8B1 DATA SELECTIVE CALLING

(FULL DUPLEX)

GENERAL DESCRIPTION AND OPERATION

1. GENERAL

1.01 This section describes the 8B1 Full Duplex Data Selective Calling Operation and associated equipment used to implement the outlying stations.

1.02 An arrangement consisting of a data communications processor and one or more full duplex branch circuits is used to exchange data between 8B1 outlying station sets on a noncontention basis. The outlying stations are situated on the send and receive legs of each full duplex branch; the sending devices have access to the send leg, and the receiving devices have access to the receive leg. Data is exchanged at 100 words per minute using the 8-level, American Standard Code for Information Interchange (ASCII).

1.03 The data communications processor exerts complete control of all signal line activity. It polls each sending device for message transmission, selectively calls one or more receiving devices for message reception, and inserts the appropriate control code to hold or disconnect a sending and receiving device. All control codes and incoming messages are issued by the processor on the receive leg and are directed to one or more outlying receivers. Answer-back responses and outgoing messages, originated from outlying stations, are received by the processor on the send leg. The send and receive legs are independent of each other; traffic on one leg does not appear on the other.

1.04 The outlying stations are equipped with an 8B1 Automatic Send-Receive (ASR) or Receive-Only (RO) Teletypewriter Set. Variations of the ASR and RO sets are identified in Table 1. Each teletypewriter set is equipped with a station controller assembly to provide the necessary logic elements for automatic operation.

TABLE 1 - AVAILABLE 8B1 TELETYPEWRITER SETS

Set	Typing Unit Platen		Tape Punch Unit	
	Friction Feed	Sprocket Feed	Typing	Non-Typing
ASR (35BC)	X		X	
ASR (35BF)		X	X	
ASR (35BP)	X			X
ASR (35BR)		X		X
RO (35BE)	X			
RO (35BH)		X		

1.05 The sending and receiving devices at each outlying station operate on dc signals and are compatible with telegraphic loops carrying 20 ma or 60 ma. If telephone lines and switching centers are used to interconnect the stations, each dc telegraphic loop can be terminated locally in a 130-type subset (with modified 43A1 channel) or a 103 series data set plus TP198420 data set coupler. Typical station arrangements for the 8B1 full duplex branch circuits are illustrated in Figure 1.

1.06 Each outlying station can exist as a terminal station or as a manual or an automatic relay station. As a terminal station, data could be terminated or transferred to other low or high speed services on a torn tape basis. As an automatic relay station, auxiliary equipment must be added to relay traffic automatically between an 8B1 station and another low or high speed service.

Note: All sending devices, ie, tape reader units and answer-back distributors, transmit on the send leg of a branch circuit. The receiving devices, ie, tape punches, typing units, and station logic elements, respond to the receive leg. Conversely, the data communications processor receives from the send leg and transmits on the receive leg.

2. CONTROL CODES

2.01 Traffic flow on the send and receive legs is regulated by the data communications processor through application of control codes. Polling and selective calling functions are performed with appropriate Transmitter Start Codes (TSC) and Call Directing Codes (CDC). An End-Of-Address (EOA) following one or more CDCs identifies the beginning of message text. The End-Of-Transmission code (EOT) identifies the end of message text.

2.02 In full duplex operation, interrupt sequences are necessary to maintain maximum traffic flow to and from the data communications processor. A sending tape reader may be interrupted to allow the transmission of an answer-back response to a called station's CDC. Similarly a receiving unit copying text may be interrupted to allow a new station transmitter to be polled after the data communications processor has sensed an idle send leg or recognized the end of a message.

TRANSMITTER START CODES (TSC) AND RESPONSES

2.03 An outlying station is polled for traffic by the data communications processor by the transmission of a TSC on the receive leg. The processor pauses after each TSC in order to allow the station to respond. A station having no traffic to send will respond with a \ ACK code sequence. A station having traffic will respond by beginning message transmission. At the conclusion of traffic the processor will poll the next station or can disconnect an operating reader in order to initiate the next poll.

2.04 A Transmitter Start Code is comprised of two characters; the first character is always DC_O and the second is any one of the 63 printing characters of the ASCII code. A printing character has code level 6 or 7 marking (not both). Each tape reader on the send leg is assigned a discrete TSC.

SELECTIVE CALLING CONTROL CODES

TSC - Transmitter Start Code. Originated from DCP. Recognized by designated sending station (ASR or RO w/auxiliary tape reader).

CDC - Call Directing Code. Originated from DCP relay unit to select receiving unit.

STATION CONTROL CODES

EOA - Command from DCP to activate selected receiving or sending unit or both.

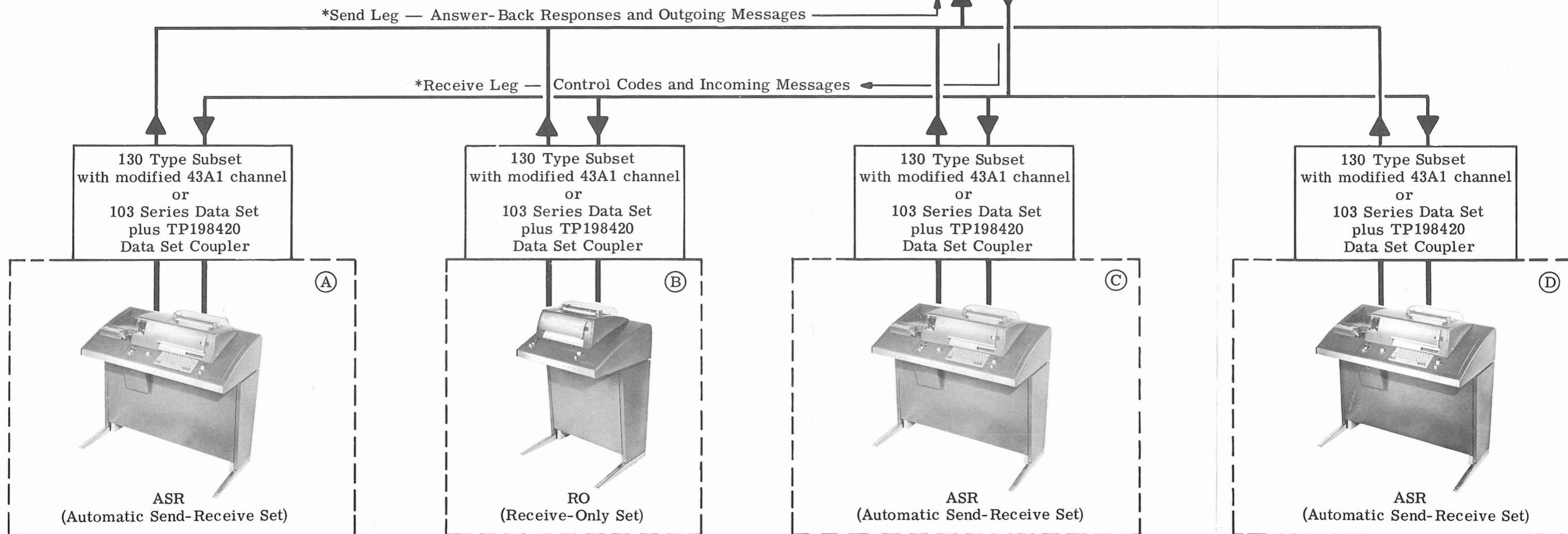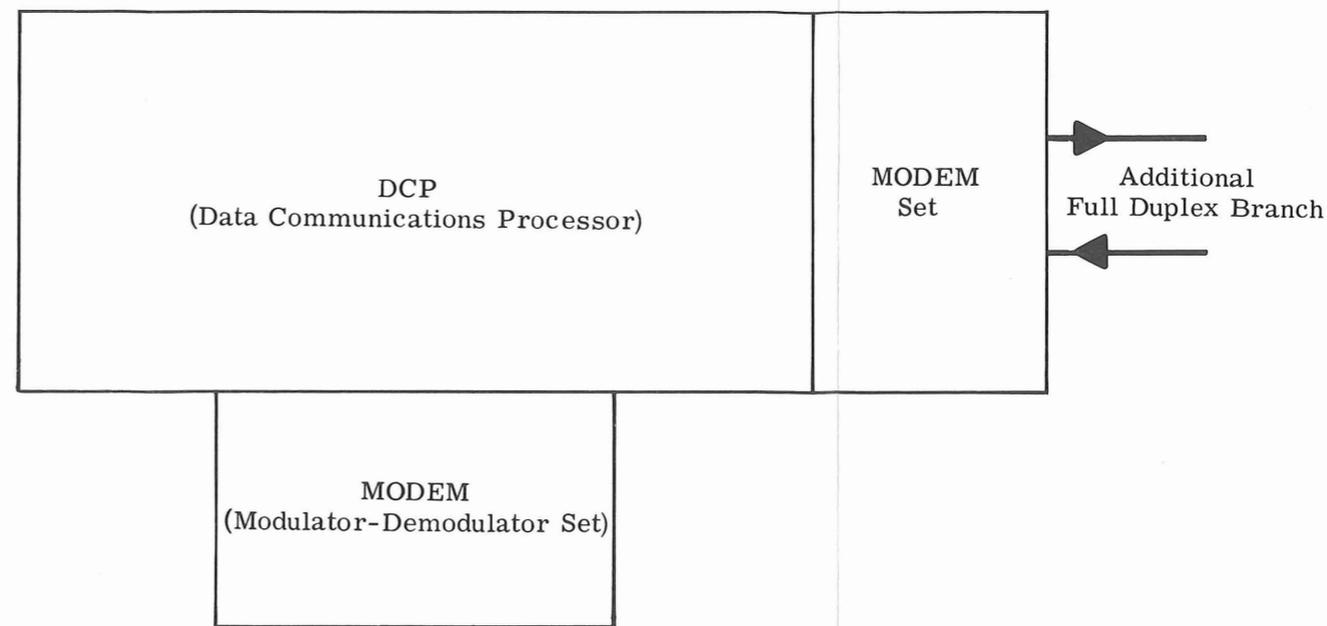NULL - Command from DCP to hold receiving or sending unit or both.

XOFF - Command from DCP to disconnect a sending unit.

EOT - Command from DCP to disconnect a receiving unit.

SIGNAL LINE LEGEND

━━━ 20 ma, dc loop.
─── 110 baud, ac line.

DCP
(Data Communications Processor)

MODEM
Set

Additional
Full Duplex Branch

MODEM
(Modulator-Demodulator Set)

*Send Leg — Answer-Back Responses and Outgoing Messages

*Receive Leg — Control Codes and Incoming Messages

130 Type Subset
with modified 43A1 channel
or
103 Series Data Set
plus TP198420
Data Set Coupler

Ⓐ

ASR
(Automatic Send-Receive Set)

130 Type Subset
with modified 43A1 channel
or
103 Series Data Set
plus TP198420
Data Set Coupler

Ⓑ

RO
(Receive-Only Set)

130 Type Subset
with modified 43A1 channel
or
103 Series Data Set
plus TP198420
Data Set Coupler

Ⓒ

ASR
(Automatic Send-Receive Set)

130 Type Subset
with modified 43A1 channel
or
103 Series Data Set
plus TP198420
Data Set Coupler

Ⓓ

ASR
(Automatic Send-Receive Set)

*See Sequence Diagram, Figure 2.

Figure 1 - Typical Station Arrangements
and Branch Circuit Layout
(Full Duplex 8B1 Data Selective Calling)

CALL DIRECTING CODES (CDC) AND RE-SPONSES

2.05 When the data communications proces-sor has a message available for trans-mission, it will transmit the CDCs on the receive leg, pausing after each CDC for an answer-back response on the send leg. The CDCs provide a means for selecting one or more receiving units on the receive leg.

2.06 A called receiving station, if capable of receiving message text, will respond with a \ ACK code sequence. If the receiving unit is in a low tape or low paper condition, the station will respond with a maintenance code sequence, BELL BELL, on the send leg. A BELL BELL response will occur only if the specific receiving unit is in a maintenance condition.

2.07 A Call Directing Code consists of any two alpha-block characters with code levels 6 spacing and 7 marking. If only alphas are permissible, then 26^2 or 676 combinations are possible. If a mixture of alphas and sym-bols are permissible, 32^2 or 1024 combinations are possible. A CDC is assigned to each re-ceiving unit on the receive leg.

NULL CODE

2.08 The NULL code is generated by the data communications processor. The station controller logic is designed to temporarily dis-connect a sending tape reader or selected re-ceiving unit(s) upon receipt of a NULL code. This renders both legs idle for subsequent polling or selective calling by the data com-munications processor. An EOA code reacti-vates the interrupted tape reader or selected receiving unit(s).

END-OF-ADDRESS (EOA) CODE

2.09 An EOA code, transmitted by the data communications processor, will place all selected receiving units in the PRINT or PUNCH condition and all unselected receiving units in the NONPRINT or NONPUNCH condi-tions. An EOA code will also cancel a pre-viously transmitted NULL code in order to restore activity on the send or receive leg. In this system an EOA code is followed by a DELETE (same as RUBOUT) character; the DELETE provides time for connecting a tape punch.

XOFF CODE

2.10 When an outlying station's tape reader starts sending, it will continue to oper-ate until the tape ends and the tape-out pin rises. The message preamble and text will be transmitted without interruption (except when temporarily interrupted by a NULL on the re-ceive leg for a subsequent selective calling function). Should a tape reader tend to monop-olize the send leg or send garbled information, the data communications processor can gener-ate an XOFF code to disconnect the tape reader. A TSC would then be required to restart the disconnected reader.

END-OF-TRANSMISSION (EOT) CODE

2.11 An EOT code when transmitted from an outlying station on the send leg, is re-ceived solely by the data communications proc-essor; it cannot affect activity on the receive leg.

2.12 However, when an EOT code is trans-mitted by the data communications proc-essor on the receive leg, it will disconnect the selected receiving devices and introduce the SELECT, NONPRINT mode to all receiving stations. It will not affect the activity on the send leg.

FORMAT EFFECTOR CODES

2.13 ASCII control codes can be used with 8B1 station sets. When sending a hor-izontal tab, vertical tab, or form-out function from an outlying station, no special buffering character is required on the tape. However, the data communications processor must enter a multiple number of buffer (DELETE) codes after each tab or form-out function, or must pause for the duration of each form effector function. Horizontal tabulation requires one buffer character per three character spaces of tabulation; vertical tabulation requires one buffer character per six lines of tabulation.

3. OPERATION

INTERRUPT SEQUENCES

3.01 Special control sequences must be gen-erated by the data communications proc-essor on the receive leg in order to stop a reader or interrupt a receiver. If selective calling is to be performed, the send leg must become idle to allow a called station to send an

answer-back response. If polling is to be performed, an outgoing message from the data communications processor must be interrupted to allow the processor to send TSCs on the receive leg.

A. Send Leg Busy; Receive Leg Idle

3.02 In order to stop a busy reader and start a receiver, the processor must generate a NULL DELETE sequence on the receive leg. The code following NULL may be a DELETE character or at least 70 milliseconds idle line pause so that the reader has time to stop. At the conclusion of processor generated CDCs and station generated answer-back responses, an EOA DELETE sequence will restart the reader and activate the receivers. NULL DELETE is a customer implemented option.

B. Send Leg Idle; Receive Leg Busy

3.03 In order to temporarily stop a busy receiver and start an idle reader, the processor must generate a NULL DELETE sequence on the receive leg. The DELETE may be a complete permutation or at least 70 milliseconds idle line pause to cause all receiving printers to enter the NONSELECT, NONPRINT mode and all receiving punches to turn off. The processor can then send a TSC for starting the reader followed by an EOA DELETE for reactivating the receivers. NULL DELETE is customer implemented.

C. Send and Receive Legs Busy

3.04 In cases where a reader is monopolizing the send leg with a long multiple message tape, it may be necessary to disconnect the reader and poll another station reader. The processor should not interrupt the reader during message transmission, but should wait until an EOM (End-Of-Message) or EOT is received before sending a NULL DELETE code sequence. Both the reader and the selected receivers will be temporarily deactivated with the NULL DELETE sequence. The processor can then send an XOFF to disconnect the reader.

Note: If the receive leg is idle when disconnecting a reader, the processor need not generate the NULL DELETE sequence.

A different TSC will start another reader; a subsequent EOA DELETE sequence will reac-

tivate the receivers. A disconnected reader must be repolled with a TSC in order to send again.

D. Send and Receive Legs Idle

3.05 The special interrupt sequence (NULL DELETE) is not required if both legs are idle when polling or calling. The processor, upon recognizing the idle legs, can poll the readers with TSCs or call the receivers with CDCs.

E. Operating Sequence

3.06 A sequence of events for full duplex operation is shown in Figure 2.

FUNCTIONS OF DATA COMMUNICATIONS PROCESSOR

3.07 The following functions must be performed by the data communications processor: (The processor sends on the receive leg and recognizes on the send leg.)

(a) Send TSCs.

(b) Send XOFF.

(c) Send NULL DELETE sequence.

(d) Send CDCs.

(e) Send EOA DELETE sequence.

(f) Send text.

(g) Send EOT on the receive leg.

(h) Recognize idle line, EOM and EOT on the send leg.

(i) Recognize answer-back code sequence.

(j) Recognize no-traffic response.

(k) Recognize maintenance response.

(l) Continually police the send and receive leg traffic.

(m) Purge all NULL codes from send leg to prevent transmission on receive leg.

(n) Add DELETE codes or equivalent pause after form effector codes (vertical tab, horizontal tab, and form out).
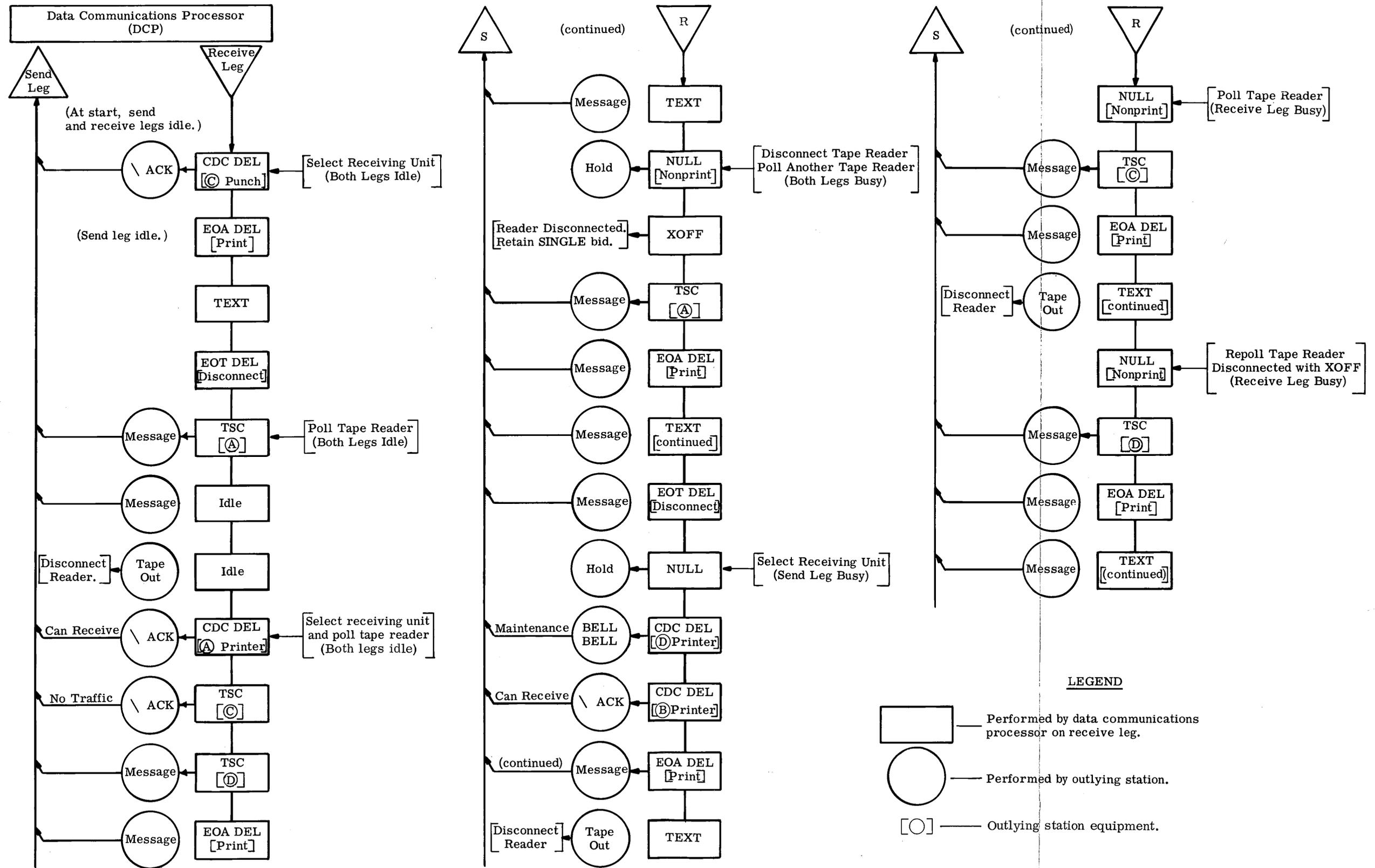
Figure 2 - Full Duplex Sequence Diagram

TABLE 2 - FORMAT SEQUENCES FOR DATA COMMUNICATIONS PROCESSOR ENTRY

Condition	Status of Outlying Signal Line		Status of Outlying Station Units			DCP Entry Format
	Receive Leg	Send Leg	Interrupt	Disconnect	Start	
1	Idle	Idle			Receiver	CDC DELETE (PAUSE) EOA DELETE TEXT EOT DELETE
2	Idle	Idle			Reader	TSC
3	Idle	Idle			Receiver And Reader	CDC DELETE (PAUSE) TSC (PAUSE) EOA DELETE TEXT EOT DELETE
*4	Idle	Busy	Reader		Receiver	NULL DELETE CDC DELETE (PAUSE) EOA DELETE TEXT EOT DELETE
5	Busy	Idle	Receiver		Reader	NULL DELETE TSC (PAUSE) EOA DELETE TEXT (contd) EOT DELETE
6	Busy	Busy	Receiver	One Reader	Another Reader	NULL DELETE XOFF TSC EOA DELETE TEXT (contd) EOT DELETE
*Note: If answer-back to CDC is not required, use DCP format for Condition 1.						

FUNCTIONS OF STATION SETS

3.08 The following functions are performed by the station sets:

(a) Accept BID to send from tape by attendant.

(b) Recognize its TSC.

(c) Recognize its CDCs.

(d) Recognize NULL DELETE.

(e) Recognize XOFF.

(f) Send answer-back sequence to CDC.

(g) Send maintenance response, when applicable, to CDC.

(h) Send no-traffic response to TSC.

(i) Control reader and two receivers. (ASR set)

(j) Copy all traffic. (receive leg only)

(k) Provide visual and audible alarms.

FORMAT SEQUENCES FOR DCP ENTRY

3.09 The data communications processor can initiate and regulate the flow of traffic on the send and receive legs by applying the format sequences in Table 2. A pause is required after each CDC sequence or TSC to determine the status of the called or polled station.

3.10 There are no restrictions as to when the NULL code can be introduced in relation to traffic on the send leg. However, a restriction does exist on the receive leg. The NULL cannot be introduced between the first EOA and the EOA DELETE LF CR sequence where more than one EOA is present in message. Multiple EOA codes are used to delineate addresses in messages which require relaying to other systems. The presence of NULL during these messages will cause the format checking devices in these systems to reject the address as invalid. See Figure 3.

Low Speed
Address #1
{
CDC

DELETE
}

Low Speed
Address #2
{
CDC

DELETE
}

EOA

DELETE

High Speed
Address
{
HS

DELETE
}

EOA

DELETE

Dial TWX
Address
{
SOM

12 ... 90
}

EOA

DELETE

CR

LF

NULLS are not permitted.

TEXT

EOT

DELETE
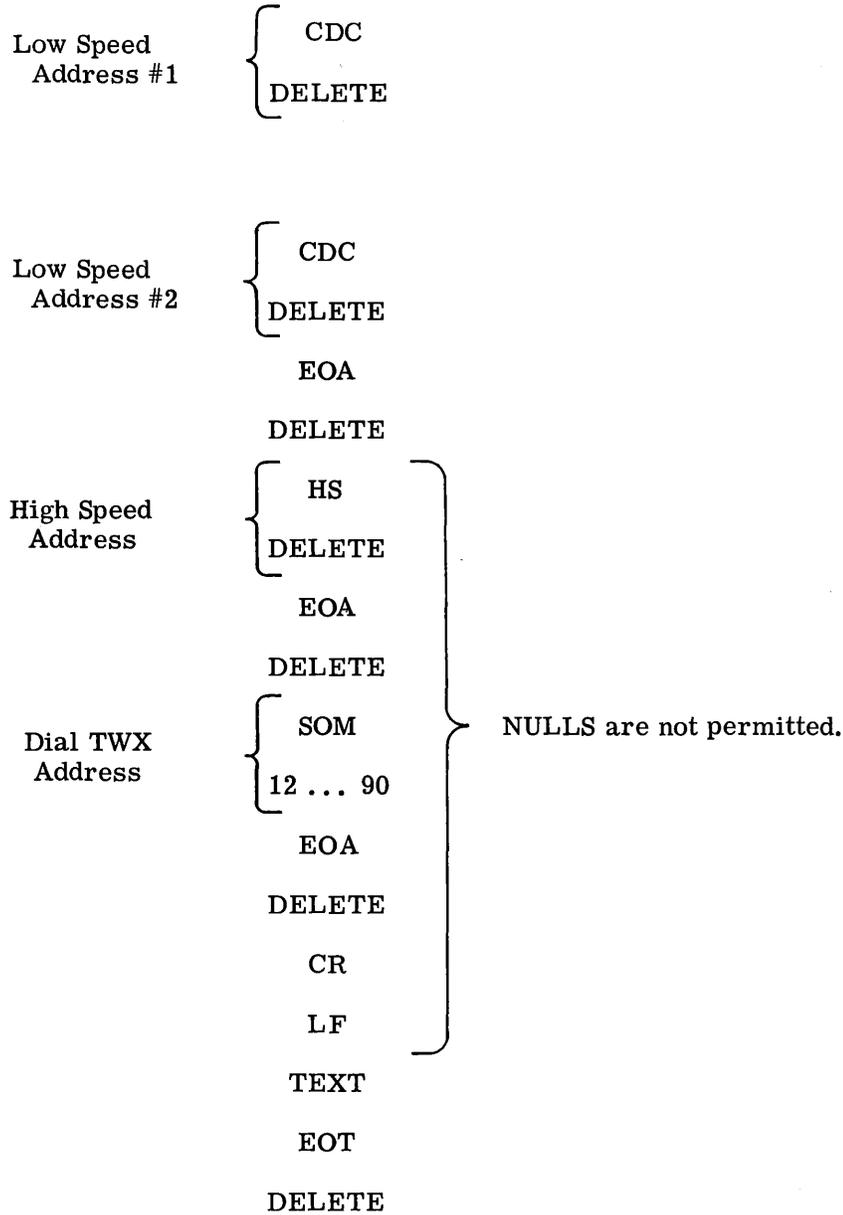
Figure 3 - Multiple Addressed Message

4. TECHNICAL DATA

CODE DATA

Type: American Standard Code for Information Interchange (ASCII). Refer to Figure 4.

Transmission Rate: 110 Baud (bits/sec) or 100 words/minute.

Code Units: 11 equal units; unit breakdown is as follows:

(a) 1 unit - start bit . . . . always spacing

(b) 7 units - 7 intelligence bits . . . . marking or spacing

(c) 1 unit - parity bit . . . . marking or spacing even parity

(d) 2 units - stop bits . . . . always marking

Wave Pattern: See Figure 5 for example.

● MARK

WHEN PARITY IS USED THE CHARACTERS AND FUNCTIONS SHOWN WITH
WHITE BACKGROUND HAVE 8TH BIT SPACING (EVEN PARITY IS USED).

CHARACTERS UNDERLINED WITH - (DASH) OBTAINED IN CONJUCTION WITH "SHIFT" KEY.
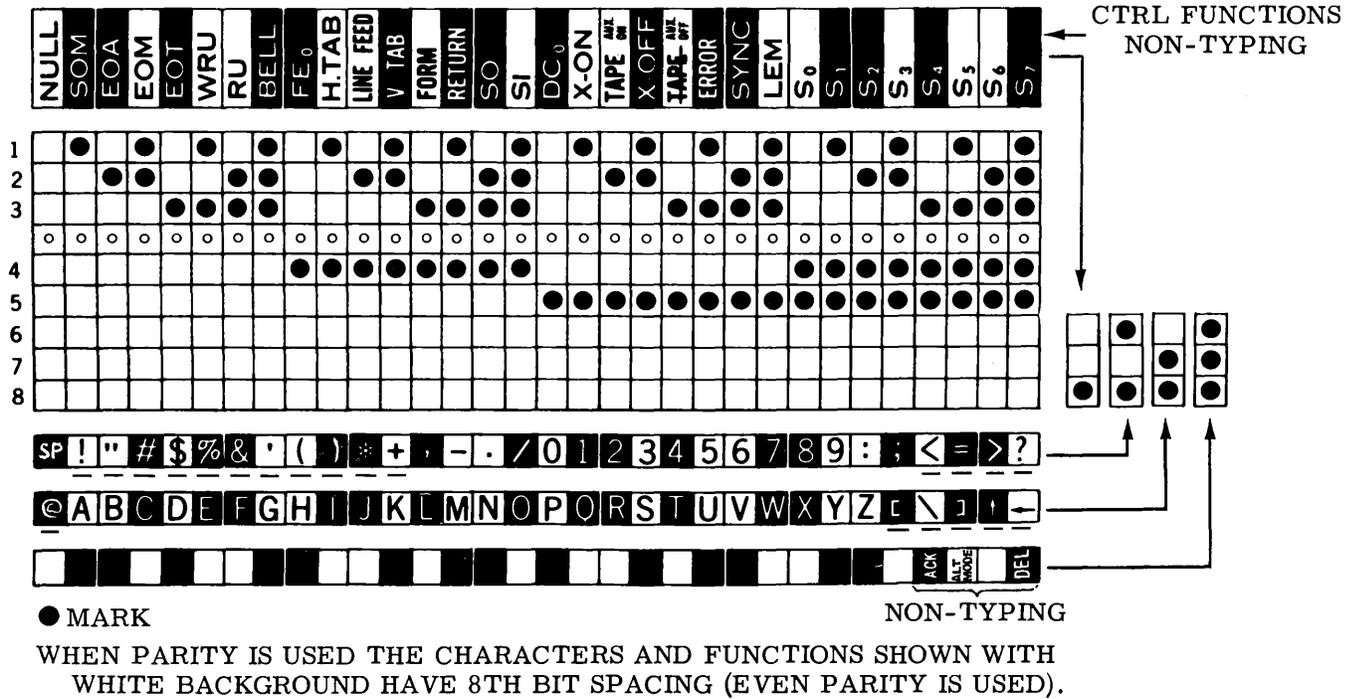
Figure 4 - American Standard Code for Information Interchange (ASCII)
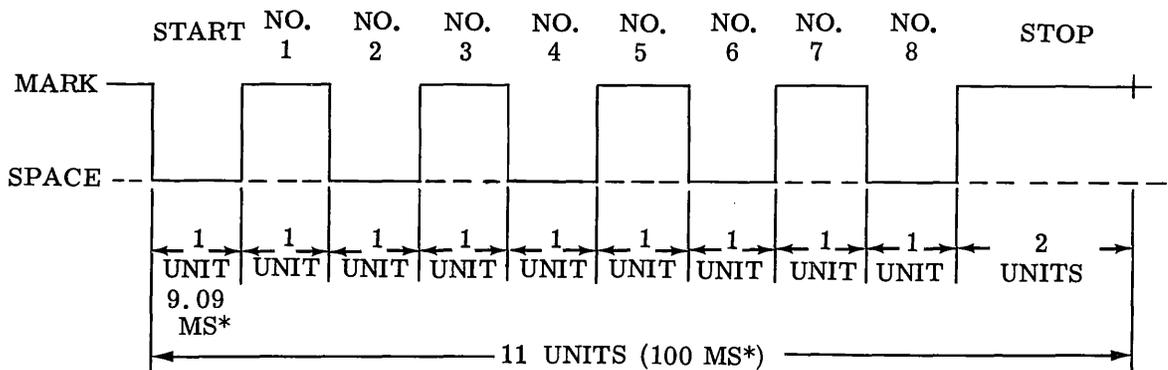
*Based on transmission rate of 100 words per minute.

Figure 5 - Wave Pattern for Letter "U" (With Even Parity Bit)

POWER REQUIREMENTS

Station Set	Approximate Power Requirements*	Power Factor	Running Current
ASR	215 Watts	0.52	3.6 amps
RO	140 Watts	0.47	2.6 amps
	*All station sets operate from a 115 volt ac ±10%, 60 cycle power line.		

RECOMMENDED TRANSMISSION FACILITIES
FOR AC SIGNAL LINE

(a) 130-type subset with modified 43A1 channel.

(b) 103-series data set plus TP198420 data set coupler.

TAPE DATA

Information Levels: 8

Feed Holes: In-line

Width: 1 inch

Characters Per Inch: 10
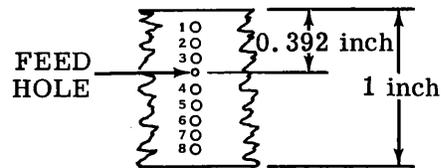
Figure 6 - Tape Data

5. BSP REFERENCES

SECTION	EQUIPMENT COVERED	CONTENTS*	ASR				RO	
			35BC	35BF	35BP	35BR	35BE	35BH
581-122-101	8B1 Station Sets	D & PO	X	X	X	X	X	X
-200		I & CO	X	X	X	X	X	X
-300		TS	X	X	X	X	X	X
-400		WD	X	X	X	X	X	X
-800		P	X	X	X	X	X	X
570-220-100	Motor Unit	D & PO	X	X	X	X	X	X
-400		WD	X	X	X	X	X	X
-700		A	X	X	X	X	X	X
-701		L	X	X	X	X	X	X
-702		D & R	X	X	X	X	X	X
-800		P	X	X	X	X	X	X
574-220-100	35 Typing Unit	D & PO	X	X	X	X	X	X
-700		A	X	X	X	X	X	X
-701		L	X	X	X	X	X	X
-702		D & R	X	X	X	X	X	X
-800		P	X	X	X	X	X	X
574-221-100	35 Keyboard and Base for KSR & RO	D & PO					X	X
-700		A					X	X
-701		L					X	X
-702		D & R					X	X
-800		P					X	X
574-222-100	35 Keyboard for ASR	D & PO	X	X	X	X		
-700		A	X	X	X	X		
-701		L	X	X	X	X		
-702		D & R	X	X	X	X		
-800		P	X	X	X	X		
574-223-100	35 Tape Reader Base	D & PO	X	X	X	X		
-700		A & L	X	X	X	X		
-800		P	X	X	X	X		
574-224-100	35 Nontyping Reperforator	D & PO			X	X		
-700		A			X	X		
-701		L			X	X		
-702		D & R			X	X		
-800		P			X	X		
574-225-100	35 Transmitter Distributor	D & PO	X	X	X	X		
-700		A	X	X	X	X		
-701		L	X	X	X	X		
-702		D & R	X	X	X	X		
-800		P	X	X	X	X		
574-226-100	35 Electrical Service Unit	D & PO	X	X	X	X	X	X
-800		P					X	X
-801		P	X	X	X	X		
574-228-100	35 Cabinet for ASR	D & PO	X	X	X	X		
-700		A	X	X	X	X		
-701		L	X	X	X	X		
-800		P	X	X	X	X		
574-229-100	35 Cabinet for KSR & RO	D & RO					X	X
-700		A					X	X
-701		L					X	X
-800		P					X	X

SECTION	EQUIPMENT COVERED	CONTENTS*	ASR				RO	
			35BC	35BF	35BP	35BR	35BE	35BH
574-233-100	35 Typing Reperforator	D & PO	X	X				
-700		A	X	X				
-701		L	X	X				
-702		D & R	X	X				
-800		P	X	X				
574-235-100	35 Answer-Back	D & PO	X	X	X	X	X	X
-700		A	X	X	X	X	X	X
-701		L	X	X	X	X	X	X
-800		P	X	X	X	X	X	X

*A	– Adjustments	I & CO	– Installation and Checkout
AWD	– Actual Wiring Diagrams	L	– Lubrication
D & O	– Description and Operation	P	– Parts
D & PO	– Description and Principles of Operation	TS	– Trouble Shooting
D & R	– Disassembly and Reassembly	WD	– Wiring Diagrams
I	– Installation		