DATA SET 203-TYPE
DESCRIPTION AND OPERATION

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section contains descriptive and operational information for data set 203-type. This section does not include information regarding the business machine and associated equipment used in station arrangements.

1.02 This section is reissued to include the following information:

- New list codes providing automatic retraining auxiliary channel (ARAC) options for speed options L2 and L6 only
- New list code providing multiple access interface using the 38A-type data unit
- Provision for permanent request to send (RS/CA)
- Standard private line termination utilizing data auxiliary sets 828A and 828C
- Digital loop-back function.

Due to extensive revision and rearrangement, change arrows ordinarily used to indicate changes have been omitted.

1.03 For the purpose of this practice, reference to a customer business machine should be interpreted to mean any electronic equipment whose input and output signals are in accordance with EIA Standards RS-232-C and RS-334 or MIL. Standard 188B.

1.04 Data sets 203-type have been designed to transmit and/or receive digital data over the dial switched message telecommunications network and 2- or 4-wire private line facilities. The data sets have the following basic design features:

(a) Synchronous data transmission, with transmitter bit timing supplied by the data set or by the customer, and receiver bit timing supplied only by the data set

(b) 2-, 4-, or 8-level amplitude modulation with suppressed carrier

(c) Vestigial sideband (VSB) line signal shaping

(d) Synchronous detection with upper and lower pilot tones transmitted near the edges of the VSB spectrum providing means for carrier recovery

(e) Automatic adaptive equalization.

1.05 The data sets may contain, as required or as optional equipment, a low-speed secondary or auxiliary transmitter/receiver. The secondary channel has the following design features:

(a) Nonsynchronous data transmission up to 150 bits per second (bps)

(b) Binary frequency modulation with a MARK frequency of 450 Hz and a SPACE frequency of 375 Hz

(c) Frequency spectrum of 300 to 525 Hz which allows simultaneous operation with, but in a transmitted direction opposite to, the high-speed channel over 2-wire facilities. When used with the L3 or L4 on 4-wire lines, simultaneous parallel operation is possible with the high-speed channel.

The secondary channel feature is required in the following cases:

- Operation over 2-wire direct distance dialing (DDD) lines
- Operation over 2-wire private lines
- Operation with either data set 203B or 203C.

The secondary channel feature is optional in the following case:

- Operation with data set 203A over 4-wire private line or 4-wire DDD lines.

When used in 4-wire circuit operation, the secondary channel is sent on-line in the same direction as the high-speed channel. In 2-wire operation, the secondary channel is normally used as a reverse channel.

1.06 The data set is designed to be used primarily as terminal equipment for service over the switched telephone network or over a 2-wire or a 4-wire private line. Voice capability service can be provided through the optional data auxiliary set (DAS) 804A-, 804M-, or 828-type. Compatibility with DAS 801-type automatic calling units is also provided.

1.07 Regeneration features can be provided when required. Refer to Section 592-019-150 for detailed description.

1.08 Data sets 203-type have been designed on a modular basis to facilitate implementation of optional configurations and speeds. The three main parts of the data set are the 22A-type data unit which contains the basic transmitter circuitry, the 23A-type data unit which contains the basic receiver circuitry, and the 24A-type data unit which contains the customer and telephone line interface circuits, data set control circuits, remote test circuits, power unit, and provision for the low-speed secondary channel.

1.09 Table A lists the optional data units and data auxiliary sets used with data set 203-type. A typical data set 203-type installation is shown in Fig. 1. Table B lists the function and data units for the main data set codes without regard to speed or functional options.

1.10 The data set code identifies the basic, speed, and functional options of the individual sets as list (L) numbers. The basic unit options are covered in List L1A, L1B, etc. The speed and functional options are by numbered lists only, such as L2, L3, etc. Table C contains the basic unit lists, the size, and the weight of the data sets. Table D contains the speed option lists. Table E contains the functional option lists. A typical example of a coded 203-type data set is 203A-L1C/4/7/8. This is a 203-type transmitter and receiver mounted in a KS-20018-L3 cabinet (L1C/) for operation on switched network, 2- or 4-wire private lines at a bit rate of 2400, 4800, or 7200 bps (/L4/) with a 150-bps secondary channel (/L7/) and an EIA Standard interface (/L8). (Refer to list of authorized codes given in Section 592-019-180.)

1.11 Components of data set 203-type are designed to operate in an environmental temperature ranging from +40 to +120° F with a relative humidity between 20 and 90 percent. The 41A-type power unit is provided with the 24A-type data

TABLE A

NOMENCLATURE AND DESCRIPTIONS

APPARATUS	FUNCTIONAL DESCRIPTION	QUALIFICATIONS
22A-Type Data Unit	Data set transmitter	Requires plug-in networks and associated circuit packs according to intended service of the data set to be operational.
23A-Type Data Unit	Data set receiver	
24A-Type Data Unit	Data set common control equipment	
38A-Type Data Unit	Multiple access interface (fanout to allow up to 6 customer terminals)	
Data Auxiliary Sets 801A-Type and 801C-Type (optional)	Automatic calling features	Requires internal option strapping according to intended service.
Data Auxiliary Sets 804A-Type and 804M-Type (optional)	Voice communication and network signaling control functions	Requires internal modification and option strapping according to intended service.
Data Auxiliary Set 828A (optional)	Standard means to terminate private line data channels and provide alternate voice capability.	
Data Auxiliary Set 828C (optional)	Provides back-up capability to a 4-wire private line by using a pair of DDD lines	

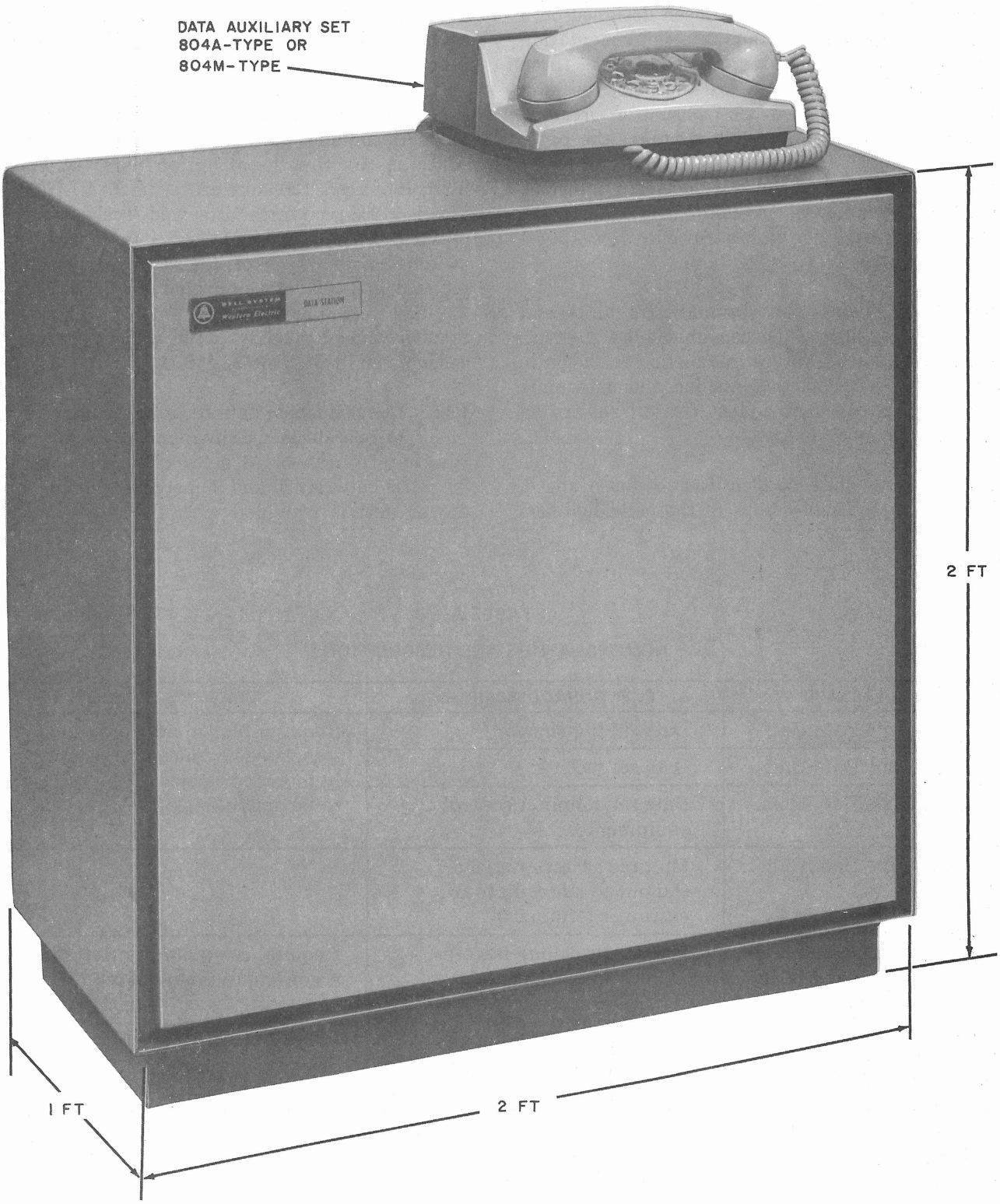


Fig. 1—Typical Data Set 203-Type Installation With DAS 804-Type

TABLE B

DATA SET 203-TYPE ARRANGEMENTS

DATA SET CODE	FUNCTION	INTERNAL APPARATUS
203A-( )	Transmitter and receiver	22A-type, 23A-type, 24A-type data units, all with Table A qualifications.
203B-( )	Transmitter only	22A-type, 24A-type data units with Table A qualifications
203C-( )	Receiver only	23A-type, 24A-type data units with Table A qualifications

TABLE C

BASIC UNIT LISTS

DATA SET LIST NUMBER (NOTE 1)	DESCRIPTION	DATA SET SIZE AND WEIGHT		
		203A-( )	203B-( )	203C-( )
L1 (MD) L1C (STD)	Mounted in a KS-20018-L3 cabinet.	2 ft wide 1 ft deep 2 ft high 110 lbs	2 ft wide 1 ft deep 2 ft high 72.5 lbs	2 ft wide 1 ft deep 2 ft high 89.5 lbs
L1A (MD) L1D (STD)	No cabinet — 23-inch frame. Mounting with provision for adding auxiliary data units.	23 in. wide 9 in. deep 20 in. high 90 lbs	23 in. wide 9 in. deep 14 in. high 53 lbs	23 in. wide 9 in. deep 20 in. high 70 lbs
L1B (MD) L1E (STD)	No cabinet — 23-inch frame. Mounting without provision for adding auxiliary data units.	(Not applicable)	(Not applicable)	23 in. wide 9 in. deep 14 in. high 65 lbs

Note 1: MD — Manufacture Discontinued; STD — Standard.

TABLE D

SPEED OPTION LISTS

DATA SET LIST NUMBER	LINE SYMBOL RATES (BAUDS)	LINE SIGNAL BANDWIDTH (HZ)	SPEED CAPABILITY BITS/SEC			RECOMMENDED APPLICATION
			NUMBER OF LEVELS			
			2	4	8	
L2	2400	500-2900	2400	4800	7200*	4800 bps on 4-wire C2 private line
L3	1800	700-2700	1800	3600	5400*	3600 bps on switched network or on C2 private line (2- or 4-wire)
L4	2400	700-2700	2400	4800	7200*	4800 on switched network and C2 private line (2- or 4-wire)
L5	3200	400-2900	3200	6400	9600*	6400 on 4-wire C2 private line.
L6	3600	401-2900	3600	7200	10,800*	7200 bps on 4-wire C2 private line

* May have degraded performance.

unit and requires operating voltages from an ac power input of 117 volts ($\pm$10 percent) at a frequency between 47.5 and 63 Hz.

2. DESCRIPTION

PHYSICAL DESCRIPTION

A. Data Set Types

Data Set 203A-Type

2.01 Data set 203A-type contains both a transmitter and receiver. A typical data set 203A-type is shown in Fig. 2. Internal components for this data set are 22A-type, 23A-type, and 24A-type data units equipped with optional circuit packs and networks.

2.02 Data set 203A-type will transmit and receive synchronous serial binary data at rates given in Table D. The relationships between line symbol rates (bauds), speed capabilities (bit per second), and the number of signal levels are also shown.

Data Set 203B-Type

2.03 Data set 203B-type is a transmitter only and must always be provided with a secondary channel. Its transmitter features are identical in operation to those of data set 203A-type. A typical data set 203B-type is shown in Fig. 3. Internal components for this data set are 22A-type and 24A-type data units equipped with optional circuit packs and networks.

Data Set 203C-Type

2.04 Data set 203C-type is a receiver only and must always be provided with a secondary channel. Its receiver features are identical in operation to those of data set 203A-type. A typical data set 203C-type is shown in Fig. 4. Internal components for this data set are 23A-type and 24A-type data units equipped with optional circuit packs and networks.

TABLE E

FUNCTIONAL OPTION LISTS

DATA SET LIST NUMBER	FUNCTION
L7*	To provide a low-speed ($\leq$ 150 bps) secondary (auxiliary or reverse) channel.
L8†	To provide an EIA Standard interface
L9†	To provide a MIL. Standard interface
L11	To provide the ARAC function to data set 203A with speed option L2.
L12	To provide the ARAC function to data set 203A with speed option L6.
L13	To provide a multiple access interface (fanout).

* The secondary channel is optional only for data set 203A-type operating on 4-wire lines. Data set 203A-type operating on 2-wire lines, and data sets 203B-type and 203C-type must be equipped with secondary channel.

† Optional only for 24A2 data unit. The 24A1 data unit, which has been replaced by the 24A2 data unit, contains an EIA Standard interface as common equipment.

B. Data Set Components

22A-Type Data Unit (Transmitter)

Physical Description

2.05 The 22A-type data unit shown in Fig. 5 consists of a mounting frame with a 61B apparatus mounting and space to plug in an optional 4164-type network. The apparatus mounting is always equipped with three AR-type circuit packs and has provision for an optional circuit pack. It is wired with a 25-pin plug on the end of an 8-inch cord for connection to the 24A-type data unit. The 22A-type data unit, when fully equipped with the optional circuit pack and network and plugged into the 24A-type data unit, provides the transmitter function in data set 203A- or 203B-type. Refer to Fig. 2 and 3 for a view of a fully equipped 22A-type data unit. The approximate overall dimensions are 6.5 inches wide, 6 inches high, and 9 inches deep. The weight of the 22A-type data unit is 5.5 pounds. The optional network and circuit pack weigh 5.2 pounds.

2.06 Circuit packs common to all 22A-type data unit code listings are as follows. (The circuit pack code is given first, followed by the circuit pack title and the circuit pack slot number.)

- AR325—Digital-to-Analog Converter, Modulator, and Summer Amplifier—01
- AR473—Serial-to-Parallel Converter, Scrambler, and Start Sequence Generator—03
- AR327—Bit Speed and Sample Generator—05.

2.07 The optional circuit pack and network, added to the 22A-type data unit for the data set 203 speed option lists (Table D), are presented in Table F.

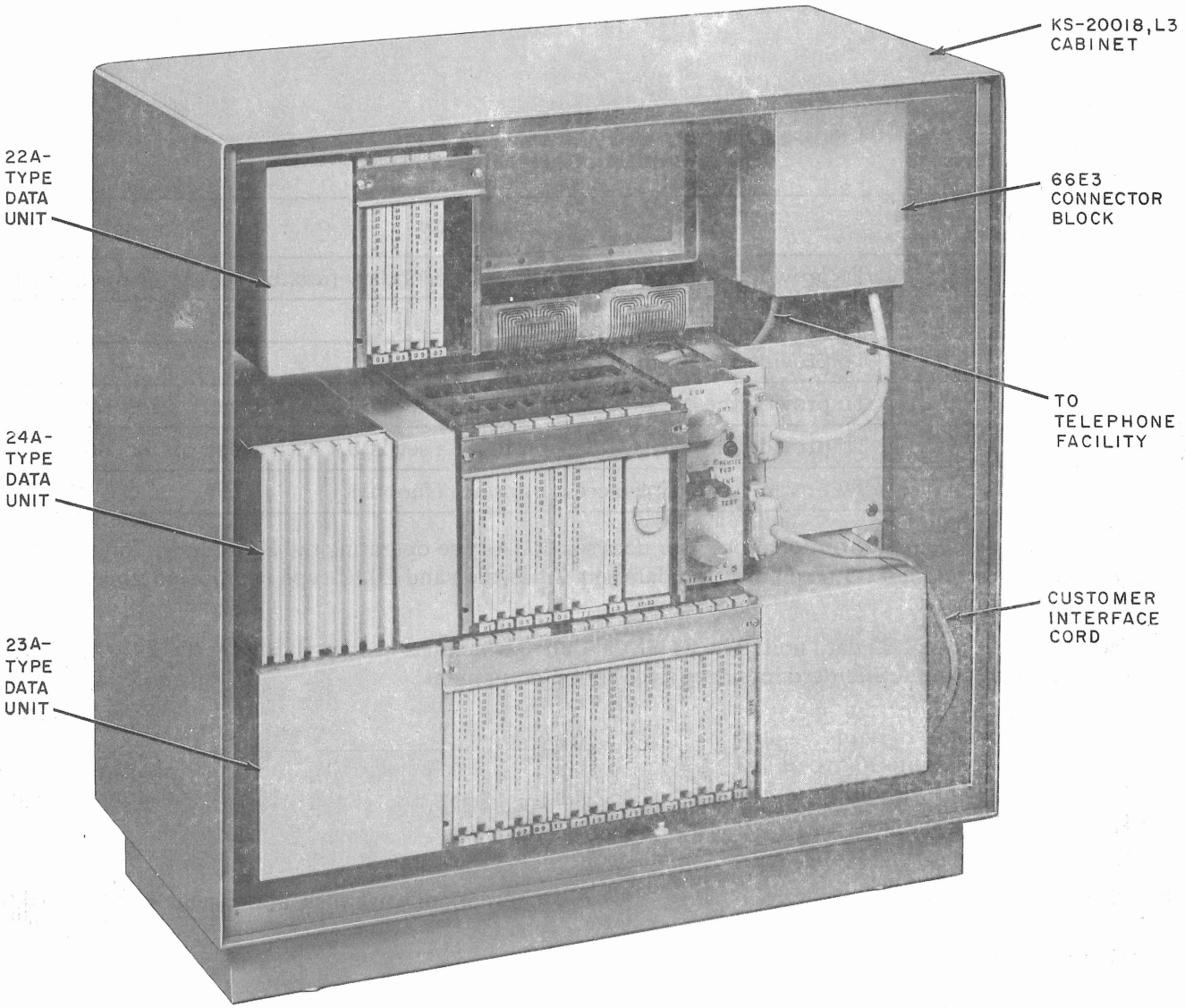


Fig. 2—Typical Data Set 203A-Type With Front Cover Removed

Functional Description

2.08 The transmitter uses an amplitude-modulating technique to provide synchronous transmission of serial digital data over switched or private line facilities. The basic baud rates are listed in Table D. The transmitter generates or accepts timing signals and provides a means for voiceband transmission of the serial digital data generated by the customer business machine. A 203-type transmitter can operate only with a 203-type receiver having an identical speed list number and set to operate at the same speed. The transmitter can be converted from one optional speed list to another by inserting the appropriate circuit pack and network as listed in Table F.

23A-Type Data Unit (Receiver)

Physical Description

2.09 The 23A-type data unit shown in Fig. 6 consists of a mounting frame with a 59C apparatus mounting and space to plug in two 4165-type networks. The apparatus mounting is always equipped with 14 circuit packs and has

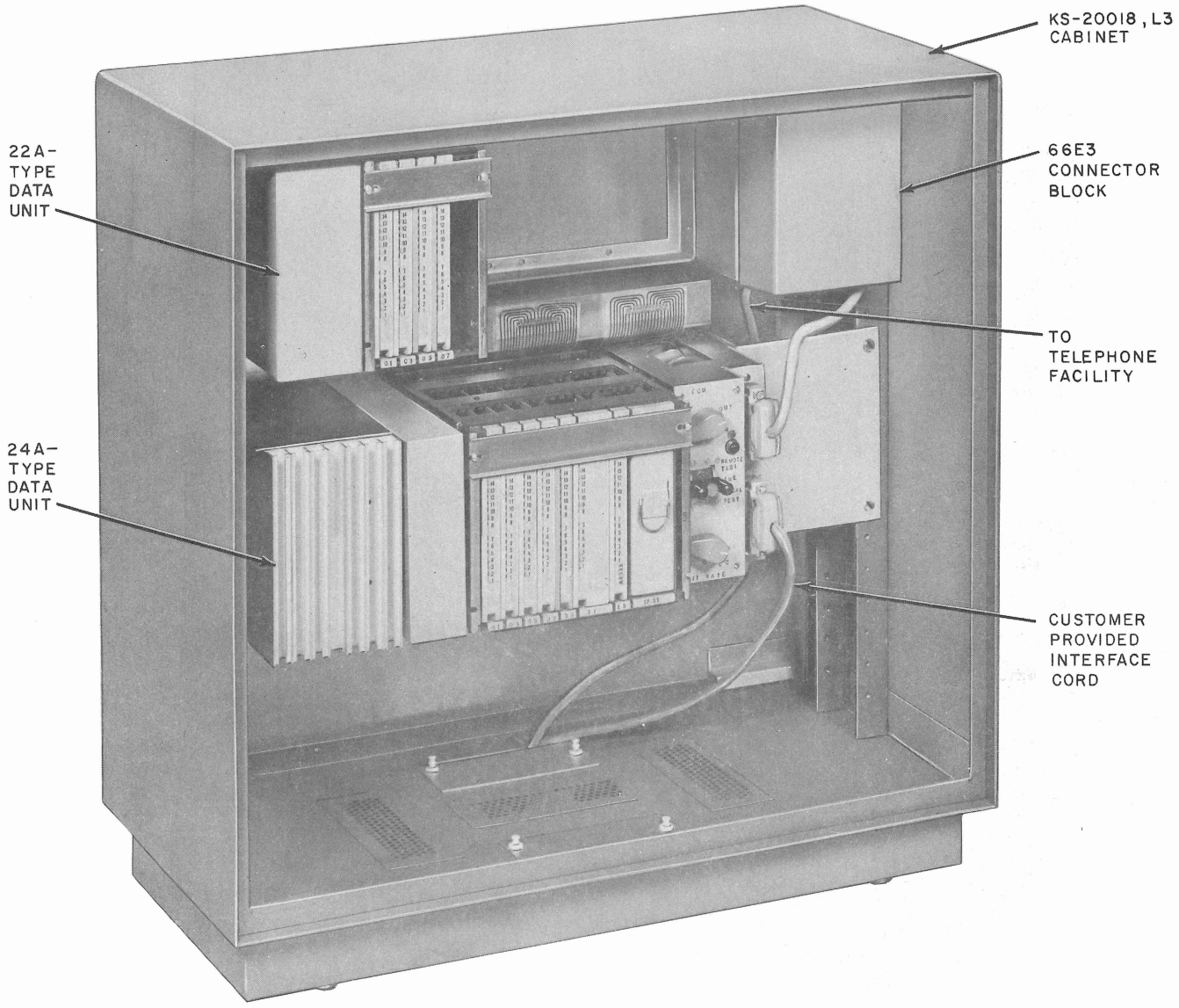


Fig. 3—Typical Data Set 203B-Type With Front Cover Removed

provision for 2 optional circuits packs. It is wired with a 25-pin plug on the end of a 15-inch cord for connection to the 24A-type data unit. The 23A-type data unit, when fully equipped with the optional circuit packs and networks and plugged into the 24A-type data unit, provides the receiver function for data sets 203A- and 203C-type. The mounting brackets shown attached to the frame in Fig. 6 are not provided with the data unit but are supplied with the data set. Refer to Fig. 2 and 4 for a view of a fully equipped 23A-type data unit. The approximate overall dimensions are 21 inches long, 6 inches high, and 9 inches deep. The weight of the 23A-type data unit is 15.3 pounds. The optional networks and circuit packs weigh 22.3 pounds.

2.10 Circuit packs common to the basic 23A-type data unit are as follows. (The circuit pack code is given first, followed by the circuit pack title and the circuit pack slot number.)

- AR328—Buffer Amplifier—11
- AR342—Start Sequence Generators—19

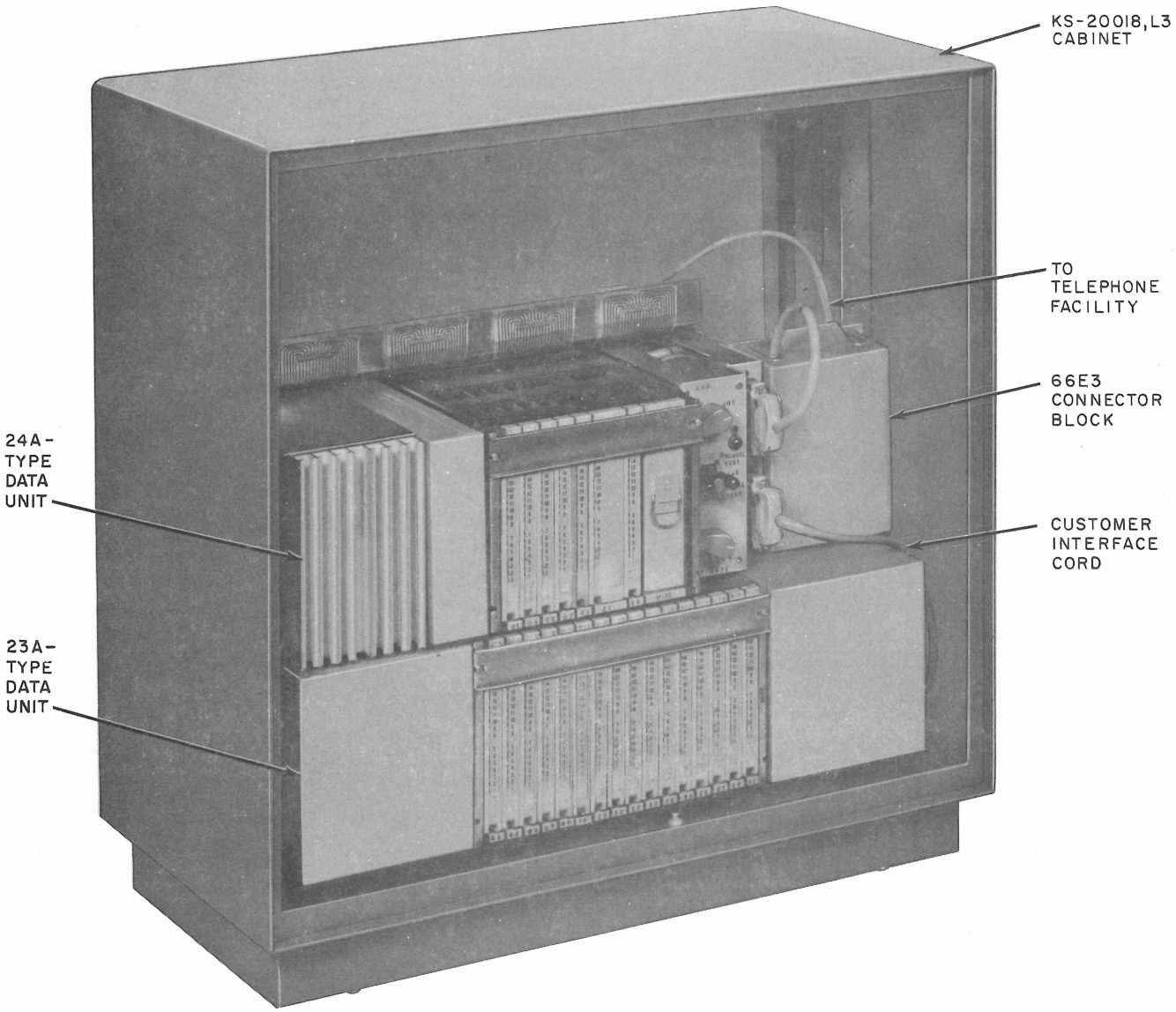


Fig. 4—Typical Data Set 203C-Type With Front Cover Removed

- AR343—Carrier Recovery Modulators and Slicers—25
- AR344—Clock Generator II—17
- AR349—Received Carrier Frequency/Phase Adjust—15
- AR350—Demodulator and Amplitude Adjust—27
- AR474—Parallel-to-Serial Converter and Descrambler—21
- AR352—Analog-to-Digital Converter—23
- AR353—Pilot Detector—29
- AR354—Automatic Gain Control—31
- AR359—4-Tap Attenuator—03, 05, 07

(*Note:* Three AR359 circuit packs are required.)

- AR360—Summer Amplifier—09.

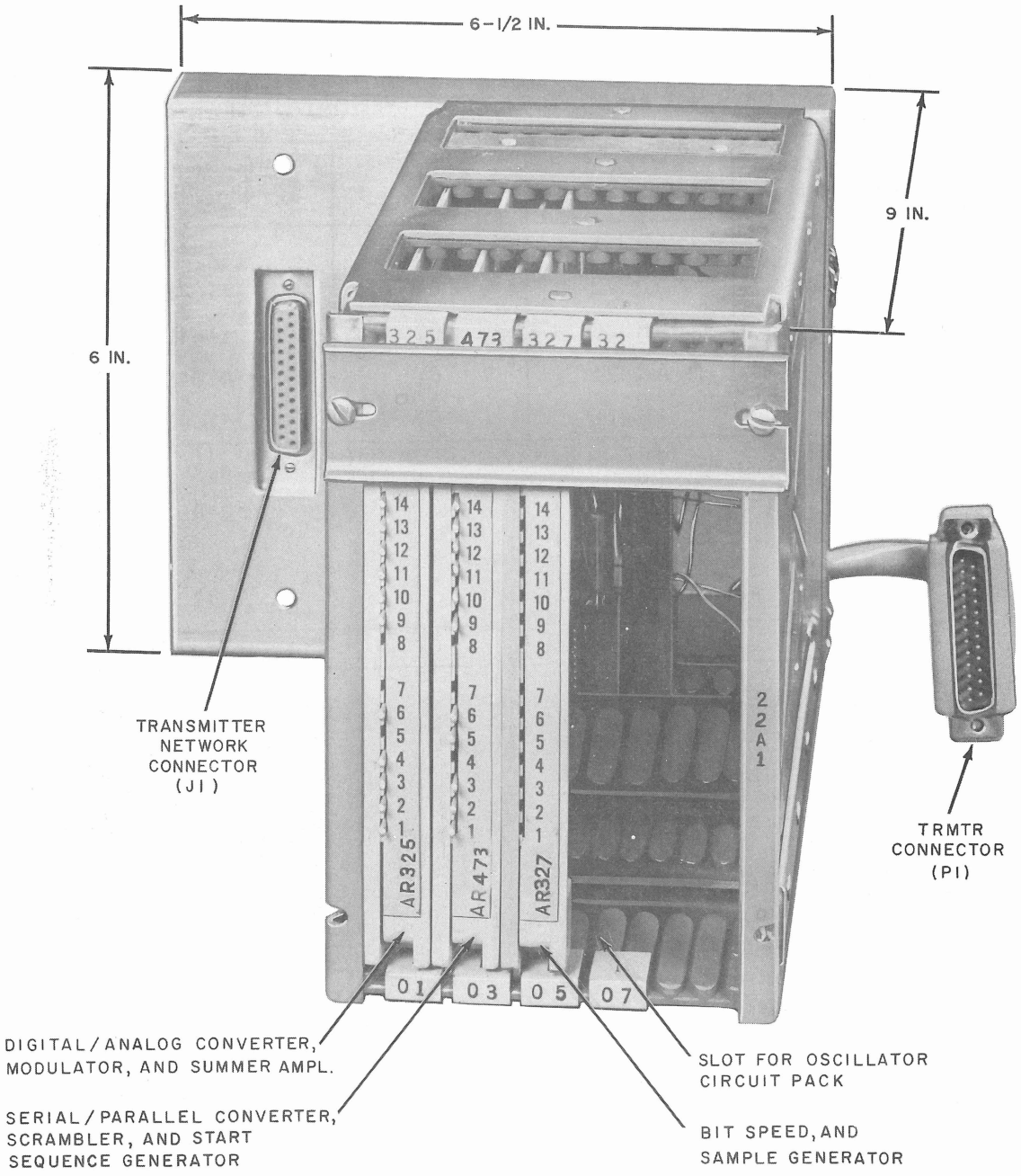


Fig. 5—Typical 22A-Type Data Unit (Transmitter) Without Oscillator and Network

TABLE F

OPTIONAL APPARATUS FOR 22A-TYPE DATA UNIT

DATA SET 203 LIST NUMBER	OSCILLATOR CIRCUIT PACK	CIRCUIT PACK SLOT LOCATION	COMPLEMENTARY NETWORK
L2	AR321	07	4164A
L3	AR322	07	4164B
L4	AR323	07	4164C
L5	AR324	07	4164D
L6	AR411	07	4164E

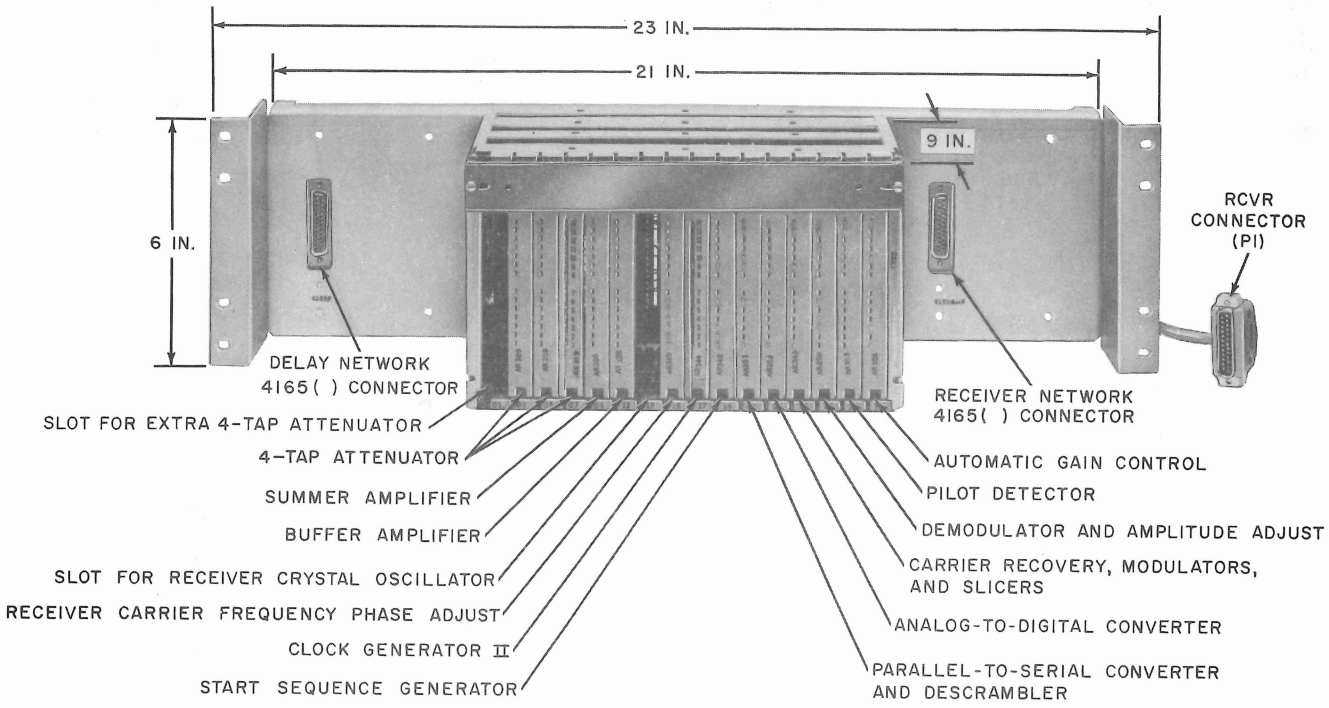


Fig. 6—Typical 23A-Type Data Unit (Receiver) Without Optional Circuit Packs and Networks

2.11 The optional circuit packs and networks added to the 23A-type data unit for the speed option lists (Table D) are presented in Table G.

Functional Description

2.12 The receiver uses a synchronous vestigial sideband technique to detect synchronous serial binary data at discrete bit rates ranging from 1800 bps to 10,800 bps.

2.13 The VSB amplitude-modulated line signal is demodulated using a synchronously recovered carrier. The demodulated line signal, in the form of discrete analog levels, is decoded into parallel data trains which are grouped to form the serial binary recovered data. A 203-type receiver can only operate with a 203-type transmitter having an identical speed list number and set to operate at the same speed. The receiver can be converted from one optional speed list to another by inserting the appropriate circuit packs and networks as listed in Table G.

24A-Type Data Unit (Common Control)

Physical Description

2.14 The 24A-type data unit shown in Fig. 7 consists of a mounting frame with a 58B apparatus mounting, a control and interface connector panel, a 41A-type power unit, and space to plug in an optional 4166-type network. The apparatus mounting is always equipped with six (24A1 data unit) or four (24A2 data unit) AR-type circuit packs together with a 19A1 data unit and has provision for one (24A1 data unit) or three (24A2 data unit) optional circuit packs. The control panel is equipped with two selector switches, a 3-position key with an associated lamp, and the customer and telephone interface connectors. A plate on top of the frame is equipped with four 25-pin connectors to provide interconnection from the rear with the data set 203-type data units. The mounting brackets shown in Fig. 7 are not provided with the data unit but are supplied with the data set. Refer to Fig. 2, 3, or 4 for a view of a 24A-type data unit equipped with the optional circuit pack and network. The approximate overall dimensions are 17 inches long, 8 inches high, and 9 inches deep. The weight of the 24A-type data unit is 23.7 pounds without the secondary channel. The optional secondary channel circuit pack and network weigh 4.3 pounds.

2.15 The 24A-type data unit is provided with a special ac power cord. This cord ***must*** be used to connect between the 117-volt ($\pm$10 percent) ac power source and the 41A-type power unit input connector located in the rear of the unit. The customer business machine interfaces with the 24A-type data unit through a 25-pin CUSTOMER

TABLE G

OPTIONAL APPARATUS FOR 23A-TYPE DATA UNIT

DATA SET 203 LIST NUMBER	CIRCUIT PACKS	CIRCUIT PACK SLOT LOCATION	NETWORK	NETWORK
L2	AR348	13	4165A	4165K
L3	AR347	13	4165B	4165F
L4	AR346 AR359	13 01	4165C	4165G
L5	AR345 AR359	13 01	4165D	4165H
L6	AR412 AR359	13 01	4165E	4165J

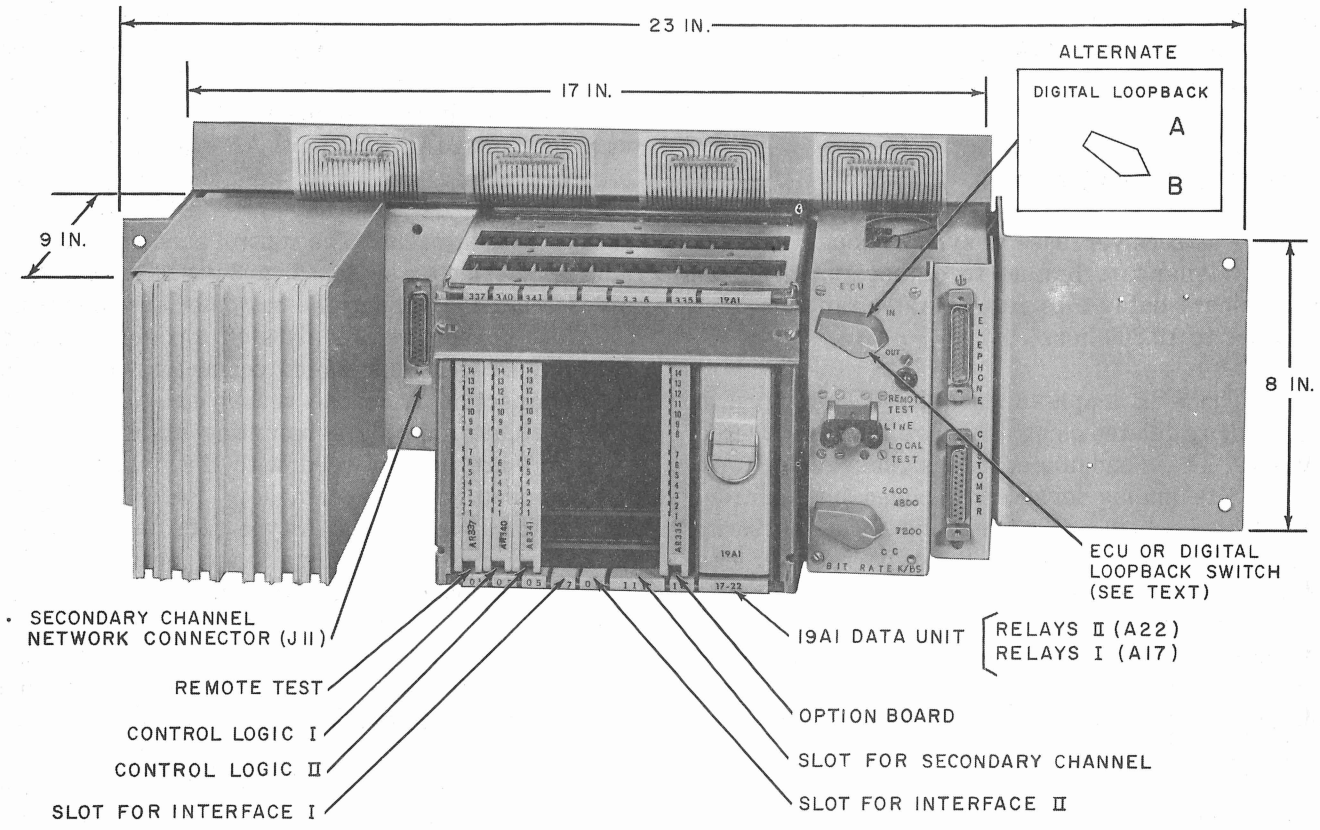


Fig. 7—Typical 24A-Type Data Unit (Common Control) Without Secondary Channel and Interface Components

connector (J12) for L8 and both a 25-pin and a 15-pin connector for L9. The customer must supply (1) the mating plug, Cinch (or Cannon) DB-19604-432 for L8 and L9 25-pin connectors, or a Cinch DA-19603-403 for the L9 15-pin connector; (2) mating plug hood, Cinch DB-51226-1 for the 25-pin connector or the Cinch DA-51225-1 for the L9 15-pin connector; and (3) the required cabling.

2.16 Circuit packs common to the basic 24A1 data unit (which has been Manufacture Discontinued) are as follows. (The circuit pack code is given first, followed by the circuit pack title and the circuit pack slot number.)

- AR337—Remote Test—01
- AR340—Control Logic I—03
- AR341—Control Logic II—05
- AR338—Interface I—07
- AR339—Interface II—09
- AR335—Option Board—15
- AR386—Relays I—17
- AR387—Relays II—22.

} 19A1 Data Unit

2.17 Circuit packs common to the basic 24A2 data unit (which replaces the 24A1 data unit) are as follows. (The circuit pack code is given first, followed by the circuit pack title and the circuit pack slot number.)

- AR337—Remote Test—01
- AR503—Control Logic I—03
- AR501—Control Logic II—05
- AR335—Option Board—15
- AR386—Relays I—17
- AR387—Relays II—22.

} 19A1 Data Unit

2.18 The optional circuit packs and network added to the 24A-type data unit for the functional option lists (Table E) are presented in Table H.

Functional Description

2.19 The 24A-type data unit is common control equipment to all data sets 203-type and provides the following circuits and functions:

(a) Telephone facility interface

(b) Customer interface and control logic circuits

(c) Remote and local test capabilities

(d) Data speed selection capability

(e) All installer strapping options

(f) Power supply and distribution

(g) Secondary channel circuitry (when required)

(h) Automatic retraining auxiliary channel (optional)

(i) Digital loopback (conditional).

2.20 The interface and control logic circuits are provided on four of the eight circuit packs located in 24A-type data unit. The Interface I and II circuit packs provide circuits to convert the customer-provided levels into internal data set logic levels and to convert the internal data set logic levels to meet the customer requirements at the interface connection. The Control Logic I and Control Logic II circuit packs contain circuitry which generates and/or controls various functions of the data set.

2.21 Remote and local test capabilities are provided through circuitry mounted on the Remote Test circuit pack and the switches contained on the 24A-type data unit. The circuitry permits the remote testing of (1) a high-speed channel transmitter and/or receiver, and (2) a low-speed secondary channel transmitter and/or receiver. The local test capability is provided for data set 203A through contacts of the REMOTE TEST—LINE—LOCAL TEST switch on the 24A-type data unit. In REMOTE TEST position, the data set is conditioned to be remotely tested by the serving data test center. (An amber lamp is provided to indicate when the set is in remote test.) The LOCAL

TABLE H

OPTIONAL APPARATUS FOR 24A-TYPE DATA UNIT

DATA SET 203 LIST NUMBER	CIRCUIT PACKS	CIRCUIT PACK SLOT LOCATION	NETWORK
L7*	AR336	11	4166A
L8†	AR338 AR502 (AR339 — A&M)	07 09 (09)	
L9†	AR496 AR497	07 09	
L11	AR582	11	4166B
L12	AR583	11	4166C

* Optional only for data set 203A-type.

† Optional only for 24A2 data unit.

TEST position loops the data set high-speed transmitter to the high-speed receiver to permit testing through the data station interface connector. (The line is terminated on the loop side.) The switch should be locked in LINE position during normal operation.

2.22 The error control switch (ECU) was designed to provide an error control function which was never made available. For Series 3 or higher 24A2 data units, the function of this switch (ECU) has been changed to DIGITAL LOOPBACK. Earlier data sets may be field-modified to include this feature. These may be identified as 24A1, Series 5, or 24A2, Series 2 data units. A data set 203A under control of the DIGITAL LOOPBACK switch may be looped at the customer interface; it is then conditioned to operate as a regenerator to allow it to be tested from another data set.

2.23 Data rate selection capability is provided with the control panel BIT RATE switch. The lowest speed, midrange speed, and highest speed capabilities are represented by switch positions labeled accordingly for the functional option provided. Switch position CC permits the customer to select either of the two higher speeds through the interface. When the customer business machine applies a positive voltage on the SS lead, the highest speed capability is provided. If a negative voltage is applied to the SS lead, the midrange speed capability is provided.

2.24 Option strapping which is to be performed during installation or prior to testing is accomplished by proper connections of the 38 pairs of screw terminals located on the AR335 circuit pack. This circuit pack also provides the transmitter signal attenuator pad, which is adjustable between 0 and 15 dB in 1.0-dB steps, and the receiver attenuator pad which provides either 0-dB or 10-dB attenuation.

2.25 The 41A-type power unit provides the operating voltages required by data set 203-type components. A distributing system from the power unit to all data units provides connection to the regulated +4.5 Vdc source and circuit ground. The power unit is also the source of both +18.5 Vdc and −18.5 Vdc, which are distributed to the data units through the interface connectors on the rear of the 24A-type data unit.

2.26 When required, the secondary channel transmitter/receiver circuitry is provided in the 24A-type data unit by the AR336 circuit pack. The circuit consists of an FSK transmitter, a differential detector receiver, and an energy-level carrier detector. The circuit operates with the 4166A network to provide a low-speed nonsynchronous secondary channel.

2.27 When applicable, the automatic retraining auxiliary channel (ARAC) transmitter-receiver circuitry is optional in the 24A-type data unit by using AR582 or AR583 circuit packs in circuit pack position 11 and corresponding networks 4166B or 4166C, respectively (depending upon the speed option), in network connector J11. The ARAC function provides a retraining command upon detection of a deteriorated line quality [or signal quality (SQ)] situation and/or a retrain command upon restoration of a channel after a dropout condition has occurred. Either circuit pack consists of a transmitter section that provides a single tone, which is inserted between the lower pilot and the data spectrum of the high-speed data signal. The receiver section detects a phase reversal of the transmitted tone and provides a signal to control the RS/CA lead to the corresponding high-speed transmitter.

38A-Type Data Unit (Multiple Access Interface)

Physical Description

2.28 The 38A-type data unit shown in Fig. 8 consists of a mounting frame with a 61B apparatus mounting, a 4-inch nest for the circuit packs, and interface connector panel containing six 25-pin connectors. The apparatus mounting is always equipped with two circuit packs: AR603 in slot 08 and AR604 in slot 10. Two cords terminated with 25-pin connectors extend from the rear of the 38A-type data unit for interconnection with data set 203-type. The approximate dimensions are 5-3/4 inches high, 9-1/2 inches long, and 8-3/4 inches deep. Weight of the 38A-type data unit is 8 pounds. Power for the 38A-type data unit is supplied from data set 203-type.

Functional Description

2.29 The 38A-type data unit provides a multiple access (1 through 6) customer interface for data set 203-type. There are six interface ports, one of which incorporates all the standard data set

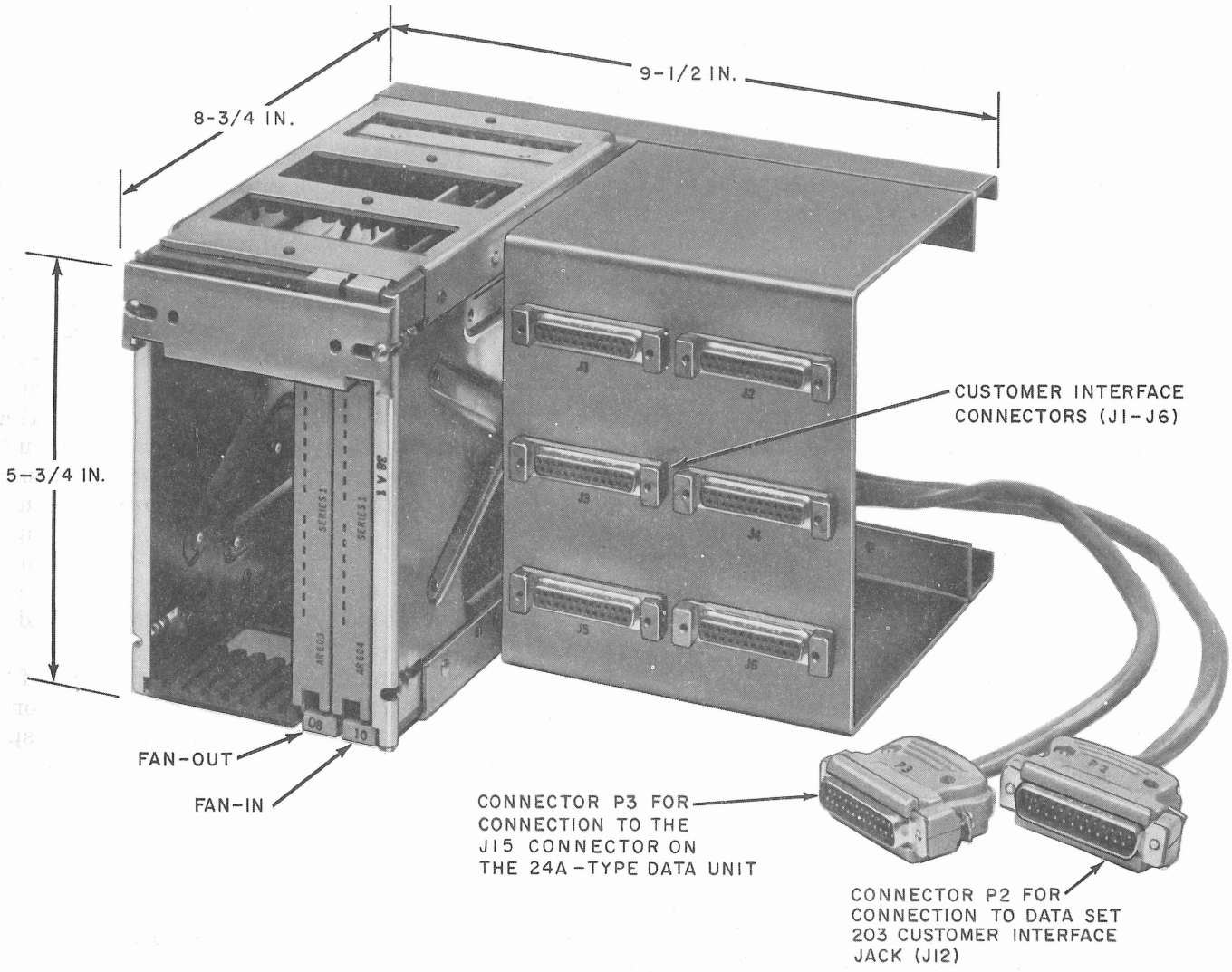


Fig. 8—38A-Type Data Unit

203-type interface leads, while the remaining five ports include only the functions: RD/BB, SCT/DB, CS/CB, SCR/DD, DSR/CC, CO/CF, RS/CA, and SD/BA. Each interface port provides signals conforming to EIA Standard RS-232-C.

2.30 A permanent request-to-send mode of operation is provided for data set 203-type by using option YF of the 38A-type data unit. Option YF straps the internal RS/CA interface lead high, which will hold the carrier on-line constantly. This will prevent retraining of data set 203-type each time one of the customer RS/CA leads is turned ON. Option YF is installed by tightening a screw switch on AR604 circuit pack.

Data Auxiliary Sets 804A-Type and 804M-Type

2.31 Both DAS 804A-type and 804M-type units are a common battery, illuminated key, 6-button, dial or TOUCH-TONE® telephone and control unit. Control features are provided by keys labeled TEST, TALK, and DATA. The remaining keys provide control over such special functions as the station arrangement requires. Further information regarding the DAS 804A-type equipment and features will be found in Data Auxiliary Set 804A-Type, Identification and Connections (Section 598-030-100). Further information regarding the DAS 804M-type equipment and features will be found in Data Auxiliary Set 804M-Type, Identification and Connections (Section 598-057-100).

Data Auxiliary Sets 828A-Type and 828C-Type

2.32 Data auxiliary sets 828A-type provide a standard means to terminate 4-wire private line voiceband data channels. Data auxiliary sets 828A-type contains the circuitry necessary to provide amplification or attenuation in the receive and transmit pairs and conversion from 4-wire to 2-wire modems. Further information regarding the DAS 828A-type equipment and features will be found in Data Auxiliary Set 828A Data Service Unit, Description and Operation (Section 598-080-100).

2.33 Data auxiliary sets 828C-type provide transmission capability over the DDD network for one 4-wire voiceband data channel. The primary function of this apparatus is to furnish a backup facility for DAS 828A-type. Further information regarding the DAS 828C-type equipment and features will be found in Data Auxiliary Set 828C Data Service Unit, Description and Operation (Section 598-080-101).

Data Auxiliary Sets 801A-Type and 801C-Type (Automatic Calling Units)

2.34 Both DASs 801A-type and 801C-type units contain the circuitry necessary to provide the means by which a business machine can automatically originate calls on switched network operation. (DAS 804A- or 804M-type must also be provided.) This unit is capable of calling any number using information provided by the business machine. Further information regarding the DAS 801A-type equipment and features will be found in Data Auxiliary Sets 801A5 and 801A6 for Automatic Calling, Identification and Operation (Section 598-010-101). Further information regarding the DAS 801C-type equipment and features will be found in Data Auxiliary Sets 801C3 and 801C4, Description and Operation (Section 598-012-101).

Special Cords

P3BG Power Cord

2.35 The P3BG cord provides a shielded ac input to the data set power supply. The shield reduces the possibility of radiating interference, generated by some office machines, from affecting the data set operation. The connector end which mates to the 41A-type power unit is provided with a 90-degree locking body. This provides a tight electrical connection without strain when the data set is mounted in a KS-20018-L3 cabinet and the rear cover is in place. This cord was initially designed for data set 203-type.

M23A-51 Cord

2.36 The M23A-51 cord is used in some installations where the customer desires the request-to-send (RS/CA) interface signal to be permanetly ON. This cord is manufactured to interface with customer equipment and also apply +18.5 Vdc to the request-to-send interface lead which reduces the data set start-up time for some arrangements. This cord was initially designed for data set 203-type.

Remember that remote testing of data set 203-type cannot be performed while the special M23A-51 cord is attached to the CUSTOMER connector.

M6AL Cord

2.37 The M6AL cord is a 5-inch long special purpose cord. It is required to provide circuit continuation when modifying early series 24A1 and 24A2 data units to accept the digital loop-back function. When used, this cord will be connected between J14 and J15 on the 24A-type data unit. This cord was initially designed for data set 203-type.

FUNCTIONAL DESCRIPTION

A. 22A-Type Data Unit (Transmitter)

2.38 A block diagram of the transmitter is shown in Fig. 9. The following descriptions are referenced to the functional circuit blocks.

> ***Note:*** The number which follows circuit designation refers to block diagram numbers.

Scrambler (1)

2.39 A scrambler circuit is used to maintain a constant transmitter line-signal power level which is independent of the customer-supplied serial input data sequence. This type of operation also provides the far-end receiver with a sufficient number of data crossings for timing recovery.

2.40 Serial send data from the customer business machine is applied through the 24A-type data unit to the scrambler input. The scrambled

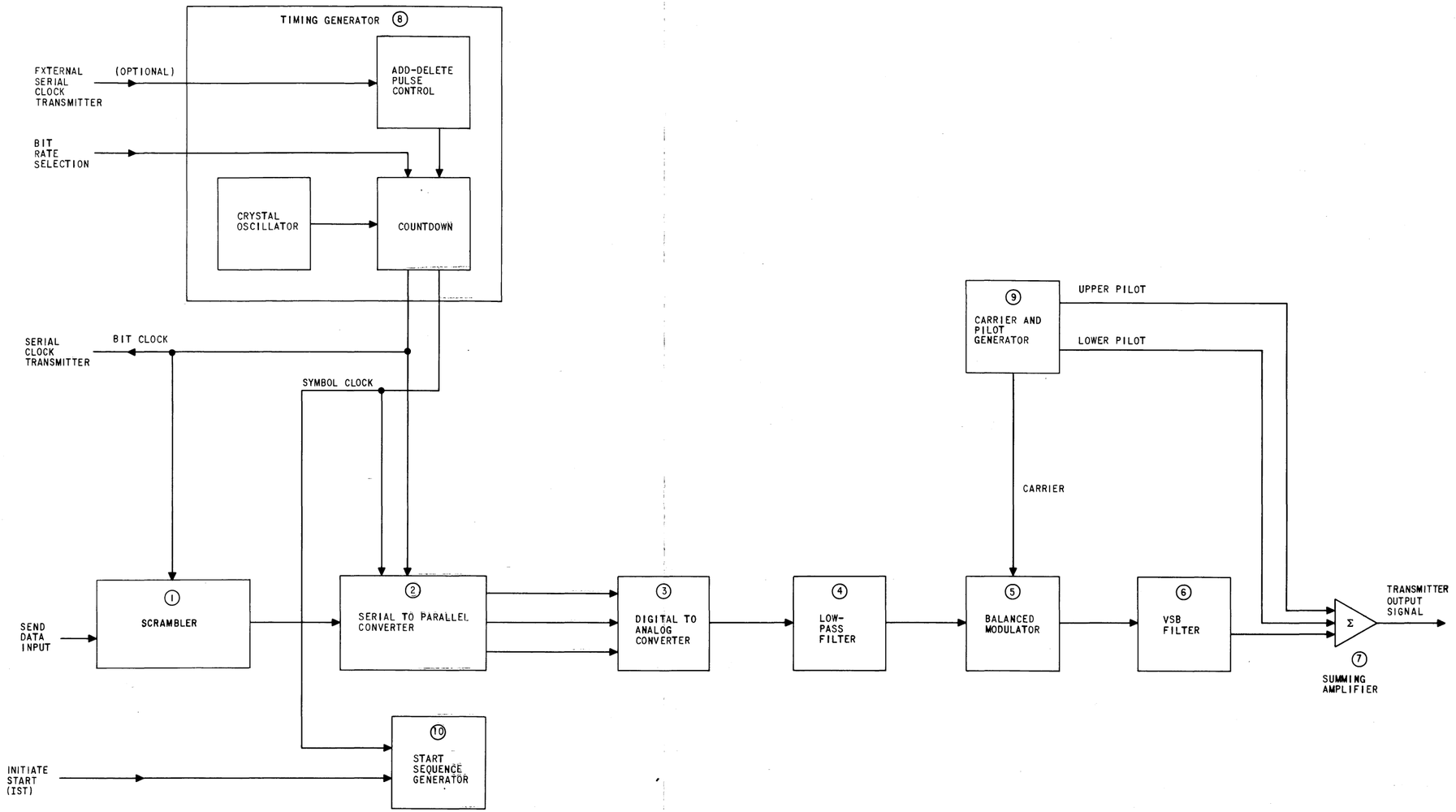


Fig. 9—Data Set 203-Type, 22A-Type Data Unit, Transmitting Circuits, Block Diagram

serial data is shifted into the serial-to-parallel converter stage at the bit rate.

Serial-to-Parallel Converter (2)

2.41 The serial-to-parallel converter circuits provide for grouping the scrambled serial data into "bit blocks" (or symbols) for further coding into analog levels. Each symbol consists of one, two, or three bits corresponding to 2-, 4-, and 8-level operation, respectively.

Digital-to-Analog Converter (3)

2.42 The parallel digital data is applied to the digital-to-analog converter which transforms the parallel digital data input into one of 2, 4, or 8 discrete analog or voltage levels which will determine the amplitude of the modulated carrier. The resultant waveform is amplified and applied to the low-pass filter as a multilevel data signal.

Low-Pass Filter (4)

2.43 The low-pass filter is used to band-limit the multilevel baseband data signal. After shaping, the signal is applied to the modulator.

Modulator (5)

2.44 The modulator translates the filtered baseband data signal up in frequency to a spectrum acceptable for transmission over telephone facilities. The baseband data from the low-pass filter is applied to the input of the balanced modulator which is being switched at the carrier frequency. Balanced operation of the modulator suppresses energy at the carrier frequency from appearing at the modulator output. The result is a double sideband, suppressed carrier, amplitude-modulated signal at the modulator output which is applied to the vestigial sideband filter.

Vestigial Sideband (VSB) Filter (6)

2.45 The VSB filter provides the desired spectral shaping for the double sideband amplitude-modulated signal before transmission over telephone facilities. The filter suppresses all but a small portion, or vestige, of the upper sideband and lightly suppresses the lower sideband. Low-end roll-off characteristics (Fig. 10) allow the insertion of pilot tones at both ends of the line spectrum. The output signal from the VSB filter is applied to the summing amplifier.

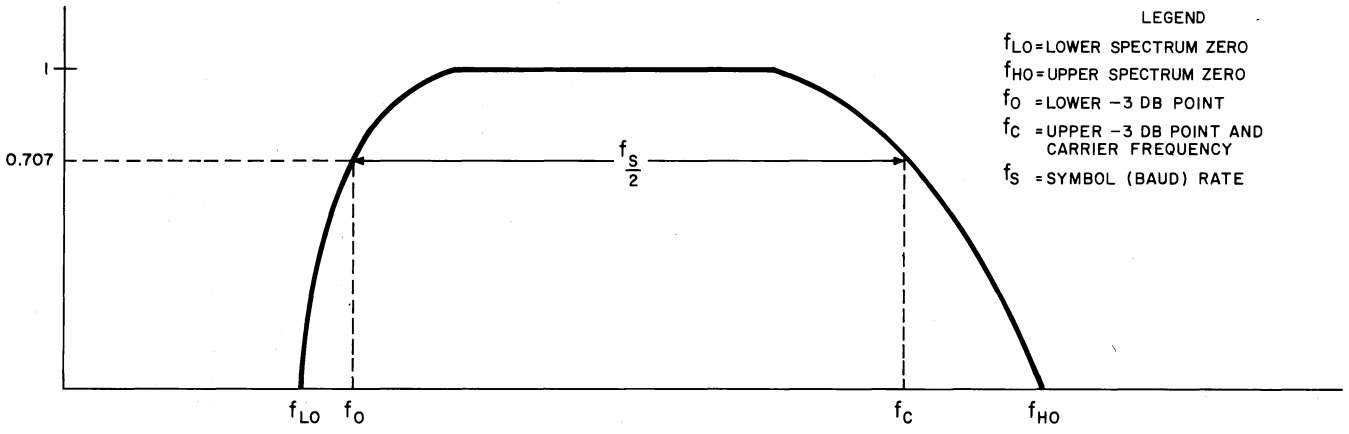


Fig. 10—General VSB Filter Amplitude Characteristics

Summing Amplifier (7)

2.46 The VSB filtered modulated carrier and two separate pilot tones are summed together in the summing amplifier. The composite signal is amplified to the proper level for transmission over telephone facilities through the 24A-type data unit. Amplifier gain for each input has been designed to provide the proper relative levels between pilot tones and the modulated carrier signal. The amplifier output has a broadband power level of approximately +2.0 dBm which is attenuated by the 24A-type data unit to the desired level for transmission over the telephone facilities.

Timing Generator (8)

2.47 Bit and symbol clock signals for the transmitter are derived from a high-frequency crystal oscillator and a binary countdown chain. A pulse adding and deleting circuit is designed into the countdown chain to provide a means for synchronizing the internally generated clock signal to an external timing source.

2.48 Bit and symbol clocks are required for operation of the following circuits:

(a) Scrambler

(b) Serial-to-parallel converter

(c) Start sequence generators

(d) Bit clock for customer interface.

2.49 ***Internal Timing Mode:*** Operation in the internal timing mode requires the add-delete pulse control circuit to be disabled. The crystal oscillator frequency is counted down to provide the three required bit rate clock signals and the symbol clock signal. The accuracy of the internal clock signal is $\pm$0.001 percent.

2.50 ***External Timing Mode:*** An externally supplied timing signal is used to adjust the phase and frequency of the internal clock signal. The external clock signal source must supply a frequency equal to the bit rate with an accuracy of $\pm$0.001 percent.

Carrier and Pilot Generator (9)

2.51 A carrier frequency is generated synchronously with two pilot tones. The carrier is necessary to drive the modulator. The pilot tones are necessary for carrier recovery in the receiver.

2.52 The circuit consists of two crystal-controlled oscillators. The carrier frequency is derived from one of the crystal oscillators which is operated at a multiple of the desired frequency. The remaining oscillator is operated at a multiple of the upper pilot frequency. A difference frequency of the two oscillators after frequency division is used as the lower pilot frequency. This results in a carrier which is phase-locked with the two pilot tones.

2.53 Accuracy of the carrier and pilot tone frequencies is maintained within $\pm$0.01 percent. The carrier signal is a square wave which is used to drive the modulator. Both pilot frequencies are applied to low-pass filters which attenuate undesired higher frequencies and then are applied to the summing amplifier for transmission through the 24A-type data unit as the line signal.

Start Sequence Generator (10)

2.54 The start-sequence generator provides precise time-sequenced control signals which are used to step the transmitter through the start-up (or training) period. An initiate start (IST) control signal from the customer through the 24A-type data unit initiates the start-up sequence.

2.55 While in the start-sequence mode, the transmitter goes through five distinct states. The order of start-sequence states, their purposes, and time duration are listed in Table I.

B. 23A-Type Data Unit (Receiver)

2.56 A block diagram of the receiver is shown in Fig. 11. The following descriptions are referenced to the functional circuit blocks.

Note: The number which follows circuit designation refers to block diagram numbers.

TABLE I

DATA SET START-UP SEQUENCE

STATE	PURPOSE	TIME (SECONDS)		SPEED OPTION
		TRANS	RCVR	
OPERATOR TONE: A tone equal to one-half the symbol clock frequency is transmitted through the 24A-type data unit as the line signal.	This tone signals the far-end receiver station to enter the DATA mode.	1.71	—	L2
		2.28	—	L3
		1.71	—	L4
		1.28	—	L5
		1.14	—	L6
STEADY CARRIER: A time period when a steady level of carrier frequency and two pilot tones are transmitted.	This time period enables the far-end receiver to adjust the recovered carrier phase and frequency for proper data recovery.	1.07	0.96	L2
		1.42	1.28	L3
		1.07	0.96	L4
		0.80	0.72	L5
		0.71	0.64	L6
BINARY DATA: A time period of scrambler-word transmission where only both extreme levels of analog data for the selected level format are transmitted.	This time period allows the automatic equalizer and the amplitude adjust circuit to operate in a coarse or high-speed mode and also allows the timing recovery circuit to adjust the frequency and phase of the bit and symbol clock.	2.35	2.35	L2
		3.13	3.13	L3
		2.35	2.35	L4
		1.76	1.76	L5
		1.56	1.56	L6
MULTILEVEL DATA: A time period of scrambler-word transmission when all analog levels for the selected level format are permitted.	This time period allows the automatic equalizer and the amplitude adjust circuit to begin a fine adjust mode and also allows the descrambler to synchronize to the scrambler.	2.77	2.77	L2
		3.69	3.69	L3
		2.77	2.77	L4
		2.08	2.08	L5
		1.85	1.85	L6
	TOTAL START-UP TIME	7.90	6.08	L2
		10.52	8.10	L3
		7.90	6.08	L4
		5.92	4.56	L5
		5.26	4.05	L6

Note: The receiver steady carrier start-up intervals are shorter than the corresponding transmitter start-up intervals to advance the receiver start-up sequence and ensure that the receiver initializing circuits are disabled before the transmitter terminates transmission of the required initializing line signal.

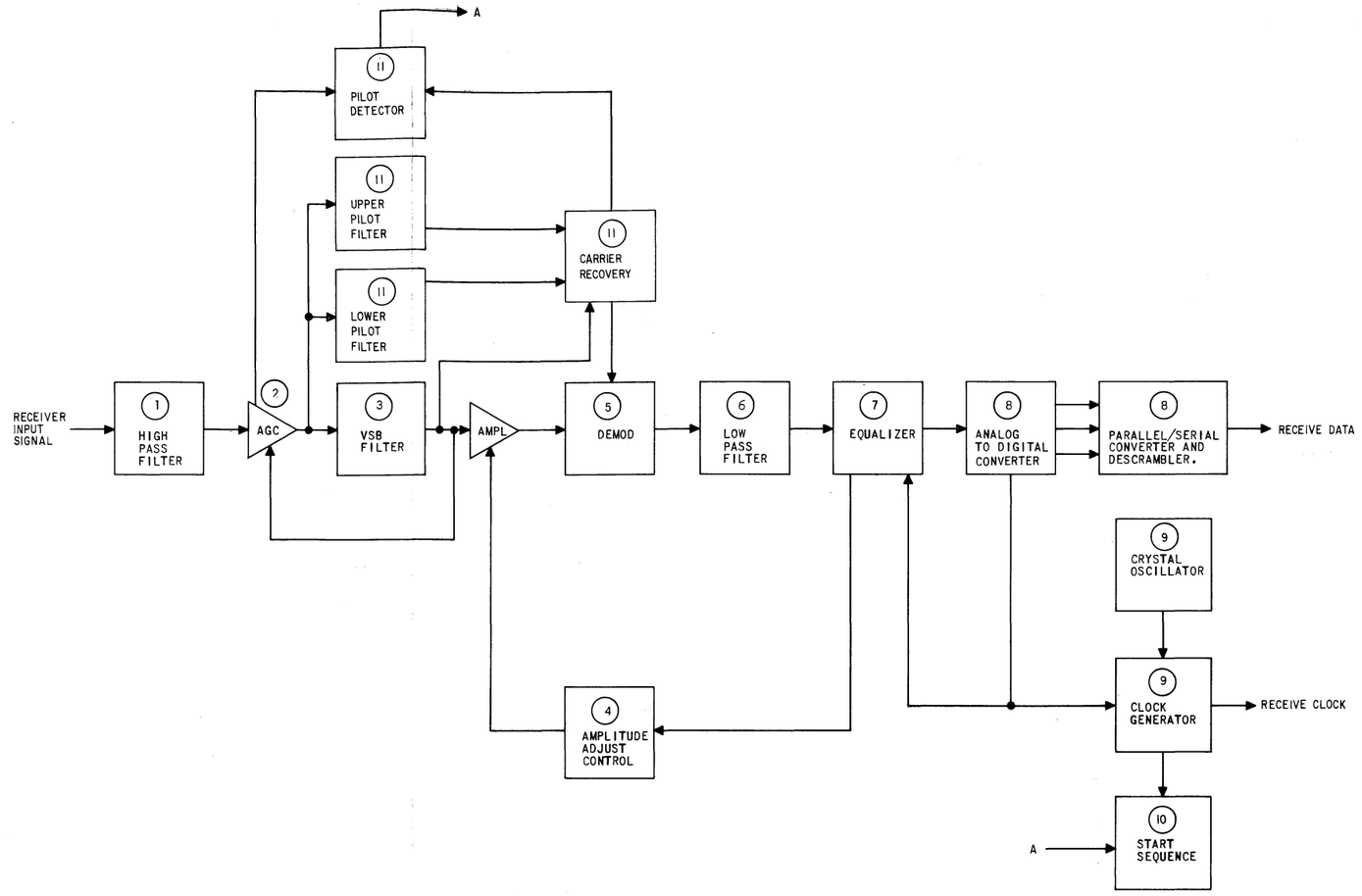


Fig. 11—Data Set 203-Type, 23A-Type Data Unit, Receiving Circuits, Block Diagram

High-Pass Filter (1)

2.57 When a data set 203A- or C-type having suffix list codes of L3 or L4 is used as terminal equipment, a high-pass filter is connected between the telephone line and the receiver circuitry. The remaining data sets 203A- or C-type do not use a high-pass filter. The filter provides a maximum loss to the low-speed secondary channel frequency spectrum and a minimum loss to the high-speed data channel frequency spectrum. The resulting isolation of the two channels minimizes interchannel interference.

Automatic Gain Control (AGC) (2)

2.58 The AGC circuitry adjusts the received line signal level by maintaining the passband (VSB filtered) signal at a specific level. The gain of an amplifier contained in the circuit is adjusted by a voltage-controlled attenuator. To generate a control signal for the voltage-controlled attenuator, the filtered line signal is full-wave rectified and differentially compared to a reference voltage.

2.59 The AGC circuit has a dynamic range of approximately 24 dB. The average passband signal is constantly maintained to within ± 2.5 dB from nominal for AGC input levels ranging from approximately -20 dBm to -44 dBm. The AGC circuit provides input signals for the two pilot filters.

Vestigial Sideband (VSB) Filter (3)

2.60 Shaping of the passband signal by the VSB filter is one of the necessary spectral-shaping requirements. The receiver VSB filter has the same amplitude characteristics as the transmitter VSB filter (Fig. 10). The VSB filter also suppresses out-of-band line signal energy, particularly pilot tones and secondary channel energy. Loss and delay characteristics of the filter vary with the list coding of the receiver.

Amplitude Adjust Control (4)

2.61 The amplitude adjust control circuit provides an automatic, continuously tracking, fine-level adjustment for passband data by monitoring baseband analog levels. The filtered VSB line signal is applied to a variable gain amplifier which has a dynamic range of $+5.0$ dB. The amplifier gain is controlled by the amplitude adjust control which makes corresponding gain adjustments for this amplifier which drives the demodulator.

2.62 The amplitude adjust control circuit has three modes of operation: (1) reset mode—corresponding to the steady carrier mode of the start sequence (also corresponds to the idle mode), (2) coarse-adjust mode—corresponding to the receiver binary mode of the start sequence, and (3) fine-adjust mode—corresponding to the remainder of start sequence and during customer data transmission.

Demodulator (5)

2.63 The demodulator translates the passband frequency spectrum down to baseband frequencies. This is a balanced-type demodulator circuit using the passband data as the linear input and recovered carrier as the square-wave switching input. The baseband signal output is applied to the low-pass filter.

Low-Pass Filter (6)

2.64 The low-pass filter completes the required spectral shaping of the signal from the VSB filter. The VSB and low-pass filters provide the spectral shaping of passband data by shaping the received signal complementary to the signal shaping provided by the distant transmitter. The resulting output provides an approximation of the transmitted signal before modulation.

2.65 The low-pass filter output is buffered before being applied to the automatic equalizer. Low-pass filters for the various receiver configurations differ basically in roll-off rate and bandwidth characteristics.

Automatic Equalizer (7)

2.66 The automatic equalizer improves the noise margin for the analog-to-digital converter circuits by minimizing baseband signal distortion due to linear intersymbol interference. The signal input to the automatic equalizer is a series of analog levels being applied at the symbol rate. Errors or distortion of the input signal are presumed to be proportional to the amplitudes being transmitted. The automatic equalizer functions to minimize this type of interference. It should be noted that the automatic equalizer is designed only to reduce intersymbol interference and should not be affected by noise. Reducing intersymbol interference improves error performance by increasing the margin which noise must overcome to cause errors.

Analog-to-Digital Parallel-to-Serial Converters and Descrambler (8)

2.67 The equalized baseband signal in the form of one of 2, 4, or 8 discrete analog levels is first converted from analog to digital form resulting in corresponding parallel binary bits (of one, two, or three bits for each analog level). The parallel-to-serial converter changes the parallel data into serial form. The serial data is applied to a descrambler which subtracts the quasi-random word that was added to the customer data at the transmitter. The descrambled output is given to the business machine through the 24A-type data unit and the CUSTOMER interface connector.

Clock Generator (9)

2.68 The frequency and phase for the receiver bit and symbol timing is recovered by using baseband data transitions to control a pulse-adding and deleting circuit. This circuit adds and deletes pulses in a binary countdown chain which counts down the output signal of a high-frequency crystal oscillator to generate bit and symbol timing. The timing frequencies are accurate to $\pm$0.001 percent.

Start Sequence (10)

2.69 The start-sequence circuits provide precise control signals which are used to step the receiver circuits through the start-up (or training) period. The start sequence is initialized by the OFF-to-ON transition of the pilot detector. The length of the start-sequence period varies between 4.0 and 8.1 seconds, depending on the data set symbol rate. The higher symbol rate corresponds with the shortest start-up period. The various states of the start sequence, their purposes, and their time durations are listed in Table I in the sequence in which they occur.

Pilot Detection and Carrier Recovery (11)

2.70 The pilot detector is activated by the presence of the two pilot tones and a minimum passband signal level. The detector is used to initiate the receiver start sequence. A slow-release, or hold-over, feature prevents restart of the training sequence due to short periods of line outage. The hold-over intervals for the pilot detector, which are inversely proportional to the symbol rate, are shown in Table J.

TABLE J

SPEED OPTION (L NUMBER)	HOLDOVER (SECONDS)
2	1.39
3	1.85
4	1.39
5	1.04
6	0.92

2.71 The recovered carrier is derived from the two pilot tones which are phase-locked to the modulated carrier in the transmitter.

2.72 The recovered carrier phase is compared to the received carrier phase during the steady carrier mode of the start sequence. During this time period, the phase of the locally generated carrier is changed until the received carrier and the locally generated carrier are in phase.

C. 24A-Type Data Unit (Common Control)

2.73 The functions of the 24A-type data unit have been illustrated in the block diagrams of the transmitter and receiver. Since this unit provides common control features for all arrangements of data set 203-type, individual controlling functions are described in Part 2E, Common Functions, in this section.

D. 38A-Type Data Unit (Multiple Access Interface)

2.74 The 38A-type data unit is an add-on option which provides the capability of serving up to six data terminals with one data set 203-type. Each data terminal can receive data simultaneously from a remote terminal, but only one data terminal can transmit data at a time.

2.75 The multiple access interface can provide a continuous carrier from the data set by installing option YF. Using this option causes the data set transmitter to send carrier continuously which may be used to prevent data set retraining each time one of the customer request-to-send (RS/CA) is turned ON. The send data (SD/BA) circuit is controlled by the request-to-send (RS/CA) circuit making it necessary for the customer to use

RS/CA at each terminal port. With the continuous carrier option YF, the data set clear-to-send (CS/CB) circuit is ON at the six terminal ports when the data set is in the data mode. This condition is independent of the status of the request-to-send (RS/CA) circuits.

E. Common Functions

Connectors, Switches, and Common Facility

2.76 The 24A-type data unit provides common control circuits for data set 203-type. Interconnections with the 24A-type data unit are made with connectors as shown in Table K.

2.77 The pin designations used for the CUSTOMER (J12) and TELEPHONE (P1) connectors are shown in Fig. 12. Connection to the telephone line from P1 is accomplished through a DAS 804M or a 66E3 connecting block and associated leads.

TABLE K
INTERFACE INTERCONNECTIONS

DESIGNATION	CONNECTS TO
CUSTOMER (J12)	Business machine
TELEPHONE (P1)	Telephone facility
TRMTR (J13)	22A-Type data unit*
RCVR (J16)	23A-Type data unit*
(J15)	38A-Type data unit*†
(J14)	To J15 for loop-back conversion*‡
66E3 Connecting Block	External DAS equipment
Line Cord (P3BG)	AC power
Flexible Tape Distribution	+4.5 Vdc and ground dc power

* Internal connection
† When provided by option L13
‡ Requires use of M6AL cord.

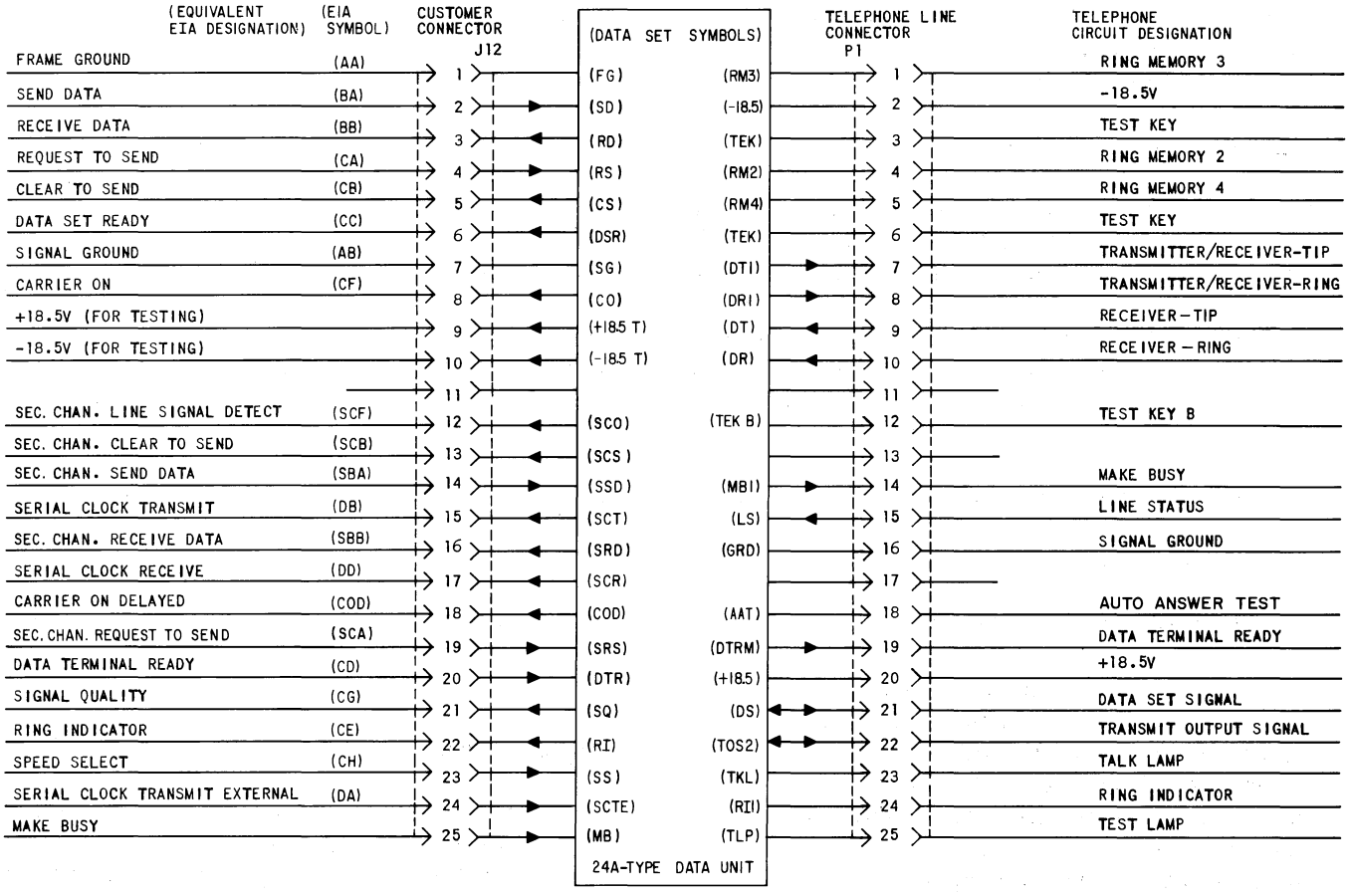


Fig. 12—Customer and Telephone Line Interface Signals

REMOTE TEST—LINE—LOCAL TEST Key

2.78 When the key is momentarily operated to REMOTE TEST position, the test lamp is illuminated and indicates that the data set is conditioned for testing from a data test center. The REMOTE TEST mode is usually released by the data test center, but it can be manually released by momentarily operating the key to the LOCAL TEST position and then to the LINE position.

2.79 Loop-back connections are made (203A only) when the key is operated to the LOCAL TEST position. With the data set connected for 4-wire operation, both the high-speed and secondary channels (where used) are looped back. With the data set connected for 2-wire operation, only the high-speed channel (if used) is looped back.

Speed Selection Switch

2.80 The 4-position BIT RATE—KB/S switch provides manual selection of the bit speeds indicated in the first three positions. The fourth switch position (CC) permits the business machine to select either of the two highest speeds through the CUSTOMER interface connector using the speed select (SS/CH) lead.

ERROR CONTROL Unit (ECU) Switch

2.81 This switch was provided on all 24A1 data units and some 24A2 data units. The ECU switch was removed on Series 5 24A1 data units and Series 3 24A2 data units. The ECU switch provides a bypass of the error control unit when the switch is set to the OUT position. Present data set operation requires that the switch be permanently set to the OUT position.

> ***Note:*** The block diagrams show that ***all*** major circuit leads are controlled by ECU switch contacts.

DIGITAL LOOPBACK Switch

2.82 In Series 3 or higher of the 24A2 data unit, the ECU switch has been replaced by the DIGITAL LOOPBACK switch. A data set 203A which uses either the 24A2 data unit, Series 3 or higher or a field modified 24A1 data unit, Series 5 (including Series 1/5, 2/5, or 3/5) or 24A2 data unit, Series 2, has the capability to loop back at the customer interface under control of the DIGITAL LOOPBACK switch and the REMOTE TEST key. In the digital loop-back mode, the data set operates as a regenerator so that signals from a remote data set 203A are demodulated in the receiver and applied to the transmitter for modulation and transmission back to the remote data set. The digital loop-back function in field modified units cannot be used in data sets 203A, List 7, 11, or 12. If the data set 203A uses a 24A2, Series 3 or higher, data unit (factory-installed DIGITAL LOOPBACK switch), operation with List 7 is possible, but operation with Lists 11 and 12 is possible (1) ***only*** if the attendant has control of the RS/CA interface lead or (2) option J or ZR has been installed.

41A-Type Power Unit

2.83 The 41A-type power unit is a regulated power supply which furnishes +18.5 Vdc, −18.5 Vdc, and +4.5 Vdc for use in the data set. The +18.5 and −18.5 voltages are distributed to the plug-in units and associated apparatus through connectors J13, J14, J15, J16, and TELEPHONE connector P1. The +4.5 Vdc and associated ground return are distributed through flexible tape connections at the rear of associated data units. The 41A1 is Manufacture Discontinued and the 41A2 is standard. The 41A2 must be used with the 22A2, 23A2, and 24A2 data units.

Positive and Negative Test Voltages

2.84 Data set power supply voltages are provided through the CUSTOMER connector (J12). These current-limited voltages may be used to supply ON and OFF signals to other interface leads during test; however, they should not be used to supply power to any customer equipment.

Signal Ground (SG) and Frame Ground (FG)

2.85 All data set operating voltages are with respect to the signal ground. Frame ground between the data set and the business machine is connected to the 41A-type power unit which is part of the 24A-type data unit.

Interface Circuits

2.86 The 24A-type data unit, as part of data set 203A-type, contains two circuit packs (Interface I and Interface II) which provide either an EIA Standard (List 8) or a MIL. Standard (List 9)

customer interface. Signals to and from the customer are level-converted by the circuits of Interface I and Interface II circuit packs. Signals delivered to the data set are terminated and converted to voltage levels compatible with data set circuits. Conversely, signals delivered to the customer are converted to EIA or MIL. Standard levels. The EIA interface leads meet the specifications of EIA Standards RS-232-C and RS-334. All but four of the MIL. Standard interface leads meet the specifications of MIL. Standard 188B. The four leads not meeting the MIL. Standard are: request to send (RS), data terminal ready (DTR), speed select (SS), and secondary request to send (SRS). These four leads meet the specifications of EIA Standard RS-232-C.

Note: The customer interface leads described will be designated by both their data set mnemonic abbreviations and their EIA symbols, respectively, separated by a slant line.

Control Circuits

2.87 A simplified block diagram (Fig. 13) illustrates circuit paths of active control functions.

Data Terminal Ready (DTR/CD)

2.88 The DTR/CD signal is used when the data set is operated with DAS 804A- or M-type. The potential at the CUSTOMER connector (J12) is converted and applied through OUT contacts of the ECU switch to a gate on Control Logic I circuit pack. The purpose of the DTR/CD is to give the customer control of a data call. To enter the data mode, the DTR/CD lead must be positive. To terminate a call through the customer interface, the DTR/CD lead must be negative so that the data set will go on-hook (hang up) directly from the data mode. During remote test, DTR/CD is effectively clamped positive by circuits within the data set.

Data Set Ready (DSR/CC)

2.89 The DSR/CC signal to the business machine is made positive when: (1) the line status signal from DAS 804A- or M-type is a positive potential, and (2) functions generated by the local test and remote test circuits are at ground. If the DAS 804A- or M-type is not used, installer option N (not shown) must be provided. Through this option, a DSR/CC ON signal is present at all times except during testing.

Speed Select (SS/CH)

2.90 The SS/CH lead permits the customer business machine to change the data set bit rate between the two highest speeds when the BIT RATE—KB/S switch is in the CC position. The potential of the SS/CH lead is converted by circuits on the Interface I circuit pack. The circuit path is completed through the BIT RATE—KB/S switch position CC to a relay driver on Control Logic I circuit pack. When the SS/CH lead potential is positive, relay K4-A17 is energized, and data set components operate at the 3X speed. (X represents the baud rate.) Conversely, when the SS/CH lead potential is negative, relay K4-A17 is not energized, and data set components operate at the 2X speed.

Ring Indicator (RI/CE)

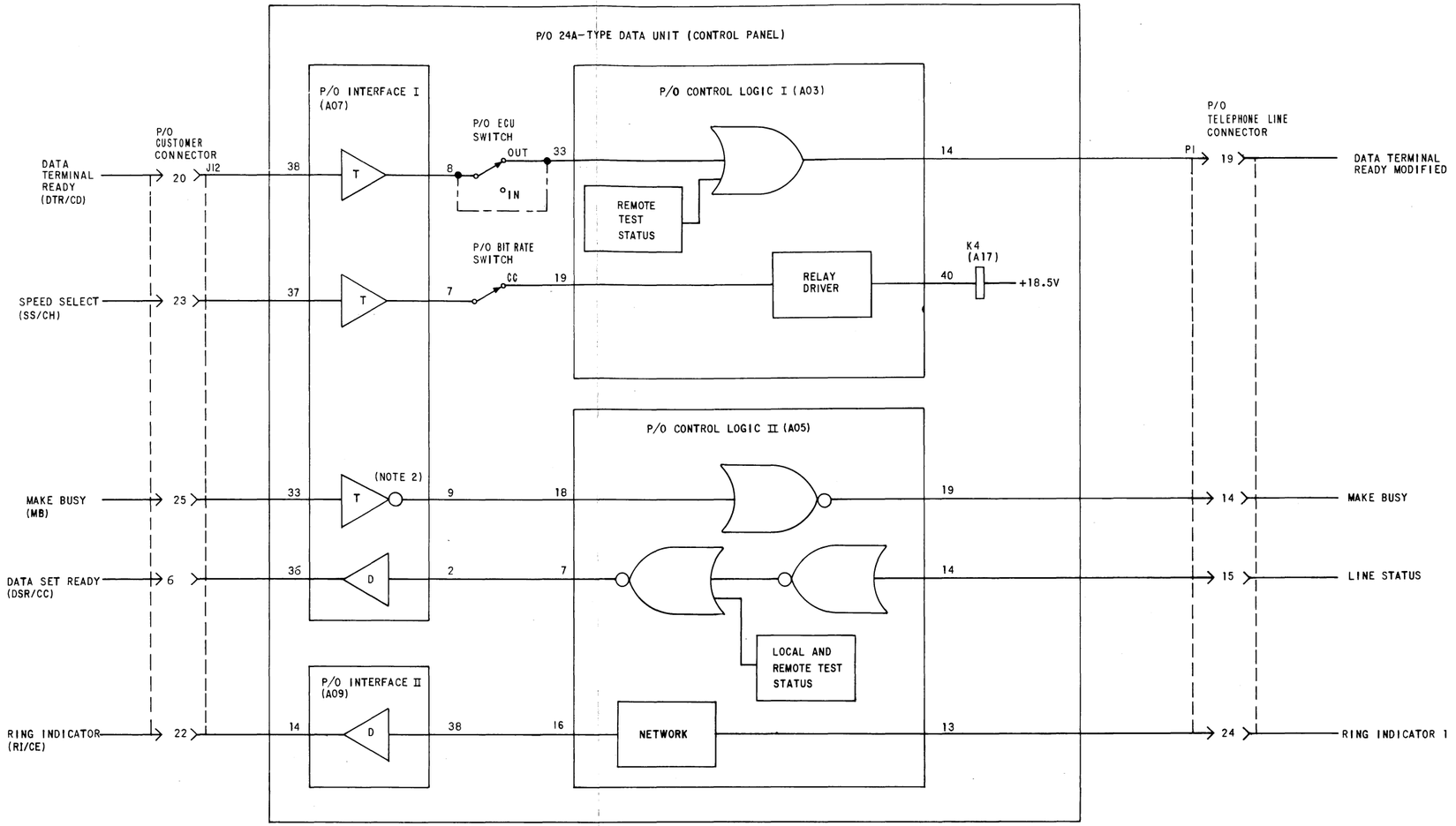
2.91 The RI/CE circuits are controlled by ring detector circuitry in DAS 804A- or M-type. The DAS provides a positive potential through the TELEPHONE connector (P1) for each detected ringing cycle. The signal is filtered through a network on Control Logic II circuit pack and converted to an EIA or MIL. Standard level on Interface II circuit pack.

Make Busy (MB)

2.92 An MB signal is intended for future use in multiple data set installations and is not provided on current standard models. At the present time, there is no standard equipment capable of using an MB signal. The MB signal from the customer business machine is converted by components on Interface I circuit pack. A positive potential on the MB lead is amplified on Control Logic II circuit pack to approximately a +15 volt level and applied to the TELEPHONE connector (P1) as a "Not Busy" indication. When MB is at a negative potential, a ground is provided to the TELEPHONE connector as a "Busy" indication.

Transmitter Circuits

2.93 A simplified block diagram of the transmitter circuits through the 24A-type data unit is shown in Fig. 14.



NOTES: -
1. CIRCUIT PACKS AND RELAY CONTACTS ARE IDENTIFIED BY TITLE AND CIRCUIT PACK SLOT LOCATION IN THE 24A-TYPE DATA UNIT.
2. WHEN A MIL.STANDARD INTERFACE (LIST 9) IS PROVIDED, THE MAKE BUSY TERMINATOR IS A NONINVERTING TYPE.
3. CIRCUIT PATHS SHOWN AS ——- —— INDICATES CHANGES MADE FOR DIGITAL LOOPBACK SWITCH FUNCTIONS ON SERIES 3, 24A2 DATA UNITS.

Fig. 13—Data Set 203-Type, 24A-Type Data Unit, Control Circuits, Simplified Block Diagram

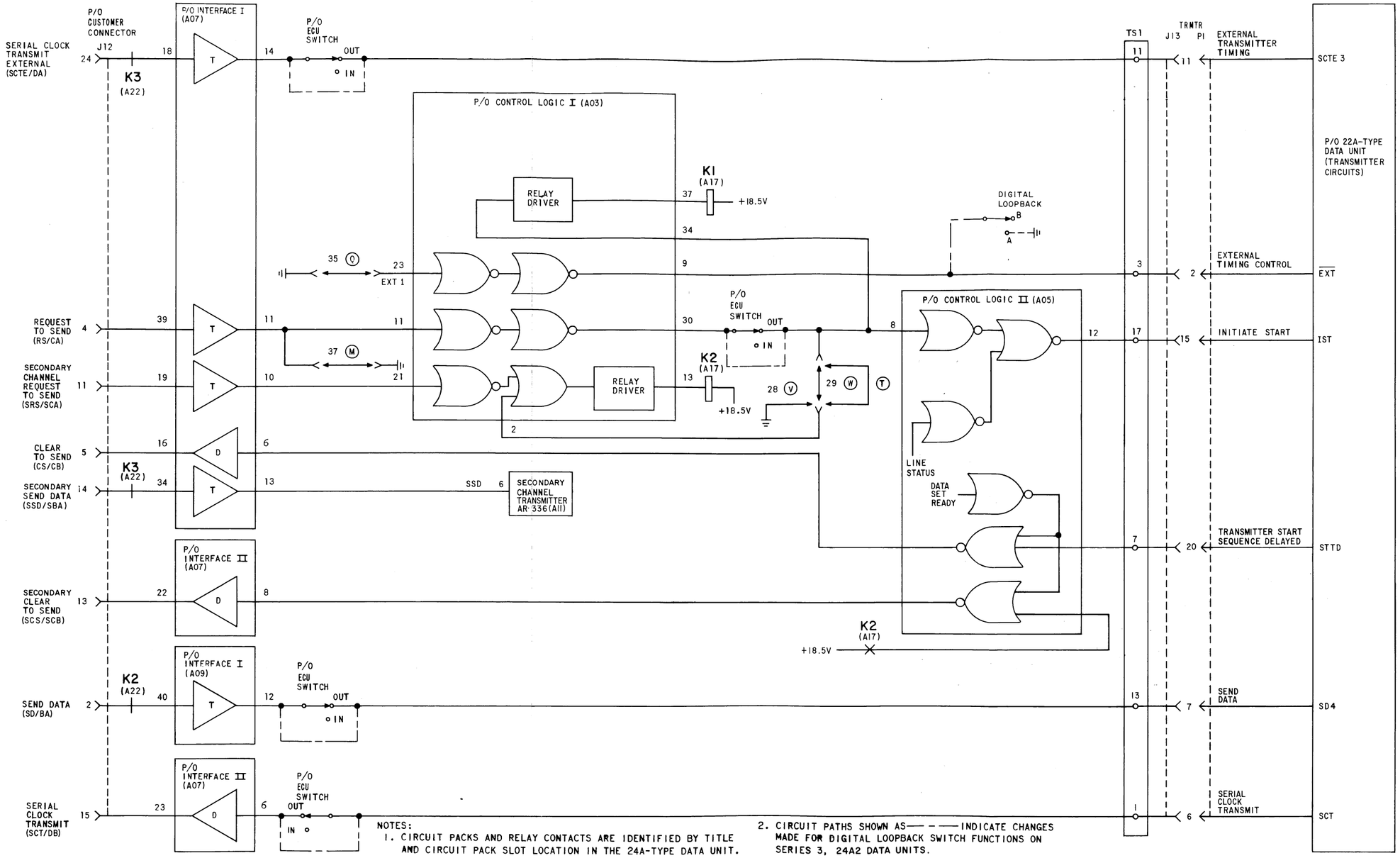


Fig. 14—Data Set 203-Type, 24A-Type Data Unit, Transmitting Circuits, Simplified Block Diagram

Request to Send (RS/CA)

2.94 The RS/CA signal from the customer is terminated and converted to data set internal logic level. If installer option M (receiver only) has been provided, the RS/CA signal is clamped OFF. With option M removed, the RS/CA signal is applied to Control Logic I circuit pack where it is clamped and controlled during remote testing. The modified RS/CA signal path is completed through OUT contacts of the ECU switch to the relay K1-A17 driver on Control Logic I circuit pack. The circuit path for the modified RS/CA signal is also extended to Control Logic II circuit pack, where it is combined with other signals to generate initiate start (IST) for the data set transmitter. When using the ARAC option, the customer must connect SRD/SBB to this lead. This permits ARAC to have sole control of the request-to-send function.

2.95 During normal operation, when the line status (LS) signal is positive or installer option N (without DAS 804A- or M-type) is provided, IST will be controlled directly from the modified RS/CA signal. If installer option J or ZR (initiate start automatic) (not shown in Fig. 14) is provided, IST will be pulsed OFF, then ON if either (1) the transmitter start sequence delayed (STTD) signal is a ground and the pilot detector slow (PDS) signal goes positive, or (2) the receiver signal quality (SQ) and receiver start sequence (STR) signals are both at ground. The option is used in a 4-wire full-duplex station and will initiate a new transmit start sequence if (1) the local data set is not in a start sequence and the associated receiver detects pilots, or (2) the receiver completes a start sequence and the signal quality is not acceptable.

2.96 Half-duplex operation may use initiate start on secondary channel carrier (SCO) installer option K (not shown). This option permits the transmitter start sequence to be held in operator tone mode until the secondary channel detects low-speed carrier from the distant station. Then the operator tone is released and the transmitter progresses through the normal start-up sequence.

Clear to Send (CS/CB)

2.97 The CS/CB signal is generated on Control Logic II circuit pack when the transmitter start sequence delayed signal lead is at ground potential and data-set-ready (DSR/CC) signal lead is positive. The CS/CB signal is converted and delivered to the customer.

Send Data (SD/BA)

2.98 The SD/BA signal from the business machine passes through contacts of remote test control relay K2-A22 to the Interface I circuit pack. The signal is converted to data set logic levels and applied through OUT contacts of the ECU switch to the data set transmitter.

Serial Clock Transmit (SCT/DB)

2.99 The SCT/DB is a square-wave clock signal provided by the data set transmitter at the selected data bit rate and is used by the customer in synchronizing SD/BA with the transmitter timing.

Serial Clock Transmit External (SCTE/DA)

2.100 External timing input signal from the business machine is connected through relay K3-A22 contacts (used during remote testing) to the Interface I AR338 circuit pack. The SCTE/DA signal is converted to data set logic levels and the circuit is completed through OUT contacts of the ECU switch to the data set transmitter. The accuracy of SCTE/DA must be within 0.001 percent of nominal.

2.101 When installer option Q is provided, the external timing control (EXT1) signal is at ground potential. This potential is applied to gate circuits on Control Logic I circuit pack to produce an output signal which conditions the data set transmitter to accept an external serial clock.

Secondary Request to Send (SRS/SCA)

2.102 The SRS/SCA is similar to the RS/CA operation except that it controls the secondary channel transmitter only. Installer option W is used with DDD service and provides control of the secondary channel by RS/CA only. Installer option V permits control of the secondary channel transmitter using SRS/SCA only and provides operation of relay K2-A17 independent of RS/CA. Installer option T is used for data sets 203-type which do not permit the simultaneous transmission of high-speed data and the secondary channel on the same pair of wires. When this option is provided and the customer requests to send on

both transmitters, only the high-speed transmitter will be transferred to the line.

Secondary Clear to Send (SCS/SCB)

2.103 The SCS/SCB ON signal to the business machine is originated in the data set when the K2-A17 relay is not operated and the data-set-ready (DSR/CC) lead is positive. The SCS/SCB signal is interlocked by connections on secondary channel circuit pack before being applied to Interface II circuit pack where the signal is converted to EIA or MIL. Standard levels. In the 24A1 data unit, the time between SRS/SCA ON or DSR/CC ON (whichever occurs last) and the SCS/SCB ON is 80 milliseconds. In the 24A2 data unit, which replaces the 24A1 data unit, the time between SRS/SCA ON and DSR/CC ON (whichever occurs last) and SCS/SCB ON is 1.4 to 2.3 seconds.

Secondary Send Data (SSD/SBA)

2.104 This signal is provided by the customer. Secondary send data is asynchronous and can be provided at a bit rate up to 150 bits per second. A positive signal is a binary "0" or SPACE and a negative signal is a binary "1" or MARK. When using the ARAC option, the SQ/CB lead must be connected to this lead by the customer.

Receiver Circuits

Receive Data (RD/BB)

2.105 A simplified block diagram of the receiver circuits through the 24A-type data unit is shown in Fig. 15.

2.106 The received data (RD/BB) signal is clamped off by circuits on Control Logic I circuit pack. The clamp is removed under the following conditions: (1) pilot frequencies are detected (signal lead PDF is positive) and (2) the receiver start sequence is completed and STR is at ground potential. With the clamp removed, the RD/BB signal path is completed by OUT contacts of the ECU switch to components on Interface I circuit pack. The circuits on Interface I convert the RD/BB signal to EIA or MIL. Standard levels before it is delivered to the customer business machine.

2.107 Installer option F provides a ground potential which inhibits the clamping action on RD/BB under any circumstances.

Serial Clock Receiver (SCR/DD)

2.108 SCR/DD is a square-wave clock signal at the selected bit rate. Positive transitions of SCR/DD are coincident with transitions of the received data. The receiver clock frequency accuracy is at least 0.001 percent.

2.109 The SCR/DD signal is clamped by the binary mode-receiver (BMR) function. At the end of the binary mode of the start-up sequence, the SCR/DD clamp on Control Logic II circuit pack is removed. The SCR/DD signal is applied through OUT contacts of the ECU switch to Interface II circuit pack, where it is converted to the EIA or MIL. Standard level and delivered to the customer.

2.110 When installer option E is provided, the SCR/DD clamp is inhibited. This option is intended for use when the data set is operated as a regenerator. This option should not be provided in customer terminal equipment because erroneous timing may be provided to the customer business machine during the start-up period.

Carrier On (CO/CF)

2.111 The CO/CF circuit is held at a positive potential to signal the business machine that a high-speed data signal is being detected in the data set receiver.

Carrier On Delayed (COD)

2.112 The COD signal is converted to an EIA or MIL. Standard level by circuits on Interface II circuit pack. This lead provides a positive potential within 70 milliseconds after the carrier is detected. A negative potential is given approximately 1.0 second after loss of line signal.

Signal Quality (SQ/CG)

2.113 The SQ/CG lead provides a positive potential to the business machine when receiver sampling circuits indicate that the received signal quality is acceptable. If the received line signal is sufficiently degraded to indicate an unacceptable signal quality, the SQ/CG lead provides a negative potential to the business machine. When using the ARAC option, the SSD/SBA lead must be connected to this lead by the customer.

NOTES:
1. CIRCUIT PACKS AND RELAY CONTACTS ARE IDENTIFIED BY TITLE AND CIRCUIT PACK SLOT LOCATION IN THE 24A-TYPE DATA UNIT.
2. CIRCUIT PATHS SHOWN AS — — — INDICATES CHANGES MADE FOR DIGITAL LOOPBACK SWITCH FUNCTIONS ON SERIES 3, 24A2 DATA UNITS.

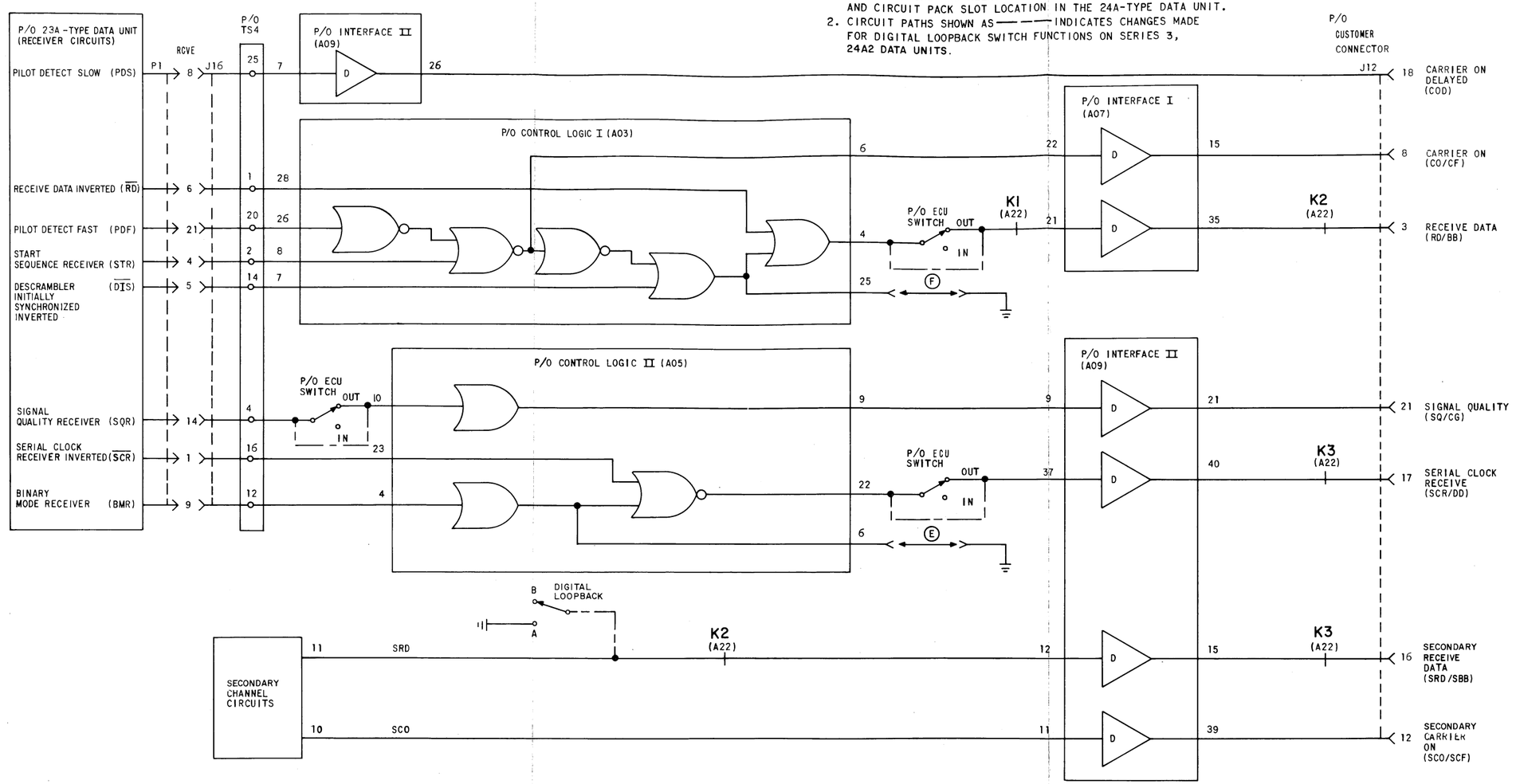


Fig. 15—Data Set 203-Type, 24A-Type Data Unit, Receiving Circuits, Simplified Block Diagram

Secondary Receive Data (SRD/SBB)

2.114 This signal is provided to the customer from the data set secondary channel circuits. The secondary receive data (SRD/BB) output signal is controlled by the secondary carrier-on function. When secondary carrier is not received, the secondary receive data lead is clamped OFF (MARK condition). Conversely, when secondary carrier is received, the secondary receive data lead is unclamped.

Secondary Carrier On (SCO/SCE)

2.115 This signal is provided to the customer from the data set secondary channel circuits. An ON indication is provided whenever energy within the bandwidth of the secondary channel at its input is greater than −48 dBm. For an energy level below −48 dBm, the indication is OFF. In the 24A1 data unit, the time required for this function to change from OFF to ON is within 80 milliseconds of receipt of energy. In the 24A2 data unit, which replaces the 24A1 data unit, the OFF to ON time is 0.9 (±0.2) second. When the ARAC option is used, the secondary carrier ON indication is presented at all times.

3. OPERATION

A. Two-Wire Operation

3.01 A simplified block diagram of data set 203A-type operation (speed options L3 and L4) over a 2-wire telephone facility is shown in Fig. 16. A secondary channel must be provided for 2-wire operation. This configuration permits the customer to (1) transmit high-speed data while receiving low-speed data through the secondary channel receiver circuits, or (2) receive high-speed data while transmitting low-speed data through the secondary channel transmitter circuits. This operation requires installer options X and W.

3.02 Relays K1-A17 and K2-A17 control the transmit-receive mode. Relay K3-A17 controls the operator tone (OPT) during the start-up sequence. Installer option W provides for simultaneous transmission of the high-speed and low-speed data in reverse directions and causes parallel operation of relays K1-A17 and K2-A17 under control of request to send (RS/CA).

3.03 Simultaneous use of the secondary channel is accomplished through frequency division of the telephone channel spectrum. The secondary channel occupies the band of frequencies from 300 to 525 Hz and can only be used simultaneously on the same wire pair with data sets 203-type whose spectra do not extend below 700 Hz (L3 and L4). See Table D.

3.04 Nonsimultaneous transmission of the secondary channel is possible for all data sets 203-type by providing installer option T instead of installer option W. Option T permits control of relays K1-A17 and K2-A17 by both RS/CA and secondary channel request to send (SRS/SCA) and thus inhibits simultaneous transmission.

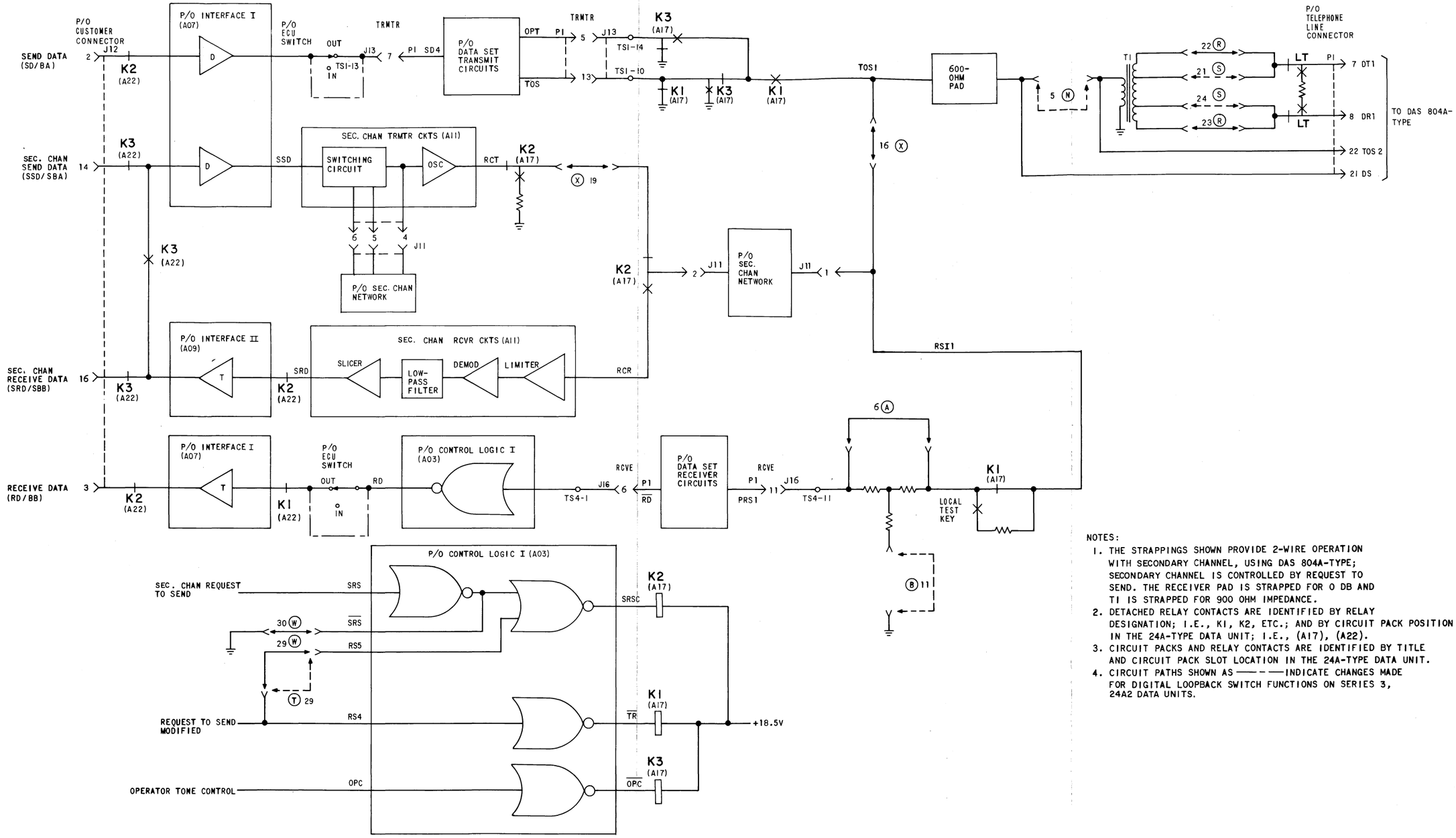
3.05 Installer option X is required for 2-wire operation with secondary channel. With option X (terminals 16 strapped), the high-speed receiver circuits connect to the telephone line under control of relay K1-A17 contacts. Option X (terminals 16 and 19 strapped) connects the secondary channel transmitter and receiver circuits to the telephone line under control of relay K2-A17 contacts.

3.06 When installer option A (terminals 6 strapped) is provided, the 10-dB pad which provides receiver input signal attenuation is strapped out. The pad can be inserted by removing installer option A and installing option B (terminals 11), although this option is primarily intended for 4-wire operation. Installer option R (terminals 22 and 23) provides the 900-ohm impedance required for 900-ohm lines. Option S (terminals 21 and 24) provides the impedance required for 600-ohm lines.

B. Four-Wire Operation With Secondary Channel

3.07 A simplified block diagram of data set 203A-type operation over a 4-wire telephone facility is shown in Fig. 17.

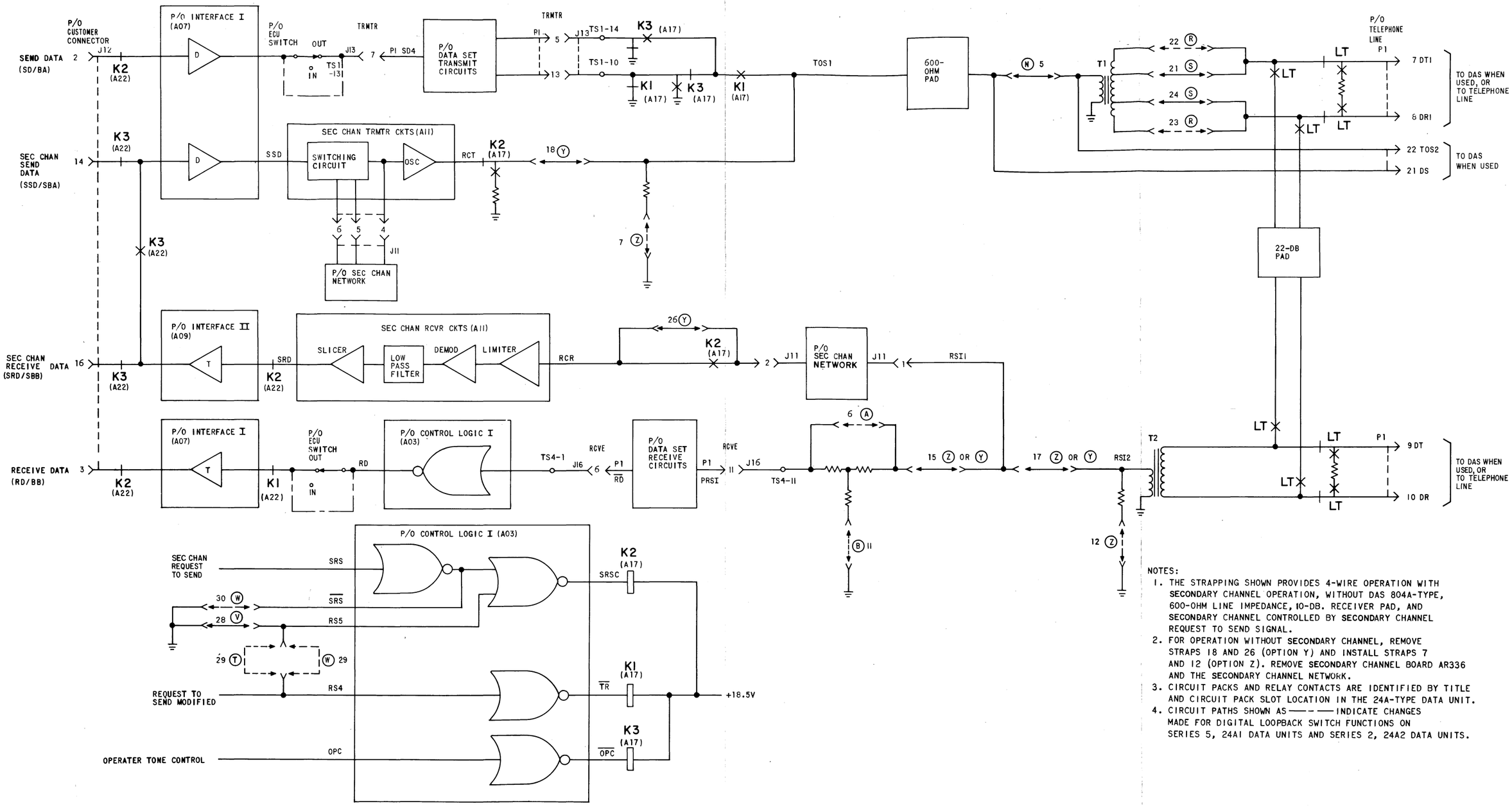
3.08 Installer option Y is required to provide 4-wire operation with the secondary channel. This option permits full-duplex simultaneous operation of the high-speed and secondary channels on 4-wire facilities with the secondary channel operating in parallel. Control of relays K1-A17 and K2-A17 by RS/CA and SRS/SCA, respectively, requires installation of installer option V (terminals 28). Option Y permits both the high-speed receiver and the secondary channel receiver to remain connected to the receive line at all times.



NOTES:

1. THE STRAPPINGS SHOWN PROVIDE 2-WIRE OPERATION WITH SECONDARY CHANNEL, USING DAS 804A-TYPE; SECONDARY CHANNEL IS CONTROLLED BY REQUEST TO SEND. THE RECEIVER PAD IS STRAPPED FOR 0 DB AND T1 IS STRAPPED FOR 900 OHM IMPEDANCE.
2. DETACHED RELAY CONTACTS ARE IDENTIFIED BY RELAY DESIGNATION; I.E., K1, K2, ETC.; AND BY CIRCUIT PACK POSITION IN THE 24A-TYPE DATA UNIT; I.E., (A17), (A22).
3. CIRCUIT PACKS AND RELAY CONTACTS ARE IDENTIFIED BY TITLE AND CIRCUIT PACK SLOT LOCATION IN THE 24A-TYPE DATA UNIT.
4. CIRCUIT PATHS SHOWN AS ——— — ——INDICATE CHANGES MADE FOR DIGITAL LOOPBACK SWITCH FUNCTIONS ON SERIES 3, 24A2 DATA UNITS.

Fig. 16—Two-Wire Private Line or Switched Networks With Secondary Channel, Simplified Block Diagram



NOTES:

1. THE STRAPPING SHOWN PROVIDES 4-WIRE OPERATION WITH SECONDARY CHANNEL OPERATION, WITHOUT DAS 804A-TYPE, 600-OHM LINE IMPEDANCE, 10-DB. RECEIVER PAD, AND SECONDARY CHANNEL CONTROLLED BY SECONDARY CHANNEL REQUEST TO SEND SIGNAL.
2. FOR OPERATION WITHOUT SECONDARY CHANNEL, REMOVE STRAPS 18 AND 26 (OPTION Y) AND INSTALL STRAPS 7 AND 12 (OPTION Z). REMOVE SECONDARY CHANNEL BOARD AR336 AND THE SECONDARY CHANNEL NETWORK.
3. CIRCUIT PACKS AND RELAY CONTACTS ARE IDENTIFIED BY TITLE AND CIRCUIT PACK SLOT LOCATION IN THE 24A-TYPE DATA UNIT.
4. CIRCUIT PATHS SHOWN AS — — — INDICATE CHANGES MADE FOR DIGITAL LOOPBACK SWITCH FUNCTIONS ON SERIES 5, 24A1 DATA UNITS AND SERIES 2, 24A2 DATA UNITS.

Fig. 17—Four-Wire Operation With Secondary Channel, Simplified Block Diagram

3.09 When operation without a DAS 804A- or M-type is required, option N (terminals 5 and 20) must be installed to complete the transmit circuit path to repeat coil T1 and the telephone facility. Option S (terminals 21 and 24) establishes the line impedance required for a 600-ohm line.

C. Four-Wire Operation Without Secondary Channel

3.10 Full-duplex operation on 4-wire facilities (Fig. 17) without the secondary channel is provided by installing options Z and YD and removing the secondary channel AR336 circuit pack and the 4166A network from the 24A-type data unit. Connections between the CUSTOMER interface and the telephone facility are the same as shown in Fig. 17. Note that the receiver circuits are connected to the telephone facility at all times. Installer option Z (terminals 12) inserts a resistive load equal to the impedance of the removed secondary channel filter network. Installer option Z (terminals 7) inserts a resistive load equal to the removed secondary channel transmitter.

D. Four-Wire Operation With Option List Codes L11 and L12 (ARAC)

3.11 The function of option list codes L11 and L12 is identical. The exceptions, required because of the baud rate for which they were designed, include a difference in (1) line frequency, (2) oscillator frequency, (3) logic circuitry, and (4) circuit reaction timing. A block diagram illustrating the ARAC operation is shown in Fig. 18. The ARAC is used ***only*** on 4-wire private line facilities and ***only*** with data set 203A arranged for full-duplex operation using speed options L2 or L6. The following description and Fig. 18 presume a tandem regenerative mode of operation.

3.12 The ARAC circuitry will provide transmission and reception of a single-frequency control signal for the purpose of retraining one-half of a data set 203A transmitter-receiver pair. When a high-speed receiver requires retraining, the phase of the control signal is reversed for a time interval and then returned to its original phase in the local ARAC transmitter and sent on-line to the remote ARAC receiver. The remote ARAC receiver detects the phase change of the control signal and initiates a training sequence in the remote high-speed transmitter.

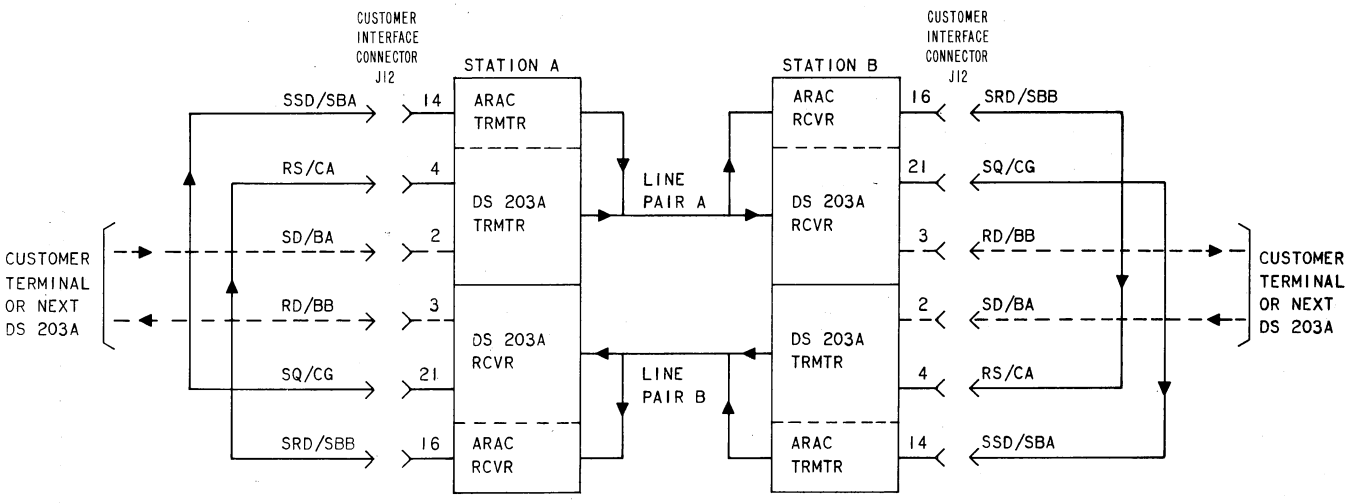


Fig. 18—Block Diagram of Data Set 203A Using ARAC Circuitry

3.13 When the remote high-speed transmitter restarts, it causes the local high-speed receiver to retrain. If the retraining is successful, the ARAC request-to-retrain sequence signal is terminated. If the retraining is not successful, the phase of the control signal is changed periodically until successful retraining occurs. The phase change of the control signal is initiated by the ARAC circuitry in response to (1) poor line signal quality, (2) a line dropout that exceeds the data set holdover time, and/or (3) simultaneous recovery of both channels of the full-duplex line.

3.14 The customer terminal must provide the proper cross connections at the CUSTOMER interface connector (J12) to achieve the ARAC functions. The request-to-send (RS/CA, pin 4) lead must be connected to the secondary receive data (SRD/SBB, pin 16) lead, and the signal quality (SQ/CG, pin 21) lead must be connected to the secondary send data (SSD/SBA, pin 14) lead. These cross connections must be provided for every data set 203A using the ARAC function.

3.15 The option list code L11 is compatible ***only*** with data set 203A speed option L2. ARAC components are AR582 circuit pack and a 4166B network. The AR582 is put into circuit pack slot location 11 in the 24A-type data unit in place of AR336 circuit pack. The 4166B network is connected to J11 in the 24A-type data unit in place of the 4166A network.

3.16 The option list code L12 is compatible ***only*** with data set 203A speed option L6. ARAC components are AR583 circuit pack and a 4166C network. The AR583 is put into slot location 11 in the 24A-type data unit in place of AR336 circuit pack. The 4166C network is connected to J11 in the 24A-type data unit in place of the 4166A network.

3.17 Both AR336 circuit pack and the 4166A network are the components which provide option list code L7 (secondary channel) which is removed when using either the L11 or L12 ARAC functions.

3.18 The function of the ARAC circuitry is to insert a single-frequency tone into the data set line signal above the lower pilot tone and below the data spectrum. The position of the ARAC control signal in the line signal does not interfere with either the pilot tone or the data signals. Approximate locations of the transmitted signals within the frequency spectrum are illustrated in Fig. 19. The ARAC transmitter has a crystal-controlled oscillator to provide the control signal and synchronize the ARAC receiver.

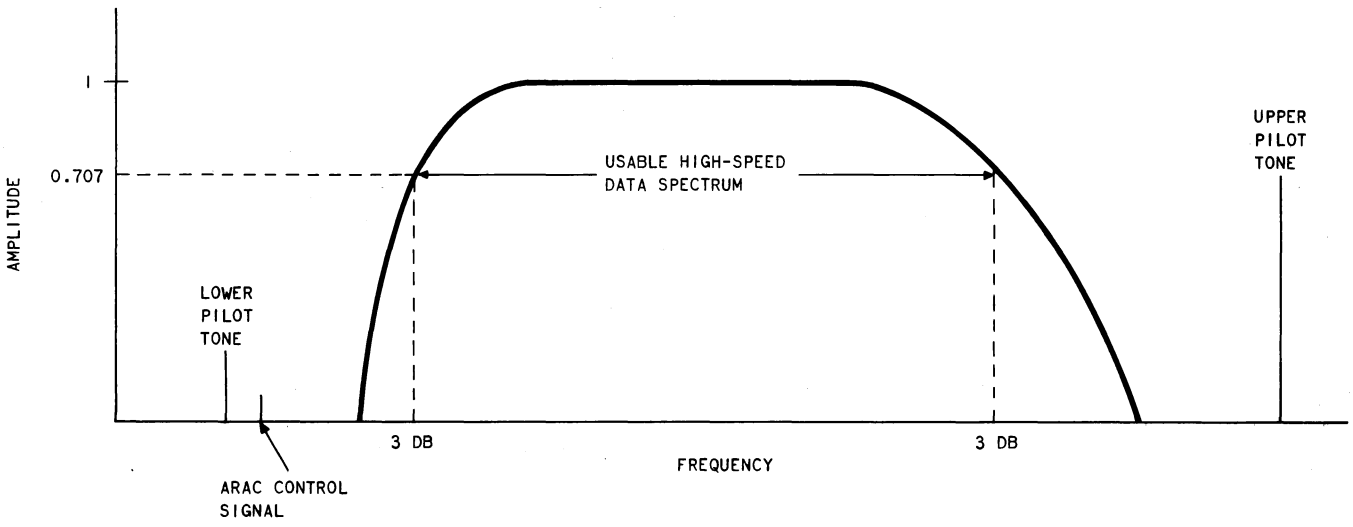


Fig. 19—Approximate Spectrum Location of Data Signal and Control Components

3.19 During normal operation, the ARAC control signal is transmitted between a pair of data set 203A units. The phase of the ARAC tone remains constant and the ARAC circuitry in both data stations recognizes the constant phase of the ARAC tone as circuit continuity. If the signal quality of Line Pair A (see Fig. 18) drops below the design minimum, the ARAC request-to-retrain sequence circuitry is automatically initiated by the high-speed data set receiver at Station B.

3.20 When the receiver senses poor signal quality, the interface lead SQ/CG goes low which is recognized by the SSD/SBA input to the ARAC transmitter. The low input signal unlatches ARAC transmitter control circuitry which causes the phase of the ARAC tone to be reversed for approximately 1/4 second and returned to the original phase. The phase change of the tone impressed on the Line Pair B carrier is recognized by the ARAC receiver at Station A which is constantly monitoring the ARAC tone. The ARAC receiver responds by conditioning the SRD/SBB interface lead to momentarily apply a negative potential to the data set transmitter RS/CA interface lead which starts the retraining process on Line Pair A.

3.21 The ARAC transmitter timing circuit will attempt to latch into the original starting state after approximately 18 seconds for L11 and 14 seconds for L12. If the retraining is successful, the ARAC receiver circuitry monitors the ARAC tone for the next phase-reversal pulse. If the SQ/CG interface lead has not been restored to normal, a 1/4-second pulse is generated every 18 (or 14) seconds until the line improves and the SQ/CG interface lead returns to normal.

3.22 Automatic retraining is recycled until the line signal quality improves. The ARAC control signal has no effect on high-speed data being carried on the other line pair. There is a timing sequence which affects the initiation and recycling of the ARAC control signal. Four screw switches are provided on the ARAC circuit pack decaled S1A, S1B, S2C, and S2D (see Fig. 20) which control the response time sequence. The important differences between the L11 and L12 codes are listed in Table L.

3.23 The two separate time intervals are required for proper ARAC operation. When a line impairment initiates the ARAC circuitry, the respective data set transmitter starts the normal retraining sequence as shown in Table I. If separate time intervals were not provided and the line impairment affected both telephone line pairs, the transmitters would try to retrain simultaneously. In practical application, one station ***must*** be provided with the fast start-up and the opposite station provided with the slow start-up. The different timing prevents erroneous ARAC retrain command sequences when line impairment either blocks transmission in excess of the data set holdover time or provides poor line signal conditions on one or both of the line pair connections.

3.24 If both ARAC circuits between two stations were to be strapped for fast start-up and both line pair connections became blocked or signal quality went below normal, simultaneous recovery of the two stations may be possible but not at all probable. With both data sets trying for recovery, one retraining cycle would probably be blocked. If simultaneous recovery were to occur, the data and carrier signals might not be phase-locked, which may provide a good eye pattern (which line signal quality monitor circuits sample), but data signal could not be recovered.

3.25 The data set receiver SQ/CG interface lead can only signal the ARAC circuitry after the pilot detect slow (PDS) function has timed out the data set holdover time. This feature prevents unnecessary retraining if the line dropout occurs for a relatively short time.

3.26 The ARAC circuitry is designed to operate within an input voltage range of −10 dB to −35 dB as measured at the tip and ring input to the data set 203A. The relative temperature and humidity range for ARAC circuitry is the same as the data set 203-type (see 1.11).

4. REFERENCES

4.01 The following references provide additional information on data units and data sets used in a typical data set 203-type installation:

- Data Set 203-Type, Reference Guide (Section 590-002-107)
- 22A-Type Data Unit (Transmitter), Identification (Section 590-100-115)
- 23A-Type Data Unit (Receiver), Identification (Section 590-100-116)

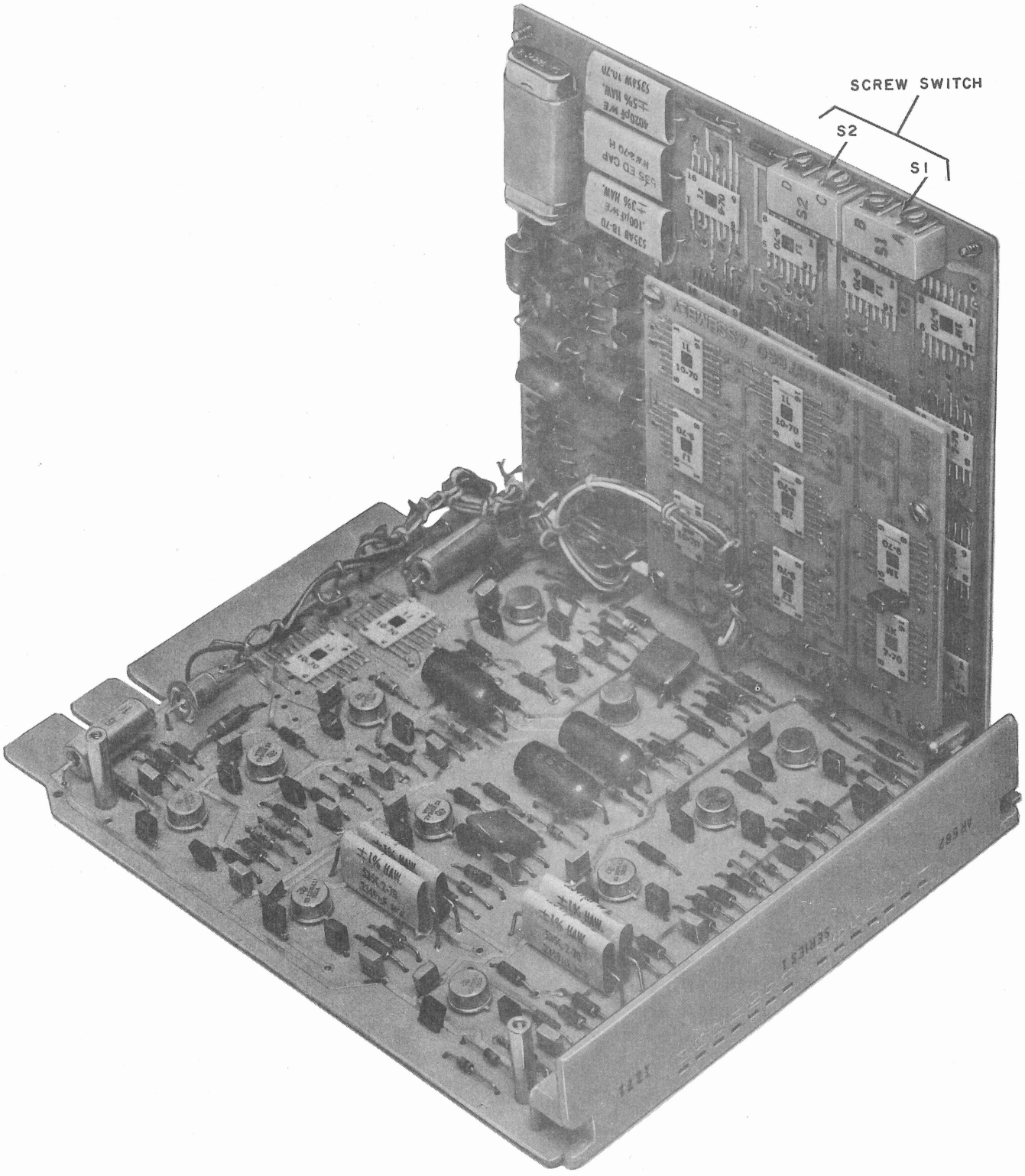


Fig. 20—Typical ARAC Circuit Pack (Associated Network not Shown)

TABLE L

DIFFERENCES BETWEEN OPTIONS L11 AND L12

FUNCTION	L11	L12
Transmit Line Frequency	571.4 Hz	445.5 Hz
Crystal Frequency	9143 Hz	7129 Hz
Bandpass Filter Center Frequency	71.4 Hz	44.5 Hz
Turnaround Sequence Time		
Fast	3.08 Sec	2.37 Sec
Slow	10.92 Sec	8.40 Sec
Total Sequence Time	17.90 Sec	13.78 Sec
Screw Switch Settings (Applicable to Both L11 and L12)		
Fast Turnaround	S1A and S2D Closed S1B and S2C Open	
Slow Turnaround	S1A and S2D Open S1B and S2C Closed	

- 24A-Type Data Unit (Common Control Equipment), Identification (Section 590-100-117)
- 38A-Type Data Unit, Identification (Section 590-100-129)
- Data Set 203-Type, Transmitter/Receiver, Summarizing Specification, Data Systems Station (Section 592-019-180)
- CD- and SD-1D151-01 (Data Set 203 Station Arrangements)
- CD- and SD-1D152-01 [22A-Type Data Unit (Transmitter)]
- CD- and SD-1D153-01 [23A-Type Data Unit (Receiver)]
- CD- and SD-1D154-01 [23A-Type Data Unit (Control)]
- CD- and SD-1D230-01 (38A-Type Data Unit)
- Bell System Data Communications Technical Reference—Data Set 203-Type—June, 1970.