

**DATA SET 208B-TYPE  
TRANSMITTER-RECEIVER  
SUPPLEMENTARY INFORMATION**

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F. Operating Controls . . . . .	16	1.01 This section contains detailed description, application, and maintenance information for data set (DS) 208B-type. It supplements information contained in other sections and is not required for normal installation or maintenance.	
G. Operating Adjustments . . . . .	17	1.02 This section is reissued to include information on DS 208B-L1B. DS 208B-L1A is rated Manufacture Discontinued (MD) concurrent with the introduction of DS 208B-L1B. DS 208B-L1B contains all the features of DS 208B-L1A, plus the following additional features:	
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**NOTICE**

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because of differences in backplane wiring. Information in this section pertains to DS 208B-L1, DS 208B-L1A, and DS 208B-L1B, except as otherwise specified.

**1.04** The purpose of DS 208B-type (Fig. 1) is to provide 4800 bps DATA-PHONE® service over the 2-wire switched telecommunications network.

**1.05** DS 208B-type is a synchronous, 4800 bps, serial, binary data set which requires a type III DATA-PHONE loop to the serving central office (CO). It is only compatible for use with another DS 208B-type. Since DS 208B-type is a 2-wire data set, it may only be used for one-way (simplex) or two-way nonsimultaneous [half-duplex (HDX)] data communications.

**1.06** DS 208B-type accepts data from terminal equipment in the form of voltage signals which conform to the Electronic Industries Association (EIA) Standard RS-232-C. It uses an 8-level phase-shift keyed (PSK) modulation scheme for transmission. DS 208B-type features a fast start-up (less than 50 ms) automatic equalizer which permits fast turnaround on 2-wire voiceband facilities. In addition, DS 208B-type is capable of performing comprehensive self tests and remote tests which facilitate easy isolation of transmission troubles by the station attendant or telephone company (telco) data test center (DTC) personnel.

**1.07** Once a connection between two DS 208B-types is established, alternate voice and data communications are possible using a separate telephone set. The voice mode is primarily used

for coordinating manually originated and/or answered calls.

**1.08** DS 208B-type can be optionally arranged to answer incoming calls automatically. In addition, automatic call origination may be provided by use of a data auxiliary set (DAS) 801A- or 801C-type automatic calling unit (ACU). The combination of the automatic answer option along with the ACU makes possible fully automated "machine-to-machine" calls.

## 2. EQUIPMENT CHARACTERISTICS

### A. Physical Description

**2.01** DS 208B-L1 and -L1A (Fig. 2) consists of 18 HG-type circuit packs (CPs), while DS 208B-L1B (Fig. 3) uses only 15 CPs. The CPs and an 83A power unit are mounted in an extruded aluminum housing equipped with two (front and rear) black plastic covers. Overall exterior dimensions are: 16 inches wide, 4-1/4 inches high, and 11-1/2 inches deep. It weighs approximately 20 pounds when fully equipped with CPs. A summary of the CPs used in each of the DS 208B-type is presented in Table A.

**2.02** DS 208B-type can be mounted in either 19- or 23-inch racks or in a KS-20018-L15 or -L17 cabinet. For rack or cabinet mounting, the data set must be equipped with a D-180467 mounting bracket kit (Fig. 4). The mounting bracket kit must be ordered separately. The data set will operate in an ambient temperature range of 40 to 120°F and a relative humidity range of 20 to 95 percent. See Part 4C for thermal considerations.



Fig. 1—Data Set 208B-Type With 2565HK Telephone Set

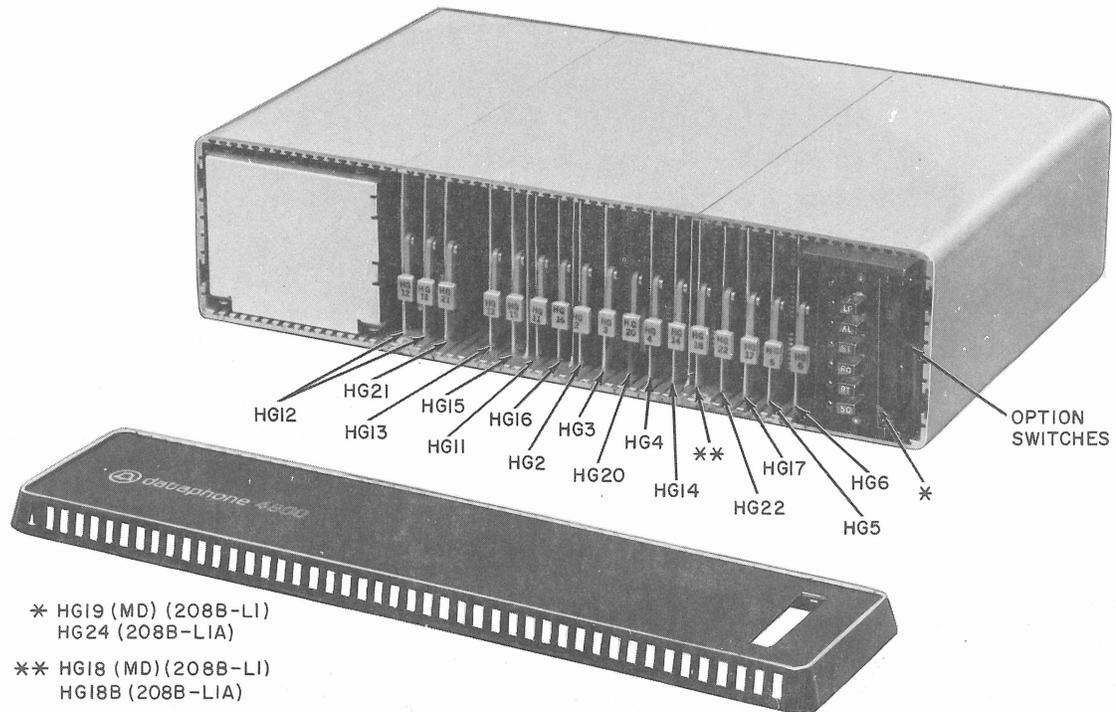


Fig. 2—Data Set 208B-L1 or -L1A—Front View With Cover Removed

**2.03** DS 208B-type provides two interface connectors and a power cord connector at the rear of the set (Fig. 5). The customer interface connector is a KS-19087-L2 female connector. It requires that the customer interface cord be equipped with a plug such as a DB-19604-432 plug manufactured by Cannon or Cinch. In addition, a DB-51226-1 (or equivalent) hood manufactured by Cinch is recommended to protect the connection, anchor the cable to the plug, provide a finger grip for easy insertion or removal of the plug, and provide a positive screw-in locking arrangement for the plug. The telephone set interface is a KS-19088-L2 male connector. An M13F cord (5-foot 6-inch) is supplied with the data set for connection to the telephone set. The M13F cord can be extended up to 200 feet by use of a separately ordered B25A cable.

**2.04** A 6-foot-long KS-14532-L24 power cord is supplied with the data set. One end is a Twist-lock female connector that connects to the power connector on the data set. The other end is a three-prong male connector for connecting to the customer supplied ac outlet.



*The customer-provided ac outlet must not be under control of a switch.*

#### B. Power Unit Requirements

**2.05** DS 208B-type 83A power unit requires an ac input of 105 to 129 volts, 57 to 63 Hz. The outputs of the 83A power unit are +5, -6, +12, and -12 volts dc. Total power consumption of DS 208B-type is approximately 26 watts.

**2.06** An output shutdown and an alarm signal are provided in the 83A power unit in the event that an over-voltage condition should occur. The output voltage level and over-voltage protection and alarm level are factory adjusted and should not require adjustment in the field. However, if adjustment is found to be necessary, the procedures are given in Part 5 of this section. If an over-voltage condition should occur, the ac power cord must be momentarily disconnected from the customer-provided outlet to reset the over-voltage protection and alarm circuit.

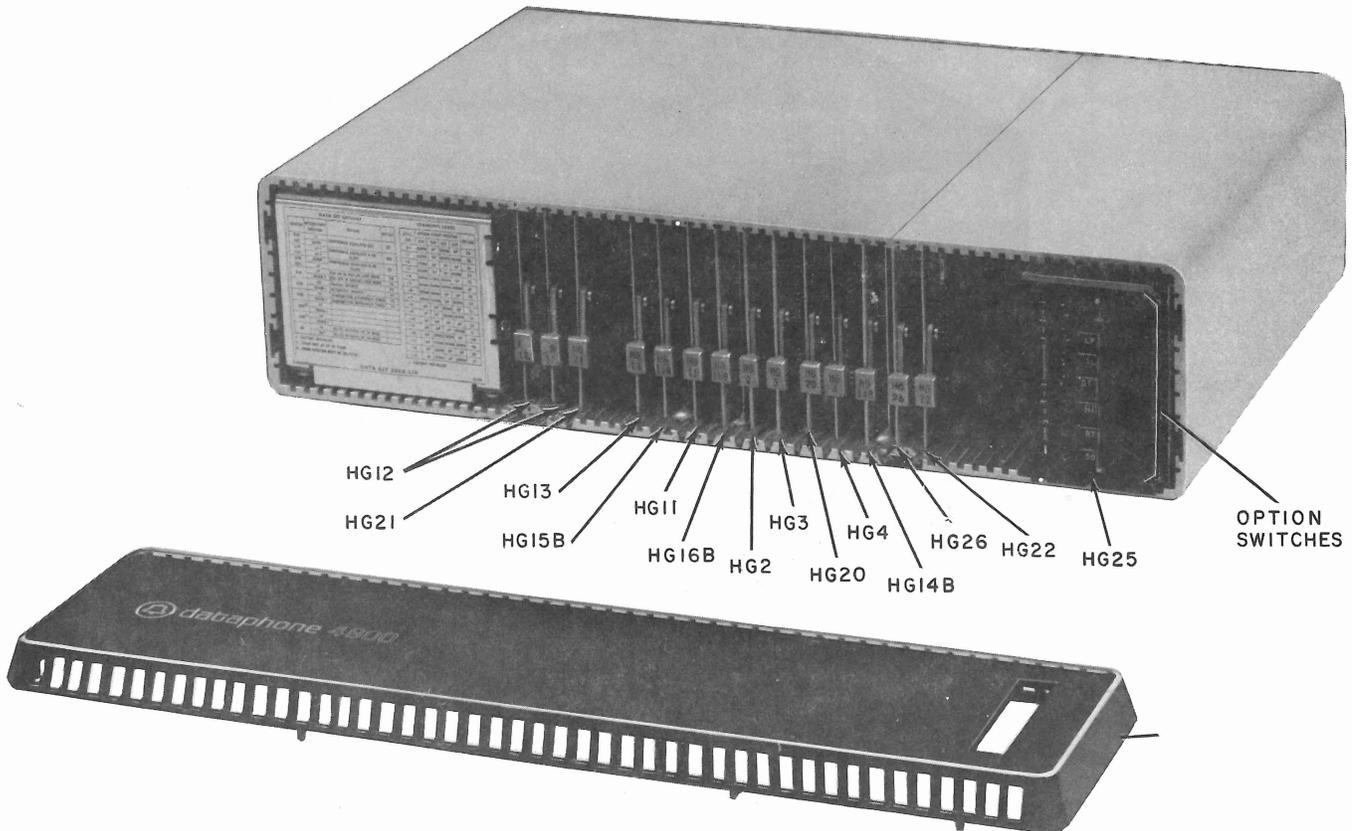


Fig. 3—Data Set 208B-L1B—Front View With Cover Removed

**2.07** The data set protective ground lead is established through the third wire ground lead of the ac power cord. This also grounds the data set chassis and housing to the local building power ground.

**Caution:** *The data set and terminal equipment should be tied to the same building power ground. This will eliminate ground potential differences which could adversely affect performance or damage the data set electronic circuitry.*

The data set protective ground and signal ground are tied together by a factory installed strap. This makes the data set less susceptible to power line noise. The signal-ground-to-protective-ground strap may be disconnected at the customer's request provided due consideration has been given to possible noise conditions, ground potential differences, local electrical codes, and data terminal manufacturer recommendations.

### C. Customer Interface

**2.08** The point of connection between DS 208B-type and the terminal equipment is the customer interface. The customer must supply the plug and the necessary cable to connect the terminal equipment to the data set. **The customer interface cable must not exceed 50 feet in length.**

**2.09** Signals on all but three of the DS 208B-type customer interface leads (leads 16, 18, and 25) meet requirements of EIA Standards RS-232-C (Table B). The peak individual distortion of the signal element (bit) timing circuits and the isochronous distortion of data circuits conform to EIA Standard RS-334.

**2.10** All voltage levels on the customer interface leads are with respect to signal ground. For control leads **from** the customer-provided equipment (CPE) (data set terminators), an **on** condition is a voltage between +3 and +25 volts;

→TABLE A←

## CIRCUIT PACK COMPLEMENT FOR DATA SETS 208B-TYPE

208B-L1 (MD)	208B-L1A (MD)	208B-L1B
HG2	HG2	HG2
HG3	HG3	HG3
HG4	HG4	HG4
HG5 (A&M)	HG5 (A&M) (Note 1)	—
HG6 (A&M)	HG6 (A&M) (Note 1)	—
HG11	HG11	HG11
HG12 (Note 2)	HG12 (Note 2)	HG12 (Note 2)
HG13	HG13	HG13
HG14 (MD) (Note 3)	HG14 (MD) (Note 3)	HG14B
HG15 (MD) (Note 3)	HG15 (MD) (Note 3)	HG15B
HG16 (MD) (Note 3)	HG16 (MD) (Note 3)	HG16B
HG17 (A&M)	HG17 (A&M) (Note 1)	—
HG18 (MD) (Note 4)	HG18B (A&M) (Note 6)	—
HG19 (MD) (Note 5)	—	—
HG20	HG20	HG20
HG21	HG21	HG21
HG22	HG22	HG22
—	HG24 (A&M) (Note 6)	—
—	—	HG25
—	—	HG26

*Note 1:* CP HG5, HG6, and HG17 in DS 208B-L1A are replaced by CP HG26 in DS 208B-L1B.

*Note 2:* Two CP HG12 required in each data set.

*Note 3:* CP HG14B, HG15B, and HG16B are direct replacements for CP HG14, HG15, and HG16, respectively.

*Note 4:* CP HG18 in DS 208B-L1 is replaced by CP HG18B in DS 208B-L1A.

*Note 5:* CP HG19 in DS 208B-L1 is replaced by CP HG24 in DS 208B-L1A. When a CP HG24 is installed in a DS 208B-L1, CP HG18 *must also* be replaced with a CP HG18B.

*Note 6:* CP HG18B and HG24 in DS 208B-L1A are replaced by CP HG25 in DS 208B-L1B.

an **off** condition is a voltage between -3 and -25 volts. For control leads *to* the CPE (data set drivers), an **on** condition is a voltage between +5 and +25 volts; an **off** condition is a voltage between -5 and -25 volts. The transmit and receive data leads are in the **marking** condition when the voltage present is more negative than -3 volts and in the **spacing** condition when the voltage is

more positive than +3 volts. Table C gives a summary of EIA data and control lead signal states.

**2.11** The terminating impedance of the receiving end of a customer interface circuit has a dc resistance of not less than 3 kohms and not more than 7 kohms over the range of voltages for which the signal is defined (-25 to +25 volts except for

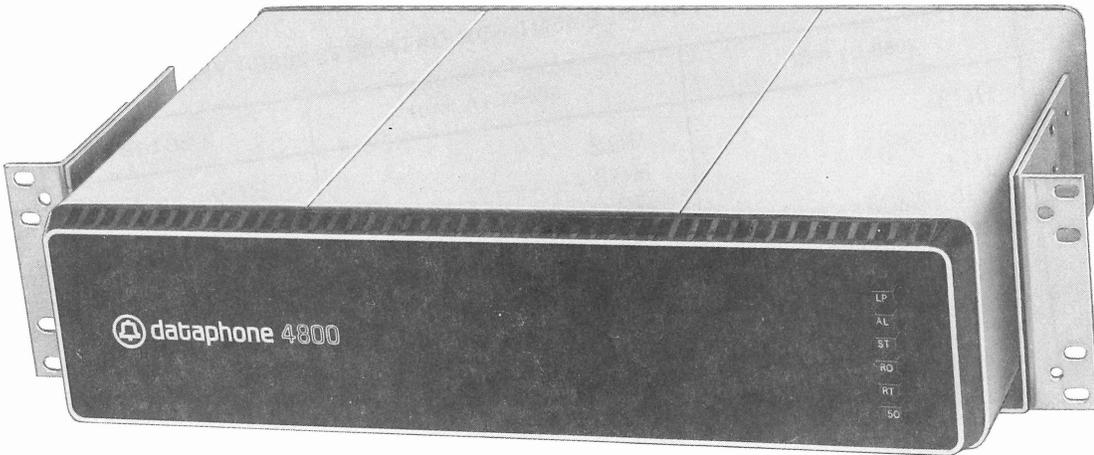


Fig. 4—Data Set 208B-Type With D-180467 Mounting Bracket Kit Installed—Front View

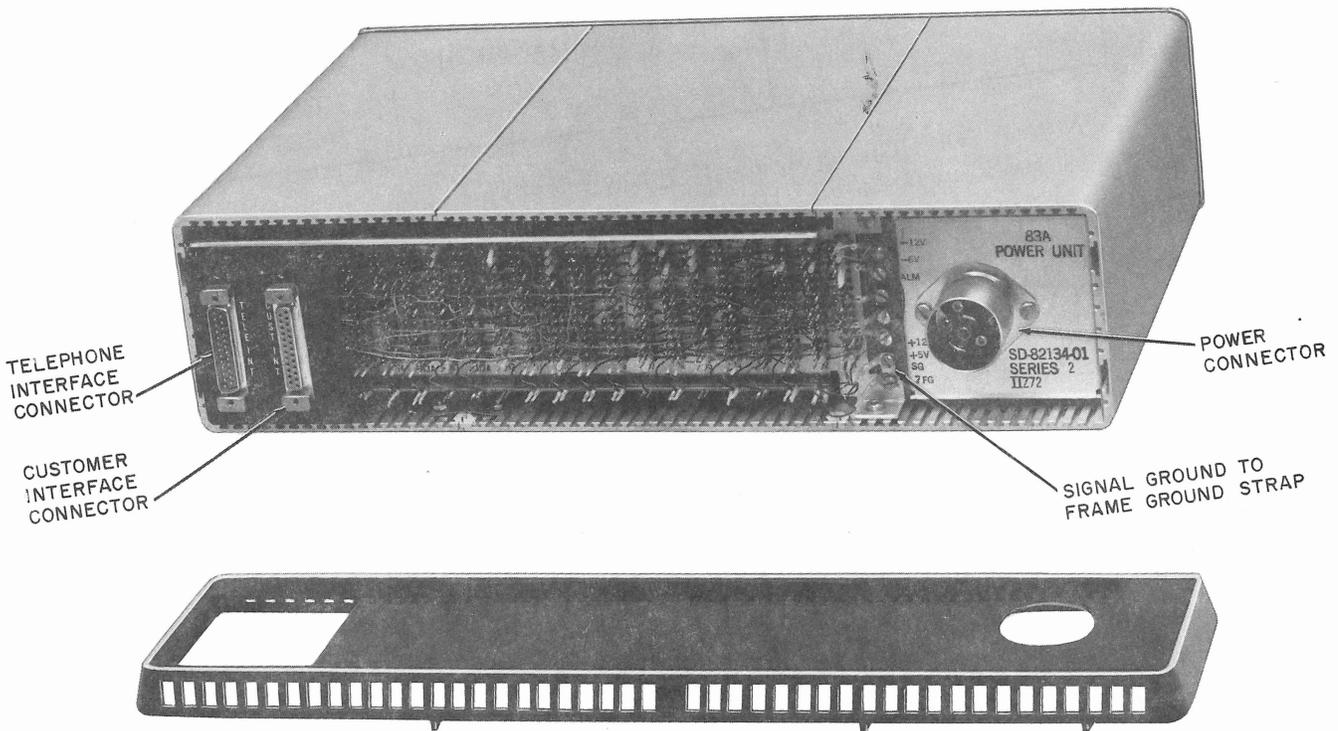


Fig. 5—Data Set 208B-Type—Rear View With Cover Removed

TABLE B

## CUSTOMER INTERFACE CONNECTOR PIN ASSIGNMENTS

PIN NO.	NOTE 1	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
1	—	Frame Ground	FG	AA
2	T	Send Data	SD	BA
3	D	Receive Data	RD	BB
4	T	Request to Send	RS	CA
5	D	Clear to Send	CS	CB
6	D	Data Set Ready	DSR	CC
7	—	Signal Ground	SG	AB
8	D	Carrier On	COD	CF
9	—	+12V	CI9 (+12V)	Reserved for Data Set Testing
10	—	-12V	CI10 (-12V)	Reserved for Data Set Testing
15	D	Serial Clock Transmitter	SCT	DB
16	D	Divided Clock Transmitter (Note 2)	DCT	SBB (Note 3)
17	D	Serial Clock Receiver	SCR	DD
18	D	Divided Clock Receiver (Note 2)	DCR	Unassigned
20	T	Data Terminal Ready	DTR	CD
22	D	Ring Indicator	RI	CE
24	T	Serial Clock Transmitter External	SCTE	DA
25	—	+5V (Note 2)	CI25 (+5V)	Unassigned

*Note 1:* T = terminator; D = driver.

*Note 2:* Functions not defined by EIA Standard RS-232-C.

*Note 3:* DS 208B uses pin 16 for a different function than that specified by EIA Standard RS-232-C.

TABLE C

**CUSTOMER INTERFACE  
DATA AND CONTROL LEAD EIA SIGNAL STATE**

LEAD	VOLTAGE	
	NEGATIVE (BINARY 1)	POSITIVE (BINARY 0)
Data	Mark	Space
Control	Off	On

the region of -3 to +3 volts, which is the region of indecision). When the interface plug is disconnected, the interface voltage on terminating circuits is less than -2 to +2 volts.

**2.12** Operation of DS 208B-type circuitry that terminates an interface lead is dependent only on the signal voltage on the interface lead and conforms to EIA Standard RS-232-C with regard to rise and fall time. On control leads, the time required for the signal to pass through the transition region (-3 to +3 volts) during a change in state does not exceed 1 ms. On received data, receive signal element timing, and transmit signal element timing circuits, the rise and fall time through the transition region does not exceed 8  $\mu$ s. The rise and fall times of transmitted data and transmitter signal element external (if used) signals from the terminal equipment should also conform to the above limits.

**2.13** The open circuit driver voltage on any DS 208B-type interface circuit does not exceed -25 or +25 volts. All DS 208B-type interface circuit terminators will withstand any input signal that is within the -25 to +25 volt limits. The interface driver circuits are such that when the proper terminating impedance (3 kohm to 7 kohm) is provided and the terminator open circuit voltage is zero, the voltage at the point of interface is between +5 and +15 volts or -5 and -15 volts.

**2.14** The DS 208B-type interface connector provides 15 EIA interface circuits for connection to terminal equipment and three additional non-EIA circuits for use with telco test equipment. Table B gives pin assignments for each interface circuit along with the circuit function, EIA designation, and mnemonic designation. Seven of the interface connector pins (11, 12, 13, 14, 19, 21, and 23) are

not used. The following are descriptions of the operation of each circuit, signals appearing on each circuit, and direction of signal flow.

- (a) **Protective Ground (AA):** This lead is electrically bonded to the data set housing and chassis. It is connected to local power ground through the third wire of the power cord.
- (b) **Transmitted Data (BA):** Mark and space signals generated by the terminal equipment are delivered to DS 208B-type on this lead. The data set samples the signals on this lead on the negative transition (**on** to **off**) of the transmitter signal element timing (DB) signal or the clock signal provided by the terminal equipment on the DA lead for externally timed data sets. Terminal equipment must be arranged to transmit data on this lead only when an **on** voltage is detected on both the clear-to-send (CB) and data set ready (CC) leads.

**Note:** If the data set is equipped with option YN and the analog loop-back test mode is selected, the CC lead will be **off**. However, the terminal equipment can transmit test data on the BA lead (see Part 3E).

- (c) **Received Data (BB):** Mark and space signals generated by DS 208B-type in response to data signals received from the distant end data set are delivered to the terminal equipment on this lead. The data signals are clocked to the terminal equipment and the terminal equipment is timed to sample the data signals by negative transitions (**on** to **off**) of the received signal element timing (DD) signals. An **off** voltage on the received line signal detector (CF) lead causes this lead to be clamped in the mark condition. When the data set is in any of the test modes

(see Part 3C), the test data signals are applied to the BB lead.

(d) **Request-to-Send (CA):** When the terminal equipment is ready to transmit data, an **on** voltage (generated by the terminal equipment) is delivered to the data set on this lead. This causes the data set to enter the transmit mode. While the data set is in this mode, the receiver is disabled, an **off** voltage is applied to the CF lead, and the BB lead is clamped to the mark condition. Therefore, the data set cannot be used to provide local copy of transmitted data. After the **on** voltage is applied to this lead, the terminal equipment must wait for the data set to apply an **on** voltage to the clear-to-send (CB) lead before starting to transmit data. To minimize the variation in the nominal CA-CB delay, the positive transition (**off** to **on**) of the CA lead should coincide with a positive transition on the divided clock transmitter (DCT) lead. At the end of a message transmission, an **off** voltage is applied to the CA lead. Approximately 2 ms later, the data set transmitter is turned off. The 2 ms delay is provided to ensure that the last few data bits have cleared the transmitter before it is turned off.

(e) **Clear-to-Send (CB):** Signals on this lead are generated by DS 208B-type to indicate to the terminal equipment whether or not the data set is ready to transmit data. When the data set detects an **on** voltage on the CA lead, it will wait approximately 50 (48 to 49) ms or 150 (135 to 170) ms and then apply an **on** voltage to the CB lead. The duration of the CB response to CA signal is a customer option that is selected with the "50" switch at the front panel of the data set. This delay allows the adaptive equalizer of the remote data set to train itself and get into synchronization before data transmission begins. As long as the **on** voltage is maintained on the CB lead, the data set will transmit all data presented to the BA lead. When the data set detects an **off** voltage on the CA lead, it will apply an **off** voltage to the CB lead. The **off** voltage on CB will be maintained as long as the **off** voltage is present on the CA lead. This indicates to the terminal equipment that the data set is not ready to transmit. The terminal equipment must be equipped to not present data to the BA lead while an **off** voltage is applied to the CB lead.

(f) **Data Set Ready (CC):** Signals on this lead are generated by the data set to indicate to the terminal equipment whether or not the data set is in the data mode. The data set generates **on** or **off** voltages on this lead in response to the voltage detected on the data terminal ready (CD) lead in conjunction with the request-to-send (CA) and clear-to-send (CB) circuits. An **on** voltage on the CC lead indicates to the terminal equipment that the data set is connected to the line, the start-up sequence is complete, and the data set is in the data mode and ready to transmit data signals. A CC **on** voltage is required in conjunction with CA and CB **on** voltages when the data set is transmitting data. An **off** voltage on the CC lead indicates that the data set is in a test, talk, call setup, or on-hook mode.



**The CC lead indication alone cannot be used to indicate that a communication channel has been established to a distant end data set or used to determine the status of any remote end terminal equipment.**

**Note:** An option (YM) is provided in DS 208B-type that causes the CC lead to be clamped **on** when the data set is in the analog loop-back test mode (see Part 3C). When this option is installed in the data set and the analog loop-back test mode is selected, the data set will indicate to the terminal equipment that it is in the data mode even though it is not connected to the telephone line.

(g) **Signal Ground (AB):** This lead establishes a common ground reference point for all of the interface leads except AA. It is normally connected to AA by a factory installed strap. This minimizes the introduction of longitudinal power line noise into the electronic circuitry through the power transformer. Depending on local procedures and conditions, the AA to AB strap can be removed by the telco installer.

(h) **Received Line Signal Detector (CF):** When the data set detects a data carrier signal level that is above its receiver threshold for a minimum of 44 to 50 ms, it will deliver an **on** voltage to the terminal equipment on this lead. The 44 to 50 ms requirement prevents the data set from generating an **on** voltage on

the CF lead because of transmission circuit noise or other spurious interference. The data set will apply an *off* voltage to this lead whenever the line signal level drops below the receiver threshold for more than approximately 8 ms. An *off* voltage on CF causes the BB lead to be clamped to the marking condition. When an *on* voltage is applied to the CA lead, the data set generates an *off* voltage on the CF lead and the data set receiver is disabled.

- (i) **Pins 9 and 10:** These leads are reserved for use by telco personnel in data set testing. Pin 9 provides access to the data set +12 volt dc supply and pin 10 to the data set -12 volt dc supply.

**Caution: Terminal equipment MUST NOT be connected to these leads.**

- (j) **Transmitter Signal Element Timing (DB):** At station arrangements that are *internally* timed, (ie, timed by the data set) the data set 4800-Hz internal clock signals are delivered to the terminal equipment on this lead. This provides the terminal equipment with signal element timing for the transmitted data (BA) lead. The negative transition (*on* to *off*) of the signal on this lead occurs at the same time as the nominal center of each data bit on the BA lead. The 4800-Hz signal will always be present on this lead so long as ac power is supplied to the data set. When the data set reaches the clear-to-send status during the initiation of a message transmission, the application of the *on* voltage to the CB lead will be triggered by a positive transition (*off* to *on*) of the signal on the DB lead. The terminal equipment may present the first bit of data to the BA lead on the first positive transition of the DB signal that is coincident to the *on* condition of the CB lead, but it is not necessary that the first bit be presented on the first transition. At station arrangements that are *externally timed*, the data set timing signal is provided by the terminal equipment on the transmitter signal element timing external (DA) lead. In this case, the signal on the DB lead will be phase-locked to the signal on the DA lead.

- (k) **Divided Clock Transmitter (DCT):** The data set delivers a 1600-Hz square-wave signal to the terminal equipment on this lead. This is a non-EIA (ie, not defined by RS-232-C)

signal derived from the data set 4800-Hz internal clock signal. Positive transitions of the DCT signal occur simultaneous to every third positive transition of the DB signal and the negative transitions of the DCT signal occur simultaneous to every third negative transition of the DB signal. This signal controls the rate at which phase changes are made in the transmitted line signal. The data set requires three data bits to determine the degree of each phase change. The grouping of the three data bits is established by the transitions on the DCT lead so that for one cycle of the DCT signal, three data bits are encoded into one phase shift. The 1600-Hz signal is always present on this lead so long as ac power is supplied to the data set.

- (l) **Receiver Signal Element Timing (DD):**

The data set delivers a 4800-Hz square-wave signal to the terminal equipment on this lead. This signal provides the terminal equipment with receiver signal element timing information. The negative transitions (*on* to *off*) of the DD signal indicate the center of each data bit on the BB lead. The 4800-Hz signal is always present on this lead so long as ac power is supplied to the data set.

- (m) **Divided Clock Receiver (DCR):** The

data set delivers a 1600-Hz square-wave signal to the terminal equipment on this lead. This is a non-EIA signal derived from the data set 4800-Hz internal clock signal. Positive and negative transitions of the DCR signals are simultaneous to every third positive and negative transition of the DD signal. This signal provides the terminal with a reference for defining the three-bit grouping for the decoded phase shifts of the received line signals. This means that in one cycle of the DCR signal, three data bits that were encoded into a phase shift by the distant end DS transmitter, are decoded into three data bits with the same sequential relationship that existed at the transmitter. The 1600-Hz signal is always present on this lead so long as ac power is supplied to the data set.

- (n) **Data Terminal Ready (CD):** The

terminal equipment delivers *on* and *off* voltages to the data set on this lead. The terminal equipment applies an *on* voltage to this lead when it is ready to go into the data mode. When the data set has connected to the line and the start-up sequence is completed, it

will generate an **on** voltage on the CC lead. The **on** voltage must be applied to the CD lead throughout the entire message transmission. When the data set is arranged to answer incoming calls automatically, an **on** voltage must be present on the CD lead before the data set will go off-hook and initiate the start-up sequence. To disconnect the data set from the line at the end of a message transmission, an **off** voltage must be applied to the CD lead until an **off** voltage is detected on the CC lead (approximately 10 ms).

(o) **Ring Indicator (CE):** The data set delivers **on** and **off** voltages to the terminal equipment on this lead. When the data set detects ringing voltage on the line, it generates an **on** voltage on the CE lead. Between bursts of ringing voltage and at all other times when ringing voltage is not present on the line, the data set generates an **off** voltage on the CE lead. The data set will continue to apply an **on** voltage to this lead every time it detects ringing until the terminal equipment applies an **on** voltage to the CD lead or the station attendant answers the call manually.

(p) **Transmitter Signal Element Timing External (DA):** At stations arranged for external timing, the terminal equipment delivers the bit rate timing signal to the data set on this lead. The negative transitions (**on** to **off**) of the signal on this lead coincide with the center of each data bit on the BA lead. The frequency of the DA signal must be 4800 Hz  $\pm$ 0.01 percent with a maximum peak individual distortion level on the negative transitions (**on** to **off**) of 0.5 percent (per EIA Standard RS-334). With this arrangement, signals on the DB lead will be phase-locked to this signal. In addition, signals on the DCT lead will be derived from the DA signal rather than the data set 4800-Hz internal clock signals. When required, the DA signal must be present at all times that the data set is in service.

(q) **Pin 25:** This lead is reserved for use by telco personnel in data set testing. It provides an access to the data set +5 volt dc supply. This lead is a non-EIA circuit.

**Caution: Terminal equipment MUST NOT be connected to pin 25.**

#### D. Telephone Set Interface

2.15 The point of connection between DS 208B-type and the 565HK-type telephone set is the telephone set interface. An M13F cord is supplied with DS 208B-type for connecting the TEL INT connector of the data set to the telephone set cord. The data set/telephone set interface for a single DS 208B-L1 or -L1A installation without an ACU is shown in Fig. 6; for a single DS 208B-L1B installation without an ACU, see Fig. 7. The designation, function, and TEL INT connector pin assignment for each telephone set interface lead are given in Table D.

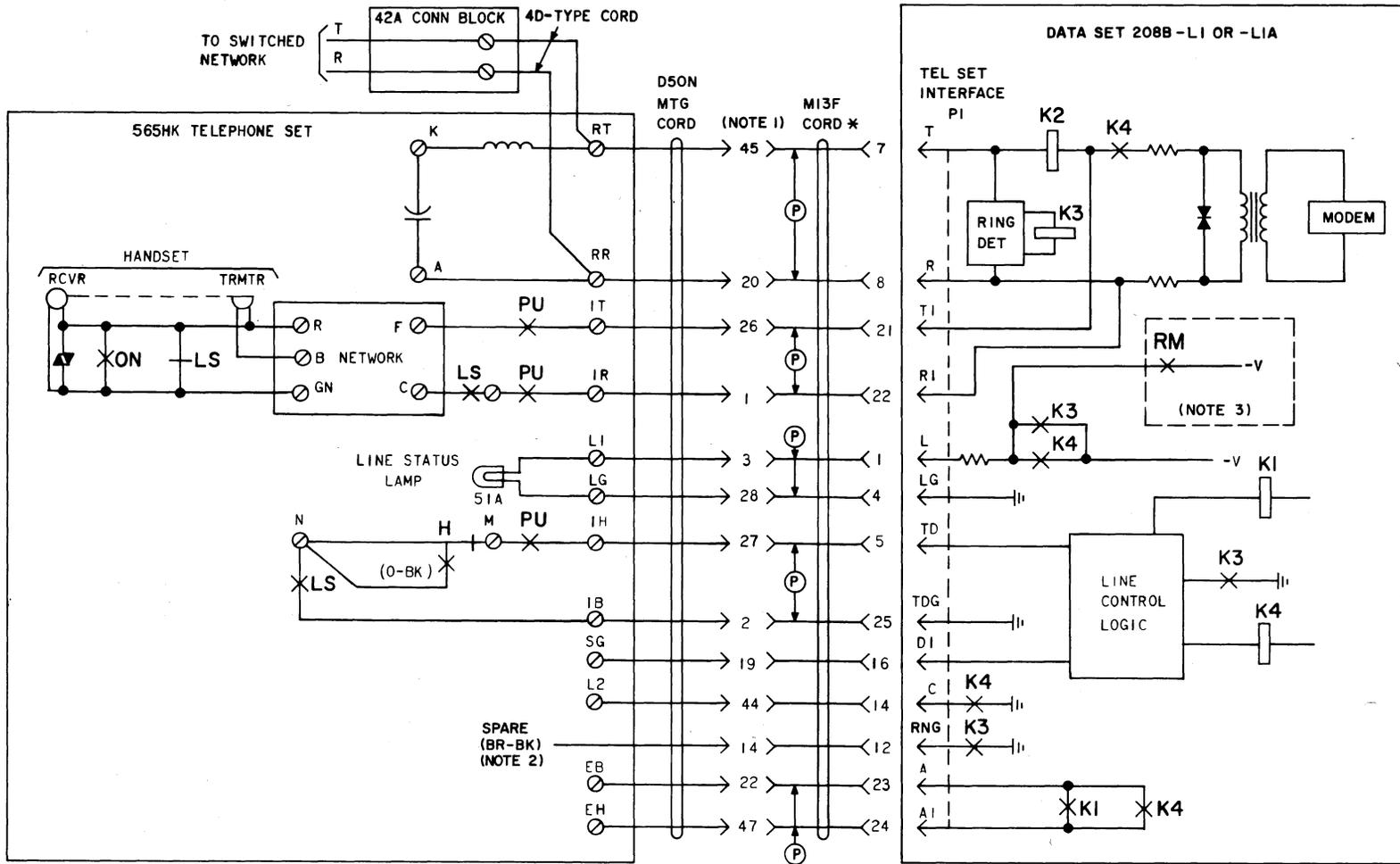
#### E. Data Set/ACU Interface

2.16 The DAS 801-type ACU/data set interface connection is made via a 149B adapter and/or a KS-21253-L3 adapter. Connection to the ACU and data set through the 149B adapter and the KS-21253-L3 adapter are shown in Fig. 8 and 9, respectively. Functions of the data set/ACU interface leads are as follows:

(a) **R (BL-W):** This lead connects the ACU to the ring lead of the telephone line. When the ACU is in the idle state, this lead is connected through to the DR lead. Upon receiving a request to automatically originate a call from the terminal equipment, the ACU disconnects the R lead from the DR lead and connects it to ground. The serving CO recognizes the ground on the ring lead as a service request and applies ground to the tip lead. When the call setup is completed, the ACU reconnects the R lead to the DR lead for data transmission.

(b) **T (W-BL):** This lead connects the ACU to the tip lead of the telephone line. When the ACU is in the idle state, this lead is connected to the DT lead. Upon receiving a request to automatically originate a call from the terminal equipment, the ACU disconnects the T lead from the DT lead and monitors it for ground. When ground is detected on the T lead for a minimum of 250 ms, the ACU signals the terminal equipment that it is ready to dial the call. When the call setup is completed, the ACU reconnects the T lead to the DT lead for data transmission.

(c) **DR (W-G) and DT (G-W):** These leads connect the ACU to the data set ring and tip leads, respectively. When the ACU is



- NOTES:
1. CAN BE EXTENDED UP TO 200 FEET BY USE OF B25A CABLE
  2. INSULATE AND STORE
  3. -LIA SET ONLY (RING MEMORY)
- Ⓟ DENOTES PAIR

Fig. 6—Data Set 208B-Type/Telephone Set Interface



TABLE D  
TELEPHONE INTERFACE

PIN	DESIGNATION	FUNCTION
1	L (Lamp)	Used to light lamp on associated telephone set when ringing is received or data set is in data mode or ring memory is set in the called -L1A data set during both talk and data modes.
2	-12V	Provides voltage for test purposes.
3	+5V	Provides voltage for test purposes.
4	LG (Lamp Ground)	Provides ground path for lamp on associated telephone set.
5	TD (Talk-Data)	A ground on this lead indicates to the data set that the associated telephone is in talk mode.
7	T (Tip)	Tip of telephone line (from CO).
8	R (Ring)	Ring of telephone line (from CO).
12	RNG (Ringing)	Provides ground indication during ringing.
14	C	Provides ground to ACU when data set is in data mode.
16	D1	ACU places ground on this lead when end of answer tone has been detected.
21	T1	Tip of telephone line (internal).
22	R1	Ring of telephone line (internal).
23	A	A lead control.
24	A1	A lead control.
25	TDG	Talk-Data-Ground lead.

in the idle state, the DR lead is connected to R and the DT lead is connected to T by the ACU. While originating a call, these connections are opened.

(d) **G (O-W)**: This lead connects the ACU signal ground to the data set TDG and A1 leads.

(e) **TK (W-O)**: When the data set is in either talk mode or data mode, it delivers a ground to the ACU on this lead.

(f) **C (BR-W)**: When the data set is in data mode, it delivers a ground to the ACU on this lead. This causes the ACU to indicate to the terminal equipment that the data set is busy which inhibits any requests for call origination.

(g) **D1 (W-BR)**: When the ACU detects the end of answer tone from the distant end data set, it delivers a ground to the local data set on this lead. This ground causes the local data set to bypass the 2-second quiet interval and the 2-second answer tone sequence.

NOTES:

1. OPTIONS FOR 801 WILL BE SPECIFIED ON THE SERVICE ORDER. REFER TO 598-010-201 AND 598-012-201 FOR INSTALLING AND REMOVING OPTIONS.
2. FOR MULTIPLE INSTALLATION USING KS-21253-L3 ADAPTER, REMOVE STRAPS 2A-2B AND 1A-1B; ADD STRAPS 2A-11B AND 1A-12B. THE T AND R LEADS LABELED "TO SWITCHED NETWORK LINE" ARE NOT REQUIRED.
3. EXTEND, IF NECESSARY, WITH B25A CABLE.

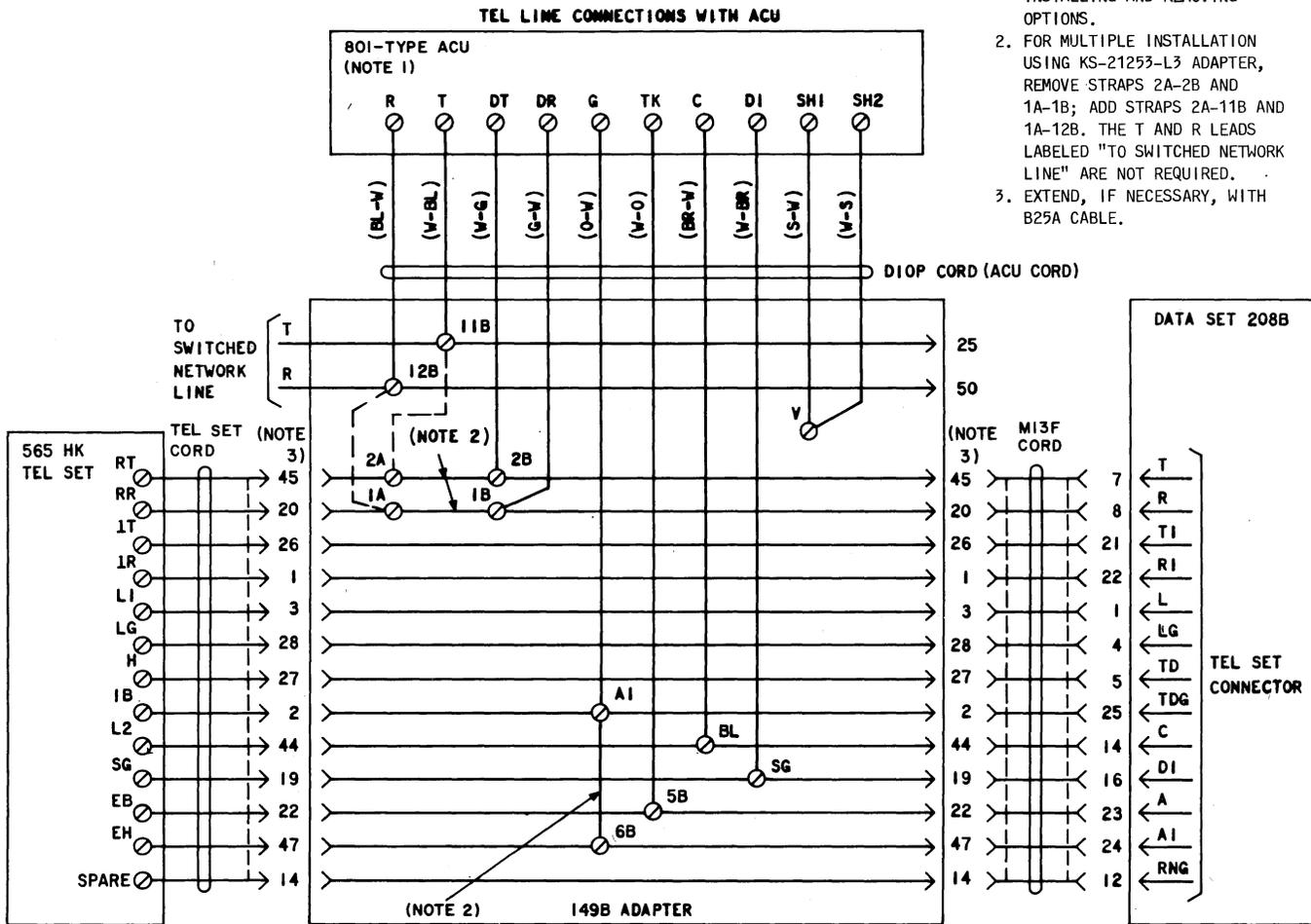


Fig. 8—Single Data Set 208B-Type Installation With ACU—Connection Diagram

(h) **SH1 (S-W) and SH2 (W-S):** These two leads are not used by DS 208B-type.

**F. Operating Controls**

**2.17** Operating controls for DS 208B-type are provided by the 565HK-type telephone set and the test switches on the front of the data set (Fig. 1). The controls provided by the telephone set are as follows:

- (a) **LINE Buttons:** These buttons are used to select the line associated with the data set to be used to transmit data when manually originating a call or to select the proper line when manually answering an incoming call.
- (b) **DATA Button:** This button is used to transfer the data set from talk mode to

data mode when a manually answered or originated call is set up.

**2.18** Five test switches are provided on the front of the data set. These switches provide the means for the customer or a telco employee to isolate most troubles to the transmission facility, data set, or terminal equipment without the use of any other test equipment. The five switches are:

- LP—Lamp test (nonlocking)
- AL—Analog loop (locking)
- ST—Self test (locking)
- RO—Receive only (locking)

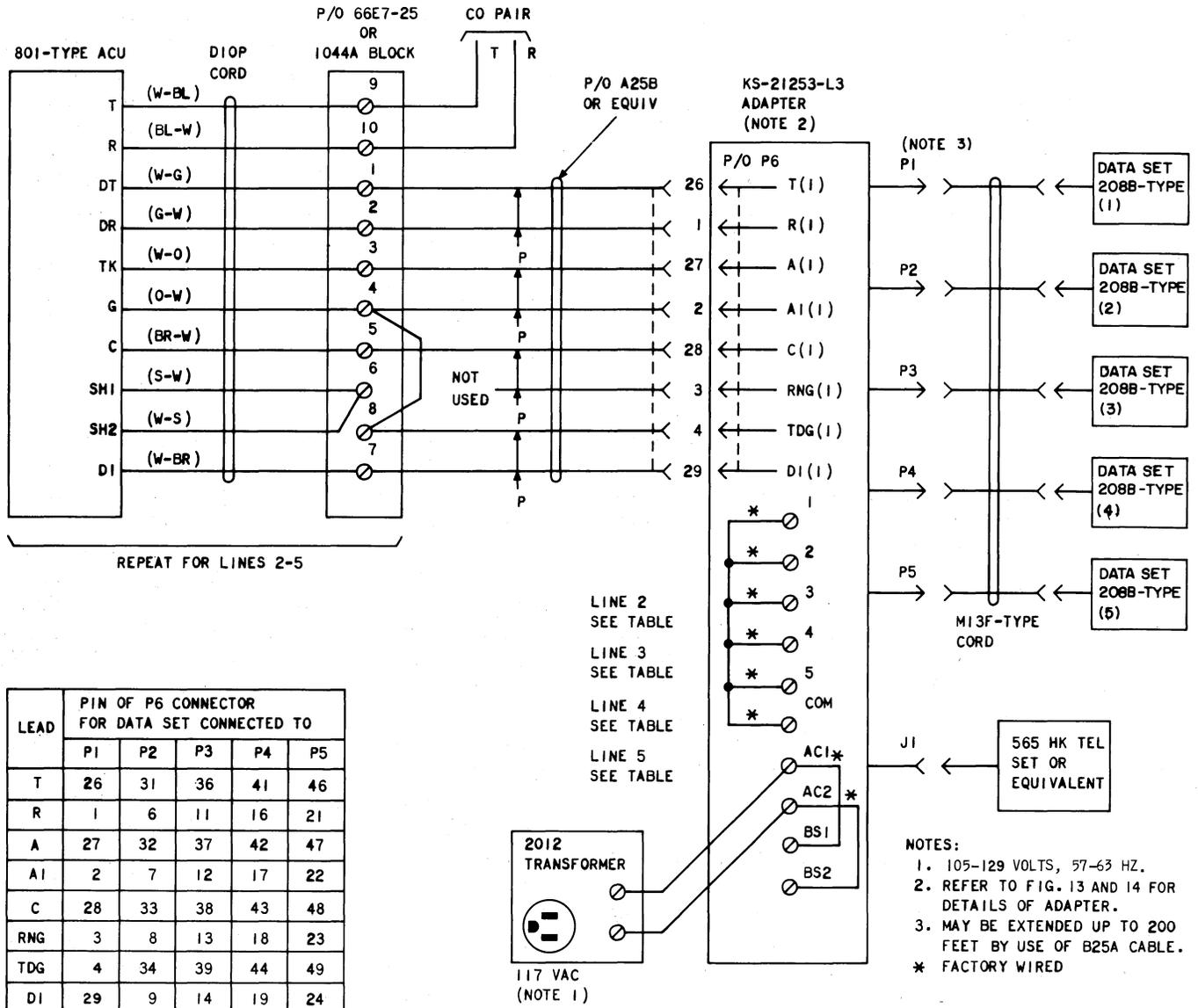


Fig. 9—Multiple Data Set 208B-Type Installation Using P6 of KS-21253-L3 Adapter for ACU Access—Connection Diagram

- RT—Remote test (locking).

For a functional description of the features provided by these switches, refer to Part 3C.

### G. Operating Adjustments

2.19 The only operating adjustments required for DS 208B-type are the compromise equalizer and transmitter output level settings. Both of these adjustments are under control of option switches on CP HG24 (DS 208B-L1A), CP HG19 (DS 208B-L1),

or CP HG25 (DS 208B-L1B). A detailed description of these adjustments is given in Part 3E.

## 3. FUNCTIONAL DESCRIPTION

### A. Transmitter (Fig. 10)

3.01 The DS 208B-type transmitter accepts customer data on the BA interface lead, scrambles and encodes this data as discrete phase changes in the carrier signal, and shapes the carrier signal into a waveform suitable for transmission on the

2-wire switched network. It basically consists of the following six circuits:

- Transmitter timing (3.02)
- Start sequence controller (3.03)
- Pattern generator and scrambler (3.04)
- Phase modulator (3.05)
- Compromise equalizer (3.06)
- Pad (3.07).

**Note:** In DS 208B-L1B, the first four functions are embodied in the large scale integration (LSI) transmitter chip. Some of the interface leads between circuits discussed below are internal to the LSI chip.

**3.02 Transmitter Timing Circuit:** This circuit generates the various clock signals required by the data set transmitter. These signals are derived from the 460.8- and 28.8-kHz square-wave clocks in the oscillator and common countdown circuit. Countdown in DS 208B-L1B is done internally in the LSI transmitter chip from a 691.2-kHz square wave.

**3.03 Start Sequence Controller Circuit:**

When the RS interface lead is turned *on*, this circuit controls the start sequence. The timing and content of the start-up sequence is given in Fig. 11. The length of one symbol is 0.625 ms. The purpose of the 4-phase idle code (12 to 13 symbols) is to allow the receiver to rapidly recover timing. The 4-phase, 17-bit word is cycled three times (52 symbols). It causes the automatic equalizer to adjust to its final tap gain setting. This completes the 4-phase operation of the data set. The initialization code and customer data is in the 8-phase mode of operation. The initialization code (13 symbols for the 50-ms start-up option or 175 symbols for the 150-ms start-up option) is to allow the scrambler and phase modulator circuits to prepare for the 8-phase mode of operation. At the end of the initialization code, the CB interface lead is turned *on* to inform the customer that the data set is ready to transmit data.

**3.04 Pattern Generator and Scrambler Circuit:** During the start sequence, this circuit supplies the special idle code, 17-bit word,

and initialization code signals to the phase modulator circuit. Once the start sequence is complete (CB is *on*), it converts the serial stream of data being received on the SD lead into the three parallel streams of data required by the phase modulator. The scrambler portion of the circuit is self synchronizing and operates on one of the three streams of parallel data. It randomizes the customer data and allows synchronization and equalization operations of the data set to be independent of customer data patterns. This results in an improved error performance over what would be possible if the data stream were not scrambled.

**3.05 Phase Modulator Circuit:** By definition, phase modulation is the conveyance of information from the transmitter to the receiver by changing the phase of the carrier for each symbol transmitted. The DS 208B-type phase modulator circuit consists of a new phase calculator, two channel binaries, a data selector, and a digital envelope modulator. Phase change information is encoded from the three parallel data inputs (tribits) supplied by the pattern generator and scrambler circuit. A fourth input which is supplied by the data set determines whether the data set is in the 4-phase or 8-phase mode of operation. Table E lists the degrees of phase change provided for each tribit that may be supplied on the three parallel data input (TBA, TBB, and TBC) leads and the mode control input (8 PT) lead. In the modulator, the signal generated by one of the channel binaries (eg, I) is effectively on-line during a particular symbol. At the same time, the new phase calculator determines, from the next tribit of customer data, the phase of the next symbol with respect to the symbol on-line and inserts it into channel binary II. Channel binary I is then taken off-line and channel binary II is put on-line. A new phase is inserted in channel binary I and the process is repeated. The output of the channel binaries are not put on-line suddenly, but are time weighted by the digital envelope modulator, so that the transition from one channel binary output to the other is gradual. Each new phase to be inserted is obtained from the new phase calculator circuit which functions as follows:

- (1) The pattern generator and scrambler circuit feed the next tribit to the new phase calculator (the difference in phase of the new symbol is known according to Table E).

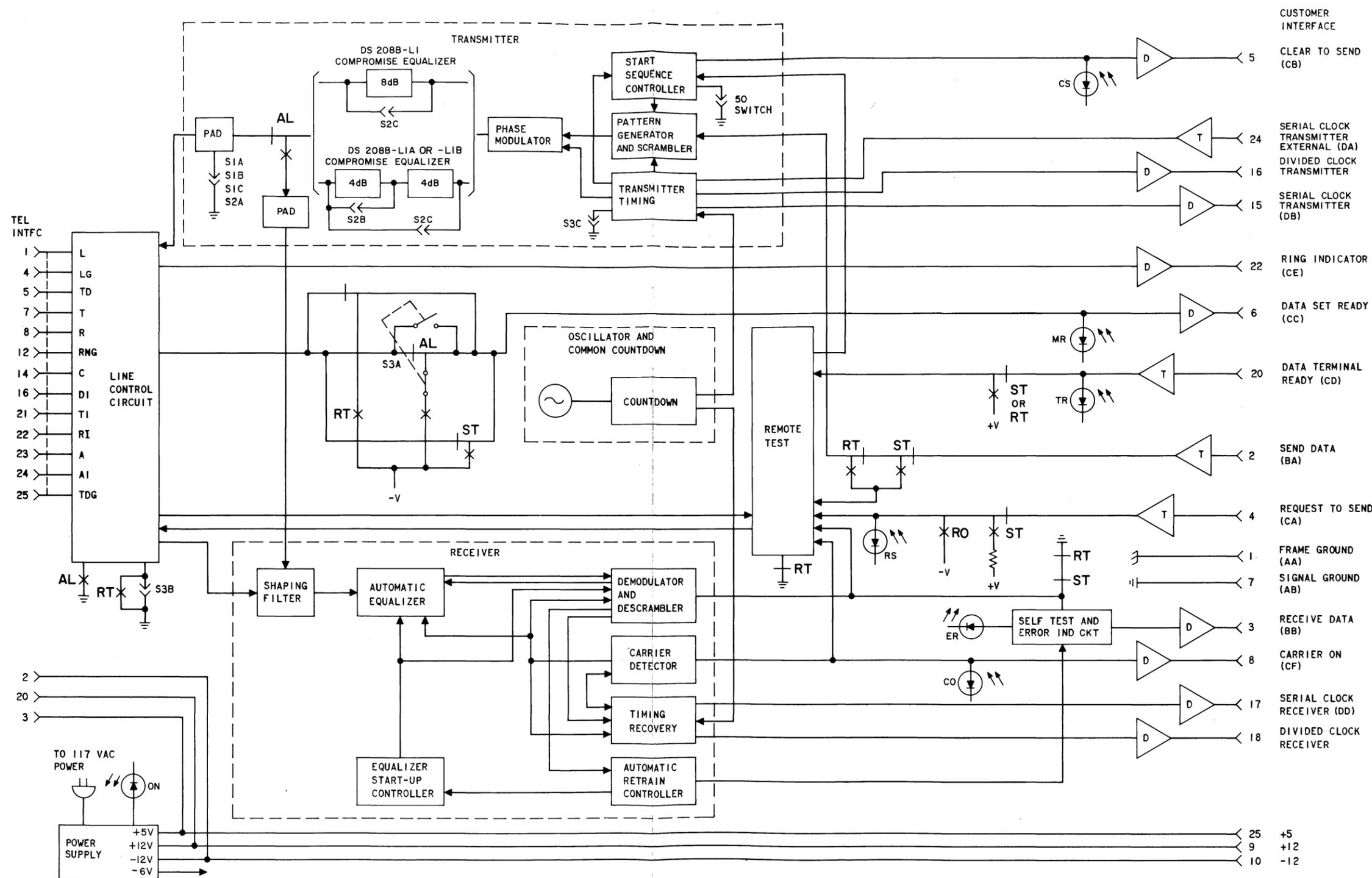


Fig. 10—Data Set 208B-Type—Functional Block Diagram

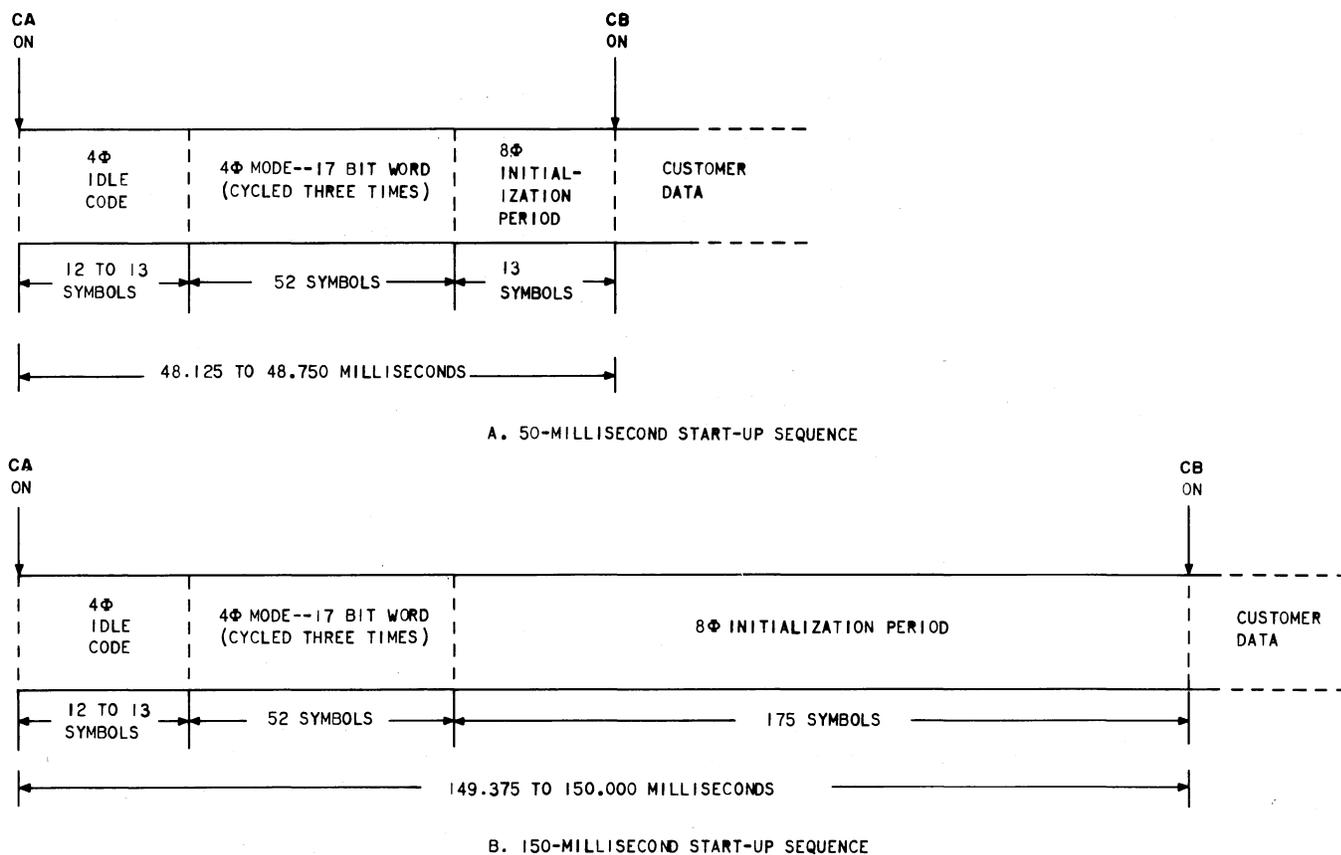


Fig. 11—Data Set 208B-Type Start-Up Sequence Timing and Content

- (2) The data selector portion of the modulator holds the information in the on-line channel binary and feeds it back to the new phase calculator.
- (3) The new phase calculator adds the phase difference (from Table E) of the new symbol to the phase of the on-line channel binary (I) and inserts the sum into the off-line channel binary (II).

**Example:**

Data set in 8-phase mode.  
 Channel binary I = 000 ( $22.5^\circ$ )  
 New symbol = 010 ( $112.5^\circ$  phase difference)  
 $22.5^\circ + 112.5^\circ = 135.0^\circ$   
 $+135^\circ$  phase will be loaded in channel binary II.

- (4) The digital envelope modulator gradually takes channel binary I off-line and puts channel binary II on-line.

**3.06 Compromise Equalizer Circuit:** This circuit is a filter which provides some nominal equalization to compensate for distortion present on the switched telephone network lines. For DS 208B-L1, the compromise equalizer IN (ZS) option (see Part 3D) **must** always be provided for normal operation. At DS 208B-L1A and -L1B installations, it is recommended that the 4-dB slope + symmetric delay (WU) option be initially installed. The 8-dB slope + symmetric delay (ZT) option should only be installed if specifically called for on the service order or circuit layout record card (CLRC). [See 3.19(b) through (f)].

**3.07 Pad Circuit:** This is a variable attenuator which is located on CP HG19 (DS 208B-L1), CP HG24 (DS 208D-L1A), or CP HG25 (DS 208B-L1B). It is used to set the data set transmitter

TABLE E

## PHASE MODULATOR PHASE CHANGES

MODE	PATTERN GENERATOR AND SCRAMBLER INPUTS			DS 8 PT INPUT	MODULATOR PHASE CHANGE (DEGREES)
	TBA	TBB	TBC		
4-Phase	0	0	1	0	45
	0	1	1	0	135
	1	0	1	0	-135
	1	1	1	0	-45
8-Phase	0	0	0	1	22.5
	0	0	1	1	67.5
	0	1	0	1	112.5
	0	1	1	1	157.5
	1	0	0	1	-157.5
	1	0	1	1	-112.5
	1	1	0	1	-67.5
	1	1	1	1	-22.5

output level (options ZA through ZP) so that the line signal reaches the serving CO at the required -12 dBm maximum signal level (see Part 3E).

#### B. Receiver (Fig. 10)

**3.08** The DS 208B-type receiver accepts signals from the telephone line, decodes and descrambles the discrete carrier signal phase changes, converts the received tribits into a serial data stream, and delivers the data to the terminal equipment in the form of EIA voltage signals. It basically consists of the following seven circuits:

- Shaping filter (3.09)
- Automatic equalizer (3.10)
- Equalizer start-up controller (3.11)
- Demodulator and descrambler (3.12)

- Carrier detector (3.13)
- Timing recovery (3.14)
- Automatic retrain controller (3.15).

**3.09 Shaping Filter Circuit:** This circuit band limits the received line signal between 600 and 3000 Hz. It also provides some spectral shaping in that frequency band and delivers its output to the automatic equalizer circuit.

**3.10 Automatic Equalizer Circuit:** This circuit uses information fed back from the demodulator and descrambler circuit to continuously adjust its spectral shaping characteristics to compensate for amplitude and delay distortion introduced by the telephone lines.

**3.11 Equalizer Start-Up Controller Circuit:** This circuit conditions the automatic equalizer

circuit to start adjusting when the special start-up pattern sent by the transmitter is received.

### 3.12 Demodulator and Descrambler Circuit:

This circuit uses differential demodulation to recover baseband data which is then descrambled to remove the randomization added by the transmitter. The phase difference of the line signal is determined in the demodulator by comparing the phase of the line signal at a particular sampling instant to a reference phase determined by the preceding sampling instant. The output of the demodulator is a digital representation of the line signal phase difference. The descrambler removes the randomization added by the transmitter and delivers the resultant serial data stream of EIA RS-232-C voltage signals to the terminal equipment on the BB customer interface lead.

**3.13 Carrier Detector Circuit:** This circuit delivers an *on* voltage to the terminal equipment on the CF customer interface lead whenever the signal received within the 600- to 3000-Hz band is  $-43$  dBm or greater. If the received line signal drops below the threshold level ( $-43$  dBm) this circuit will apply an *off* voltage to the CF lead. Note that the carrier threshold depends on the transmit attenuator setting. The  $-43$  dBm level applies only when the transmit attenuator is set at 0 dBm. For example, if the transmit attenuator were set at  $-12$  dBm, the threshold level would be  $-31$  dBm.

**3.14 Timing Recovery Circuit:** This circuit uses the envelope of the modulated line carrier signal to recover timing and synchronize the receiver to the received signals. It also produces the clock signals required by the demodulator and the signals used to clock data to the terminal equipment.

### 3.15 Automatic Retrain Controller Circuit:

This circuit examines the demodulated signal to determine whether the automatic equalizer circuit has been properly adjusted to compensate for telephone line distortion. If the equalizer is not properly adjusted, this circuit will initiate a local retraining of the equalizer. During the retrain period, data delivered to the terminal equipment on the BB lead may be invalid. The equalizer retrain (ER) lamp will light while the set is retraining.

## C. Test Modes

**3.16** This part covers the functional description of the five test switches located on CP HG19 (DS 208B-L1), CP HG24 (DS 208B-L1A), or CP HG25 (DS 208B-L1B) and the various DS 208B-type test modes.

### 3.17 Lamp (LP) Test Switch (Nonlocking):

While this switch is depressed, all status lamps will remain lighted. This provides a quick way for the customer or telco employee to check for defective lamps. Depressing this switch while the data set is in use will not affect operation. When the ST test switch is depressed, it reconfigures the lamp test circuit to become an error inject circuit (DS 208B-L1B only). This switch may then be used to inject errors (space signals) when in analog loop self-test mode or end-to-end self-test mode. When used in the analog loop self-test mode, the TR and MR lamps remain *off* when the LP switch is depressed. When used in the end-to-end self-test mode, the CO lamp remains *off* at the transmitting end when the LP switch is depressed.

### 3.18 Analog Loop-Back (AL) Switch (Locking):

Depressing this switch connects the data set transmitter output to the data set receiver input through an internal attenuator (Fig. 12). This allows the terminal equipment (if full-duplex) to be used to check transmission through the data set. The AL switch may also be used in conjunction with the ST switch as described in 3.19. If the data set is connected to the line when the AL switch is depressed, the line will be dropped and the data set will enter the analog loop-back test mode.

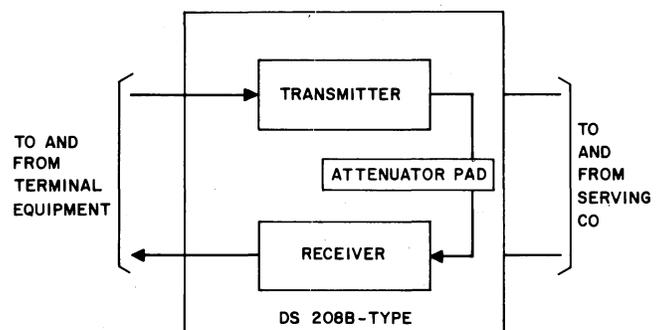


Fig. 12—Analog Loop-Back Test Mode



*A data set equipped with the automatic answer option WILL NOT automatically answer incoming calls while the AL switch is depressed. However, incoming calls can still be answered manually. Also, a transfer from talk to data mode cannot be made when the AL switch is depressed.*

### 3.19 Self Test (ST) Switch (Locking):

Depressing this switch turns on the data set transmitter and causes it to transmit steady marks. It is used as follows:

#### Analog Loop-Back Self Test

- (a) To perform an analog loop-back self test, depress both the ST and AL switches. In this case, the data set will be arranged as shown in Fig. 13 and the ER lamp will flash each time an error is detected.

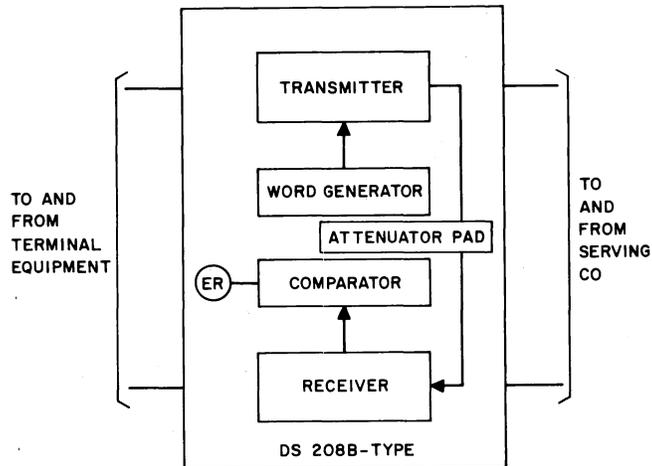


Fig. 13—Analog Loop-Back Self Test Mode

#### End-to-End Start-Up Test

- (b) To perform an end-to-end start-up test, call a distant data set and arrange for the test. Request that the ST switch be depressed on the distant end data set, and that the data set be transferred to data mode. The ON, RS, CS, and ER lamps on the distant data set are illuminated. On DS 208B-L1 and -L1A, the MR and CO lamps are extinguished. The TR lamp may be illuminated or extinguished (depending

on state of CD lead). On DS 208B-L1B, the TR and MR lamps are illuminated.

- (c) Depress ST and RO switches on the local data set, then transfer to data mode by depressing the DATA button on the telephone set. The ON and CO lamps should be illuminated. On DS 208B-L1 and -L1A, the RS, CS, MR, and ER lamps should be extinguished. The TR lamp may be illuminated or extinguished, (depending on the state of the CD lead from the customer). On DS 208B-L1B, the TR and MR lamps are illuminated. The data set will be arranged as shown in Fig. 14 and the ER lamp will flash each time an error is detected. Make the following test with the 4-dB slope compromise equalizer installed.

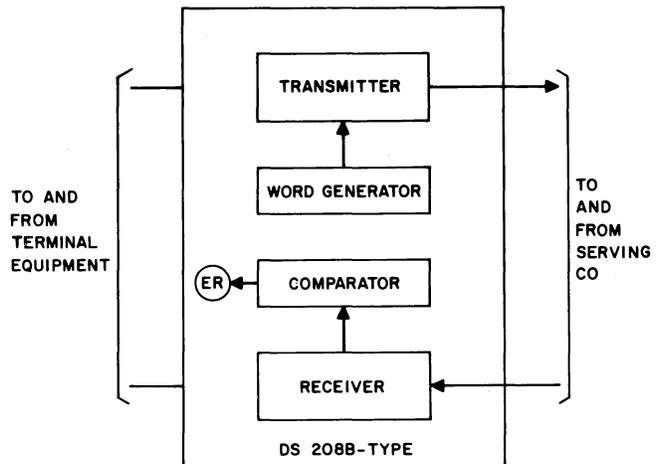


Fig. 14—End-to-End Self Test Mode

- (d) Request the distant operator to depress and release RO at 5-second intervals for 1 minute. At the local data set, observe that the CO lamp illuminates at the same time the ER lamp is extinguished, without flickering.
- (e) If the ER lamp flickers more than twice during the start-up interval, replace the 4-dB slope compromise equalizer with an 8-dB slope compromise equalizer and repeat the test.
- (f) If one slope produces substantially less flicker of the ER lamp than the other slope, use the slope compromise equalizer producing the least flicker. Unless the 8-dB slope compromise

equalizer produces significantly less flicker of the ER lamp, the 4-dB slope compromise equalizer is preferred.

(g) Return data sets to data mode by releasing the ST buttons at both ends. Depress TALK button to discuss previous test and to arrange for the following test.

### **End-to-End Self Test**

(h) To perform an end-to-end test of the local data set receiver, call a distant data set and arrange for the test. Request that the ST switch be depressed on the distant end data set, and that the data set be transferred to data mode. The ON, RS, CS, and ER lamps on the distant data set are illuminated. On DS 208B-L1 and -L1A, the MR and CO lamps are extinguished. The TR lamp may be illuminated or extinguished (depending on state of CD lead). On DS 208B-L1B, the TR and MR lamps are illuminated.

(i) Depress ST and RO switches on the local data set, then transfer to data mode by depressing the DATA button on the telephone set. The ON and CO lamps should be illuminated. On DS 208B-L1 and -L1A, RS, CS, MR, and ER lamps should be extinguished. The TR lamp may be illuminated or extinguished (depending on the state of the CD lead from the customer). On DS 208B-L1B, the TR and MR lamps are illuminated. The data set will be arranged as shown in Fig. 14 and the ER lamp will flash each time an error is detected.

**Note:** If the transmitting set is a DS 208B-L1B, an error inject feature is available to ensure the ability of the receiving set to detect errors. Have the attendant at the transmitting end depress the LP switch before the 5-minute error run. At the receiving data set, the ER lamp should illuminate. At the transmitting set, the CO lamp should remain extinguished when LP is depressed. Continue with test if satisfied that error detection circuits are operative. The ER lamp should extinguish when the LP switch is released.

(j) Conduct a 5-minute error run. The ER lamp should be extinguished and should not blink more than an average of three times in any 1-minute period.

(k) If the system fails the test, the data set or the channel could be at fault. Repeat the test using a different connection. If the system fails the second attempt, it has failed the end-to-end self test.

(l) If the system passes the second attempt, after a prearranged time return to talk mode and discuss test results.

(m) To perform the test in the opposite direction, request that the RO button at the distant end be depressed. Release the RO button on the local data set, and return both data sets to data mode. The local data set must meet the criteria of (h) above. The distant data set must meet the criteria of (i) and (j) above.

(n) Return data sets to normal operating condition by releasing the ST buttons at both ends and the RO button where depressed.

### **3.20 Receive Only (RO) Test Switch**

**(Locking):** Depressing this switch holds the data set in the receive mode. It is used in conjunction with the ST switch to perform an end-to-end self test from a remote DS 208B-type as described in 3.19.

### **3.21 Remote Test (RT) Switch (Locking):**

Depressing this switch conditions the data set for remote testing from a data test center (DTC). When the RT switch is depressed, the data set will answer the next incoming call automatically and enter the remote test mode. In remote test mode, the data set is conditioned to respond to the received line signals as follows:

#### **DS 208B-L1 and -L1A**

(a) If the DTC sends steady marks for a minimum of 1 second and the data set **does not** detect any errors, it will respond with approximately 1 second of steady marks.

(b) If the DTC sends steady marks for a minimum of 1 second and the data set **does** detect errors, it will respond with approximately 1 second of steady spaces.

#### **DS 208B-L1B**

(c) If the DTC sends steady marks for a minimum of 1.25 seconds and the data set **does not**

detect any errors, it will respond with approximately 2 seconds of steady marks.

- (d) If the DTC sends steady marks for a minimum of 1.25 seconds and the data set **does** detect errors, it will respond with approximately 2 seconds of steady spaces.

Once the data set is in remote test mode, the DTC can repeat the test sequence as many times as desired. To end the test, after testing a DS 208B-L1 or DS 208B-L1A, the DTC must send steady spaces for a minimum of 1 second to cause automatic disconnect. To cause automatic disconnect after testing a DS 208B-L1B, the DTC must send steady spaces for a minimum of 3 seconds. This causes the data set to disconnect from the line. However, the data set will remain in remote test mode and no further incoming calls may be answered until the data set is released by a second operation of the RT switch.

#### D. Customer Options

**3.22** Customer options are installed by use of screw switches located on CP HG19 (DS 208B-L1) or CP HG24 (DS 208B-L1A) and strap switches on CP HG25 (DS 208B-L1B). Customer options and screw/strap switch settings for each are given in Table F.

**3.23 DSR ON in Analog Loop-Back Test Mode Option (YM):** The current EIA Standard RS-232-C requires that the data set ready (CC) interface lead be in the **off** condition when the data set is in any mode other than data mode. This option allows the data set to clamp an **on** voltage on the CC lead when the data set is in analog loop-back test mode (AL switch is operated). Since the analog loop-back test mode is used to test the terminal equipment through the data set, normal operation of the CC lead may defeat this test feature. If the terminal equipment is capable of performing a loop-back test, and requires the CC lead to be **on** during the test, this option should be installed in the data set.

**3.24 DSR OFF in Analog Loop-Back Test Mode Option (YN):** This option is factory installed. It allows the CC lead to operate in accordance with EIA Standard RS-232-C (hold CC **off** while the data set is in any mode other than data mode). If the terminal equipment is not

capable of performing a loop-back test, this option must be left in the data set.

#### **3.25 Manual Answer Only Option (YO):**

With this option installed, all incoming calls **must** be answered manually. Transfer to data mode is accomplished by depressing the DATA button on the 565HK-type telephone set. Provided an **on** voltage is present on the CD customer interface lead (TR lamp on the data set is lighted), the data set will transmit the answer tone sequence and after approximately 4 seconds the MR lamp will light to indicate that the data set is in data mode.

**3.26 Automatic Answer Option (YP):** This option conditions the data set to detect ringing, automatically answer the call, and enter the data mode, provided an **on** voltage is present on the CC customer interface lead. If an **off** voltage is present on the CC lead, the data set will not trip ringing until the call is answered manually.

#### **3.27 Transmitter Externally Timed Option (YD):**

This option allows the data set transmitter to be timed by an external clock signal provided by the customer on the DA customer interface lead. The clock signal provided by the customer must be 4800 Hz  $\pm 0.01$  percent. With this option installed, the data set will deliver a clock signal to the terminal equipment on the DB customer interface lead which is phase-locked to the customer-provided clock signal on the DA lead.

#### **3.28 Transmitter Internally Timed Option (YC):**

This option allows the data set transmitter to be timed from the internal clock provided in the data set. With this option installed, the data set will ignore any clock signals on the DA customer interface lead.

**3.29 CA-CB Interval/50-ms:** This provides a 50-ms start time for the data set. At the transmitter, the start-up time is a 50-ms delay between the positive transition on the CA customer interface lead and the positive transition on the CB customer interface lead. During this time the transmitter is sending the start-up sequence to the distant end data set. At the receiver, the start-up time is the delay between the reception of a signal at the input to the receiver and the positive transition on the CF customer interface lead. During this time, the receiver recovers

TABLE F

## DS 208B-TYPE CUSTOMER OPTIONS

OPTION FEATURE	OPTION DESIG	SWITCH	SWITCH POSITION	REMARKS
DSR <i>on</i> in analog loop-back test mode.	YM	S3A	Up	
DSR <i>off</i> in analog loop-back test mode.	YN		Down	Factory installed.
Manual answer only.	YO	S3B	Up	
Automatic answer	YP		Down	Factory installed.
Transmitter externally timed.	YD	S3C	Up	
Transmitter internally timed.	YC		Down	Factory installed.
RS-CS interval, 50 ms	—	“50”	In	If not specified on service order or CLRC, install 50-ms option.
RS-CS interval, 150 ms	—	“50”	Out	

timing and automatically equalizes on the incoming signal.

**3.30 CA-CB Interval/150-ms:** This performs the same function as the CA-CB interval/50-ms except the start time is extended to 150 ms. At installations where extremely long channel delay and short message lengths exist, the round trip delay time of the channel may be greater than the combined 50-ms CA-CB and message length intervals. In this case, the CA-CB interval/150-ms must be switched into the data set to prevent the local receiver from interpreting far-end echo as a message from the distant end data set.

#### E. Telco Options

**3.31** Telco options are installed by use of screw switches located on CP HG19 (DS 208B-L1) and CP HG24 (DS 208B-L1A) or strap/switches on CP HG25 (DS 208B-L1B). Telco options and switch settings for each are given in Table G.

**3.32 Compromise Equalizer IN—4 dB Slope + Symmetric Delay Option (WU):** This option is available in DS 208B-L1A and -L1B only. The compromise equalizer is

a filter which shapes the transmitted line signal to partially compensate for distortion encountered on the broad range of telephone channels that may be used. When installed, this option provides 4 dB of slope equalization. In addition, symmetrical delay and equal gain are maintained.

**Note:** It is recommended that this option (WU) be used initially whenever a DS 208B-L1A or -L1B is installed.

**3.33 Compromise Equalizer IN—8 dB Slope and Symmetric Delay Option (ZS):** This option is available in all DS 208B-type. It performs the same function as option WU except it provides 8 dB of slope equalization. Symmetric delay and equal gain are also maintained by this option.

**3.34 Compromise Equalizer OUT Option (ZT):** This option removes the compromise equalizer from the data set transmit path. It is only used for test purposes.

**3.35 Transmitter Output Level Options (ZA Through ZP):** These options are used to set the output level of the data set to

→ TABLE G ←

## DS 208B-TYPE TELCO OPTIONS

OPTION FEATURE	OPTION DESIG	SWITCH	SWITCH POSITION	REMARKS
Compromise equalizer IN — 4-dB slope + symmetric delay.	WU	S2B	Up	Factory installed in DS 208B-L1A and -L1B. Not provided in DS 208B-L1.
		S2C	Up	
Compromise equalizer IN — 8-dB slope + symmetric delay.	ZS	S2B	Down	Factory installed in DS 208B-L1.
		S2C	Up	
Compromise equalizer OUT.	ZT	S2B	Up or down	Use only for test purposes.
		S2C	Down	
—	—	S4A	Up	DS 208B-L1B only
—	—		Down*	
—	—	S4B	Up	DS 208B-L1B only
—	—		Down*	

\* Down position *must* be selected.

compensate for any local loop loss between the data set and the serving CO. The level of the data signal received at the serving CO must not exceed a maximum of -12 dBm. Therefore, to determine which option (ZA through ZP) should be installed in the data set it is necessary to know the local loop loss. This information should be given on the service order or CLRC as either the expected measured loss (EML) or the actual measured loss (AML). If only the EML is given, it is necessary to measure the actual loop loss. The AML must be within  $\pm 1$  dB of the EML or the line must be turned in for repair and another line selected for use. Once the AML is determined, subtract that value from 12. Locate the difference between the AML and 12 in Table H and install that option in the data set.

**Example:**

EML = 4 dB

AML must = 3 dB to 5 dB.

AML = 5 dB

12 dB - 5 dB = 7 dB.

Install option ZH in the data set.

**4. APPLICATIONS**

**4.01** This part describes the typical single and multiple DS 208B-type arrangements shown in Fig. 15 through 19.

**4.02** In all cases, the M13F cord used to connect the data set TEL INT connector is supplied with DS 208B-type. Also, the 565HK-type telephone set is always required to provide manual call originate and answer capabilities and to allow TALK-to-DATA and DATA-to-TALK mode transfers. The HOLD key on the telephone set should be relabeled DATA.

**4.03** Whenever automatic call origination is desired, the DAS 801A- or 801C-type automatic calling unit (ACU) must be provided (Fig. 16, 18, and 19). The ACU must be ordered separately; however, the D10P cord required for the data set/ACU interface is supplied with the ACU. For simplicity's sake, the customer interface to the ACU is not shown on the block diagrams (Fig. 16, 18, and 19). For details of the terminal equipment/ACU interface, refer to the appropriate ACU BSP.

TABLE H  
TRANSMITTER OUTPUT LEVEL OPTIONS

TRANSMIT OUTPUT LEVEL, dBm	OPTION DESIG	SWITCH POSITIONS			
		SWITCH S1A	SWITCH S1B	SWITCH S1C	SWITCH S2A
0	ZA*	Down	Up	Down	Up
-1	ZB	Down	Up	Down	Down
-2	ZC	Down	Up	Up	Up
-3	ZD	Down	Up	Up	Down
-4	ZE	Down	Down	Down	Up
-5	ZF	Down	Down	Down	Down
-6	ZG	Down	Down	Up	Up
-7	ZH	Down	Down	Up	Down
-8	ZI	Up	Up	Down	Up
-9	ZJ	Up	Up	Down	Down
-10	ZK	Up	Up	Up	Up
-11	ZL	Up	Up	Up	Down
-12	ZM	Up	Down	Down	Up
-13	ZN	Up	Down	Down	Down
-14	ZO	Up	Down	Up	Up
-15	ZP	Up	Down	Up	Down

\* Factory installed.

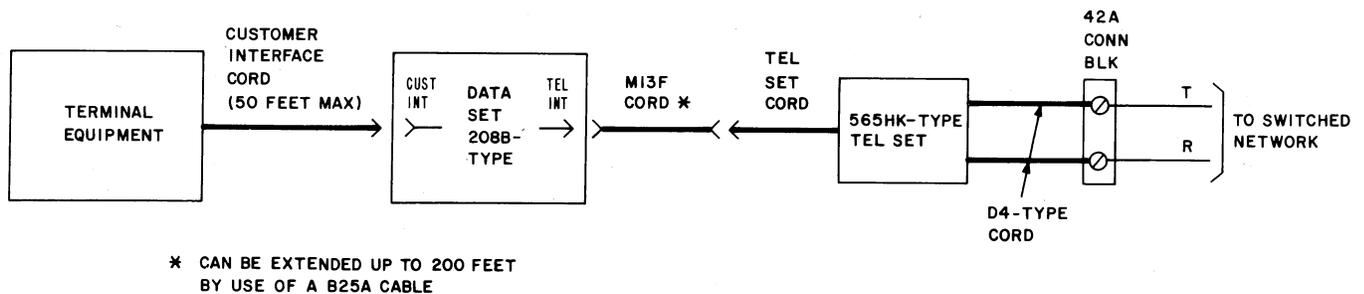


Fig. 15—Typical Single Data Set 208B-Type Arrangement Without ACU—Block Diagram

#### A. Single Data Set Arrangement (Fig. 15 and 16)

**4.04** A typical single DS 208B-type arrangement without an ACU is shown in Fig. 15. The 42A connector block and D4-type cord must be ordered separately. The data set may be located up to 200 feet from the telephone set by using a B25A cable to extend the M13F cord. The B25A cable must also be ordered separately.

**4.05** A typical single DS 208B-type arrangement with an ACU is shown in Fig. 16. The DAS 801A- or 801C-type ACUs and 149B adapters (Fig. 8) must be ordered separately. However, in this case, the distance between the data set and the telephone set is limited by the length of the telephone set cord, M13F cord, and D10P cord. This is due to the 50-foot maximum length requirement of the data set and ACU customer interface cords.

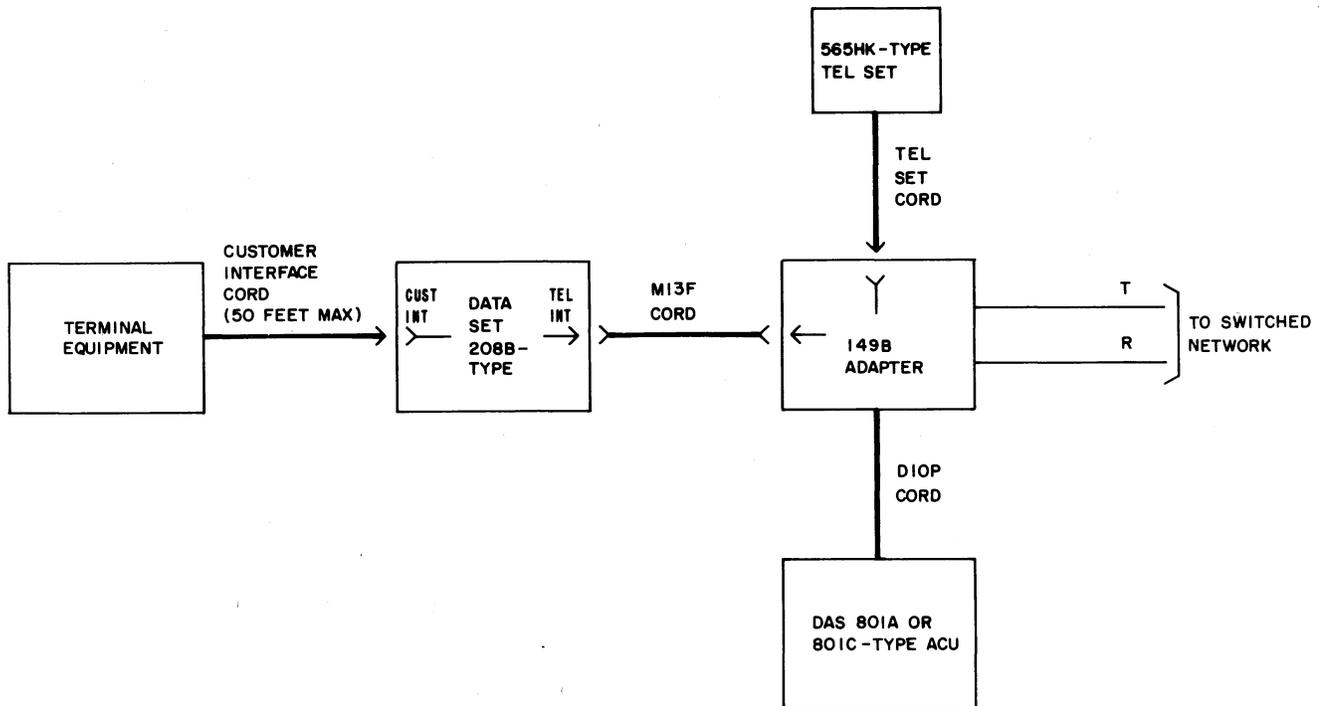


Fig. 16—Typical Single Data Set 208B-Type Arrangement With ACU—Block Diagram

**B. Multiple Data Set Arrangement (Fig. 17, 18, and 19)**

**4.06** Up to five DS 208B-type may be associated with one telephone set. When more than one data set is associated with a telephone set, a KS-21253-L3 adapter is required to interface the data sets, telephone set, telephone lines, and (if provided) ACU(s). A wiring diagram of the KS-21253-L3 adapter is shown in Fig. 20.

**4.07** A typical multiple DS 208B-type arrangement without ACU(s) is shown in Fig. 17. The KS-21253-L3 adapter, 66-type connecting block, and the B25A cable associated with the connecting block must all be ordered separately. If desired, the telephone set and KS-21253-L3 adapter may be located up to 200 feet from the data sets by using B25A cables to extend the M13F cords.

**4.08** Two typical multiple DS 208B-type arrangements with ACUs are shown in Fig. 18 and 19. As for the single data set arrangement with ACU (Fig. 16), the distance between the data set and the telephone set shown in Fig. 18 and 19 is limited by the length of the telephone set cords, M13F cords, and D10P cord. As before, this is due to

the 50-foot maximum length requirement of the data set and ACU customer interface cords.

**Note:** The combination shown in Fig. 18 is the recommended method of ACU access for multiple data set arrangements.

The DAS 801A- or 801C-type ACUs, KS-21253-L3 adapter, 1044A connector blocks (one for each ACU) or 66E7-25 connector block (one for up to five ACUs), and the associated A25B cable, must be ordered separately.

**C. Thermal Considerations for Multiple Data Set Arrangements Mounted in KS-20018-Type Cabinets**

**4.09** This part covers the factors that must be considered when mounting a multiple DS 208B-type arrangement in a KS-20018-type cabinet. For multiple arrangements of three or less data sets it is recommended that the data sets be stacked on top of each other instead of cabinet mounted. Table I lists the KS-20018-type cabinets recommended for use with multiple arrangements of four or more data sets along with the cabinet capacity (recommended and maximum) and the recommended vertical mounting centers. One

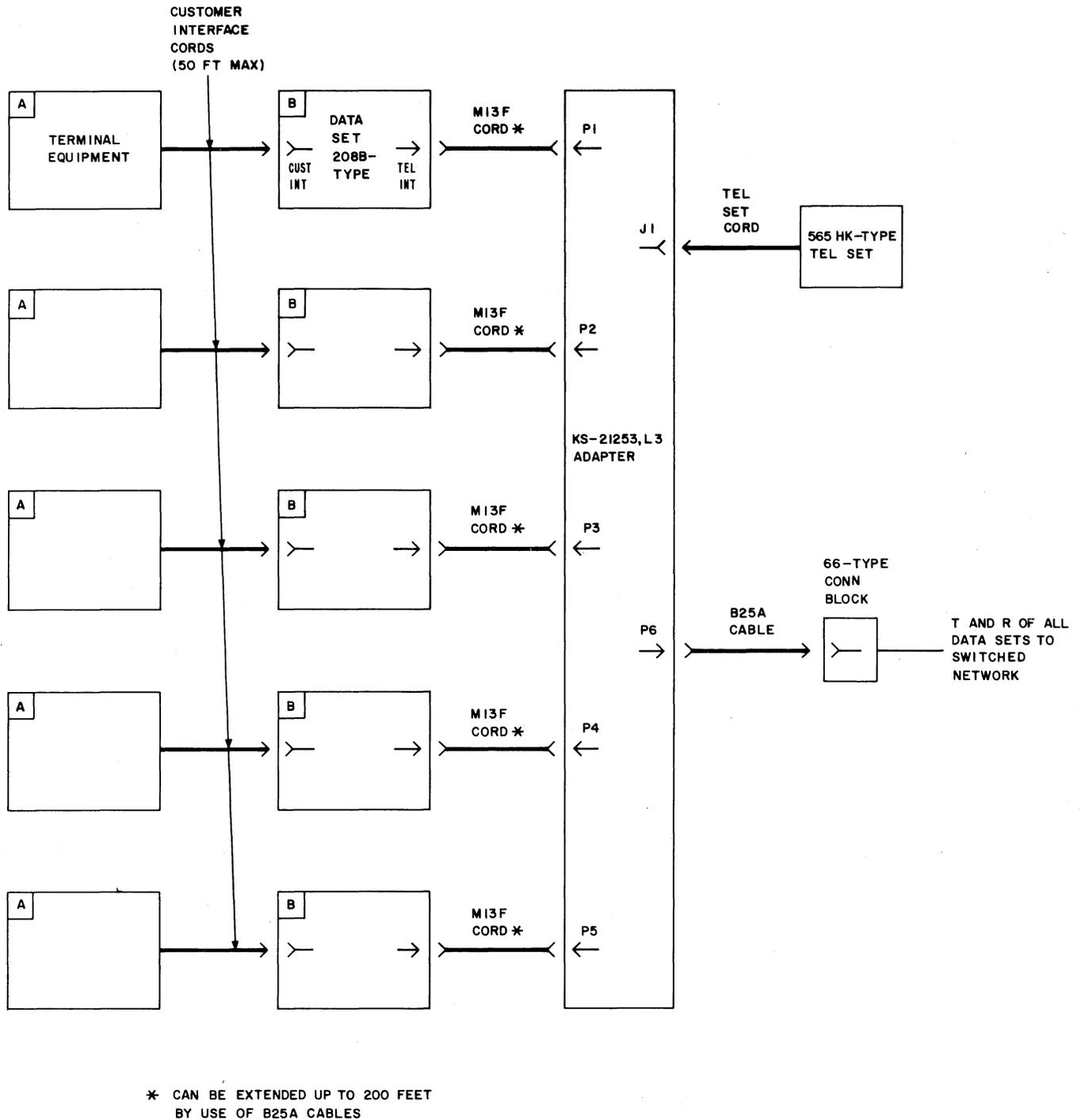


Fig. 17—Typical Multiple Data Set 208B-Type Arrangement Without ACUs—Block Diagram

D-180467 mounting bracket kit is required for each DS 208B-type that is to be mounted in a KS-20018-type cabinet. The mounting bracket kit must be ordered separately. For a detailed description of multiple data set installation in the KS-20018-type cabinet, refer to Section 590-010-201.

4.10 The two main factors that must be considered when installing multiple DS 208B-type arrangements in the KS-20018-type cabinet are the highest ambient room temperature that will be encountered and the number of data sets to be installed. Each DS 208B-type consumes approximately

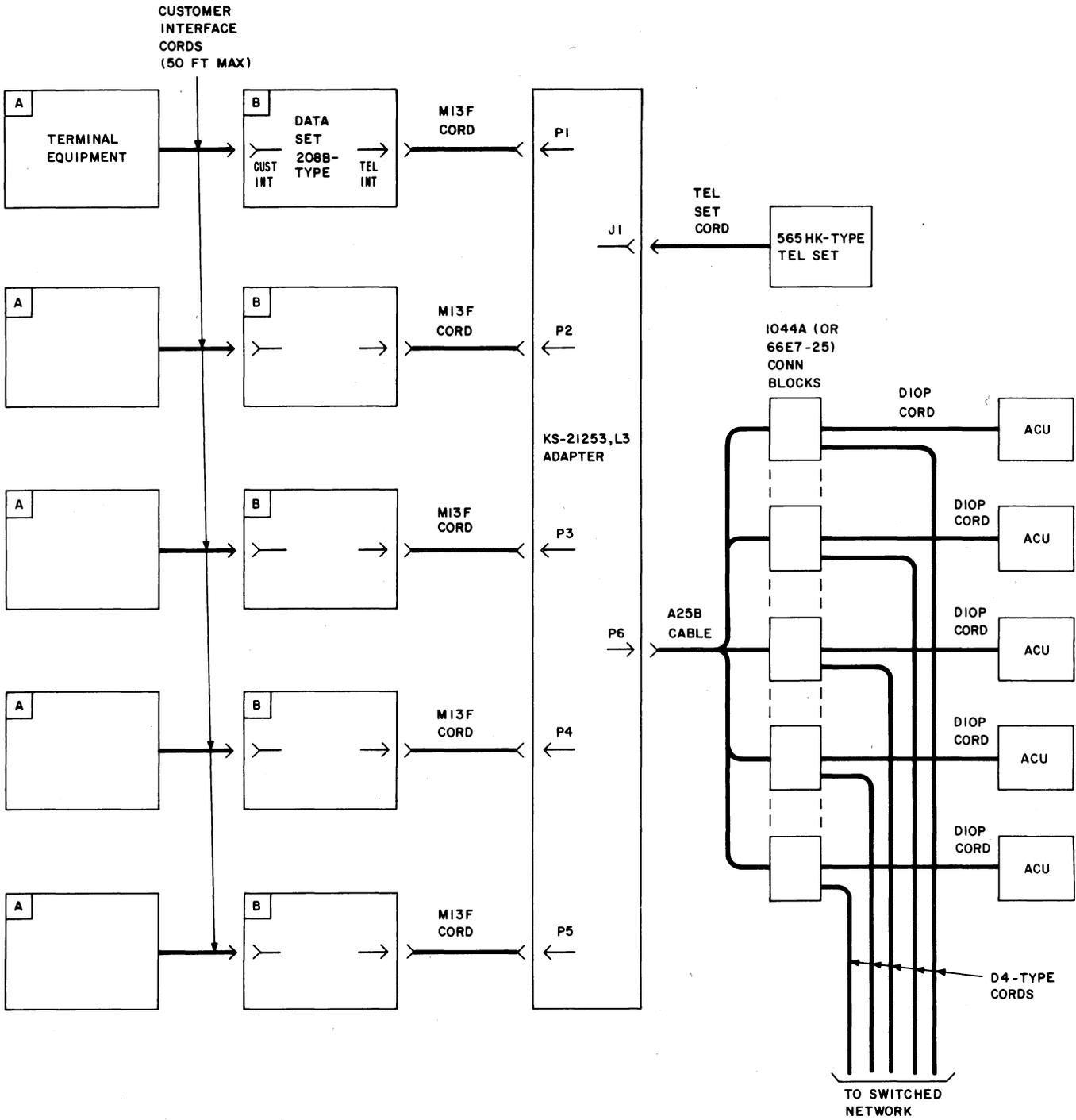


Fig. 18—Typical Multiple Data Set 208B-Type Arrangement Using P6 of KS-21253-L3 Adapter for ACU Access—Block Diagram

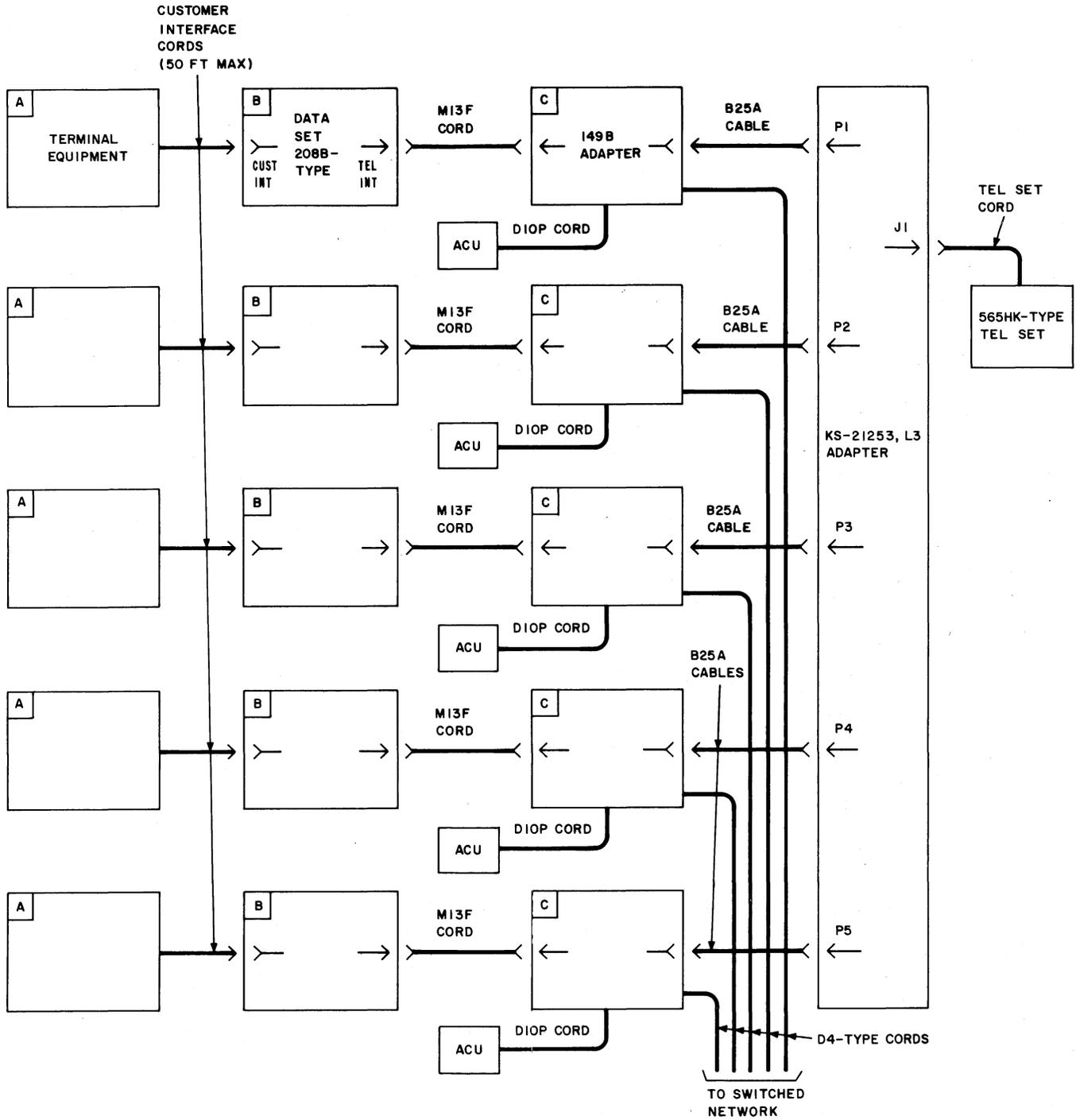


Fig. 19—Typical Multiple Data Set 208B-Type Arrangement Using 149B Adapters for ACU Access—Block Diagram

26 watts of power. This corresponds to approximately 89 BTU/hr.

**⚠Caution: Care must be taken to ensure that the maximum temperature limit of 120°F will not be exceeded in any DS 208B-type installation.⚠**

**4.11** The KS-20018-L15 and L-17 cabinets provide an increased capability for dissipating heat expected to be generated by multiple data set arrangements. This is possible because of the perforated cabinet top vent and door panel plus the availability of an internal or external forced air system. The thermal considerations are the approximate total wattage expected (BTUs/hr) and whether free air convection cooling or forced air convection cooling should be used to maintain normal internal cabinet ambient temperatures.

**4.12** Each blower (optional on KS-20018-L15 and standard on KS-20018-L17 cabinet) requires an ac power source of 105 to 129 volts, 57 to 63 Hz. This power is available on the ac power strip supplied in the KS-20018-type cabinet. The blower will deliver 150 cubic feet of filtered air per minute at zero static pressure and will dissipate approximately 80 watts (273 BTU/hr). This efficiency decreases as the filter gets dirty to approximately 60 watts (204 BTU/hr) when the air inlet is completely blocked. (The loss of efficiency is only about 25 percent if the inlet is completely blocked, due to leakage around the filter.) Examine the filter and replace when dirty.

**4.13** The maximum permissible internal cabinet temperature rise is dependent on individual component temperature limits. The free air convection patterns are dependent on the geometry of the data set and its mounting arrangement. Since the DS 208B-type is an enclosed housing type data set, higher cabinet temperatures can be expected because of the restricted air flow between these sets. For example, when mounting eight DS 208B-type on 5-inch vertical mounting centers, approximately 1 inch of clear vertical space is provided between the data set housings. In this case, a worst case internal cabinet temperature rise over the external ambient temperature will be approximately 41°F (23°C). If the vertical mounting centers are increased to 6 inches (2 inches clearance between data sets) or 7 inches (3 inches clearance between data sets), the internal cabinet temperature rise will be approximately 22°F (12°C)

or 15°F (8°C), respectively. Therefore, in considering ambient conditions above a normal room temperature of approximately 75°F (24°C), eight DS 208B-type must be mounted on 6-inch vertical centers or forced air convection cooling must be provided.

**4.14** Figure 21 shows both the free air and forced air convection cooling for heat dissipation versus temperature rise relationships for DS 208B-type. The relationships are charted for 5-, 6-, and 7-inch vertical mounting centers. Note that the maximum allowable room temperature must also be considered. Knowing the maximum room temperature that may be encountered, the proper data set spacing and whether forced air ventilation must be used can be determined by referring to Fig. 21.

#### D. One-Number Dialer Applications

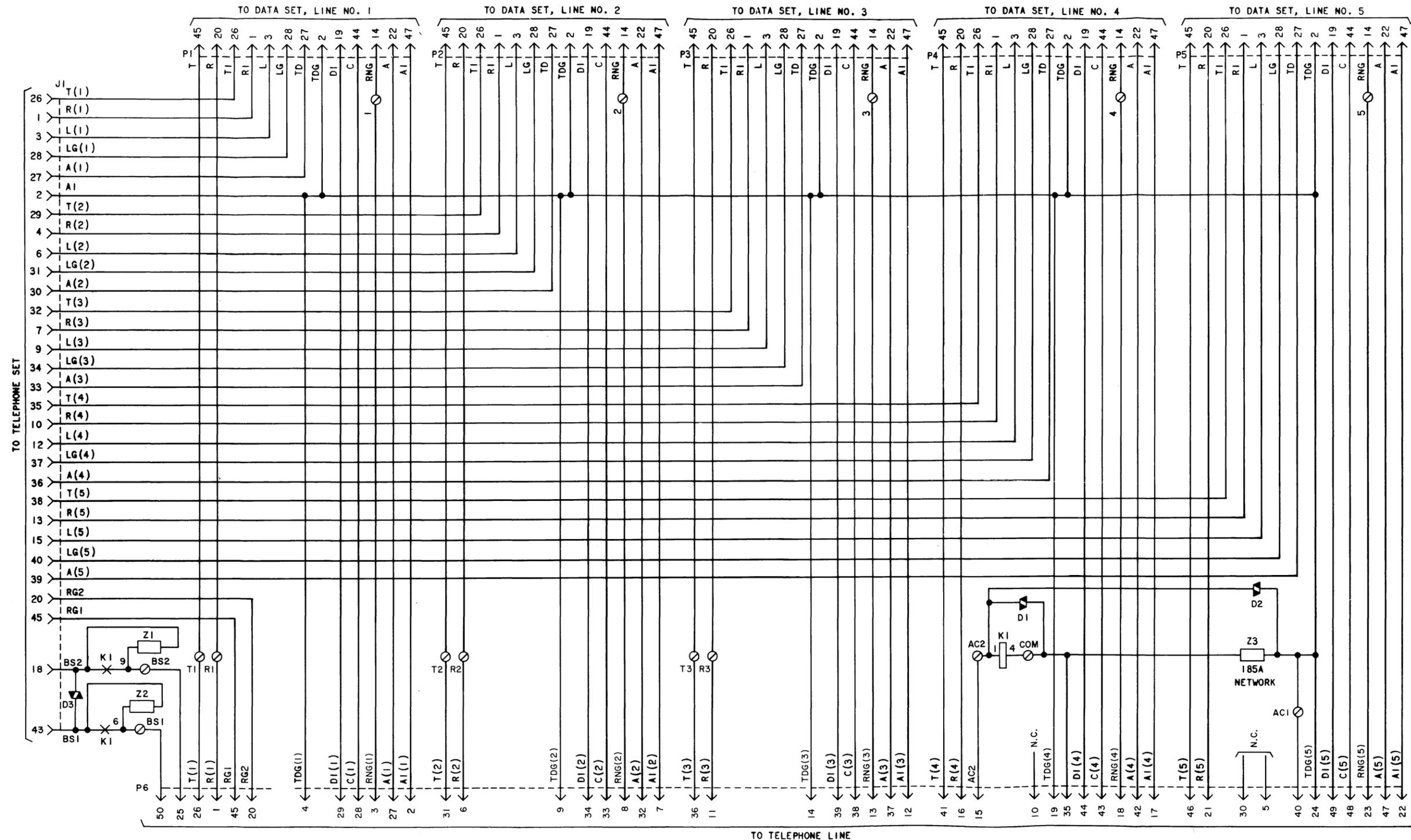
**4.15** When a 43A or 53A one-number dialer is to be used with a DS 208B-type station, it must be installed only in the *talk* path rather than the talk/data path. The connection diagram in Fig. 22 shows the method of connecting the 43A or 53A dialer for either a single or multiple DS 208B-type arrangement. Leads (N)T and (N)R are disconnected from the telephone set and connected to dialer terminals 2 and 5, respectively. Then dialer terminals 1 and 6 are connected to the telephone set terminals (N)T and (N)R, respectively, using D4-type connecting cord.

### 5. MAINTENANCE AND TESTS

**5.01** This part contains maintenance and test procedures which supplement Sections 592-030-300 and 592-030-500. They are for use when the data set meets requirements of all tests in Section 592-030-500, the maintenance procedures given in Section 592-030-300 fail to identify the faulty unit, and the data set still does not operate properly with the terminal equipment.

#### A. Maintenance

**5.02** In some installations of DS 208B-L1, a lock-up condition may occur. This happens when one terminal tries to send by turning on its carrier before the other terminal has turned off its carrier. This will not occur with DS 208B-L1A ⚠or DS 208B-L1B,⚠ or if DS 208B-L1 is equipped with CP HG19, series 8. To determine whether



FACTORY STRAPS	
1 -	COM
2 -	COM
3 -	COM
4 -	COM
5 -	COM
AC1 -	BS1
AC2 -	BS2

Fig. 20—KS-21253-L3 Adapter—Wiring Diagram

TABLE I

## KS-20018-TYPE CABINET CAPACITY

CABINET TYPE KS-20018-	CABINET CAPACITY		RECOMMENDED MOUNTING CENTERS
	RECOMMENDED	MAXIMUM*	
L3	3	4	6 inches
L4	4	5	
L7	4	5	
L8	3	4	
L11	4	5	
L15†	8	13	
L17†	8	13	

\* The maximum capacity is when data set is mounted on 5-inch centers.

† Blowers for forced air convection cooling are optional for the KS-20018-L15 cabinet and must be ordered separately. For the KS-20018-L17, the blowers are standard.

the DS 208B-L1 is equipped with CP HG19, series 8 without removing the cover, proceed as follows:

- (1) With the data set powered, all data set pushbuttons released, and the telephone set on-hook, momentarily operate the LP button.

**Requirement:** ON lamp lighted. TR, MR, RS, CS, CO, and ER lamps lighted while LP button is operated.

- (2) Operate AL button and then operate ST button.

**Requirement:** ON, RS, CS, and CO lamps lighted. TR lamp may be either lighted or extinguished. All other lamps extinguished.

- (3) Operate RT button.

**Requirement:** If CP HG19 is a series 8, no change will occur to the lamp status. If CP HG19 is earlier than series 8, the CS and ER lamps will alternately light and extinguish, the CO lamp will momentarily extinguish while CS and ER are switching, and the ON and RS lamps will remain lighted steadily.

**Note:** The net effect of the lamps turning on and off (on a data set equipped with

preseries 8 CP HG19) will appear as though the light were bouncing up and down between CS and ER.

- (4) To restore the data set to normal, operate the AL, ST, and RT switches to place them in the release state.

**5.03** Whenever the telephone line disconnects after the data set completes the answer sequence, it indicates that the telephone line is connected to the wrong terminals on the telephone set. In this case, the data set line holding relay (K2, Fig. 6 or 7) is being bypassed. The K2 relay is not needed during the quiet interval and answer sequence, but is required thereafter. Removing tip and ring of the telephone line from telephone set terminals 1T and 1R and connecting them to RT and RR, respectively, will correct this fault.

**5.04** Figure 23 is a sequence chart which shows the response of the customer interface leads when a call is originated, answered, and terminated. It is included as an aid in isolating faults which cannot be cleared with the maintenance and test procedures given in Sections 592-030-300 and 592-030-500 and Part 5B of this section.

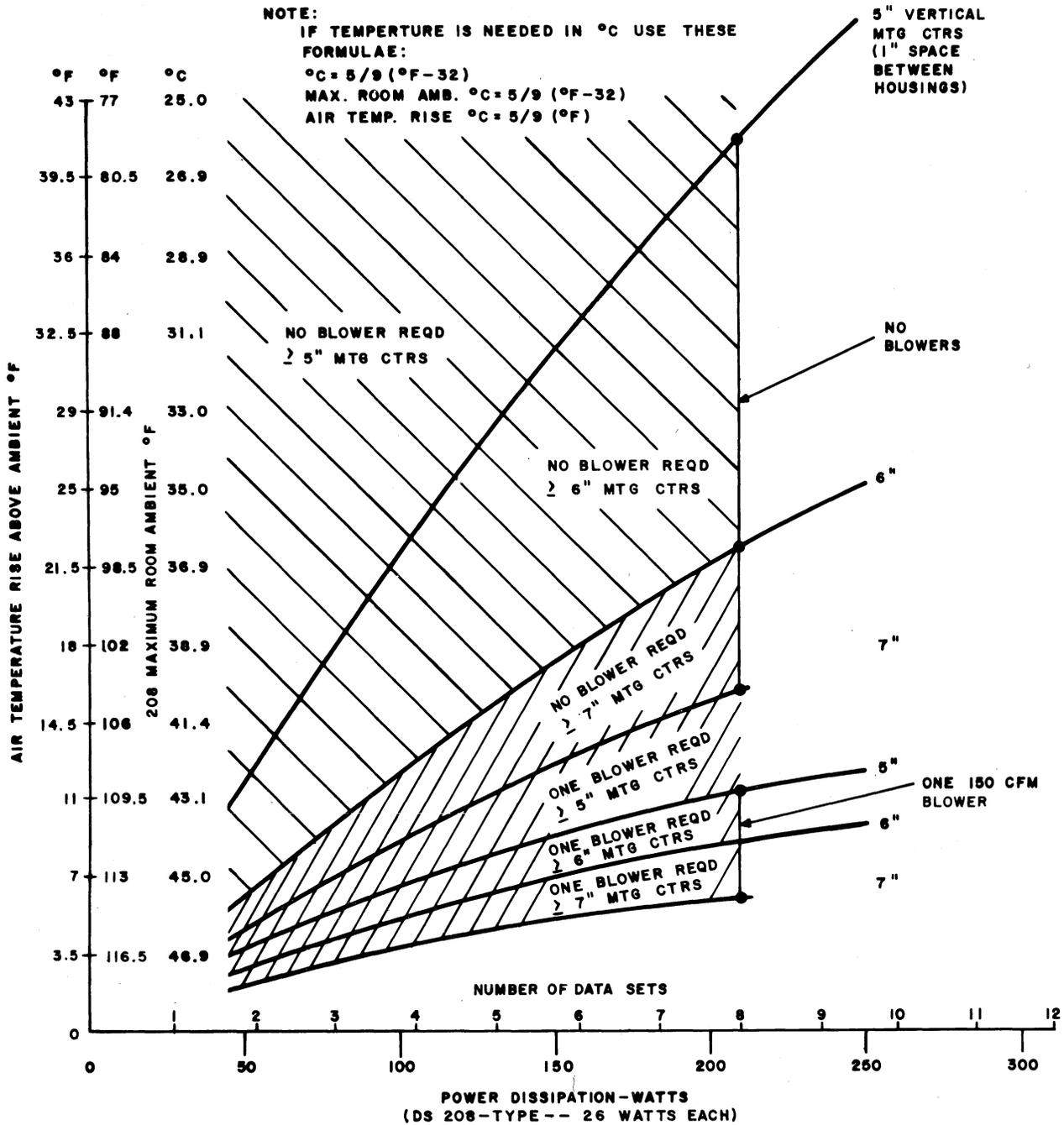


Fig. 21—Internal Air Temperature Rise Above Ambient Room Temperature Versus Heat Dissipation for Multiple Data Set 208B-Type Arrangements Mounted in KS-20018-L15 and -L17 Cabinets

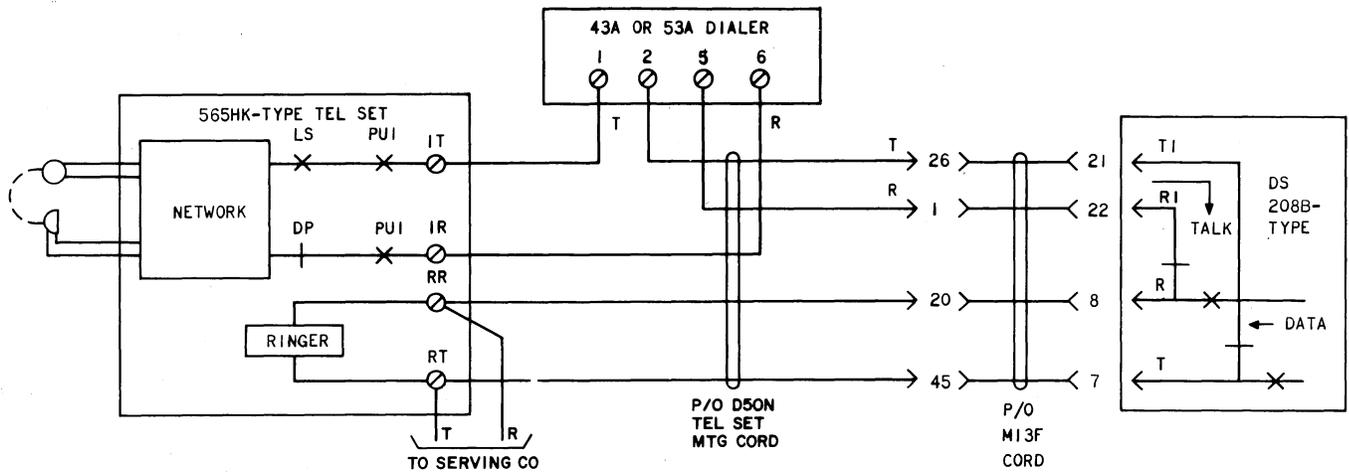
**B. Tests**

(b) DS 208B-type internal clock oscillator test (5.07).

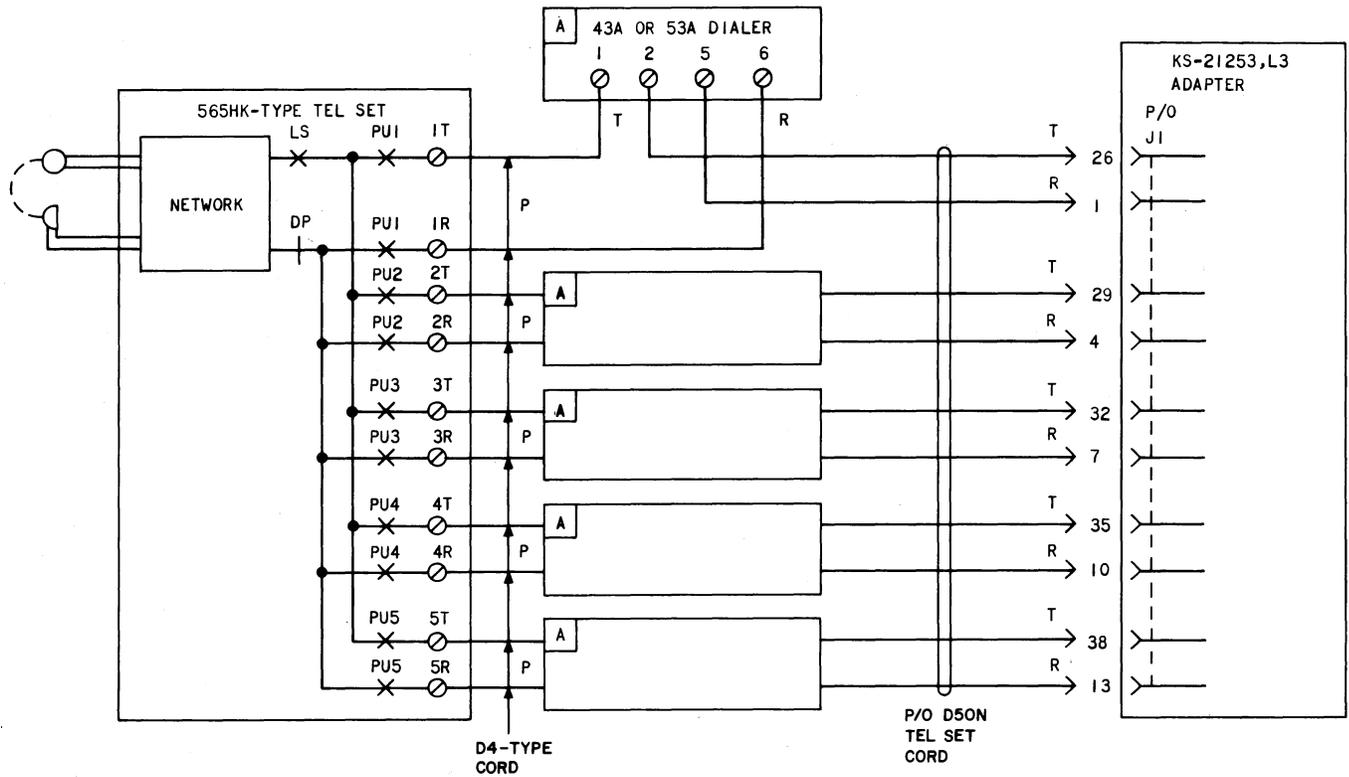
5.05 The tests covered in this part are:

(a) 83A power unit over-voltage protection and alarm circuit and output voltage level test and adjustment (5.06).

**5.06 83A Power Unit Over-Voltage Protection and Alarm Circuit and Output Voltage Level Test and Adjustment**



A. SINGLE DS 208B-TYPE ARRANGEMENT



B. MULTIPLE DS 208B-TYPE ARRANGEMENT

Fig. 22—Data Set 208B-Type With 43A or 53A Dialer—Connection Diagram

**(Fig. 24):** This test requires the use of a suitable voltmeter.

- (1) Remove the 83A power unit from the data set as follows:
  - (a) Disconnect the ac power cord and interface cord.
  - (b) Remove data set front and rear snaplock covers.
  - (c) Remove the TS1 top mounting screw.
  - (d) Remove the screw at FG of TS1.
  - (e) Remove the metal strap between FG and SG of TS1.
  - (f) Remove spade connections from terminals 1 through 7 of TS1.
  - (g) Rotate the data set 90 degrees clockwise (cw) and place the data set on its side, being careful to not mar the housing.
  - (h) Remove the five screws which secure the power unit to the data set chassis. Return data set to horizontal position.
  - (i) Remove power unit from the front of the data set by pushing on the rear of the power unit.

(2) Perform the over-voltage and alarm circuit test and adjustment as follows:

- (a) Rotate R8 fully cw.
- (b) Reconnect the ac power cord.
- (c) Condition the voltmeter to measure 13 volts dc and connect the + and - test leads to the power unit +12 and SG terminals, respectively.

**Requirement:** Voltmeter indicates 13.0 volts.

- (d) If the requirement for (c) above is not met, adjust R11 for a voltmeter indication of exactly 13.0 volts.
- (e) Slowly rotate R8 counterclockwise (ccw) until relay K1 just operates.

(f) Rotate R11 fully ccw and momentarily disconnect the ac power cord.

(g) Slowly rotate R11 cw until relay K1 operates.

**Requirement:** Voltmeter indication increases to between 12.9 and 13.1 volts and then drops abruptly to zero volts when relay K1 operates.

(h) Rotate R11 fully ccw and perform the 83A power unit output voltage test and adjustment [5.06(3)].

(3) Perform the output voltage level test and adjustment as follows:



**Before performing this portion of the test, be sure the over-voltage protection and alarm portion [5.06(2)] is performed first.**

(a) Disconnect power unit from 117 Vac outlet.

(b) Load each output of the power unit in accordance with the following:

- +5 volt output—5 ohms  $\pm 2\%$ , 20W
- +12 volt output—20 ohms  $\pm 2\%$ , 30W
- -6 volt output—18.9 ohms  $\pm 2\%$ , 8W
- -12 volt output—57.5 ohms  $\pm 2\%$ , 10W.

(c) Connect the ac power cord to a 117-volt ac outlet.

(d) Ensure that the voltmeter + and - test leads are still connected to the power unit +12 and SG terminals, respectively.

(e) Adjust R11 for the required output.

**Requirement:** A voltmeter indication of 11.6 to 11.7 volts.

**Note:** If the output voltage should be increased to the point that relay K1 operates (13 volts), rotate R11 fully ccw, momentarily disconnect the ac power cord to release relay K1, and then repeat (e) above.

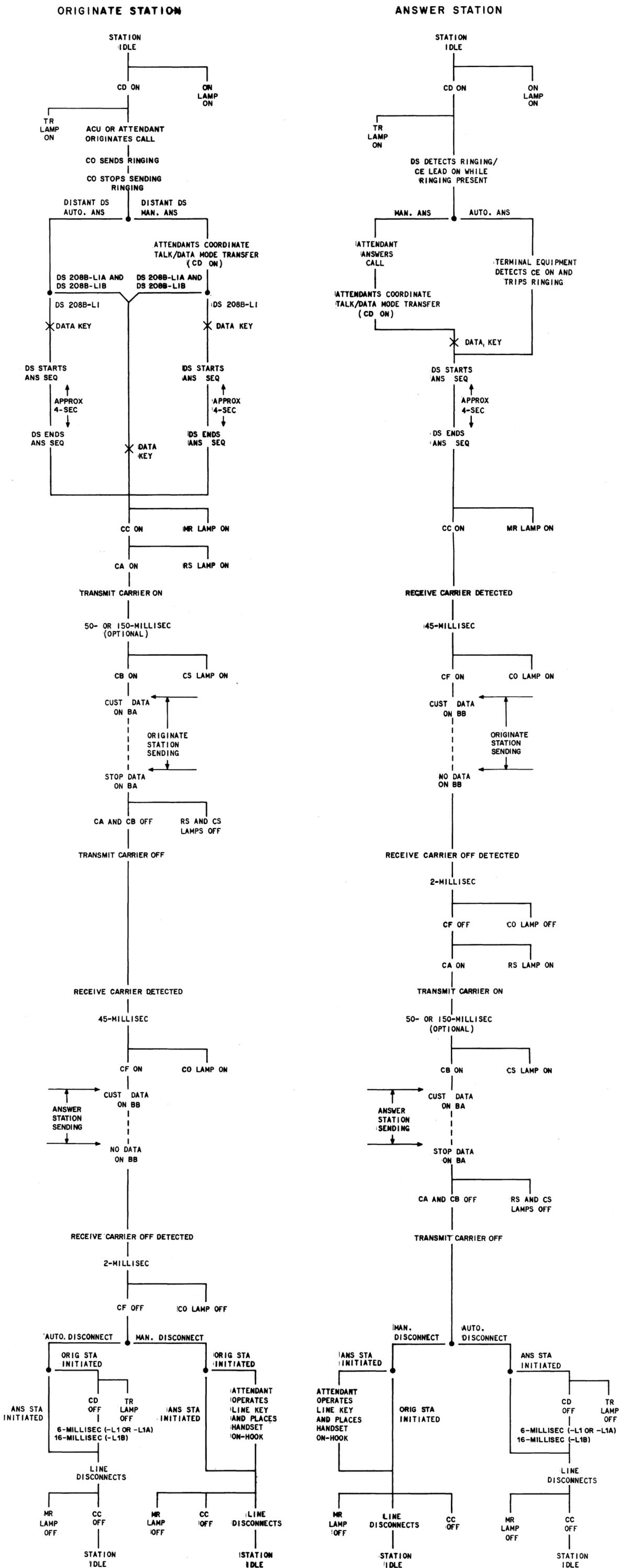


Fig. 23—Data Set 208B-Type Customer Interface  
Lead Response—Sequence Chart

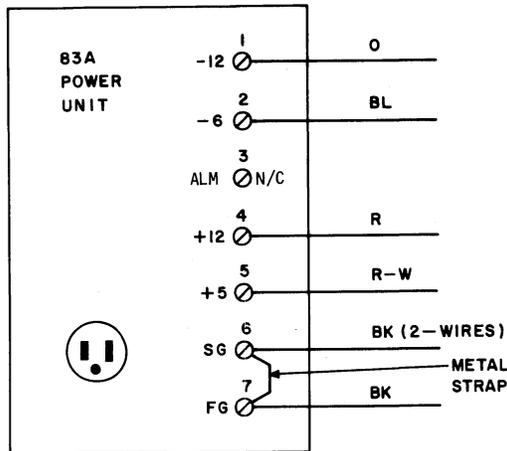


Fig. 24—83A Power Unit—Connection Diagram

- (f) Disconnect the voltmeter + test lead and connect it to the power unit +5 terminal.

**Requirement:** Voltmeter indicates 4.80 to 5.20 volts.

- (g) Disconnect both voltmeter test leads.

- (h) Connect the voltmeter + and - test leads to the power unit SG and -12 terminals, respectively.

**Requirement:** Voltmeter indicates -11.5 to -12.5 volts.

- (i) Disconnect the voltmeter - test lead and connect it to the power unit -6 terminal.

**Requirement:** Voltmeter indicates -5.75 to -6.25 volts.

- (j) Disconnect both voltmeter test leads, the ac power cord, and all four test loads.

- (4) If the power unit fails any requirement, replace it with one that is known to be good and install the replacement power unit in DS 208B-type by reversing the steps given in 5.06 (1) above.

- (5) If the power unit meets all requirements, reinstall it in DS 208B-type by reversing the steps given in 5.06 (1) above.

### 5.07 DS 208B-Type Internal Clock Oscillator and Countdown Circuit Test:

DS 208B-L1 and -L1A contain two internal square-wave clocks (460.8- and 28.8-kHz) from which the transmitter and receiver timing waveforms (DB, DCT, DD, DCR) are generated by the countdown circuits. DS 208B-L1B derives the DB and DCT waveforms internally within the LSI transmitter module, which counts down from a 691.2-kHz square-wave input. The purpose of this test is to measure the DB, DCT, DD, and DCR frequencies. If they do not meet requirements, replace the clock oscillator and/or countdown circuit in accordance with 5.09 (11).

- 5.08 The test equipment required is as follows:

- Hewlett Packard 5321B frequency counter, or equivalent.

**Note:** If an equivalent counter is used, it must be capable of counting at least five digits.

- 914B or C data test set (DTS).

- 5.09 Perform the test as follows:

- (1) Connect the frequency counter and 914-type DTS ac power cords to 117-volt ac outlets and operate their POWER switches to ON.
- (2) Disconnect the data set ac power cord.
- (3) Disconnect the terminal equipment from the data set customer interface connector.
- (4) Using the connector cord provided with the 914-type DTS, connect the data set CUST INT connector to the 914-type DTS A connector.
- (5) Push in all of the 914-type DTS A interface selector switches.
- (6) Reconnect the data set ac power cord.
- (7) Connect the frequency counter input to terminal 15A (DB) of the 914-type DTS interface selector switch panel.

**Requirement:** Frequency counter indicates between 4799- and 4801-Hz.

(8) Disconnect the counter input and connect it to terminal 16A (DCT) of the 914-type DTS interface selector switch panel.

**Requirement:** Frequency counter indicates between 1599- and 1601-Hz.

(9) Disconnect the frequency counter input and connect it to terminal 17A (DD) of the 914-type DTS interface selector switch panel.

**Requirement:** Frequency counter indicates between 4799- and 4801-Hz.

(10) Disconnect the frequency counter input and connect it to terminal 18A (DCR) of the 914-type DTS interface selector switch panel.

**Requirement:** Frequency counter indicates between 1599- and 1601-Hz.

(11) If the data set fails to meet a requirement, replace the first CP listed in Table J for the requirement not met and repeat steps (7) through (10) above. When a replacement CP does not clear the trouble, reinstall the original CP, replace the next CP listed in Table J, and repeat steps (7) through (10) above. When a faulty CP is located, process it in accordance with the directions given in Section 592-030-300. If after replacing all of the CPs listed in Table J the requirement still cannot be met, install a replacement DS 208B-type known to be operating properly and return the faulty data set to the distributing house for repair.

(12) If the data set meets all of the requirements, disconnect all test connections and restore the data set to normal operation.

◆ TABLE J ◆

CP REPLACEMENT SEQUENCE FOR INTERNAL CLOCK OSCILLATOR AND COUNTDOWN CIRCUIT TEST

REQUIREMENT NOT MET	CIRCUIT PACK REPLACEMENT SEQUENCE			
	1	2	3	4
Step 7 (DB)	HG21 (All DS 208B-Type)	HG2 (All DS 208B-Type)	HG5 (-L1 & -L1A) HG26 (-L1B)	HG18 (-L1) HG18B (-L1A) HG25 (-L1B)
Step 8 (DTC)				HG22 (All DS 208B-Type)
Step 9 (DD)			HG22 (All DS 208B-Type)	—
Step 10 (DCR)				

6. REFERENCES

6.01 For further information concerning DS 208B-type and its associated equipment, refer to the following circuit description (CD), schematic drawing (SD), and Bell System Practices (BSPs):

NUMBER	TITLE
SD- & CD-1D242-01	Data Systems Station—Data Set 208B-Type

SECTION

TITLE

107-101-100	◆914-Type Data Test Sets—Description and Operation◆
167-458-105	83A Power Unit—Identification, Connections, and Maintenance
502-541-415	Service—565HK Telephone Set
502-543-405	Service—2565HK Telephone Set

SECTION	TITLE	SECTION	TITLE
590-002-110	4800-Bit-Per-Second (BPS) Service Using Data Set 208-Type—Reference Guide	592-030-300	Data Set 208B-Type Transmitter-Receiver—Maintenance
590-010-201	Data Sets—Multiple Installation Information	592-030-500	Data Set 208B-Type Transmitter-Receiver—Test Procedures Using 914-Type Data Test Set (DTS)
592-030-100	Data Set 208B-Type Transmitter-Receiver—Description and Operation	592-030-501	Data Set 208B-Type Transmitter-Receiver—Test Procedures Using 921A Data Test Set (DTS)
592-030-180	Data Set 208B-Type Transmitter-Receiver—Summarizing Specification—Data Systems	598-010-ZZZ	801A-Type Automatic Calling Unit
592-030-200	Data Set 208B-Type Transmitter-Receiver—Installation and Connections	598-012-ZZZ	801C-Type Automatic Calling Unit.