupled Line Signal—Nonsynchronous Operation With Balanced Customer Interface, Functional Block Diagram

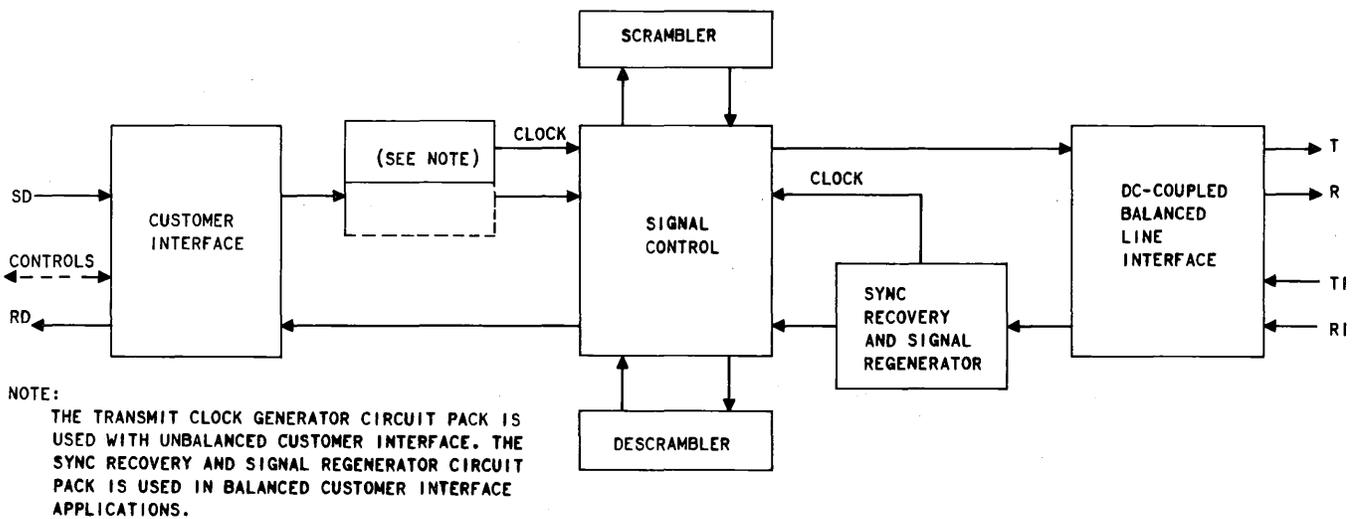
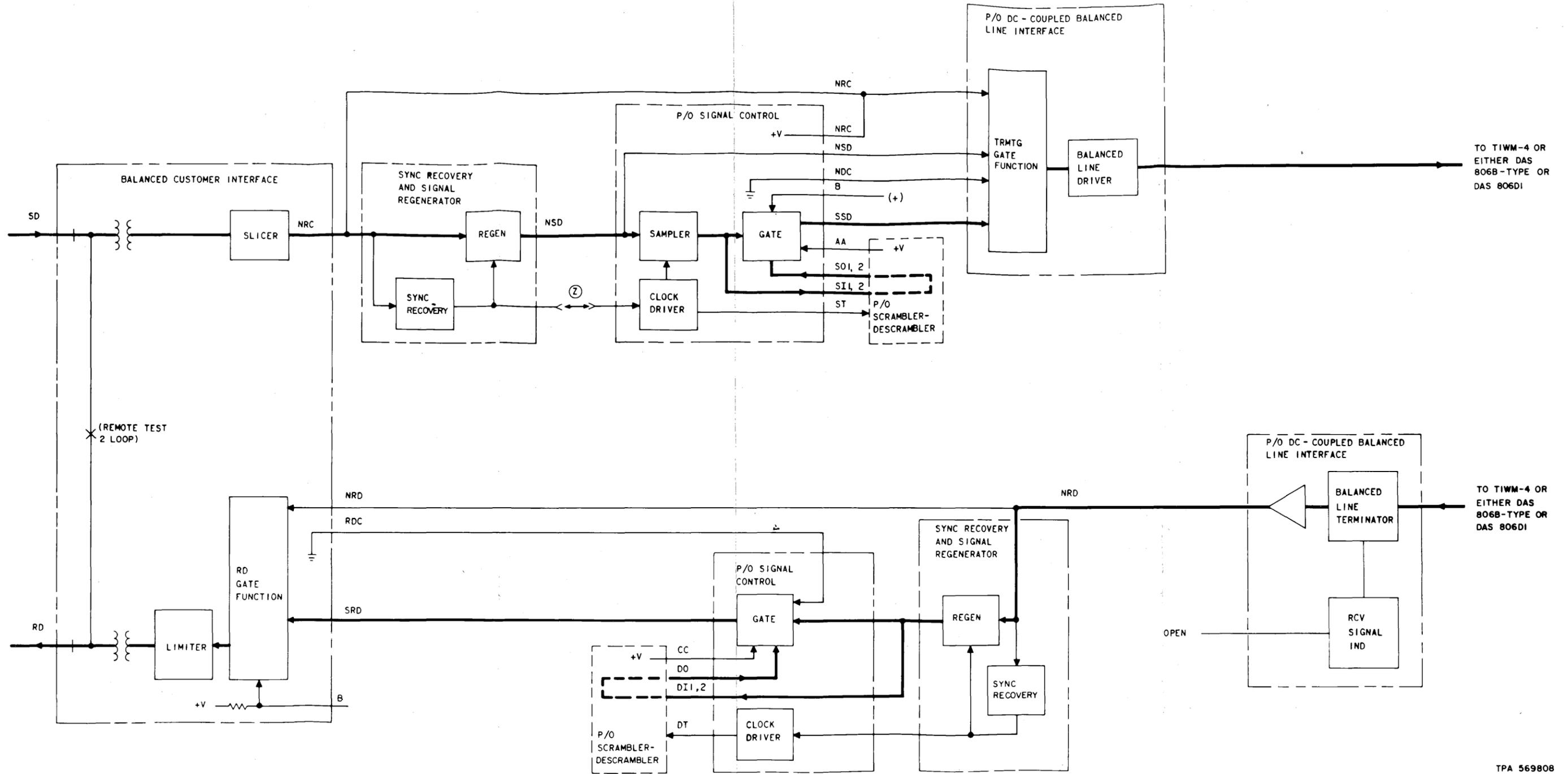


Fig. 21—DC-Coupled Line Signal—Synchronous Operation With Balanced or Unbalanced Customer Interface, Block Diagram



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Fig. 22—DC-Coupled Line Signal—Synchronous Operation With Balanced Customer Interface, Functional Block Diagram

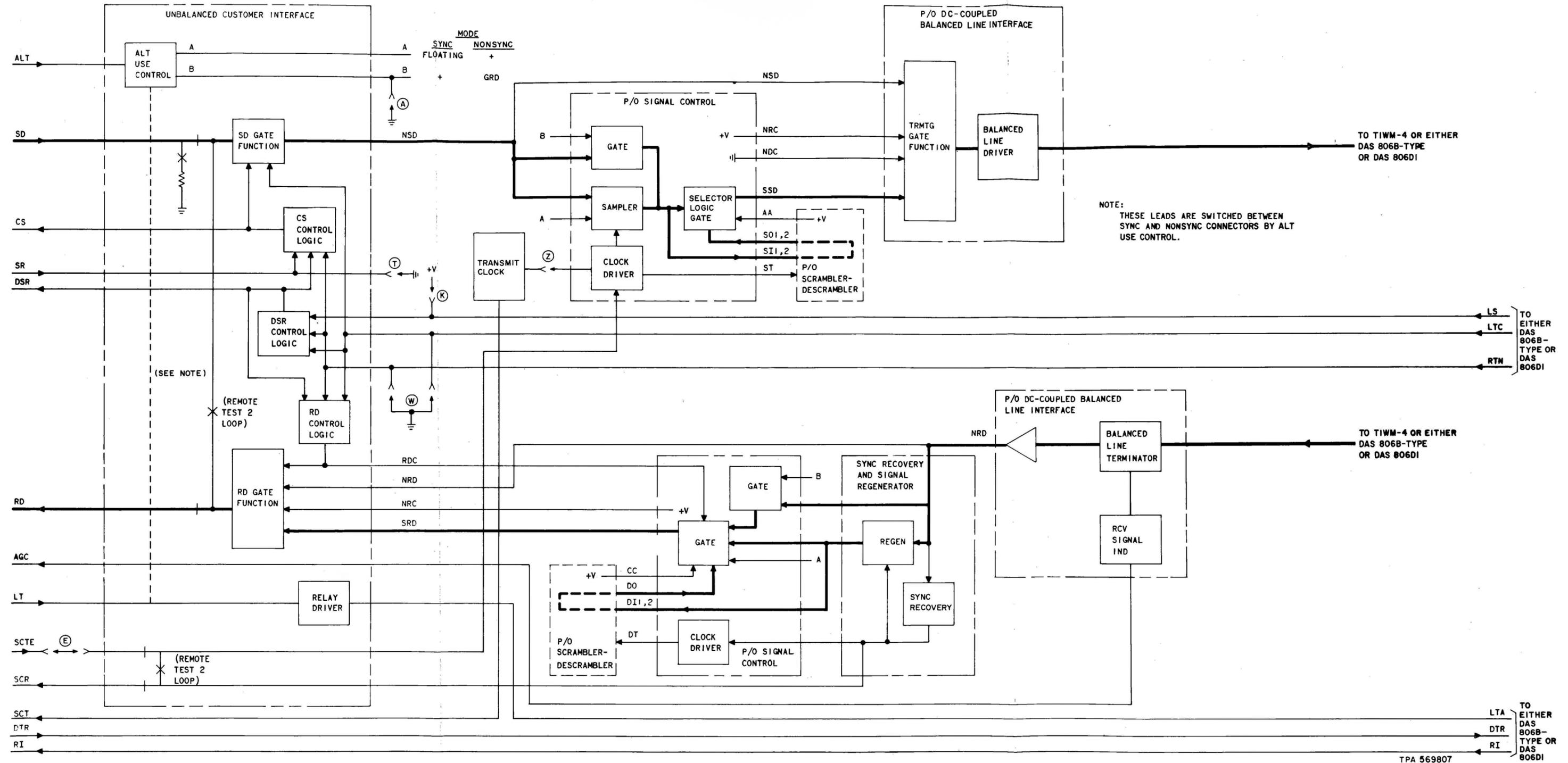


Fig. 23—DC-Coupled Line Signal Synchronous/Nonsynchronous Operation With Unbalanced Customer Interface, Functional Block Diagram

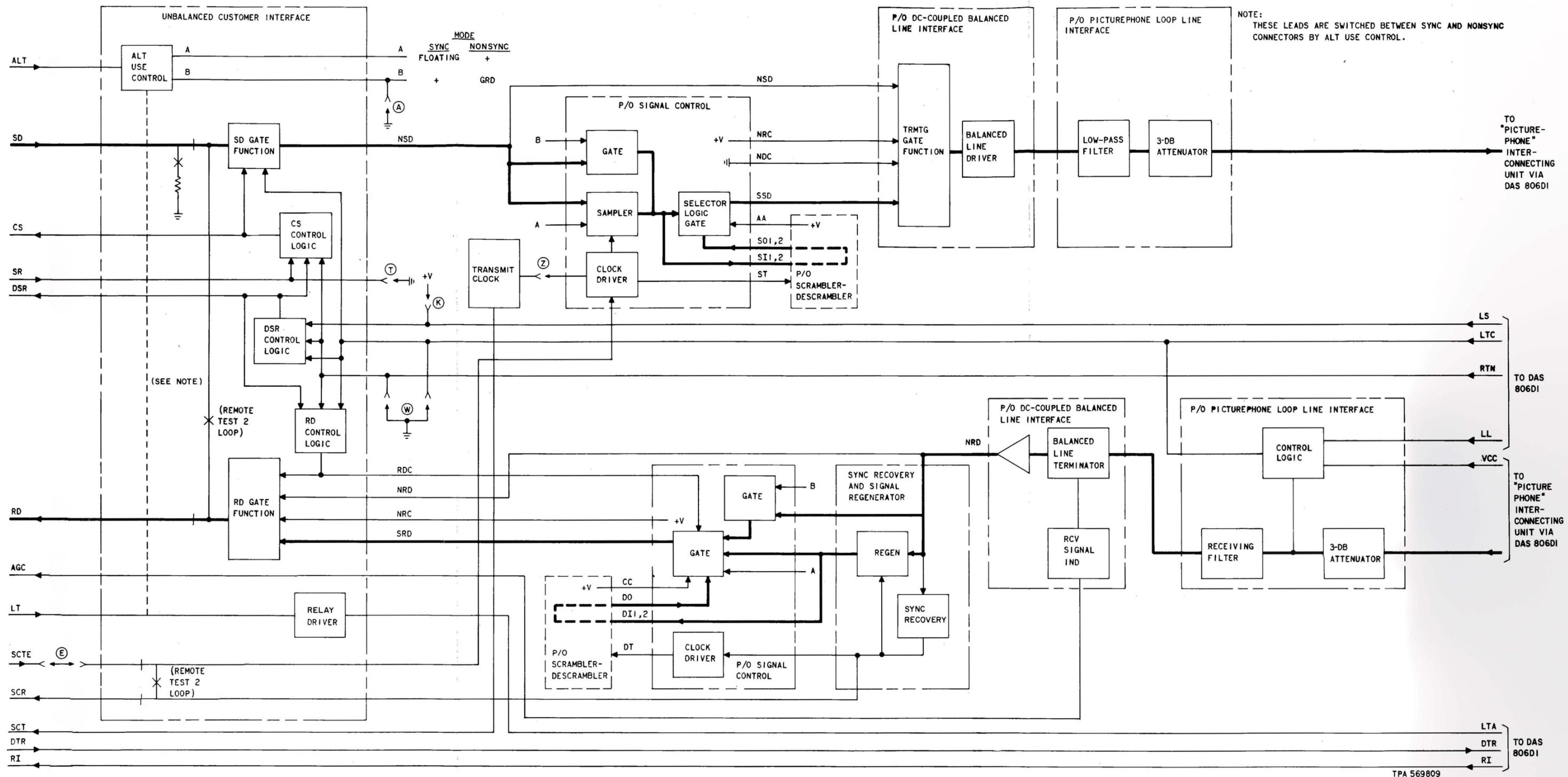


Fig. 24—PICTUREPHONE-Type Line Signal—Synchronous/Nonsynchronous Operation With Unbalanced Customer Interface, Functional Block Diagram

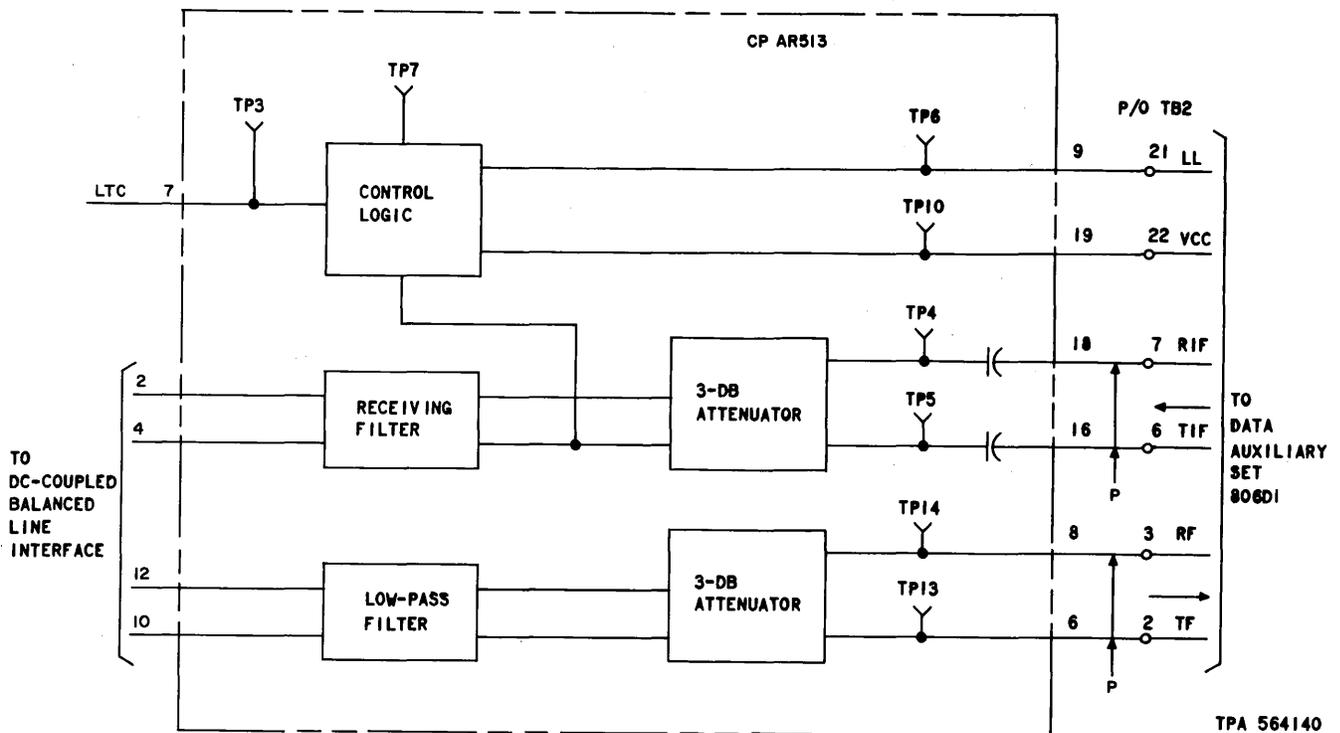


Fig. 25—PICTUREPHONE Loop Line Interface

804A-type is not used, option K must be supplied. Neither option N nor S is factory-furnished in DS 303.

- **T Option** (TB1: 16-17)—This supplies a permanent request-to-send indication to DS 303. This option, which is not factory-furnished, may be used instead of customer-supplied request to send.
- **V Option** (TB1: 25-26, 28-29)—This option, factory-furnished in all group and supergroup data sets, is used to bypass DAS 809B1. It is needed in half-group sets if a VSB unit is not used.
- **W Option** (TB2: 25-26, 26-27)—This option, which is not factory-furnished, is necessary when DAS 806-type is not used. It provides "no remote test" and "no local test" indications to DS 303 to open the transmit and receive gates in DS 303 when DAS 806-type is not used.
- **X Option** (TB1: 5-6, 12-13)—This option, which is not factory-furnished, provides for scrambling without descrambling.

- **Y Option** (TB1: 4-5, 13-14)—This option, which is not factory-furnished, provides for descrambling without scrambling. When this option is used, remove option J.

**Note:** Options X and Y are to be used only when one-way scrambling is necessary.

- **Z Option** (TB2: 10-11)—This option, factory-furnished where required, must be supplied when the customer requires a clock signal from the DS 303. Option E must not be supplied when option Z is installed.

## 5. CODE SELECTION

**5.01** Data Sets 303-type use plug-in circuit packs extensively to offer a wide variety of features. These circuit packs can be combined to make up different DS 303-type codes.

**5.02** Data sets are available with three different line signals: restored polar, balanced dc coupled, and PICTUREPHONE type. Two customer interface signals are available: unbalanced, for commercial applications, and balanced, for certain government applications. The data sets may be

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equipped for either nonsynchronous or synchronous operation. Synchronous data sets may be used with or without the scrambler-descrambler and with either an internal transmit clock or a customer-supplied (external) clock. Table G lists the combinations of these features available as standard coded data sets. Many of the data set codes have been rated Manufacture Discontinued in order to reduce the large number of codes. For additional information concerning data set codes which replace the Manufacture Discontinued codes, refer to 3.03 and 3.04.

**5.03** A specific code is given to each data set to indicate all its features. Data Set 303-type is coded with a suffix letter to denote speed capability. The signaling rates and data set codes are listed in Table F.

**5.04** Table G gives all the codes arranged in a matrix with regard to the features provided. A suffix numeral follows the suffix letter to designate the specific combination of features provided by plug-in circuit packs. Refer to Table G for the code of the data set desired and find the intersection of all the required features. The

intersection gives the complete data set code including the numerical suffix. Refer to Table F for speed designations.

**5.05** Tables H and I indicate the circuit packs furnished with each code. The tables also include factory-furnished options and other options which can be used in addition to or in place of factory-provided options. Table H indicates restored polar line signal type data sets. Table I shows de-coupled balanced line signal type data sets and PICTUREPHONE line signal type data sets.

**5.06** Tables J, K, and L give the chassis jacks used by the circuit packs for each code of DS 303. Strapping information for factory-provided options and circuit packs is also included in the tables. Table J indicates data sets with restored polar line signals and an unbalanced customer interface. Table K shows data sets with restored polar line signals and a balanced customer interface. Table L indicates sets with de-coupled balanced line signals with either balanced or unbalanced customer interface and sets with PICTUREPHONE line signals.

→ TABLE F ←

**DATA SET 303-TYPE SPEED DESIGNATIONS**

CODE	SIGNALING RATE		FACILITY						
	NONSYNCHRONOUS — MINIMUM SIGNAL ELEMENT WIDTH		SYNCHRONOUS SPEEDS	HALF-GROUP	GROUP	SUPERGROUP	WIDEBAND REPEATED LINE	TI LINE	PICTUREPHONE
303B	52	Microseconds	19.2 kbps	X			X*	X	
303C	20	Microseconds	50.0 kbps		X		X	X	
303D	4.3	Microseconds	230.4 kbps			X	X	X	
303E	4.3	Microseconds	200.0 kbps			X	X	X	
303G	20	Microseconds	40.8 kbps		X		X	X	
303H	52	Microseconds	18.75 kbps	X			X*	X	
303J	2	Microseconds	460.8 kbps					X	X

\* Requires DAS 809B1.

→ TABLE G ←  
CODE MATRIX

UNBALANCED INTERFACE					BALANCED INTERFACE						
Nonsync	303B1* 303C1* 303D1*	303B2 303C2 303D2	303J21		303C23		303B3* 303C3* 303D3*‡	303B4 303C4 303D4*‡	Nonsync		
Synchronous	Internal Transmit Clock	303B5A* 303C5A* 303D5A* 303E5A* 303G5A*	303B6 303C6A 303D6A 303E6A 303G6A	303B25 303C25 303D25 303E25 303G25 303J25	303J26	303B27 303C27 303H27		303B7A* 303C7A* 303D7A*‡ 303E7A*‡ 303H7A*	303B8 303C8A 303D8A*‡ 303E8A*‡ 303H8	Scrambler†	
		303B9* 303C9* 303D9* 303E9* 303G9*	303B10* 303C10* 303D10* 303E10* 303G10*	303B29* 303C29* 303D29* 303E29* 303G29* 303J29*		303B31 303C31 303H31		303B11* 303C11* 303D11*‡ 303E11*‡ 303H11*	303B12 303C12 303D12*‡ 303E12*‡ 303H12	No Scrambler	
		303B13A* 303C13A* 303D13A* 303E13A* 303G13A*	303C14A* 303D14A* 303E14A* 303G14A*								Scrambler†
		303B17* 303C17* 303D17* 303E17* 303G17*	303C18* 303D18* 303E18* 303G18*								No Scrambler
Line Filter	50% Roll-Off	100% Roll-Off	None	Roof & Roll-Off	None	Roof & Roll-Off	50% Roll-Off	100% Roll-Off	Line Filter		
Line Signal	Restored Polar		Balanced DC	Picture-phone	Balanced DC	Picture-phone	Restored Polar		Line Signal		

\* These data set codes are Manufacture Discontinued.

† All data set codes shown are equipped with a 16A1 Data Unit. Codes with an "A" suffix were originally equipped with CP AR134-type scrambler-descrambler and coded without the suffix. These codes are now Manufacture Discontinued.

‡ These codes were reserved for future applications but were never manufactured.



**Note 1:** The following pairs of options are mutually exclusive, and not more than one of a pair should be supplied:

- Z or E
- Y or J
- M or Q

**Note 2:** The symbol (✓) indicates a factory-provided option. The letter (X) indicates an available option.

**Note 3:** Numerals 1 and 2 indicate the number of corresponding circuit packs required for that code.

\* These data set codes are Manufacture Discontinued.

† The DAS 806B-type is rated Manufacture Discontinued.

→ TABLE 1 ←  
DC-COUPLED AND PICTUREPHONE TYPE  
LINE SIGNAL DATA SETS 303-TYPE

FEATURE OR OPTION		DC-COUPLED LINE SIGNAL CODES																	PICTUREPHONE LINE SIGNAL CODES				
		APP OR WRG	303J21	303C23	303B25	303C25	303D25	303E25	303G25	303J25	303B27	303C27	303H27	303B29*	303C29*	303D29*	303E29*	303G29*	303J29*	303B31	303C31	303H31	303J26
9A2-Type Data Mounting		ZD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9A3-Type Data Mounting		ZK	1	1	1	1	1	1	1	1	1	1	1							1	1	1	1
Group, 50% Roll-Off																							
Group, 100% Roll-Off																							
Supergroup, 50% Roll-Off																							
Supergroup, 100% Roll-Off																							
Half-Group, 50% Roll-Off																							
Unbalanced Customer Interface			1		1	1	1	1	1	1				1	1	1	1	1	1				1
Balanced Customer Interface				1							1	1	1							1	1	1	
Clock Generator	19.2 kb				1									1									
	50 kb					1									1								
	200 kb						1									1							
	230.4 kb							1									1						
	40.8 kb								1									1					
	460.8 kb									1										1			
Sync Recovery	460.8 kb									1										1			1
	19.2 kb				1						2			1							2		
	50 kb					1					2			1							2		
	200 kb						1								1								
	230.4 kb							1								1							
	40.8 kb								1								1						
	18.75 kb													2									2
Scrambler-Descrambler					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Signal Control					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Receiver and AGC																							
DC-Coupled Balanced Line Interface			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PICTUREPHONE Line Interface																							1
Transmitter Clock (Note 1)	Internal	Z			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	External	E			X	X	X	X	X	X	X			X	X	X	X	X	X				X
Descrambler, No Scrambler	(Note 1)	Y			X	X	X	X	X	X	X	X	X										X
Sync Logic Normal		J			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scrambler, No Descrambler		X			X	X	X	X	X	X	X	X	X										X
No DAS 806B-Type or DAS 806D1†		W	X		X	X	X	X	X	X				X	X	X	X	X					X
Permanent Send Request		T	X		X	X	X	X	X	X				X	X	X	X	X					X
Talk and Nonsync Data		S	X		X	X	X	X	X	X				X	X	X	X	X					X
Free-Running Scrambler		Q			X	X	X	X	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X
SR Control on Scrambler		M			✓	✓	✓	✓	✓	✓													✓
Talk and Sync Data		N			X	X	X	X	X	X				X	X	X	X	X					X
Permanent LS		K	X		X	X	X	X	X	X				X	X	X	X	X					X
Permanent Nonsync		A	X	✓																			



→ TABLE K ←

DATA SETS 303-TYPE WITH BALANCED CUSTOMER INTERFACE—  
RESTORED POLAR LINE SIGNAL

CIRCUIT PACKS — FUNCTIONAL SCHEMATICS AND OPTIONS AS USED IN DATA SETS 303-TYPE (NOTE 2)																		
CODE 303 ➤			B3 §	C3 §	B4	C4	B7A §	C7A §	H7A §	B8	C8A	H8	B11 §	C11 §	H11 §	B12	C12	H12
JACK	FUNCTION																	
J1	Roll-Off Filter	AR→	157	125	413	126	157	125	157	413	126	413	157	125	157	413	126	413
J2	AGC*	AR→	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307
J3	Receiver	AR→	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
J4	Sync Recovery and Signal Regenerator	AR→	—	—	—	—	142	550 (143)	241									
J5	Scrambler & Descrambler (Note 1)	AR→ or DU→	—	—	—	—	134 16A1	134 16A1	134 16A1	16A1	134 16A1	16A1	—	—	—	—	—	—
J6	Signal Control	AR→	—	—	—	—	579 (133)											
J7	Balanced Customer Interface	AR→	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136
J8	Transmitter & Line Interface	AR→	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
J9	Sync Recovery & Signal Regenerator	AR→	—	—	—	—	142	550 (143)	241									
<b>FACTORY-PROVIDED OPTIONS UNLESS OTHERWISE SPECIFIED†</b>																		
A (TB1: 17-18)			✓	✓	✓	✓												
Q (TB1: 17-19)							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V (TB1: 28-29, 25-26)				✓	✓	✓		✓		✓	✓	✓		✓		✓	✓	✓
Z (TB2: 10-11)							✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
J (TB1: 4-13)							✓	✓		✓	✓		✓	✓		✓	✓	
<b>STRAPS</b>																		
CP AR307			1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2
CP AR131			1-2		1-2		1-2		1-2	1-2		1-2	1-2		1-2	1-2		1-2
CP AR130‡			7-8 10-11	7-9 10-11	7-8 10-11	7-9 10-11	7-8 10-11	7-9 10-11	7-8 10-11									

**Note 1:** All data set codes shown are equipped with a 16A1 Data Unit. Codes with an "A" suffix were originally equipped with CP AR134-type scrambler-descrambler and coded without the suffix. These codes are now Manufacture Discontinued.

**Note 2:** The circuit packs in parentheses are Manufacture Discontinued and are replaced by the circuit packs above them.

\* For 303B, C, and H, CP AR129 may be used in place of CP AR307. CP AR129 does not require straps. CP AR307 supersedes CP AR129 which is Manufacture Discontinued.

† See feature and option table for complete listing.

‡ 1-2 and 4-5 are normally strapped on all CPs AR130 (factory-provided).

1-3 and 4-6 may be strapped (with engineering consideration) in cases of excessive line distortion.

§ These data set codes are Manufacture Discontinued.

→ TABLE L ←

DATA SETS 303-TYPE WITH UNBALANCED AND BALANCED CUSTOMER INTERFACE—  
DC-COUPLED BALANCED AND PICTUREPHONE TYPE LINE SIGNALS

		DC-COUPLED LINE SIGNAL																				PICTUREPHONE LINE SIGNAL	
CIRCUIT PACKS — FUNCTIONAL SCHEMATICS AND OPTIONS AS USED IN DATA SETS 303-TYPE																							
CODE 303 >			J21	C23	B25	C25	D25	E25	G25	J25	B27	C27	H27	B29 †	C29 †	D29 †	E29 †	G29 †	J29 †	B31	C31	H31	J26
JACK	FUNCTION																						
J1	PICTUREPHONE Loop Line Interface	AR→	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	513
J2		AR→	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
J3		AR→	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
J4	Sync Recovery & Signal Regeneration	AR→	—	—	142	550 (143)	145	144	552 (220)	407	142	550 (143)	241	142	550 (143)	145	144	552 (220)	407	142	550 (143)	241	407
J5	Scrambler-Descrambler	DU→	—	—	16A1	—	—	—	—	—	—	—	—	—	16A1								
J6	Signal Control	AR→	—	—	579 (133)	579																	
J7	Customer Interface	AR→	135	136	135	135	135	135	135	135	136	136	136	135	135	135	135	135	135	136	136	136	135
J8	DC-Coupled Balanced Line Interface	AR→	361	361	361	361	361	361	361	361	361	361	361	361	361	361	361	361	361	361	361	361	361
J9	Transmit Clock or Sync Recovery and Signal Regeneration	AR→	—	—	137	138	140	139	219	406	142	550 (143)	241	137	138	140	139	219	406	142	550 (143)	241	406
FACTORY-PROVIDED OPTIONS UNLESS OTHERWISE SPECIFIED*																							
A (TB1: 17-18)				✓																			
J (TB1: 4-13)					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M (TB1: 16-19)					✓	✓	✓	✓	✓														✓
Q (TB1: 17-19)											✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Z (TB2: 10-11)					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CP AR361 Straps			A1 ] B1 ]	C1 ] B1 ]																			
			A2 ] B2 ]	C2 ] B2 ]																			
			D1 ] E1 ]	F1 ] E1 ]																			
			D2 ] E2 ]	F2 ] E2 ]																			

Note: The circuit packs in parentheses are Manufacture Discontinued and are replaced by the circuit packs located above them.

\* See feature and option table for complete listing.

† These data set codes are Manufacture Discontinued.

**6. REFERENCES**

**6.01** ▶ For further information on DS 303-type, refer to SD- and CD-1D100 and the following Bell System Practices:

<b>SECTION</b>	<b>TITLE</b>	<b>SECTION</b>	<b>TITLE</b>
593-800-100	Wideband Data Station Using Data Set 303-Type, Four-Wire Point-to-Point Private Line—(Commercial Service)—Description and Operation	593-800-110	Wideband Data Station Using Data Set 303-Type, Two-Wire Switched Service (DATA-PHONE® 50 Service), Description and Operation
593-800-101	Wideband Data Station Using Data Set 303-Type, Four-Wire Point-to-Point (50-KB Government Secure Voice Service)—Description and Operation	593-800-111	Wideband Data Station Using Data Set 303-Type, Two-Wire Switched Service (460.8-KBPS Data Over PICTUREPHONE® Facilities)—Description and Operation.