Bell System
TECHNICAL REFERENCE

WIDEBAND DATA SET

306 - TYPE

INTERFACE SPECIFICATION

JULY, 1971

Bell System Data Communications

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ENGINEERING DIRECTOR - TRANSMISSION SERVICES

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This Technical Reference replaces the following Preliminary Technical Reference:

"Wideband Data Set 306-Type Interface Specification — May, 1970"

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1. GENERAL

This preliminary Technical Reference describes the new Data Set 306-type. This data set is designed to interface with the customer's equipment and provide for the transmission of serial binary synchronous data at 1.344 MB/s. Included is a description of the customer interface signals and a brief description of the 1.344 MB Data Transceiver which is the main component of the 306-type data set. Differences in the operation of this data set from previous wideband data sets will be pointed out.

The Data Set 306-type is normally located on the customer's premises and provides the interface between his business machine equipment and the wideband data transmission system. The transmission system provides a full-duplex wideband data channel for the transmission of synchronous data at 1.344 MB/s. In addition to the wideband channel a voice frequency coordination circuit is normally provided.

The first model of the data set is designed for private line point-to-point transmission over T1 digital transmission facilities with a present distance limitation of 50 miles*. Future models of the data set will be available for use over analog facilities including the switched PICTUREPHONE® network with the distance limitation essentially removed.

Two types of customer interface signals are used. The high-speed signals, clocks and data, are dc coupled balanced signals. These signals and the circuits involved meet the international balanced interface standard. The cable drivers produce a nominal 1.1 volt peak-to-peak direct-coupled signal balanced with respect to ground. The control signals are the EIA-type and meet the requirements of EIA Standard RS-232C. Both types of interface signals are transmitted over twisted pair conductors.

* Revised and augmented facility arrangements are being developed for accommodating distances greater than 50 miles.

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The operation of this data set differs from previous data sets in the use of the transmit clock. The data set generates a 1.344 MHz clock called SCT which is passed to the business machine. The SCT signal is used by the business machine to synchronize the clocking of data from the business machine with the data set. The data set requires a clock in proper phase alignment with the send data to clock the send data into the data set. Therefore, the business machine must generate from the SCT signal a clock, called SCTE, in proper phase alignment with the send data and pass it to the data set over the SCTE leads.

Returning the clock to the data set in this manner provides the most flexible arrangement for operating at this data rate. If the clock were not returned to the data set, it would have to be derived either from the customer's data signal, imposing some constraints on the data pattern, or from the SCT signal within the data set, requiring a phase adjustment to compensate for various customer interface cable lengths.

2. DATA SET 306-TYPE

A wideband data set philosophy very similar to that developed for the 303-type data station has been applied to this new data set and some of the same hardware is used. A voice coordination channel will normally be provided with the wideband installation. In certain applications the transmission of voiceband data over the voice coordination channel may be required. The use of a voiceband data set may be provided on a special engineering basis.

The Data Set 306-type is normally composed of the following units:

a) 1.344 MB Data Transceiver
b) Line and Remote Test Unit
c) Cabinet to House Apparatus

The Data Auxiliary Set 804A-type — Control Unit — is usually provided with the 306-type installation. This unit contains a telephone set, control buttons, and status lights. The control unit is normally within 50 feet of the 306-type data set.

On T1 line installations, a T1 Line Terminating Unit and Power Supply is also required. This unit is part of the T1 line installation and provides proper line terminations, maintenance functions, and powering arrangements. The T1 Line Terminating Unit may be separated from the data set by up to 750 feet or may be placed in the data set cabinet when a larger cabinet is provided.

Figure 1 is a block diagram of a complete Data Set 306-type arrangement. Figure 2 is a block diagram of the 1.344 MB Data Transceiver.

2.1 Description of New Apparatus

2.1.1 1.344 MB Data Transceiver

The 1.344 MB Data Transceiver contains all the circuitry necessary to condition the customer's 1.344 MB/s data for transmission over the T1 line. It accepts the customer's 1.344 MB/s data and converts it to a 1.544 MB/s bipolar pulse stream. Prior to transmission, framing information and stuffing bits, to insure that a sufficient number of ones are transmitted, are added to the data stream.

On the receive side, the framing and stuffing bits are removed and the 1.344 MB/s data stream is regenerated and transmitted to the business machine. Technical papers describing the new data set are in preparation. A very brief description is presented here.

The transmit portion of the data transceiver derives its timing from a 1.544 MHz master clock. The clock is applied to the transmit bit rate converter where the framing generator removes clock pulses corresponding to the framing and stuffing bit time slots. The resulting output is a staggered 1.344 MHz clock that is smoothed by the 1.344 MHz clock recovery to produce the 1.344 MHz clock supplied to the business machine (SCT). For proper operation of the smoothing circuit and for proper synchronization of the elastic store, the SCT signal must be returned to the data set on the SCTE leads.

The business machine clocks the data onto the SD leads in proper phase with the SCTE signal. The proper timing between these signals is discussed in the interface section.

The customer's SD and SCTE signals are passed through the high-speed data interface and the SD is applied to the scrambler where a quasirandom sequence is added to the send data. The scrambler output is written into the elastic store in the transmit bit rate converter. The data is read out of the elastic store at a 1.544 MB/s rate with the staggered 1.344 MHz clock and the framing and stuffing bits are added to the data stream producing the 1.544 MB/s data.

The 1.544 MB/s data is applied to the transmit line circuit where it is converted to a bipolar pulse stream by the binary to bipolar converter and then passed through the equalizer and transmitted to the T1 line terminating unit and on to the T1 line.

On the receive side the T1 bipolar line signal is applied to the receive line circuit where the bipolar line signal is converted to a binary signal and the 1.544 MHz clock is recovered.

The framing detector monitors the output of the framing generator and the 1.544 MB/s data and provides control information to the framing generator to establish frame synchronization. The clock pulses corresponding to the framing and stuffing bit time slots are removed from the 1.544 MHz clock producing the staggered 1.344 MHz clock. This clock is used to read the receive data into the elastic store. The staggered 1.344 MHz clock is then smoothed by the 1.344 clock recovery. The 1.344 MHz clock is used to read the data from the elastic store which is then descrambled and passed through the high-speed data interface along with the SCR to the business machine.

2.1.2 Physical Design

The 1.344 MB Data Transceiver consists of a 10-inch wide by 5-inch high chassis containing 9 plug-in circuit boards. The construction is

similar to that used for the 303-type data set. The required power supply is mounted on the end of the chassis. Figure 3 is a photograph of a laboratory model of the 306-type data set including the Data Auxiliary Set 804A-type. The final production models are not expected to vary significantly from the laboratory model. A larger cabinet of the same type shown in Figure 3 is used when the T1 Line Terminating Unit is installed in the data set cabinet.

3. BUSINESS MACHINE INTERFACE

This section describes the business machine interface arrangement of the 306-type wideband data set. It describes in detail the electrical characteristics of the interface and covers the operation of the data station from the interface standpoint on a lead-by-lead basis. Much of the method of operation of the Data Set 306-type is thereby covered. The pin assignments and required characteristics of the interface cable are also given.

3.1 Description of Interface Signals

The Data Set 306-type is provided with cable drivers and cable terminators which become part of the interchange circuits that interconnect the data set and the business machine. Two types of interface signals are used. The high-speed signals, including clocks and data, meet the international balanced interface standard. The cable drivers produce a nominal 1.1 volt peak-to-peak direct coupled signal balanced with respect to ground into 100 ohms. Figure 4 shows typical balanced cable driver and cable terminator circuit. Attachment A gives the electrical characteristics of balanced interface circuits.

The control signals have the electrical characteristics of the EIA Standard RS-232C.

Both types of interface signals are transmitted over twisted pair conductors.

A description of signals between the business machine equipment and the Data Set 306-type follows.

3.1.1 Balanced Interface Signals

a) (SCT) Serial Clock Transmit (Originates in Data Set)

The SCT is a 1.344 MHz balanced clock transmitted to the business machine over the SCT (A) and SCT (B) leads by the data set. The frequency accuracy is $\pm$ .003 percent. The symmetry of the SCT signal is determined by the zero crossing of the SCT (A) minus the SCT (B) signal. The time between zero crossings should be between .45 and .55 of a clock period.

The SCT is used by the business machine to synchronize the clocking of data to the data set and to generate the SCTE signal.

b) (SCTE) Serial Clock Transmit External (Originates in Business Machine)

The SCTE is the balanced transmit clock transmitted to the data set over the SCTE (A) and SCTE (B) leads. The SCTE signal is generated in the business machine from the SCT signal supplied from the data set.

For the proper transmission of data, the SCT must be returned to the data set over the SCTE leads and the send data signal must be properly aligned with the SCTE (timing requirements given in SD description). Since the SCTE must be present prior to the transmission of data, it is recommended that the SCTE be returned to the data set whenever the SCT is present.

One method of returning the clock is to use the output of the SCT cable terminator in the business machine to clock the data on to the SD leads and also to drive the SCTE cable driver.

The symmetry of the SCTE signal is determined by the zero crossings of the SCTE (A) minus the SCTE (B) signal. The time between zero crossings, measured at

the data set connector with the leads terminated in the data set or in an external 100-ohm resistor, should be between .4 and .6 of a clock period. Since the cable between the business machine and the data set is not expected to adversely affect the clock symmetry, the above requirements should be substantially the same at the business machine connector.

c) (SD) Send Data (Originates in Business Machine)

The Send Data circuit is designed to accept serial binary data from the business machine. The SD is a balanced signal transmitted to the data set over the SD (A) and SD (B) leads. The SD signal must be properly aligned with the SCTE signal. The state of the SD signal should be changed within ±10 percent of a clock cycle of the positive going transition of the SCTE (A) minus the SCTE (B) signal measured at the data set connector with the leads terminated in the data set or into an external 100-ohm load. With the type of cable recommended in Section 3.1.4, it is expected that the difference in transmission time between the SD and SCTE will be less than 1 percent of a bit length. Therefore, if the ±10 percent tolerance mentioned above is held to ±9 percent at the business machine connector, the requirements at the data set interface should be met. The SD signal should be maintained on the SD leads for the full period duration (consistent with the tolerance just mentioned). The SD signal is sampled by the data set coincident with the negative going zero crossings of the SCTE (A) minus SCTE (B) signal.

The SD (A) lead should be negative with respect to the SD (B) lead for a mark or binary ONE condition.

The above requirements can be measured at the data set connector by displaying the SD (A) minus SD (B) signal on one trace of an oscilloscope and comparing it with the SCTE (A) minus SCTE (B) signal displayed

on the second trace. The zero crossings of the SD (A) minus SD (B) signal should occur within ±10 percent of a clock cycle of the positive going zero crossing the SCTE (A) minus SCTE (B) signal. For these measurements, the balanced leads must be terminated in the data set or in external 100-ohm resistors.

d) (RD) Receive Data (Originates in Data Set)

Receive Data is a balanced signal delivered serially on the RD (A) and RD (B) leads to the business machine. The receive data signal is regenerated and, therefore, in phase with the Serial Clock Receive (SCR) signal. The RD circuit will be held in the "mark hold" condition whenever the data set is not in frame sync. The "mark hold" condition also occurs whenever the data set control signals are not in the proper condition for receiving data such as when the conditions for RLSD ON (described in Section 3.1.2) are not satisfied. During the "mark hold" condition, the RD (A) lead is negative with respect to the RD (B) lead equivalent to receiving a binary ONE. The relative timing between the RD and SCR signals is given in the SCR section.

e) (SCR) Serial Clock Receive (Originates in Data Set)

The data set receiver derives a bit synchronization signal, called Serial Clock Receive (SCR), from the received line signal. The SCR is a balanced signal transmitted to the business machine on the SCR (A) and SCR (B) leads. The data on the RD lead is changed coincident, within ±10 percent of a clock cycle, of the positive going zero crossing of the SCR (A) minus SCR (B) signal. The business machine should sample the receive data on the RD lead coincident with the negative going zero crossing of the SCR (A) minus SCR (B) signal. The symmetry of the SCR signal is defined by the zero crossings of the SCR (A) minus SCR (B) signal. The time between the zero crossings should be between .45 and .55 of a clock period. The

SCR may suffer jitter. Variation in the SCR period between adjacent cycles is expected to be less than 0.1 percent of a clock period. Since the RD signal is timed by the SCR, they will jitter together.

3.1.2 Control Signals (EIA-Type Circuits)

f) (DSR) Data Set Ready (Originates in Data Set) EIA Circuit Designation CC

An ON condition on this lead indicates to the business machine that the data set is capable of operating (not in a test mode) and can receive wideband data provided RLSD is ON and can transmit wideband data provided CS is ON.

Options may be wired in the data set to allow operation on future switched network or initial private line applications. The necessary conditions for DSR are described for each of the above cases.

In future switched network applications, DSR ON at the answering data set requires that:

1) Data set power is ON, and

2) Data set is not in the local test or remote test mode, and

3) DTR is ON, and

4) All delays inherent in setting up the call have elapsed.

At the originating data set, DSR ON requires all of the above and RLSD ON. Interruption of RLSD once DSR has been ON will not turn DSR OFF.

For all cases a DSR OFF condition indicates:

1) A local test, remote test, or power off condition, or

2) DTR OFF, or

3) The Data Auxiliary Set 804-type is on-hook.

Several modes of operation are available for private line operation:

1) The circuit may be operated as in the switched network case. The call is placed by the originating station pushing the ring button on the Data Auxiliary Set 804-type. In this case, there is an option wired in the data set by the telephone company to bypass the delay circuitry associated with switched network call placement.

2) An option may be wired in the wideband data set by the telephone company to disassociate the wideband data set control circuitry from the Data Auxiliary Set 804-type. In this case, DSR ON requires that the data set power is on, the data set is not in a local or remote test condition and DTR is ON. The telephone company may also wire the data set to provide a continuous DTR ON condition within the data set. Under this condition, the Data Auxiliary Set 804-type, if provided, may be used for voice coordination at any time. The far end may be called by pushing the ring button.

g) (DTR) Data Terminal Ready (Originates in Business Machine) EIA Circuit Designation CD

Signals on this circuit are generated within the business machine to control the holding and dropping of a wideband call on future switched network applications. When automatic answering is used (such as on a switched network), the Data Terminal Ready lead must be turned ON by the business machine to enable the data set to answer a call automatically and turned OFF to terminate the call.

When automatic answering and/or call termination by the business machine is not required, this lead may be wired in the ON condition internally by the telephone company.

h) (RLSD) Receive Line Signal Detector (Originates in Data Set) EIA Circuit Designation CF

An ON signal on this lead is one indication that signals on the Receive Data lead are reliable.

In data sets designed for operation on T1 facilities, the ON condition is an indication that the data set is in frame sync and is receiving good framing information over the T1 line from the distant data set.

In the future analog version of the data set, the ON condition is an indication that data transitions (scrambler idle code if no data is being transmitted from the far end) are being received.

The RLSD ON condition is inhibited from reaching the business machine unless certain control conditions are satisfied. DTR must be ON or wired ON in the data set. The Data Auxiliary Set 804-type must be off-hook or on-hook in the data mode or the option that disassociates the control circuitry from the 804-type Data Auxiliary Set for private line operation must be wired in by the telephone company. The RLSD ON condition is also passed to the business machine when the data set is in a test mode.

When this signal is OFF, the Receive Data lead will be held in the "mark hold" state and the Clear to Send lead will be held OFF.

i) (RS) Request to Send (Originates in Business Machine) EIA Circuit Designation CA

The Request to Send lead must be in the ON condition to send wideband data. It can be wired permanently ON in the business machine or it can be wired permanently ON in the wideband data set by the telephone company. When RS is OFF, the data set will transmit the scrambler idle code and bit synchronization will be maintained at the far data set.

j) (CS) Clear to Send (Originates in Data Set) EIA Circuit Designation CB

An ON condition on this lead indicates that the wideband data set is in a condition to permit the transmission of data or test signals in the local test condition.

The ON condition on CS requires that RLSD and RS are both ON. There is a time delay into the logic for the CS circuit to insure that the wideband data sets at both ends are in bit synchronization before CS is turned ON. The time delay, approximately 0.1 millisecond, is measured from the time RLSD goes ON. Once the time delay has been satisfied, the CS signal will follow the SR signal.

k) (RI) Ring Indicator (Originates in Data Set) EIA Circuit Designation CE

Signals on this circuit are generated within the wideband data set to indicate to the business machine that a ringing signal is being received. This circuit is independent of the condition on Data Terminal Ready.

The Ring Indicator signal is turned ON for each ring on the voice frequency coordination line. It is useful when arranging a station to answer calls automatically and to permit the answering data terminal to prepare itself (such as getting a motor up to standard speed) if necessary, before the business machine signals to answer the call by turning Data Terminal Ready ON.

l) (LT) Local Test (Originates in Business Machine)

This circuit provides for electrical control of looping the wideband data set on the telephone line side. When the Local Test lead is ON, the data set is in the Local Test Mode. The telephone lines are looped back to the Telephone Central Office at the Line Terminating Unit and the data set output is looped back to the data set. This permits the business machine to send to itself through the wideband data set for local testing. In addition to this interface control, a button on the Data Auxiliary Set

804-type performs this function on a manual basis. Any time the Local Test circuit is operated a lamp lights under the test button on the Data Auxiliary Set 804-type. The same lamp lights on the Data Auxiliary Set 804-type when the data set is put in the Remote Test Mode by the telephone company.

3.1.3 Connector Specification

The business machine interface connector on the Data Set 306-type is a 34-pin female connector with .062 inch pins. This connector may be supplied by two manufacturers as follows:

Winchester Electronics
Division of Litton Industries
Oakville, Connecticut

Socket Number
MRA-34-S-SFC-J (Fixed Contact Solder Type)

or
Continental Connector Corp.
Woodside, N.Y.

Socket Number
25034-16-SS (Fixed Contact Solder Type)

The following mating connectors for the business machine cable may be used:

Winchester
XMRA-34-P-D-1300 (Fixed Contact Solder Type)

or
XAC-34-P-D-1300 (Removable Contact)
Equipped with 34, #100-1016P (Crimp Type) Contacts

or
34, #100-2516P (Solder Type) Contacts.

Continental

25034-16-P-SKH-C (Fixed Contact Solder Type)

or
25-34-P-KH-10-C (Removable Contact)

Equipped with 34, #2500 P6A16 (Crimp Type) Contacts

or
34, #2500 P6B16 (Solder Type) Contacts

The following MIL. SPEC. mating connectors may also be used:

The MIL. SPEC. equivalent of the fixed contact connector is MIL. SPEC. – C-8384. In other words a connector meeting MIL. SPEC. – C-8384 is the equivalent of the MRA-34-S-SFC-J, XMRA-34-P-D-1300 and the 25034-16-SS, 25034-16-P-SKH-C connectors. The MIL. SPEC. equivalent of the removable contact connector is MIL. SPEC. – C-22857-C. In other words, a plug meeting MIL. SPEC. – C-22857-C is equivalent of the XAC-34-P-D-1300 and the 25-34-P-KH-10-C plugs. The lettering of the pins of the MIL. SPEC. C-22857-C connectors is not the same as the commercial connector used on the data set and the cross reference table given in Attachment B should be used.

The MIL. SPEC. C-22857-C connector mentioned above is the connector being recommended as an international standard for data in this speed range.

The connector pin assignments are as follows:

PIN ASSIGNMENT LIST

PIN

A) PROTECTIVE GROUND (EIA CKT. AA)
B) SIGNAL GROUND (CKT. AB)
C) REQUEST TO SEND (CKT. CA)
D) CLEAR TO SEND (CKT. CB)
E) DATA SET READY (CKT. CC)
F) RECEIVED LINE SIGNAL DETECTOR (CKT. CF)
H) DATA TERMINAL READY (CKT. CD)
J) RING INDICATOR (EIA CKT. CE)
K) LOCAL TEST
R,T) RECEIVED DATA
    R = RECEIVED DATA (A)
    T = RECEIVED DATA (B)
V,X) SERIAL CLOCK RECEIVE
    V = SERIAL CLOCK RECEIVE (A)
    X = SERIAL CLOCK RECEIVE (B)
P,S) SEND DATA
    P = SEND DATA (A)
    S = SEND DATA (B)
U,W) SERIAL CLOCK TRANSMIT EXTERNAL
    U = SERIAL CLOCK TRANSMIT EXTERNAL (A)
    W = SERIAL CLOCK TRANSMIT EXTERNAL (B)
Y,a) SERIAL CLOCK TRANSMIT
    Y = SERIAL CLOCK TRANSMIT (A)
    a = SERIAL CLOCK TRANSMIT (B)
L,M,N,Z,b,c,d,f,g) SPARE FOR INTERNATIONAL USE
h,i,j,k,m,n) SPARE FOR NATIONAL USE

3.1.4 Business Machine Cable Requirements

The cable from the Data Set 306-type to the business machine should be 24-gauge multiple twisted pair cable. To reduce the possibility of crosstalk between the various leads and assure proper operation, the following recommendations are made regarding the cable parameters and cable pair assignments.

The business machine cable should have the following characteristics:

Gauge	24
Characteristics Impedance of Pair	120±10% ohms at 150 kHz 100±10% ohms above 400 kHz
Mutual Capacitance of Pair	1600±20% PF/100 feet
Capacity of Single Lead to Ground all other leads grounded	4000 PF/100 feet maximum
Crosstalk — pair-to-pair	40 dB minimum at 150 kHz

The greatest amount of crosstalk is between the EIA signal leads. It is recommended that one pair be used for each EIA signal with one lead of the pair grounded. The amount of crosstalk depends on the EIA cable driver characteristics and the cable terminator input impedance. When EIA cable drivers with an output impedance of the order of 3000 ohms are used and if the rise time of the output signal is determined by the cable driver output impedance and the cable capacity, any assignment of the cable pairs will provide proper operation.

If EIA cable drivers having the minimum allowed output impedance and producing signals with the maximum rise time allowed by RS-232C are used, more crosstalk will be encountered. Proper operation may be obtained under either of these conditions with the following assignment of cable pairs in the customer cable. The balanced signals should be assigned to pairs in the center of the cable. The cable pairs around the outside of the cable should be assigned to the EIA signals. An extra pair with both leads grounded should be used between each EIA pair to provide isolation. This arrangement with the extra ground wires around the outside of the cable also provides some shielding from interfering signals from the outside environment.

The balanced cable drivers and cable terminators will operate over 100 feet of cable. The requirements of the RS-232C specifies that a maximum of 2500 PF should be presented to the EIA cable driver. This requirement would limit the cable length to approximately 65 feet. Since the EIA circuits are used only for control signals where the requirement for the time to pass through the transition region is 1 msec, it is felt that 100 feet of cable may be used. Laboratory tests have shown that 100 feet of cable will operate properly.

Cables meeting the crosstalk requirements may be obtained from several manufacturers. A 25-pair cable with the connectors installed may be ordered from the Whitney Blake Company, New Haven, Connecticut. The ordering information is as follows:

Specify the length of the cable and the cable jacket color by one of the following Whitney Blake catalog numbers:

    121-1004   Beige jacket
    121-1034   Grey jacket

Specify the connector for the data set end of the cable as given in Section 3.1.3. Specify the connector for the business machine end. Specify the data set connector pin assignments and pair numbers as in the table below.

Function	Pair #	Color Code	Pin Assignment
SCR	1	BL-W	V,X
RD	2	O-W	R,T
SCT	3	G-W	Y,a
SD	4	BR-W	P,S
SCTE	5	S-W	U,W
SPARE (P)	6	BL-R	Z,b
SPARE (P)	7	O-R	c,f
SPARE (P)	8	G-R	i,k
SPARE (P)	9	B-R	h,j
CS	10	SL-R	D,B
GRD	11	BL-BK	L,B
RS	12	O-BK	C,B
GRD	13	G-BK	N,B
RLSD	14	BR-BK	F,B
GRD	15	SL-BK	M,B
DSR	16	BL-Y	E,B
SIGNAL GRD	17	O-Y	B,B
RI	18	G-Y	J,B
GRD	19	BR-Y	d,g
DTR	20	SL-Y	H,B
GRD	21	V-BL	B,B
LT	22	V-O	K,B
GRD	23	V-G	B,B
SPARE (P)	24	V-BR	m,n
PROTECTIVE GRD	25	V-SL	A,A

Note: Pin B is circuit ground. The pairs labeled GRD are used to isolate the EIA leads and are connected to Pin B (signal ground) at the connector or within the data set.

4. DATA SET TEST FEATURES

Data set test features will be provided similar to those of a 303-type station. These test features will allow:

a) Local Test (LT) under control of business machine interface signal or manual pushbutton on the Data Auxiliary Set 804-type by the customer, or from a key on the Line and Remote Test Unit for maintenance testing. The Local Test condition disconnects the station from the T1 line at the T1 Line Terminating Unit and establishes a loopback, allowing the customer's data to be transmitted through the complete data set and checked by the customer. When provided, the 4-wire coordination circuit is also looped back and the incoming voice pairs are terminated.

The Local Test condition also loops the T1 lines back to the Telephone Central Office to allow a signal to be maintained on the T1 lines.

b) Remote Test 1 (RT1) — under control of a wideband data test bay at a Telephone Central Office or test key on the Line and Remote Test Unit. This test condition allows remote testing of the T1 line facility on a loopback basis with the wideband station disconnected. When the associated voice coordination circuit is 4-wire, it also is looped back for maintenance testing.

c) Remote Test 2 (RT2) — under control of a wideband data test bay at a Telephone Central Office or test key on the Line and Remote Test Unit. This test condition allows testing of a complete data set, looped at the business machine interface, with the business machine disconnected.

ATTACHMENT A

Balanced Cable Driver and Terminator

Electrical Characteristics

Item 1 — Interface Driver

The interface driver shall meet the following requirements:

A. Differential output impedance shall be 100 ± 50% ohms.

B. Output impedance to ground with output terminals shorted together shall be 150 ± 10% ohms.

C. When terminated in 100-ohm resistive load, the driver shall deliver a signal level of 1.1 volts ± 20% peak-to-peak, i.e. the voltage between the two output leads shall be 0.55 ± 20% volts with the polarity of the output voltage for a transmitted binary "O" being the opposite of that for a transmitted binary "1."

D. Maximum rise and fall time between the 10% and 90% levels shall be less than 40 nanoseconds.

E. The arithmetic mean of the voltage of each output with respect to ground (DC line offset) shall not exceed 0.6 volts when the driver is terminated in 100 ohms.

Item 2 — Interface Terminator

The interface terminator shall meet the following requirements:

A. Input impedance shall be 100 ± 10% ohms.

B. Resistance to ground with the input terminals shorted together shall be 150 ± 10% ohms.

Item 3 — Interface Sensitivity to Ground Potential Offset or Longitudinal Noise

An interface driver complying with the above requirements when connected to an interface terminator complying with the above requirements shall operate satisfactorily with a minimum of ±4 volts difference in ground potential or with a minimum of ±2 volts longitudinal noise. If margin is to be allocated to ground potential offset and longitudinal noise simultaneously the driver-terminator should operate satisfactorily if the following is satisfied:

$$\frac{\text{Ground Potential Offset}}{2} + \frac{\text{Longitudinal Noise}}{\text{Voltage}} = 2 \text{ volts}$$

Item 4 — Interface Circuit Protection

Any balanced driver or terminator circuit in the interface should not be damaged by:

A. Shorting to ground.

B. Crossing with any other physical lead in the interface.

ATTACHMENT B

CROSS REFERENCE FOR CONNECTOR
PIN LETTERING

MIL. SPEC. C-22857-C Connector	Commercial Connector
A	A
B	B
C	C
D	D
E	E
F	F
H	H
J	J
K	K
L	L
M	M
N	N
P	P
R	R
S	S
T	T
U	U
V	V
W	W
X	X
Y	Y
Z	Z
AA	a
BB	b
CC	c
DD	d
EE	f
FF	g
HH	h
JJ	i
KK	j
LL	k
MM	m
NN	n

804-TYPE
DATA
AUXILIARY
SET

BUSINESS
MACHINE

CLOCKS

DATA

CONTROLS

1.344 MB
DATA
TRANSCEIVER

POWER
SUPPLY

DATA

CONTROLS

LINE
AND
REMOTE
TEST
UNIT

DATA

CONTROLS

TI
LINE
TERMIN-
ATING
UNIT

POWER
SUPPLY

TO TI
LINE

TO VOICE
BAND LINE

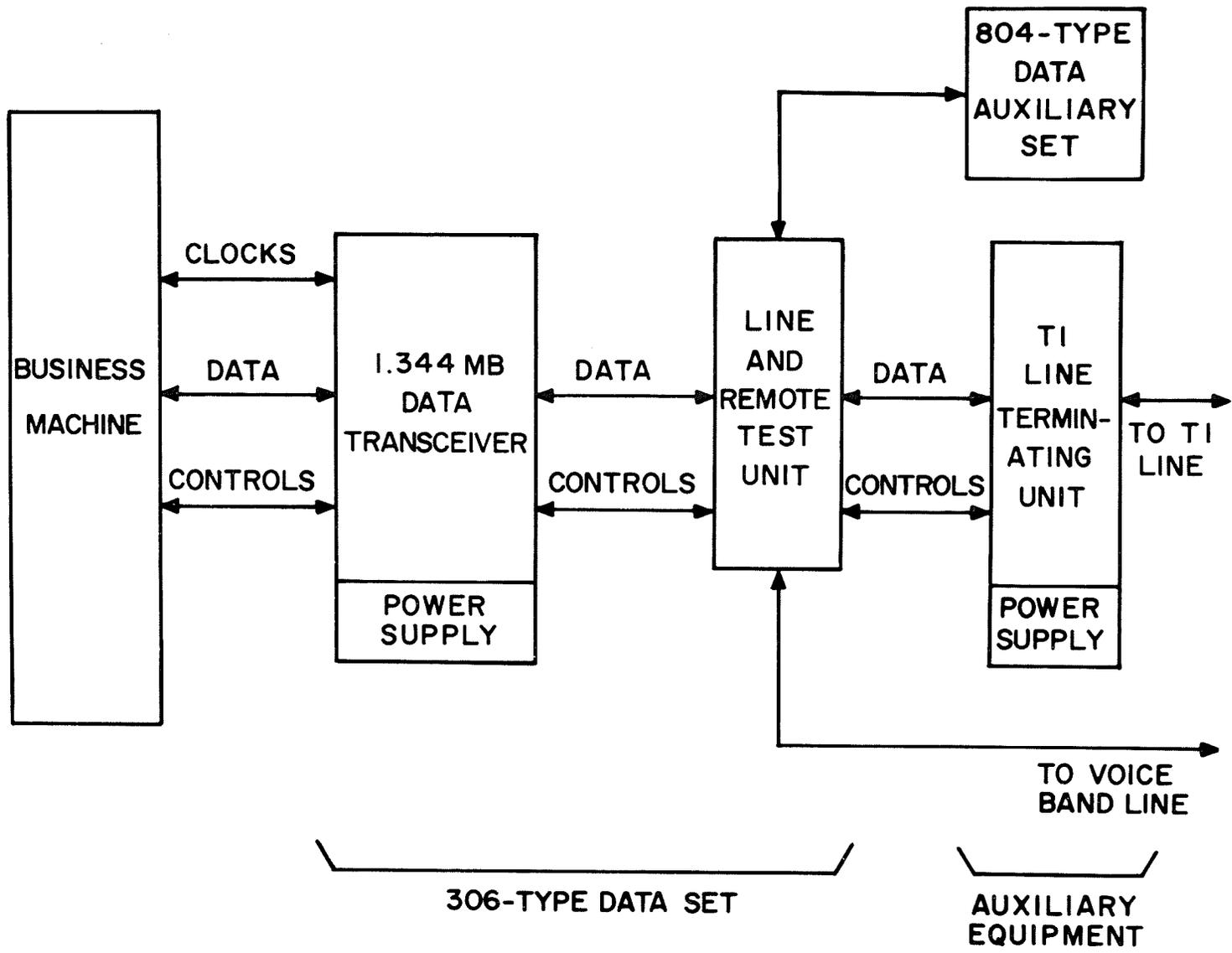306-TYPE DATA SET

AUXILIARY
EQUIPMENT
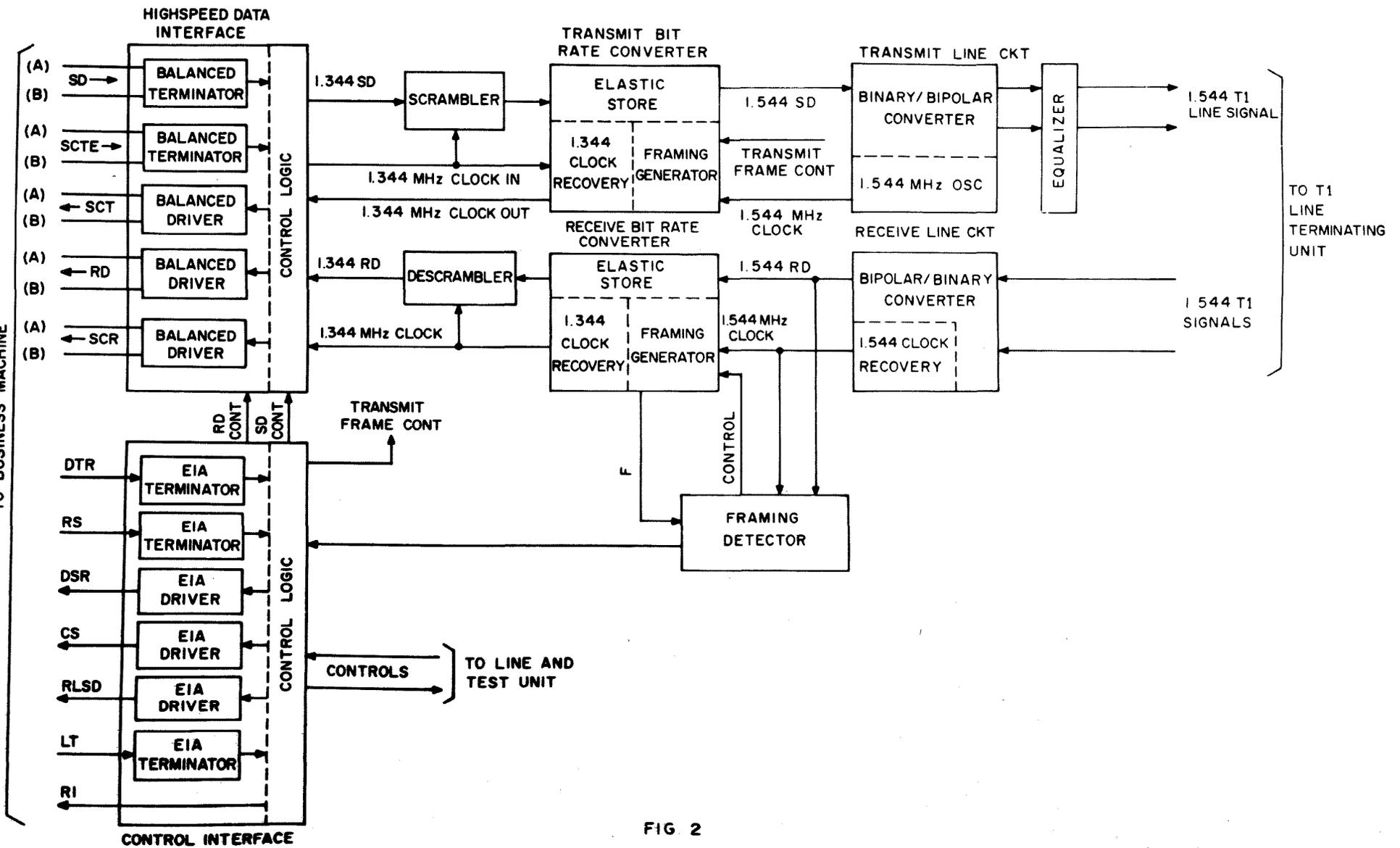
FIG. I

306-TYPE DATA SET ARRANGEMENT
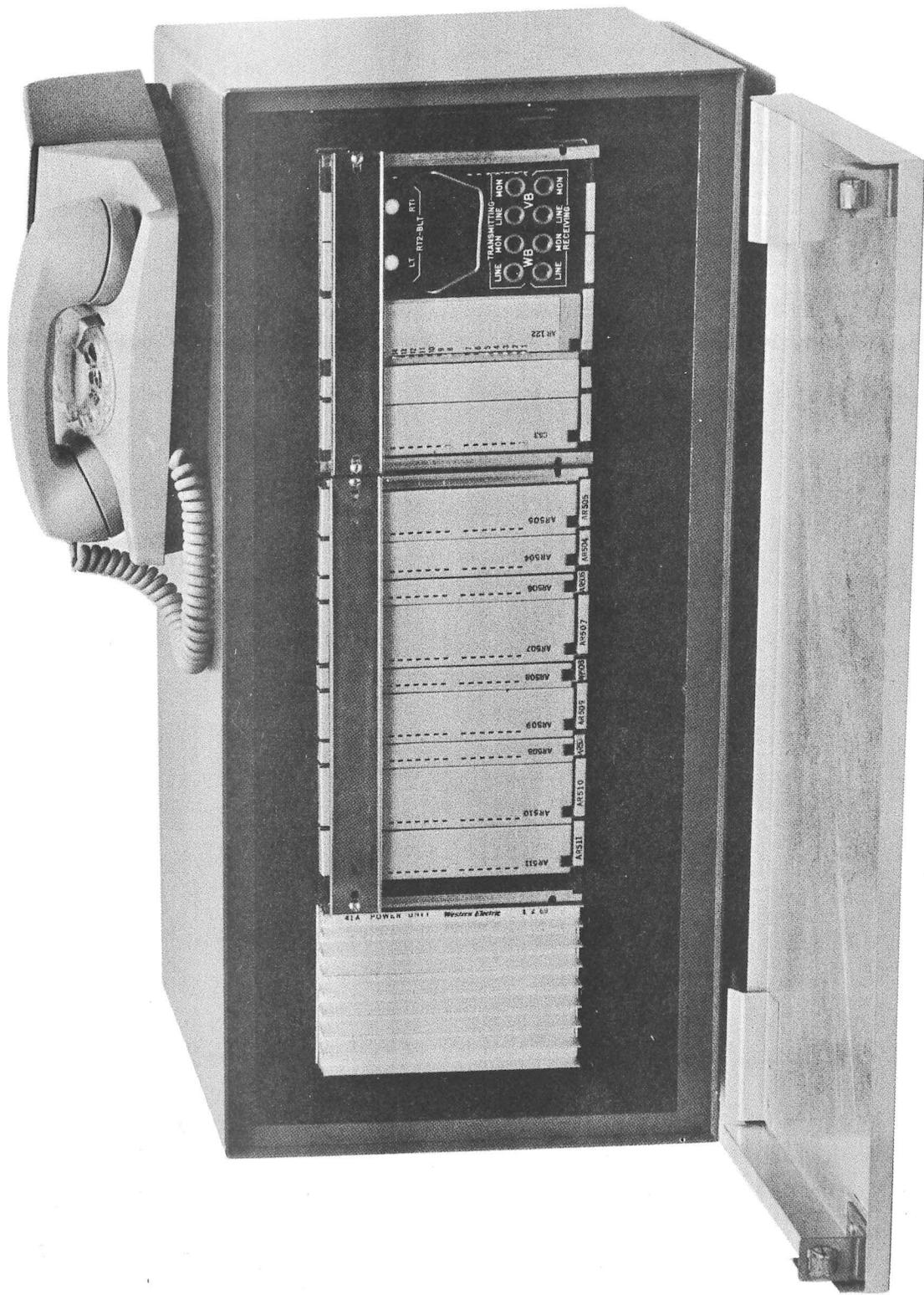
FIG. 2

1.344 MB DATA TRANCEIVER
FOR T1 LINE APPLICATION

306-TYPE DATA SET WITH
804-TYPE DATA AUXILIARY SET
FIG. 3

CABLE DRIVER

INPUT
(GRD OR
OPEN)

6.2V
L
IN709A

1780

+4.5V

46.4K

1000

600

Q1

348

8.2V

IN712A

-18V

5620

Q2

Q3

1350

1350

383

383

+4.5V

120

TO 100 Ω
BALANCED
LINE

TRANSISTORS
Q1,Q2,Q3
2N 2369A OR EQUIV.

12.7K

3830

-18V

CABLE TERMINATOR

TO 100 Ω
BALANCED
LINE

120

200
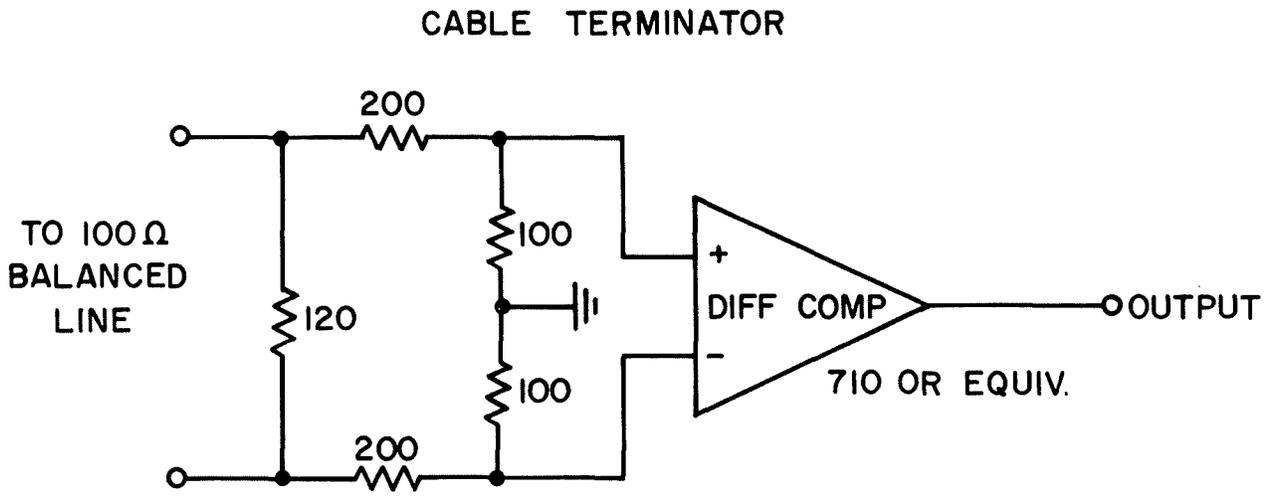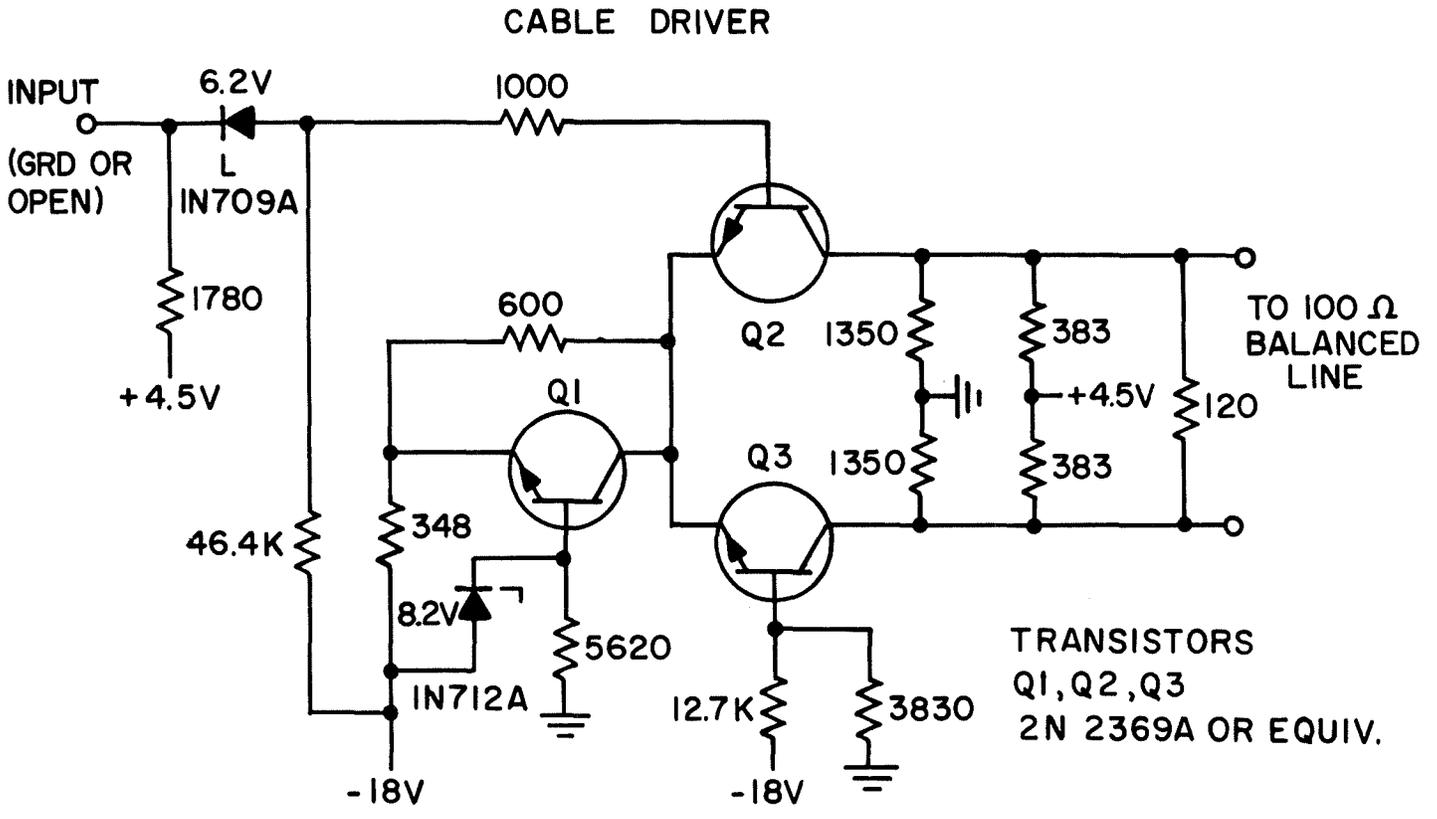
100

100

200

DIFF COMP

+

−

OUTPUT

710 OR EQUIV.

FIG. 4

TYPICAL BALANCED CABLE DRIVER
AND
BALANCED CABLE TERMINATOR CIRCUITS