INTEGRATED SYNCHRONOUS "DATASPEED*" 40 RECEIVE-ONLY

PRINTER STATION

DETAILED DESCRIPTION

1. GENERAL

1.01 This section contains a brief description of Integrated Synchronous DATASPEED 40 Receive-Only Printer (ROP) Stations in switched network, point-to-point and multipoint private line service.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 Integrated synchronous ROP station configurations are shown in Figs. 1, 2 and 3.

1.04 The Integrated Synchronous DATASPEED 40 Controller is used in Receive-Only Printer (ROP) arrangements utilizing binary synchronous communications procedures on point-to-point private line networks, switched point-to-point networks and multipoint private line networks.

1.05 The stations provide batch data communications with one or more remote stations and a Data Communications Processor (DCP) under direct control of a central Line Control Unit (LCU). All transmission is to or from the DCP; no provision is made for terminals to communicate with each other.

1.06 These arrangements are capable of being used for (1) operation on switched networks using Data Set 201C, 209A or Bell System equivalent (with appropriate data auxiliary set or telephone set as required) for 2400 bps, Data Set 208B, 209A or Bell System equivalent (with appropriate telephone set as required) for 4800 bps, or 209A (with appropriate telephone set as required) for 7200 bps, (2) operation on multipoint private lines using Data Set 201C for 2400 bps, 208A for 4800 bps or 209A for 2400, 4800, or 7200 bps or Bell System equivalent. In addition, these arrangements may be used in two-point nonselective private-line applications using Data Set 201C for 2400 bps, 208A for 4800 bps, or 209A for 2400, 4800 or 7200 bps or Bell System equivalent.

*Registered Trademark of AT&TCo.
†American National Standard Code for Information Interchange
‡Extended Binary Coded Decimal Interchange Code

1.07 The interface to the data set is compatible with EIA RS-232C. See below.

Pin No.	Lead Designations
1	Protective Ground (AA)
2	Transmit Data (BA)
3	Receive Data (BB)
4	Request to Send (CA)
5	Clear to Send (CB)
6	Data Set Ready (CC)
7	Signal Ground (AB)
8	Received Line Signal Detector (CF)
9	No connection
10	No connection
11	Secondary Transmitted Data (SBA)
12	Secondary Received Data (SCF)
13	No connection
14	No connection
15	Serial Clock Transmit (DB)
16	No connection
17	Serial Clock Receive (DD)
18	No connection
19	No connection
20	Data Terminal Ready (CD)
21	No connection
22	Ring Indicator (CE)
23	Alarm §
24	No connection
25	No connection

§ Non-EIA Signal

Cinch or Cannon Plug — DB-19604-432

Data and Control Circuits in accordance with EIA-RS-232C

Voltage	Control	Line Signal	Binary State
-3 V to -25 V	Off	Mark	1
+3 V to +25 V	On	Space	0

Physical Characteristics

1.08 The Receive-Only Printer terminal is a table-top, self-contained set incorporating a DATASPEED 40 printer. The printer is mounted on a cradle in the printer cabinet. The cradle tilts upward to provide for ribbon changing and also to facilitate removal of the printer and to gain access to the printer control logic card that is in the base of the printer. The cabinet top contains a cover that opens upward to gain access to the printer. Form or fanfold paper is supplied externally to the printer and fed through a slot in the base of the cabinet. A slot is provided in the cover for paper to exit the cabinet.

1.09 Pedestals equipped with ac power facilities are available for mounting the set. Pedestals are available in a variety of top widths. Pedestals for tractor feed sets provide convenient paper routing. When a tractor feed set is to be used with customer provided furniture, a paper routing slot, or equivalent, must be provided to route the paper through the bottom slot in the printer cabinet.

1.10 The controller assembly mounts in the base of the printer cabinet, below the printer.
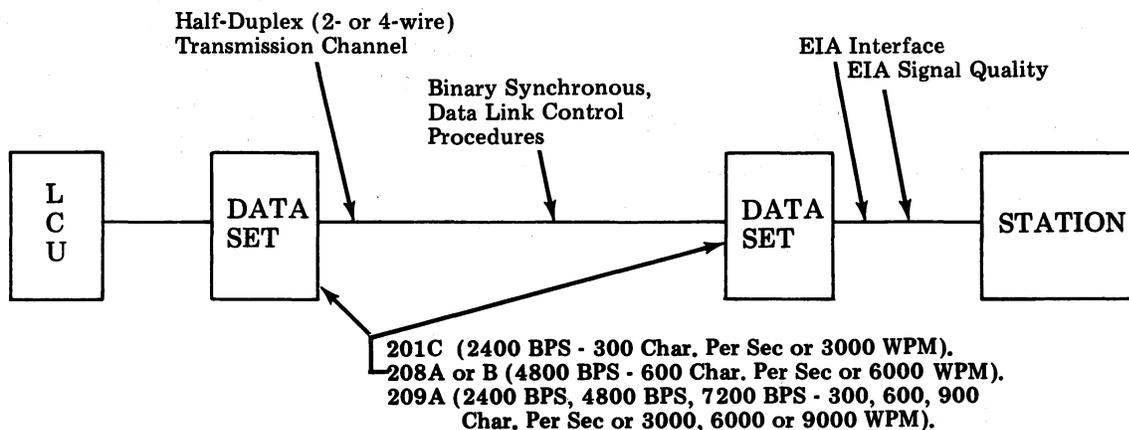
ANSI COMMUNICATIONS NETWORK

1.11   An ac power ON/OFF switch is located at the left rear of the printer cabinet. All interconnections to the unit are made at the rear of the cabinet.

1.12   Options in the integrated synchronous ROP are installed by means of miniature slide, toggle or rocker switches or by cutting diodes on the 410734 diode matrix card (Fig. 4). Option implementation is given in Section 582-202-200.

1.13   When ordering replaceable components, unless otherwise specified, prefix each part number with letters "TP" (ie, TP410734).

2.   SUPPLEMENTAL INFORMATION

BSP Sections

582-202-110	General Description
582-202-200	Installation
582-202-400	Wiring Diagrams
582-202-500	Testing and Troubleshooting
582-202-700	Disassembly/Reassembly and Parts
582-202-750	Routine Maintenance
582-210-500	Printer
999-301-121	HTO Manual (Printer)

3.   ABBREVIATIONS

ACK	Acknowledge
ASCII	American National Standard Code for Information Interchange
BCC	Block Check Character
CRC	Cyclic Redundancy Check
DLE	Data Link Escape
DSR	Data Set Ready
EBCDIC	Extended Binary Coded Decimal Interchange Code
EIA	Electronic Industries Association
ENQ	Enquire
EOT	End of Transmission
ESC	Escape
ETB	End of Transmission Block
ETX	End of Test
FF	Form Feed
HEX	Hexadecimal
ITB	Intermediate Transmission Block
LF	Line Feed
LCU	Line Control Unit
LRC	Longitudinal Redundancy Check
NACK	Negative Acknowledge
NL	New Line
OPCON	Operator Console
ROP	Receive-Only Printer
RTS	Request to Send
SID	Station Identity
SOH	Start of Heading
STX	Start of Text
SYN	Synchronous
USOC	Uniform Service Order Code
TTD	Temporary Text Delay
WACK	Wait Acknowledge

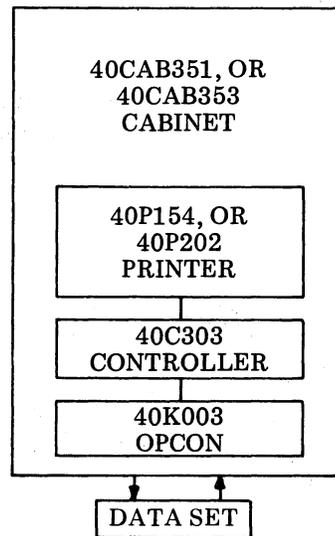4.   INTEGRATED SYNCHRONOUS DATASPEED 40 ROP ARRANGEMENTS

Fig. 1—Integrated Synchronous DATASPEED ROP Station

Table Top Tractor Feed RO Printer

Integrated Synchronous Controller
Located Inside Cabinet — (USOC XX1X+)

Note: Pedestal is empty except for convenience
strip and cable rack.

Note: Center
printer cabinet
so that wide
paper slot is
not visible.

Tractor Feed RO Printer With Pedestal
and 24-1/2" Slotted Top (USOC XX1X+ +
USOC 4TMAB) Private Line Applications
(See Part 5 for Additional Pedestal Arrangements)

Fig. 2—80-Column Tractor Feed Receive-Only Printer
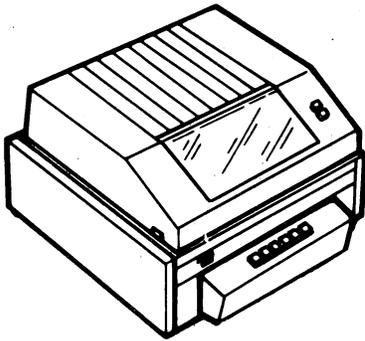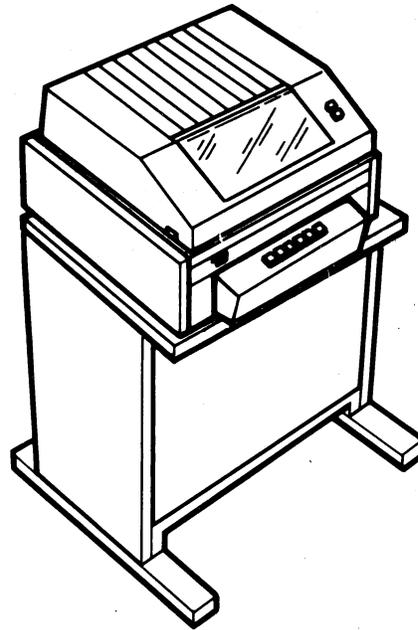Pedestal and Cabinet Arrangements

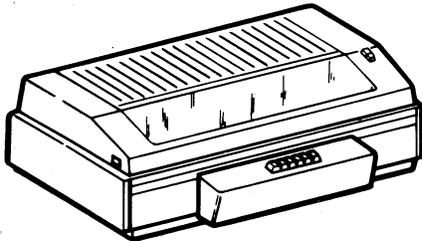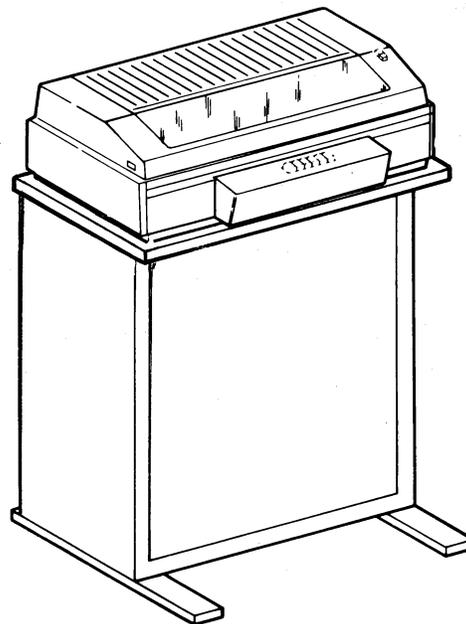Table Top Tractor Feed RO Printer

Integrated Synchronous Controller
Located Inside Cabinet — (USOC XX2X+)

Note: Pedestal is empty except for convenience
strip and cable rack.

Tractor Feed RO Printer With Pedestal
and 27-5/8" Slotted Top (USOC XX2X+ + 4TMEC)
(See Part 5 for Additional Pedestal Arrangements)

Fig. 3—132-Column Tractor Feed Receive-Only Printer
Pedestal and Cabinet Arrangements

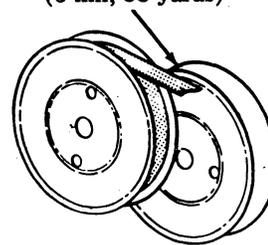5.   INTEGRATED SYNCHRONOUS DATASPEED 40 ROP ACCESSORIES

ADDITIONAL CABLE LENGTHS

USOC	LENGTH	PART NUMBER
WES7J	12 Foot	408066
WES7K	25 Foot	408067
WES7L	50 Foot	408068

407060 (80-Column)
or 407061 (132-Column) GUIDE
(Part of Printer Cabinet)
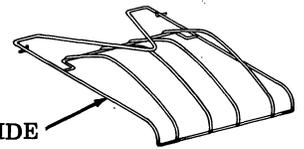
402444
W/2 SPOOLS
(5 mil, 33 yards)

FORM-OUT BELT SELECTION (USOC WES62)

Form Selector Setting				TP Part No.	Color of Belt
4	3	2	1		
Length of Form, Inches					
3-1/3	2-1/2	5	10	402571	Amber
3-2/3	2-5/6 ¶	5-1/2	11	402572**	Blue
4	3	6	12	402573	Yellow
4-1/3	3-1/3 ¶	6-1/2	13	402574	Brown
4-2/3	3-1/2	7	14	402575	Red
5	3-5/6 ¶	7-1/2	15	402576	Pink
5-1/3	4	8	16	402577	Lt Green
5-2/3	4-1/3 ¶	8-1/2	17	402578	Green
6	4-1/2	9	18	402579	Lt Blue
7-1/3	5-1/2	11	22	402580	White

¶ These lengths are not used in the Bell System

** 402572 is part of the printer and not part of
USOC WES62. It must be removed when applying
USOC WES62.
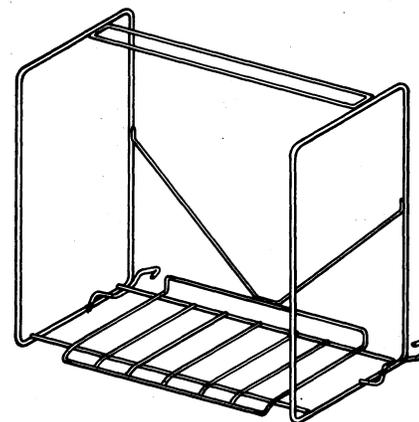
Tractor Feed Paper Guard Modification Kit For
Use With a 40CAB901 Pedestal (USOC WES8A)

Pedestal With Door Arrangements

See chart for available
tops (order seperately).

40CAB901/AJ PEDESTAL
(With power facilities plus
top and legs)
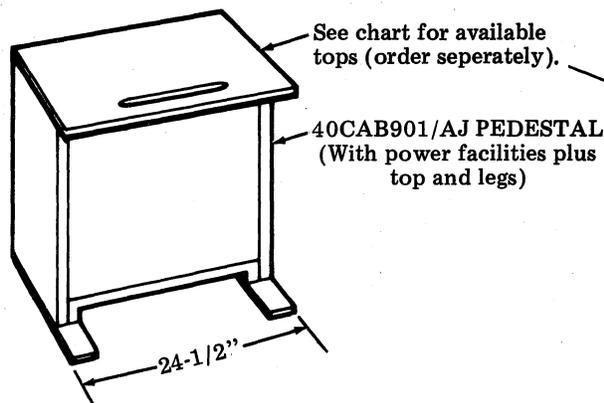
24-1/2"

TP Part No.	Top Width	Slot Width	USOC
401914	24 1/2"	11"	4TMAB
401912	31 1/2"	11"	4TMCB
401913	27 5/8"	17"	4TMEC
401915	39 1/8"	17"	4TMFC

Pedestal Without Door Arrangements

Flush top only (401911),
order separately.

40CAB902/AA
(Includes feet)

11" SLOT

No Door

Recess to store
paper supply box.

20"

20 Inch Wide Pedestal USOC 4TMKB

See chart for
available tops
(order separately).

40CAB904/AA
(Includes feet)

No Door

Recess to store
paper supply box.
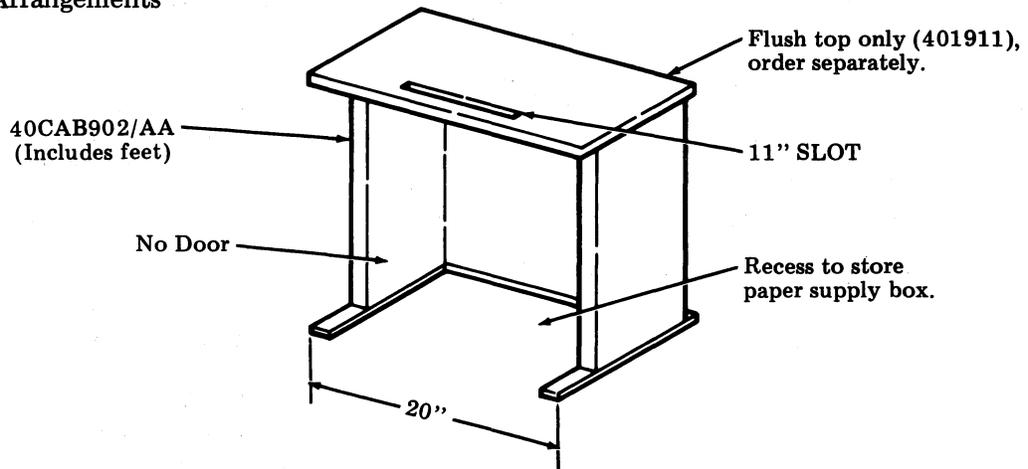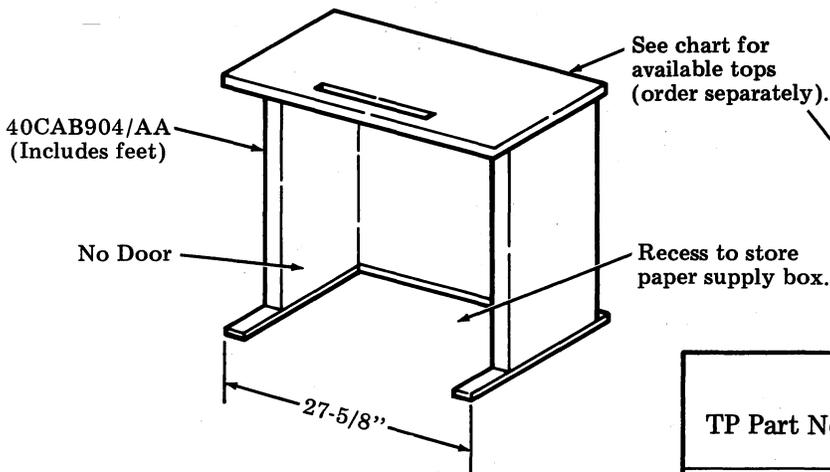
27-5/8"

27-5/8 Inch Wide Pedestal USOC 4TM++

TP Part No.	Top Width	Slot Width	USOC
401912	31 1/2"	11"	4TMGB
401913	27 5/8"	17"	4TMHC
401915	39 1/8"	17"	4TMJC

PART NO.	LINE CODE	TYPE	COLUMNS	FONT ID SYMBOL	5TH USOC CHARACTER††
400629	ASCII	Up-Low	80	A B	F
400645	ASCII	Monocase	80	A A	A
400777	ASCII	Up-Low	132	A D	F
400780	ASCII	Monocase	132	A J	A
400783	EBCDIC	Up-Low	132	A M	H
400784	EBCDIC	Up-Low	80	A И	H
400785	EBCDIC	Monocase	80	A D	G
400887	EBCDIC	Monocase	132	A 2	G
403846	ASCII/EBCDIC	48 Character	80	A S	
408271	ASCII/EBCDIC	48 Character	132	A X	

††5TH Character of station USOC denotes type arrangement.

6. DATASPEED 40 INTEGRATED SYNCHRONOUS CONTROLLER
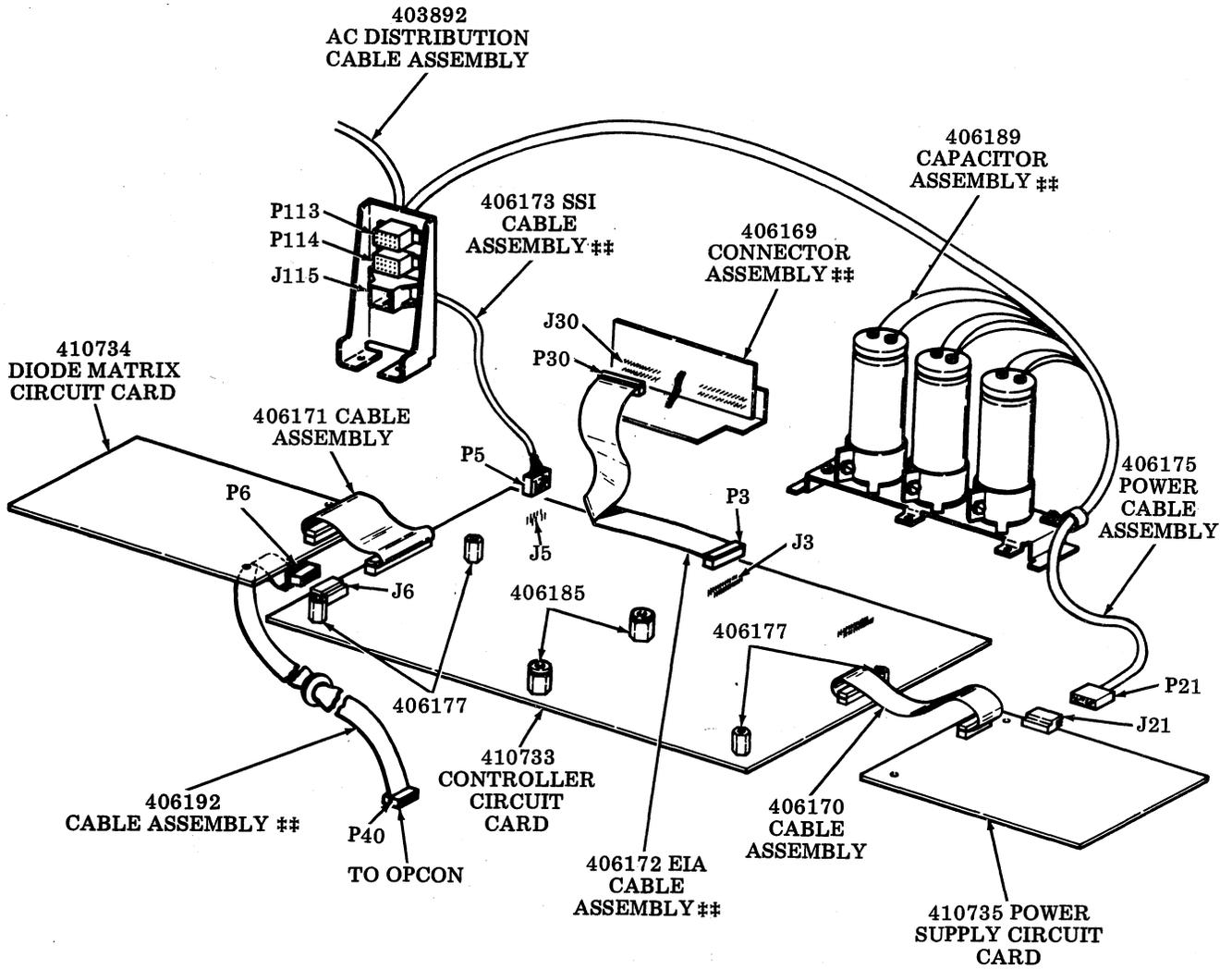
** Part of 406190 Modification
Kit.

Fig. 4—40C303AC/003 Integrated Synchronous Controller
and Associated Cables (Cover Not Shown)

7. TECHNICAL DATA

7.01   Power Source Requirements: 104 - 127 V ac at 60 Hz ±0.5 Hz or 50 Hz ±0.5 Hz from an unswitched standard 3-wire grounding type receptacle located within eight feet of the ROP set location. One additional receptacle is required for data set except when terminal includes pedestal equipped with 7-receptacle convenience strip.

7.02   Maximum inrush current 20 amps not exceeding three cycles.

7.03   Operating Power Consumption and Heat Generation:

Component	Current	Power	Heat
Integrated Synchronous ROP Set (motor OFF)	1.0 Amp	115 VA	392 BTU
Integrated Synchronous ROP Set (motor ON)	2.0 Amps	230 VA	784 BTU

7.04   Environmental Restrictions (operating):

Ambient Temperature.................+40° to +110° F
Relative Humidity.....................5% to 95% (noncondensing)
Altitude..............................Sea level to 10,000 feet

7.05   Weight (approximate) Unpacked:

80-Column Tractor Feed Printer Unit...............41 lbs
80-Column Tractor Feed Printer Cabinet ....43 lbs
132-Column Tractor Feed Printer Unit..............56 lbs
132-Column Tractor Feed Printer Cabinet ....52.5 lbs
Pedestal (with door) ....56 lbs

8. TERMINAL DESCRIPTION

8.01   Summary of features:

FEATURE	DESCRIPTION
Speed of Operation	2400, 4800, or 7200 baud synchronously with data set clock control.
Code	8 unit ASCII or EBCDIC.
Interface	EIA RS232C.
Station Selection	A number of the available selection sequences include a one- or two-character sequence that identifies the station for which the transmitter intends the message. The ROP terminal will give an ACK∅ response only if this sequence corresponds to that selected for the controller.
Storage Buffer	Built-in buffer standard. Approximately 3900 character capacity. Terminal will initiate a disconnect and indicate an alarm condition on overflow of buffer capacity.
Block Format †† (Option 154)	All messages may be transmitted in block format of 512 characters (optionally 256 or 128).
Error Detection and Retransmission	The ROP terminal verifies the odd vertical parity of each received character (ASCII only) and computes a longitudinal redundancy/block parity check (LCR) for ASCII or a cyclic

†† Refer to Section 582-202-200 for Option description and implementation.

FEATURE	DESCRIPTION
	redundancy check (CRC) for EBCDIC. Blocks for which an error reply results may be retransmitted at the option of the LCU.
Immediate WACK ss (Option 178)	With the immediate WACK Option enabled (Option 178b), the ROP terminal will respond with a WACK instead of ACKN to every second block of text. The CPU will respond to the WACK either with EOT or ENQ (the ROP terminal will respond with ACK if buffer space is available).
Type of Printer Used Option	80- or 132-column tractor feed printer can be selected.
Transmission	Transmissions between the LCU and the ROP terminal are on a two-way alternate (half-duplex) basis.
Alternating Acknowledgments	After the first block is received by the ROP, an ACK1 response is sent. After the second block is received by the ROP, an ACK∅ response is sent. Subsequent blocks are responded to with alternating ACK∅ ACK1 (referred to as correct ACK or ACKN) to insure that no blocks are missed. LCU response to the incorrect ACK (ACK̄N̄) is optional.
Horizontal Tabulation Option ss	Up to 132 column positions. The sequence ESC HT indicates the beginning of a block of data that will cause the setting of horizontal tab stops. The tab setting sequence is terminated by ETX or optionally ITB (refer to Option 175) LF (EBCDIC)/NL (refer to Option 176) or ETB (refer to Option 173). The ESC HT sequence also causes erasure of any existing horizontal tab stops (either preset or on-line set).
Vertical Tabulation Option ss	Up to 12 preset line positions. Receipt of a vertical tab (VT) code will immediately position the paper to the next stop below the present position or if no stops remain, to the end of the form. It will then cause a form feed operation to be performed. Receipt of one of the assigned ESC α vertical tabulation sequences (see below) will be recorded and upon reception of one of the following optioned characters; LF (EBCDIC)/NL (Option 176a), ETB (Option 173b), ETX (Option 174b), or IRS (EBCDIC)/RS (Option 177a) enough NL characters will be delivered to the printer to cause the next text character to be printed at the first printing position of the designated vertical tab position.

Sequence	Resulting Position
ESC A	Vertical Tab No. 1
ESC B	Vertical Tab No. 2
ESC C	Vertical Tab No. 3
ESC D	Vertical Tab No. 4
ESC E	Vertical Tab No. 5
ESC F	Vertical Tab No. 6
ESC G	Vertical Tab No. 7
ESC H	Vertical Tab No. 8
ESC I	Vertical Tab No. 9
ESC J	Vertical Tab No. 10
ESC K	Vertical Tab No. 11
ESC L	Vertical Tab No. 12

ss Refer to Section 582-202-200 for option description and implementation.

FEATURE	DESCRIPTION
Adjustable Left Margin	Left margin may be electrically selected up to any column position.
Alarm	Tone-generated on receipt of BELL character and on paper out, etc.
Delayed Motor Turnoff Option ss (Option 148)	Motor turnoff delayed approximately 30 seconds or approximately 3 minutes after end of transmission from sender. There is no option to turn off the motor immediately upon end of transmission (except for recognition of a disconnect condition DLE EOT sequence, loss of carrier (Option 166), loss of DSR (Data Set Ready) or following an internal alarm condition. A FF (form feed) character will be delivered to the printer (either a NL or a FF will take place depending on the forms mode option being used) and the printer's motor will be turned off following the FF action.
Disconnect ss	DLE EOT/EOT. SYN Character timeout. Loss of Carrier (Option 166). Idle Line timeout. Loss of CTS or no detection of CTS after RTS is turned ON in Send mode. Loss of DSR. Internal terminal trouble (loss of signals at printer controller interface). Paper alarm.
Form Feed on Disconnect ss	An additional paper advance on disconnect is available. All ROP terminals have an option (part of the printer) to enable an automatic paper feedout of 16 lines on recognition of disconnect or, optionally, on recognition of the character ETX (or not at all). With tractor feed printers forms mode on should be enabled to provide a form-out on disconnect if the form is out of register, since the 16-line feedout will be erratic (form-out overrides it). In place of this option, a form feed character is sent to the printer on disconnect in Integrated Synchronous ROP terminals. This provides uniform paper registration for each new message. Since form feed is nonrepeating until the new form has advanced at least one line, only one form feed will occur even if a FF character appeared at the end of the message.
Deselection Code Options	The station may be deselected (ROP blinded) on a fully programmable End of Transmission character.
Out of Paper	The printer monitors the paper supply condition and provides an indication to the controller whenever an out of paper condition (the last line of the last complete form has been fed through the printing position) has occured in a tractor feed printer.

ss Refer to Section 582-202-200 for option description and implementation.

FEATURE	DESCRIPTION
	The ROP terminal, upon detecting the out of paper condition, will stop delivery of characters to the printer, light the alarm lamp, and for a 3-second interval allow the terminal to send an EOT as the next reply. Following this, the alarm lamp and audible alarm will be activated for 8 seconds. A disconnect sequence will then be initiated and any remaining data in the buffer will be cleared.
Carriage Return ††	Upon receipt of CR (or ESC M) the controller will cause the next character to be printed at the left margin of the present printing line. Action due to ESC M does not take place until the next LF (EBCDIC)/NL (Option 176a), ETB (Option 173b) IRS (EBCDIC)/RS (ASCII) (Option 177a) or ETX (Option 174b).
Space Extension (Option 170)§§	The printer will print three spaces for each space character received. Enabling of this option will result in multiplying by three the number of spaces produced by the space compression/expansion function but not the spaces produced by HT. If the LCU does not take this into account, it is possible for a line of text to exceed the right-hand margin of the printer. The controller will then cause the next character on the line to be operated on or printed at the start of the next lower line.
Space Compression/Expansion	When the ROP terminal receives a GS α (ASCII) or IGS α (EBCDIC) sequence it will cause the printer to insert into the printed text a number of spaces (maximum 63) corresponding to the α character. The number of spaces is determined by the HEX count of the six low order bits of the character. For ASCII, 2 spaces is represented by a "B," 15 by "O," 26 by "Z," etc. For EBCDIC, most of the resulting characters fall into an area of the code that has no graphic assignments (refer to Table B, columns 4, 5, 6, and 7). However, 10 spaces would result form " ¢ ," 27 from "$," etc. If the number of spaces exceeds the right-hand margin position, the printer will continue to space on the next line starting at the left hand position.
Paper Advance §§	The ROP terminal optionally will perform a paper advance as a result of receiving ITB (refer to Option 175), LF (EBCDIC)/NL (refer to Option 176), ETB (refer to Option 173), ETX (refer to Option 174) or IRS (EBCDIC)/RS (refer to Option 177). Automatic New Line will be performed when the right-hand margin is exceeded.
Line Feed/New Line §§	Receipt of LF (EBCDIC) or NL will optionally cause a line to be printed and any outstanding vertical tabulation ESC sequence to be executed (or NL function to occur if no vertical tabulation ESC sequence is outstanding), terminate a horizontal tabulation sequence or cause the ROP terminal to space (refer to Option 176).

§§ Refer to Section 582-202-200 for option description and implementation.

FEATURE	DESCRIPTION
Single Line Feed §§	Receipt of ESC Q (ASCII) or ESC / (EBCDIC) will be recorded and reception of one of the following optioned characters will cause the next character to be printed at the left-hand margin of the next line below the present print line: LF (EBCDIC)/ NL (Option 176a), ETB (Option 173b), ETX (Option 174b), or IRS (EBCDIC) /RS (Option 177a).
Double Line Feed §§	Receipt of ESC R (ASCII) or ESC S (EBCDIC) will be recorded and reception of one of the following optioned characters will cause the next character to be printed at the left-hand margin of the second line below the present print line: LF (EBCDIC) /NL (Option 176a), ETB (Option 173b), ETX (Option 174b) or IRS (EBCDIC) /RS (Option 177a).
Triple Line Feed §§	Receipt of ESC S (ASCII) or ESC T (EBCDIC) will be recorded and reception of one of the following optioned characters will cause the next character to be printed at the left-hand margin of the third line below the present print line: LF (EBCDIC) /NL (Option 176a) ETB (Option 173b), ETX (Option 174b) or IRS (EBCDIC) /RS (Option 177a).
Form Feed	Receipt of the FF character will result in a tractor feed printer (with Forms mode on) advancing the paper until the next form is in registration. Tractor feed printers without the Forms mode selected will perform the new line function upon receipt of FF.

§§ The single line feed option of the printer is assumed. Use of the double line feed option will double the described movements. Refer to Section 582-202-200 for option description and implementation.

8.02   Terminal interface to the station data set meets EIA standards. Leads used in Integrated Synchronous DATASPEED 40 ROP are indicated in paragraph 1.07.

8.03   The terminal optionally responds to ASCII, EBCIDIC or an optimized form of ASCII/ EBCDIC codes. See Tables A thru D.

8.04   The terminal utilizes an 80-Column tractor feed printer (40P154/ZZ), or 132-Column tractor feed printer (40P202/ZZ). Type carriers are not part of the printers and must be provided separately. See Part 5 for available type carriers. Printers are equipped to handle form lengths of 11", 5-1/2" and 3-2/3"; see Part 5 for additional form lengths. 80-Column printers can handle widths between 4.125 inches and 9.5 inches, 132-Column printers can handle paper widths of 4.125 inches to 15 inches. See Section 582-202-200 for complete list of printer options.

8.05   Operator controls are provided by the 40K003/AAB Operator Console (Opcon).
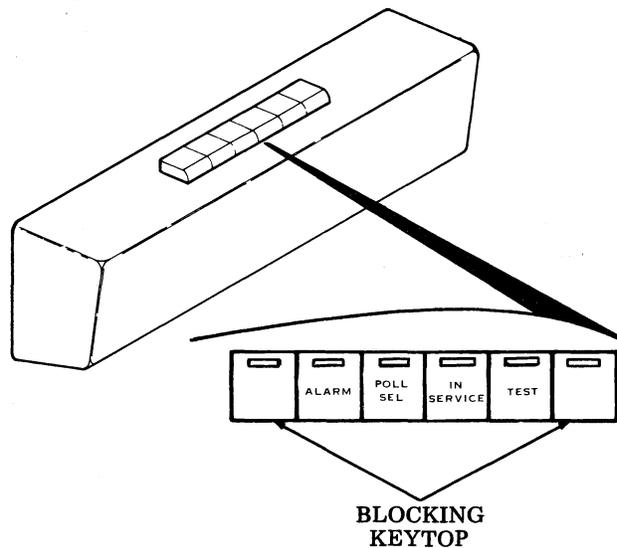
RECEIVE-ONLY PRINTER
OPERATOR CONSOLE (OPCON)
40K003/AAB

ALARM — Red Indicator. The Alarm lamp is lighted to indicate the detection of various trouble conditions. Some trouble conditions are indicated by the Alarm lamp only while others are indicated by a combination of the Alarm lamp and the other lamps on the operator console. The lamp may be flashing or steady. The flashing lights will turn on and off for approximately one second intervals repeated four times. Following this indication, the controller will turn on the audible alarm (for the last 8 seconds) and a steady Alarm light for approximately 8 to 18 seconds. The audible tone may be halted by depressing the ALARM key.

Note: Only the audible alarm is terminated, the alarm timeout interval of 8 seconds is not.

Alarm	Poll./Sel.	In Service	Test	Trouble Condition
X			X	SSI line from printer not active or is disconnected.
X		X		Printer returns a negative Receiver Ready bit after it is sent Receive Message.
X		X	X	Printer not sending status information after several requests (24).
X	X	X		Printer fails to Request Next Char for approximately two seconds with a character in buffer.
X	X			Invalid format of SSI responses from the printer or printer sending data SSI characters.
X	X	X	X	Failure of Self-Test routine. *Note:* In addition to the four indicated lamps flashing the two unmarked lamps will flash.
X				A received message block has caused available buffer space to be exceeded, an out of paper condition exists within the printer, on-line horizontal tab setting attempts to set a tab beyond the right hand margin or a flashing

lights routine has occurred and the flashing lights have gone off indicating one of the above trouble conditions.

Following the duration of the alarm lamp, the controller will initiate a data set disconnect and perform a power on reset operation. The LCU or master terminal should follow prescribed recovery procedures following the ROP terminal's disconnection.

POLL/SEL — Green Indicator. Upon completion of a selection sequence (including any device selection if applicable), the lamp will glow steadily. The key has no present function.

TEST — Red Indicator. This key performs no on-line function. Depressing the IN SERVICE key, to take the terminal out of service, permits the depression of the TEST key to initiate generation of a 63 character plus NL (new line) test message that will be printed on each line by the printer:

ASCII Type Carrier
!" # $%& '()*+,-./0123456789:;< = > ?@
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\ ]^_

EBCDIC Type Carrier
!" # $%& ⁄ ()*+,-./Ø123456789:;< = > ?@
ABCDEFGHIJKLMNOPQRSTUVWXYZ⌐\|¢_

48 Character Optimized (ASCII/EBCDIC) Type Carrier
≡ ≡ #$%&≡ ≡ ≡ * ≡ ,-./Ø123456789 ≡ ≡ ⋈ ≡ ≡ ≡@
ABCDEFGHIJKLMNOPQRSTUVWXYZ ≡ ≡ ≡ ≡ ≡

≡ represents type carrier symbols AX or AZ.

During this time the terminal will not respond positively to traffic from the LCU.

IN SERVICE — Green Indicator. The In Service lamp when lit indicates that the ROP terminal is capable of receiving messages. When the lamp is off, it indicates that the controller has detected a failure to properly complete the Power On Routine (POR), an alarm condition exists, a paper supply problem exists or it has been turned off by depression of the IN SERVICE key. The key is depressed to prevent positive replies to incoming calls, or selection sequences, while the operator is performing local maintenance (ribbon, paper, etc). or to enter the Test mode. Upon completion of such activities, depression of the key will return

the terminal to the In Service condition. A disconnect sequence will also attempt to return the ROP terminal to the In Service condition. If the ROP terminal is in a selected condition, depression of the In Service key will be ignored.

Audible Alarm — In addition to the switches and indicators the operator console (opcon) contains an audible alarm with operator adjustable volume level. The alarm is sounded on received BELL characters or terminal alarm conditions. BELL characters must be received at least one second apart for more than one continuous tone to be heard.

Cabinets

8.06   The cabinets used to house the printers and the integrated synchronous controller are the same as those used for the asynchronous tractor feed controller arrangements except that the connector opening at the rear is larger.

8.07   The cabinets are designated as shown below:

Cabinet Code +	Modification Kit	Application
40CAB351/ZZ	TP406190	80-Col Tractor Feed
40CAB353/ZZ	TP406190	132-Col Tractor Feed

8.08   Located at the left front is a PRINTER INTERLOCK switch. With the printer cabinet cover closed, the printer can be activated if a paper out condition does not exist. When the cabinet cover is opened, the motor start control is disabled and the terminal enters an Out-of-Service mode. This circuitry is enabled for maintenance activity by lifting the INTERLOCK switch lever.

Integrated Controller

8.09   The integrated synchronous controller is designated 40C303AC/003. It is composed of the following components:

410733 Controller Card
410734 Diode Matrix Card
410735 Power Supply Card
Associated cables and hardware

8.10   A diode matrix card (see Fig. 4), cable connected to the controller card, provides the system operating options. Removing a diode will activate or deactivate the feature as indicated in Section 582-202-200.

8.11   Low voltage ac power for the controller is supplied by the printer power transformer. Filter capacitors are mounted in the cabinet. Rectification and regulation are provided

on the power supply card (see Fig. 4), which is cable connected to the controller card. Refer to paragraph 8.01 of this section for the controller features.

8.12   Connections between the ROP terminal and the associated data set should be made using a shielded cable of appropriate length. The cables are not part of the 40C303AC/003 controller. A 7 foot cable is incorporated into USOCs XX1X+ and XX2X+ (See Part 4 of this section).

Additional length cables are available under USOCs WES7J (12 foot - 408066), WES7K (25 foot - 408067) and WES7L (50 feet - 408068).

9.   Theory of Operation

Line Control Characters

9.01   In addition to the use of standard ASCII and EBCDIC characters for transmission of test messages, commands, orders, etc., the following characters, character sequences, and character derivations are used for communication (link) controls.

9.02   Each character is transmitted in an eight-unit frame. In order of transmission, the units of each character frame represent:

Unit	ASCII Assigned Representation
Unit 1 through Unit 7	Bit 1 through bit 7 of the character transmitted.
Unit 8	Odd parity over all eight units.

Unit	EBCDIC Assigned Representation
Unit 1 through Unit 8	Bit 7 through Bit 0 of the character transmitted.

Listing of Line Control Characters Described In this Part

1. BCC	9. SOH
2. ACK	10. STX
3. SYN	11. ETB, ETX
4. PAD	12. EOT
5. DLE	13. SID
6. NAK	14. TTD
7. ENQ	15. ITB
8. WACK	16. RS, IRS

Block Check Character (BCC)

9.03 All messages are transmitted in a block format. During reception, the ROP terminal verifies the odd vertical parity of each received character (ASCII only) and computes either a longitudinal redundancy check (LRC) for ASCII, or a cyclic redundancy check (CRC) for EBCDIC. For convenience in this document, BCC (block check character) will be used to refer to either an LRC or CRC character as appropriate. The distant terminal (LCU) terminates each block with a BCC immediately following a check point character (ITB, ETB or ETX), then stops to wait for a reply from the ROP terminal. The reply would indicate the status/acceptability (relative to transmission problems) of the received block and the status of the terminal. If a SYN character is used as a BCC and no other character is received before 3 seconds the SYN Timeout will occur. This is possible if a trailing pad is not received before acknowledgement of the bloc is sent.

9.04 When the ROP terminal receives an errored block (eg, parity or BCC error), it responds to the transmission by sending NAK. Such blocks are retransmitted. The number of retransmissions is controlled by the LCU. BCC characters are not printed.

9.05 The maximum acceptable length of transmission blocks received by the ROP terminal is optionally 128, 256 or 512 characters.

9.06 A longitudinal redundancy check character (LRC) is accumulated for each block of ASCII data at both the LCU and the ROP terminal. In addition to the LRC, the ASCII character structure provides a vertical redundancy check (VRC). VRC is an odd parity check performed on a per-character basis with the ASCII character set. It is performed on each character including the LRC character.

ASCII

9.07 The LRC is generated by taking a binary sum independently (without carry) on each of the seven individual levels of the transmitted code (b_1 to b_7). In each code level, the number of "one" bits (including any in the LRC) is caused to be even. Thus, the sense of longitudinal parity is said to be even. The correct value of the character parity bit of the LRC shall be that which makes the sense of LRC character parity the same as for text characters.

9.08 LRC accumulation is initiated by, but does not include, the first STX or SOH framing character. An STX embedded in a block is included in the LRC. All characters (except SYN and the character following the intermediate transmission block (ITB) character) following this STX or SOH, up to, and including, the end-of-block character (ETB or ETX), are part of the accumulation. Following the ETB or ETX character, the transmitting unit transmits its LRC character. The receiving unit then compares this character with the LRC it has accumulated. If the redundancy accumulations are different, a transmission error has occurred.

EBCDIC

9.09 A cyclic redundancy check (CRC) is accumulated for each block of EBCDIC data at both the LCU and the ROP terminal. This CRC is a 16-bit cyclic accumulation using the polynominal $X^{16}+X^{15}+X^2+1$. The CRC is sent as two eight-bit characters.

9.10 CRC accumulation is initialed by, but does not include, the first STX or SOH framing character. An STX embedded in a block is included in the CRC. All characters (except SYN and the two characters following ITB) following this STX or SOH, up to and including the end-of-block character (ETB or ETX), are part of the accumulation. Following the ETB or ETX character, the transmitting unit transmits the CRC characters. The ROP terminal then compares these characters with the CRC it has accumulated. If the redundancy accumulations are different, a transmission error has occurred.

ACK0/ACK1 (Alternating Affirmative Acknowledgments)

9.11 To insure against loss of an entire block of data (due to synchronization not being attained), alternating acknowledgments (ACK0/ACK1) are employed in response to successive valid blocks. These replies in proper sequence indicate the previous block was accepted and the terminal is ready to receive the next block. ACK0 is a positive response to selection.

9.12 ACK0 and ACK1 are short hand notations for the following sequences:

ASCII

ACK0 represents DLE followed by 0 (zero).
ACK1 represents DLE followed by 1 (one).

EBCDIC

ACK0 represents DLE followed by HEX 70.
ACK1 represents DLE followed by /.

9.13 The code combinations for DLE and character following are programmable, refer to Option 159h, i, and j in Section 582-202-200.

9.14 In this document, ACKN refers to a properly sequenced acknowledge reply; ACKN refers to an improperly sequenced reply.

SYN (Synchronous Idle)

9.15 Seven consecutive SYN characters are generated by the ROP terminal before any transmission. Received SYN characters are ignored, not included in the BCC accumulation, and not passed to the printer. The ROP terminal requires two consecutive SYN characters before any line information is accepted.

9.16 While SYN characters may generally be used in transmission without adverse affect, the sequences ETX BCC, ETB BCC, ACK0, ACK1, and WACK are always transmitted contiguously with no characters inserted in the sequence.

PAD Characters

9.17 A trailing pad character (HEX FF) is sent immediately after any transmission by the ROP terminal and it is required that the LCU does the same. This insures that the carrier of the modem is not turned off while the last (nonpad) character is being sent. The ROP terminal detects 24 or more consecutive marking bits as an idle line. The ROP terminal expects to see an idle line after each transmission by the LCU. This is utilized to force detection and drop of synchronization.

9.18 A leading pad character (HEX AA) is generated by the ROP terminal preceding the seven SYN characters at the start of each reply from the terminal to insure that the LCU is prepared to receive the synchronizing pattern. A leading pad character is also generated by the LCU preceding the SYN characters at the start of each transmission.

DLE (Data Link Escape)

9.19 DLE is used to extend the ASCII and EBCDIC codes in order to provide for:

- alternating acknowledgment (refer to acknowledge description.)

- wait-acknowledge (refer to WACK description.)

9.20 The character code combination recognized and sent by the ROP terminal as DLE is programmable. Refer to Option 159 h in Section 582-202-200.

NAK (Negative Acknowledgment)

9.21 NAK is sent by the ROP terminal when:

- it receives a selection sequence (in selection with replies applications) and the ROP is unable to receive.

- it receives a block containing a parity error.

- it receives a block having an invalid BCC.

- it receives a block terminating in or containing ENQ (after an STX has been received).

9.22 The use of NAK shall not alter the sequence of alternating positive acknowledgments. The code combination sent by the ROP terminal as NAK is programmable. Refer to Option 159l in Section 582-202-200.

ENQ (Enquire)

9.23 Upon receipt of ENQ the station controller:

- repeats its previous reply, if in Receive Text mode.

- replies NAK if the received ENQ aborted a block.

- replies ACK0 and prepares to receive if the ENQ was part of a valid selection sequence and the terminal is ready to receive.
- replies NAK if ENQ was part of a valid selection sequence but the terminal is not ready to receive.

9.24 The character code combination recognized by the ROP terminal as ENQ is programmable, refer to Option 159m in Section 582-202-200. The DLE character is not passed to the printer.

WACK

9.25 The ROP terminal sends WACK if the printer is busy (ie, no buffer is available for the next block), in response to a selection or block from the LCU.

9.26 Immediate WACK (Option 178b) is used to limit the number of blocks that the ROP terminal receives before sending WACK. With immediate WACK enabled (Option 178b) the ROP terminal will respond with WACK instead of ACKN to every second block of text. The LCU will respond to the WACK either with EOT or ENQ. The ROP terminal will respond with ACK if buffer space is available. With immediate WACK "OFF" (Option 178a) the above actions will not occur. Refer to Section 582-202-200 for Option 178.

9.27 The WACK two character sequence transmitted by the ROP is DLE; (semicolon) (ASCII) or DLE, (Comma) (EBCDIC) where the code combination for DLE is programmable, refer to Option 159h in Section 582-202-200.

SOH (Start of Heading)

9.28 The ROP terminal recognizes SOH as the character preceding a block of heading characters of a received message. Typically SOH precedes only the first block of transmission. All characters within a header are printed as text.

STX (Start of Text)

9.29 The ROP terminal recognizes STX as the first character of each block transmitted (except when SOH is employed). STX also terminates a heading.

ETB and ETX (End of Transmission Block and End of Text)

9.30 The receipt of ETB or ETX (only for last block of a message) causes the ROP terminal to expect the BCC as the next character(s).

9.31 Before sending an ACKN reply, the controller verifies that enough space exists in the buffer for the reception of a block of maximum expected size (512 characters or optionally 256 or 128). The block count includes the STX or SOH, the selection sequence (first block only), text characters, ETB or ETX, and the BCC.

9.32 Normally the only blocks smaller than the expected size are:

- first text block if message is less than block size.

- last block of a text message.

9.33 Receipt of a block that is either smaller or larger than the expected block size will cause no problem for the ROP terminal unless a larger than expected block results in an overflow of the available buffer space. This will result in an alarm condition and transmission of an EOT.

9.34 The horizontal tabulation set sequence will be terminated on receipt of ETX.

9.35 The receipt of ETB or ETX optionally provides additional functions. Refer to Options 173b or 174b respectively in Section 582-202-200. ETB or ETX will optionally cause a line to be printed and any outstanding vertical tabulation ESCAPE sequence to be executed (or New Line function to occur if no vertical tabulation ESCAPE sequence is outstanding), or terminates a horizontal tabulation set sequence (ETB only).

EOT (End of Transmission)

9.36 The LCU sends EOT when:

- it has no further blocks to send.

- it is in an abnormal state and can not continue sending additional message blocks.

- To precede a poll or a select.

9.37 The ROP terminal sends EOT in place of an ACKN to a received message if the message caused a block area in the buffer to be overrun. Recovery procedures at the LCU should assume disturbance to several preceding data blocks upon detection of an EOT response.

9.38 Upon receiving or sending an EOT, the ROP terminal returns to the Control mode. In the Control mode the terminal monitors the communications line for an ENQ sequence.

9.39 The character code combination that the ROP terminal recognizes as EOT is programmable, refer to Option 159k in Section 582-202-200.

SID (Station Identity)

9.40 The SID is a programmable one- or two-character identifier associated with each ROP terminal. The SID is employed in selection. The SID, depending upon the selection format chosen, may consist of one or two characters.

Most existing systems, when a two-character sequence is chosen, send a single character twice. The capabilities of the ROP terminal; however, permit recognition of a two-character SID comprised of two different characters. Refer to Option 159a and b in Section 582-202-200.

TTD (Temporary Text Delay)

9.41 The ROP terminal will respond to a TTD from the LCU by sending NAK and awaiting the next sequence from the LCU. The TTD consists of the character STX followed by the character ENQ.

ITB (End of Intermediate Transmission Block)

9.42 ITB is used to divide a message (heading or text) for error checking purposes without a line turnaround. After the first intermediate block, successive intermediate blocks need not be preceded by STX or SOH.

9.43 The ROP terminal will accept a received ITB (US (ASCII) or IUS (EBCDIC) character in received text and process the next character(s) as a BCC. No reply will be made; however, an errored block will produce a NAK response in the next ETB or ETX reply. A new BCC accumulation will start on the next block.

9.44 Neither the ITB or BCC characters are passed to the printer.

9.45 The receipt of ITB optionally will provide additional functions (refer to Option 175 in Section 582-202-200) ITB will optionally cause a line to be printed and any outstanding vertical tabulation ESCAPE sequence to be executed (or New Line Function to occur if no vertical tabulation ESCAPE sequence is outstanding), or terminates a horizontal tabulation set sequence.

RS or IRS (EBCDIC) (Record Separator)

9.46 Receipt of RS (ASCII) or IRS (EBCDIC) character will optionally cause the ROP terminal to space or a line to be printed and any outstanding vertical tabulation ESCAPE sequence to be executed (or New Line Function to occur if no vertical tabulation ESCAPE sequence is outstanding). Refer to Option 177 in Section 582-202-200. Receipt of RS or IRS character within a horizontal tabulation set sequence will be ignored.

Formatting Characters

9.47 The ROP terminal can respond to a number of characters/sequences to control the positioning or exclusion of data in the text produced by the printer.

ESC

9.48 The ESC character is used to initiate various format control sequences that allow a distant terminal to establish a variety of printing formats or printer responses. The character following ESC is not printed. Execution of functions initiated by Escape sequences do not take place until receipt of one of the following optioned characters: LF (EBCDIC)/NL (OPTION 176a), ETB (Option 173b), ETX (Option 174b), or IRS (EBCDIC)/RS (refer to Option 177a). Refer to Section 582-202-200 for options.

Note: The function of multiple ESCAPE sequences before receipt of one of the above optioned characters is undefined, therefore, unwanted results may be produced. The ESCAPE character is not passed to the printer.

Carriage Return (CR or ESC M)

9.49 Upon receipt of CR or ESC M, the controller will cause the next character to be printed at the left-hand margin of the present printing line.

Space Extension

9.50 With the space extension option enabled, the printer will print three spaces for each Space character received. Enabling of this feature will result in multiplying by three the number of spaces produced by the Space Compression/Expansion function but not the spaces produced by HT. If the transmitting source does not take this into account, it is possible for a line of text to exceed the right-hand margin of the printer. This will cause the remainder of the spaces and text to be printed on the next lower line starting at the left hand margin position.

Space Compression/Expansion (IGS α or GS α)

9.51 When the ROP terminal receives an IGS α (EBCDIC) or GS α (ASCII) sequence, it will cause the printer to insert into the printed text a number of spaces (maximum of 63) corresponding to the α character. The number of spaces is determined by the Hex count of the six low order bits of the α character. For ASCII, bit eight provides odd character parity while bit seven is a marking bit. Thus two spaces is represented by a "B", 15 by "O", 26 by "Z", etc.

For EBCDIC, bit zero is spacing and bit one is marking. This results in most of the resulting characters falling into an area of the code that has no graphic assignments. However, ten spaces would result from "¢", 27 from "$", etc. If the number of spaces exceeds the right-hand margin position, the printer will print or execute the next character on the next line starting at the left-hand position. The ROP terminal can execute multiple space expansions.

Horizontal Tabulation (ESC HT or HT)

9.52 The HT character provides several functions (refer to Section 582-202-200 for options):

(a) Used in the sequence ESC HT, it indicates the beginning of a block of data that will initiate the setting of on-line horizontal tab stops. The tab setting sequence is terminated by ETX or optionally with ITB (refer to option 175), ETB (refer to Option 173), or LF (EBCDIC)/NL (refer to Option 176). The ESC HT sequence also causes erasure of all existing horizontal tab stops (either preset or on-line set).

(b) The tab stop setting procedure in the ROP terminal is initiated by receipt of the ESC HT sequence. The terminal tab setting always starts at the left-hand margin position. Space characters must be received for each location in the print line that is not a tab stop and a HT for each tab stop location. Each reception of HT in a block initiated by ESC HT, is used to locate a horizontal tab stop. The tab stop setting procedure is terminated by ETX or optionally with ITB (refer to Option 175.b), ETB (refer to Option 173.b.), or NL (EBCDIC)/LF (ASCII) (refer to Option 176.a.). Any character other than ETX, RS, the optioned character (ITB, ETB, or NL/LF) or an ESC sequence will function as a Space character in this procedure (if tab setting is extended between blocks ETB, ITB, STX and SOH will be included as spacing characters.) The HT character used in setting horizontal tab stops is counted as a Space character. If the number of Space characters received in the tab setting sequence causes the 80- or 132-character line length to be exceeded, the ROP terminal will attempt an EOT reply and initiate an alarm indication and disconnect sequence. These tab stops will be retained until erased by another ESC HT sequence or by a POR (Power On Reset) procedure. Following each POR, the optional reset tabs are activated and remain in effect until an ESC HT sequence is initiated.

(c) HT, when received in a message block, will cause the next character to be printed at the next horizontal tab stop to the right. An HT received when no more usable stops exist between the present printing position and the end of the line will cause the next character to be printed in the first printing position of the next line (refer to Option 131).

Paper Advance

9.53 The ROP terminal will perform a paper advance as a result of receiving ITB (refer to Option 175b), LF (EBCDIC)/NL, (refer to Option 176a), ETB (refer to Option 173b), ETX (refer to Option 174b) or IRS (EBCDIC)/RS (ASCII) (Option 177a) if so optioned. An automatic New Line will be performed when the right-hand margin is exceeded.

Line Feed/New Line (LF (EBCDIC) or NL)

9.54 Receipt of LF (EBCDIC) or NL with Option 176a enabled will cause a line to be printed and any outstanding vertical tabulation ESCAPE sequence to be executed (or New Line Function to occur if no vertical tabulation ESCAPE sequence is outstanding), or terminate a horizontal tabulation set sequence. If Option 176b is enabled, the above actions will not occur. The ROP terminal will space on receipt of a LF (EBCDIC) or NL. Refer to Section 582-202-200 for options.

Line Feed - Single (ESQ or ESC/)

9.55 Receipt of ESC Q (ASCII) or ESC / (EBCDIC) will be recorded and reception of one of the following optioned characters will cause the next character to be printed at the left-hand margin of the next line below the present print line: LF (EBCDIC)/NL (Option 176a), ETB (Option 173b), ETX (Option 174b) or IRS (EBCDIC)/RS (Option 177a). See paragraph 9.48 on ESC sequences and their execution. Refer to Section 582-202-200 for options.

Line Feed — Double (ESC R or ESC S)

9.56 Receipt of ESC R (ASCII) or ESC S (EBCDIC) will be recorded and reception of one of the following optioned characters will cause the next character to be printed at the left-hand margin of the second line below the present print line: LF (EBCDIC)/NL (Option 176a), ETB (Option 173b), ETX (Option 174b) or IRS (EBCDIC)/RS (Option 177a). See Paragraph 9.48 on ESC sequences. Refer to Section 582-202-200 for options.

Line Feed - Triple (ESC S or ESC T)

9.57   Receipt of ESC S (ASCII) or ESC T (EBCDIC) will be recorded and reception of one of the following optioned characters will cause the next character to be printed at the left-hand margin of the third line below the present print line: LF (EBCDIC)/NL (Option 176a), ETB (Option 173b), ETX (Option 174b) or IRS (EBCDIC)/RS (Option 177a). See paragraph 9.48 on ESC sequences and their execution. Refer to Section 582-202-200 for options.

    Note: In the above line feed descriptions, the single line feed option of the printer mechanism is assumed. Use of the double line feed option will double the described movements.

Form Feed (FF)

9.58   Receipt of the FF character will result in a tractor feed printer (with forms mode on) advancing the paper until the next form is in registration. Tractor feed printers without the Forms mode selected, will perform the New Line function upon receipt of FF.

Vertical Tabulation (VT or ESC α)

9.59   The ROP terminal permits presetting of twelve vertical tabulation selections. (See Option 123 in Section 582-202-200.)

9.60   Receipt of a VT character will cause the next character to be printed in the first printing position of the next lower line that corresponds to a preset vertical tabulation position. If no stops exist between the present print location and the end of the form feed then the VT will cause a form feed operation to be performed.

9.61   Receipt of one of the assigned ESC α vertical tabulation sequences will be recorded and upon reception of one of the following optioned characters enough NL characters will be delivered to the printer to cause the next text character to be printed at the first printing position of the designated vertical tab position: LF (EBCDIC)/NL (Option 176a), ETB (Option 173b), ETX (Option 174b) or IRS (EBCDIC)/RS (Option 177a). Refer to Section 582-202-200 for options.

9.62   If the received ESC α sequence calls for movement to a position that is above the present location on the form, the printer will be directed to advance to the indicated line on the next form. Since ESC A is normally assigned to the starting line position on a form, such use of ESC A is usually equivalent to the use of FF.

Sequence	Resulting Position
ESC A	Vertical Tab No. 1
ESC B	Vertical Tab No. 2
ESC C	Vertical Tab No. 3
ESC D	Vertical Tab No. 4
ESC E	Vertical Tab No. 5
ESC F	Vertical Tab No. 6
ESC G	Vertical Tab No. 7
ESC H	Vertical Tab No. 8
ESC I	Vertical Tab No. 9
ESC J	Vertical Tab No. 10
ESC K	Vertical Tab No. 11
ESC L	Vertical Tab No. 12

9.63   If the ESC α sequence invokes an unenabled position, a form feed operation will be performed.

9.64   If the received ESC α sequence is identical to the present line position, this sequence will be ignored and no paper movement will occur.

Bell

9.65   Receipt of the Bell character, as part of a data block, will cause a 1/4 second pause in printing during which the audible alarm will sound. Repeated Bell characters must be approximately one second apart for distinct tones to be heard. The bell signal can alert the operator to special message significance or call for special action. If the BELL character is used excessively it can impair printer through put.

Interface Requirements

9.66   This section describes the interface requirements between a Line Control Unit (LCU), considered the master station, and a switched network line or a dedicated line serving one (point-to-point) or several (multipoint) stations, considered the slave stations, operating at medium speed. Transmission is on two-way alternate (half-duplex) block oriented basis.

9.67   The transmission of messages in multipoint private line applications is controlled by the LCU by means of selection. In switched network and point-to-point private line applications,

selection is not necessary since connection is made direct through dial-up (switched network) or by single station connection (point-to-point.)

9.68 In point-to-point applications, the ROP terminal requires that the distant terminal initiate and control all message transmissions. In switched network applications the ROP terminal provides for automatic answering of received calls. On multipoint private line circuits, the ROP terminal interacts with a line control unit (LCU). No station-to-station message transfer can occur. The ROP terminal will optionally accept ASCII (seven bits plus one odd parity bit) or EBCDIC coded characters.

9.69 Operating line speed is 2400, 4800 or 7200 bits per second (3000, 6000, or 9000 words per minute) using synchronous transmission.

9.70 An appropriate selection code sequence (Refer to Option 171 in Section 582-202-200)must be recognized by the ROP terminal prior to any printing activity taking place. The ROP terminal will respond with a READY-TO-RECEIVE or NOT-READY-TO-RECEIVE reply in response to an ENQ character contained in the addressing sequences (whether station identifiers are used or not).

9.71 In order to be able to receive a message, the ROP terminal requires the receipt of two consecutive SYN characters before any line information is accepted. The ROP terminal will generate seven consecutive SYN characters before the transmission of any replies.

9.72 To insure that the terminal is conditioned to receive a selection sequence (be in the Select mode) the initial character of the transmission should be an EOT.

9.73 Any transmission to or from the ROP terminal must be concluded by a PAD character to insure that the carrier of the modem is not turned off while the last (nonpad) character is being sent.

9.74 All messages are transmitted in a block format. During reception the ROP terminal verifies the odd vertical parity of each received character (ASCII only) and computes either a longitudinal redundancy check (LRC) for ASCII or a cyclic redundancy check (CRC) for EBCDIC. For convenience, BCC (Block Check Character) is used to refer to either LRC or CRC

character as appropriate. The distant terminal terminates each block with a BCC immediately following a check point character (ITB, ETB or ETX) and then stops to await a reply from the ROP terminal. The reply would indicate the status/acceptability (relative to transmission problems) of the received block and the status of the terminal. Blocks for which an error reply (NAK) results are retransmitted at the option of the LCU.

9.75 Before sending an ACKN (acknowledge normally expected in the ACK0 ACK1 sequence) in acceptance of the previous transmission, the controller will check that suffcient space is available in the buffer for the maximum block size provided for in the system (512 characters or optionally 256 or 128). If insufficient space is available, a WACK will be returned. If the transmitter inadvertently sends more than the maximum block size, the controller will accept and print the data (provided the BCC is correct) unless this causes overflow of all available buffer space. In that case, the controller will send an EOT reply to the block, and initiate an alarm and a disconnect sequence.

9.76 The maximum length of the transmission block is 512 characters (optionally 128 or 256 characters) except for the first block which may contain a station identifier. The last block may be less than block length long.

Data Link Control Procedures

9.77 Data link control procedures provide systematically enabled methods for establishing, maintaining and terminating of communication links and for message transfer or alarm reporting. The structure of station identifiers, answerback responses and control procedures should not include characters which could be created by a "hit" on the signal line. Included in this category are NUL, @, p, : and DEL for ASCII applications and HEX 00, C0, F0, FA and FF for EBCDIC applications.

Station Selection

9.78 A number of the available selection sequences (see Option 171) include a one or two character sequence that identifies and selects the station which is to receive the message. The ROP terminal will give an ACK0 only if this sequence corresponds to that encoded using Option 159. Refer to Section 582-202-200 for options.

Device Selection

9.79   Certain of the selection sequences (see Option 171 in Section 582-202-200) include one character to designate the portion of the selected station that is to be activated for reception of the message. At this time only the character that activates the printer will receive an ACK response from the ROP terminal. In selection sequences that place the device selection sequence at the beginning of the first block of data the ROP terminal will maintain the device selection until the next EOT is received. If the LCU should include a device selection sequence at the beginning of subsequent blocks, the sequence will be treated as part of the text.

Disconnect

9.80   The ROP terminal will perform a disconnect operation (drop Data Terminal Ready and Request To Send to the data set for two seconds) for signal line causes such as receiving a DLE EOT sequence, loss of carrier (Option 166), failure to receive CTS after initiating a Send mode, loss of DSR, three seconds of consecutive SYN characters, 20 seconds of no legitimate or useful data (idle line) when selected, or following several internal alarm conditions as described elsewhere herein.

9.81   As part of the disconnect routine, the controller will deliver a FF character to the printer (either a NL or a FF will take place depending on the printer Option 39). The printer's motor will be turned off immediately following the FF action. Refer to Section 582-202-200 for options.

9.82   At the end of the two-second disconnect period, the controller will attempt to reestablish the In Service condition.

Out of Paper

9.83   The printer monitors the paper supply condition and provides an indication to the controller whenever an out of paper condition (the last line of the last complete form has been fed through the printing position) has occurred in a tractor feed printer.

9.84   The ROP terminal, upon detecting the out of paper condition, will stop delivery of characters to the printer and light the alarm lamp. The terminal will then send an EOT in response to the next request for a reply. Following an EOT reply, or if no reply is requested by the LCU within 3 seconds after the paper out condition occurs, the alarm lamp and audible alarm will be activated for 8 seconds. A disconnect sequence will then be initiated and any remaining data in the buffer will be cleared. The terminal will initialize its program to an out-of-service condition.

Form Registration

9.85   To insure proper form registration, it is recommended that a FF character initiate each message. If the form is already in registration, it will not advance.

Transparent Data

9.86   The ROP terminal does not recognize transparent data and can not be used on a communication line with transparent data.

Multipoint Private Line Operation

9.87   Multipoint private line data link control procedures compatible with the Integrated Synchronous DATASPEED 40 ROP Controller are multipoint with replies and station identification (requires a single character SID repeated once in an address) with or without device selection (selection of a device other than the printer will result in a NAK reply); message associated with Block Checking; two way alternate.

9.88   Message transfer is with replies to Block Check Characters; however, replies may be delayed to the end of a succeeding block (through the use of an Intermediate Transmission Block character).

9.89   Block checking utilizes longitudinal redundancy block parity checking for ASCII code structures and cyclic redundancy checking for EBCDIC Code structures.

9.90   In a multipoint private line environment, the ROP terminal is either in a Control mode, searching for line controls addressed to it by the LCU, a Text mode, in which it monitors and controls information delivered to the printer, or in a Blind mode, in which it awaits completion of delivery of a message to another station so that it may return to the Control mode.

Control Mode

9.91   The ROP terminal enters the Control mode whenever it receives or generates an EOT sequence. While in the Control mode, the terminal monitors the communications line. Detection of its selection sequence in this mode causes it to enter the Text mode. Selection sequences are shown on next page.

Selection Sequences Sent by LCU
(Refer to Section 582-202-200 for options)

1. Option 171c (with device selection):

$$\begin{matrix} P & S & S & & E & P & & P & S & S & S \\ A & Y & Y\,\alpha_1 & \# & N & A & [\;] & A & Y & Y & T \\ D_1 & N & N & & Q & D_2 & & D_1 & N & N & X \end{matrix}$$

Notes: 1, 2, 3, 4, 5, 6, 7, 8, 9

2. Option 171d (without device selection):

$$\begin{matrix} P & S & S & & & E & P & & P & S & S & S \\ A & Y & Y\,\alpha_1 & \alpha_2 & & N & A & [\;] & A & Y & Y & T \\ D_1 & N & N & & & Q & D_2 & & D_1 & N & N & X \end{matrix}$$

Notes: 2, 3, 4, 6, 7, 8, 9, 10, 12

3. Option 171g (with device selection):

$$\begin{matrix} P & S & S & & & E & P & & P & S & S & S \\ A & Y & Y\,\alpha_1 & \alpha_2 & \# & N & A & [\;] & A & Y & Y & T \\ D_1 & N & N & & & Q & D_2 & & D_1 & N & N & X \end{matrix}$$

Notes: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12

Note 1: Device selection is restricted to the printer only at this time. Refer to Paragraph 9.80.

Note 2: PAD_1 is a leading character (HEX AA) generated by either the LCU or the ROP terminal preceding the SYN characters at the start of each transmission.

Note 3: The ROP terminal has to receive at least two consecutive SYN characters to establish synchronization.

Note 4: α_1 represents the first character of the station selection sequence. Refer to Option 159a.

Note 5: # (for Option 171c) represents the device selection character in systems where the station employs more than one device. # must represent the printer. If # is used to represent other devices, the station will respond with a NAK or EOT. # should only be used to represent a device other than the printer for system compatibility. Refer to Options 159b, or 159c, or 159d.

Note 6: ENQ prepares the terminal to receive, if it is a part of a valid selection sequence. ENQ is programmable. Refer to Option 159m.

Note 7: PAD_2 is a trailing character (HEX FF) sent by either the LCU or the ROP terminal to insure that the carrier of the modem is not turned off while the last (nonpad) character is being sent.

Note 8: [ ] represents replies from the ROP terminal. ACK∅ (zero) is required for the sequence to continue. ACK∅ is a two character sequence, DLE ∅ (ASCII) or DLE HEX 70 (EBCDIC) where the code combination for DLE is programmable. Refer to Option 159h and i. NAK is sent by the ROP terminal when the printer is unable to receive any transmissions except as noted for WACK. The code combination for NAK is a programmable character. Refer to Option 159i. A WACK reply is sent by the ROP terminal when the terminal can not receive transmissions because the printer is busy (ie, no buffer space is available for the next block). WACK is a two character sequence DLE; (Semicolon) (ASCII) or DLE, (Comma) (EBCDIC) where the code combination for DLE is programmable. Refer to Option 159h. The status reply (ACK∅, NAK or WACK) is preceded by PAD_1 (see Note 2) and 7 SYN characters and is followed by PAD_2 (see Note 7).

Note 9: STX is the initial character of each block of the message, except when using an intermediate transmission block (ITB) character. Refer to Paragraph 9.42). STX optionally may be SOH.

Note 10: α_2 represents the second character of the station selection sequence. Normally α_2 is coded the same as α_1. Refer to Option 159b.

Note 11: # (for Option 171g) represents the device selection character. Selection of devices other than the printer is reserved for future applications. Selection of devices other than the printer will cause the terminal to respond with a NAK and should be made only for system compatibility. Refer to Option 159f and 159g.

Note 12: $\alpha_1\,\alpha_2$ precede the status reply and are part of [ ]. $\alpha_1\,\alpha_2$ represents the station identity. Normally α_2 is coded the same as α_1. Refer to Options 159a and 159b.

Text Mode

9.92 Upon detecting its selection sequence, while in the Control mode, the ROP terminal will, if it is in condition to receive a message, generate an affirmative reply to the LCU and enter the Text mode. Upon receiving a subsequent

STX (optionally SOH), the printer will begin copying the received message. Upon completing transmission of the message, the LCU returns the terminal to the Control mode by sending EOT.

9.93 The message format consists of blocks of 512 characters, (optionally 128 or 256). Each block will begin with STX, optionally SOH except as noted in Paragraph 9.42. All blocks except the last block will end in ETB, optionally ITB, and present one block check character for ASCII applications or two block check characters for EBCDIC applications and a PAD character. The LCU will then stop sending and wait for a reply from the ROP terminal. Blocks ending in ITB will not cause a reply from the ROP terminal but delay that reply until a block ending character of ETB or EOT is sensed. The last block of a message should end with an ETX signifying that the last block has been sent.

9.94 Positive replies are alternating ACK0, ACK1 replies beginning with ACK1 after the first block has been sent. Negative replies (NAK) do not affect the alternating sequence of the positive replies. Positive replies are sent when the block check character sent by the LCU agrees with the block check character accumulated by the ROP terminal. Negative replies are generated when the block check characters do not agree.

9.95 The message transfer is illustrated below (all notes of 9.96 apply):

```
        P S S S      E B P                         P S S S      E B P
Sent by A Y Y T TEXT T C A                         A Y Y T TEXT T C A ···
LCU     D₁N N X      B C D₂                        D₁N N X      B C D₂
Sent by        P S S S S S S A   A    N P
ROP            A Y Y Y Y Y Y C 0. C 1 or A A
               D₁N N N N N N N K   K   K D₂
```

9.96 Upon completing transmission of the message, the LCU can return the terminal to the Control mode by sending EOT.

```
        P S S S      E B P                         P S S E P
Sent by A Y Y T TEXT T C A                         A Y Y O A
LCU     D₁N N X      X C D₂                         D₁N N T D₂
Sent by        P S S S S S S A   A    P
ROP            A Y Y Y Y Y Y C 0. or C 1 A
               D₁N N N N N N N K   K   D₂
```

Note 1: PAD₁ is a leading character (HEX AA) generated by either the LCU or the ROP terminal preceding the SYN characters at the start of each transmission.

Note 2: The ROP terminal has to receive at least two consecutive SYN characters to establish synchronization.

Note 3: STX is the initial character of each block of the message except when using an Intermediate Transmission Block (ITB) character (refer to Paragraph 9.42). STX may optionally be SOH.

Note 4: ETB (or optionally ITB or ETX) signifies the end of the block.

Note 5: BCC is a one (for ASCII) or two (for EBCDIC) character check.

Note 6: PAD₂ is a trailing character (HEX FF) sent by either the LCU or the ROP terminal to insure that the carrier of the modem is not turned off while the last (nonpad) character is being sent.

Note 7: ACK0, ACK1, or NAK are replies transmitted by the ROP terminal to indicate matching or unmatching block check characters.

Blind Mode

9.97 While in the Control mode in a multipoint protocol (see Option 171 in Section 582-202-200), reception by the ROP terminal of an SOH or STX, without having detected its selection sequence will cause it to enter the Blind mode. In this mode, the terminal will respond only to an EOT which will cause it to return to the Control mode. The Blind mode prevents inadvertant recognition of character sequences in a message as its selection sequence.

9.98 The terminal will also enter the Blind mode upon being turned on or receiving a DLE EOT sequence.

Point-To-Point Private Line Operation

9.99 Private line point-to-point data link control procedures compatible with the Integrated Synchronous DATASPEED 40 ROP Controller are point-to-point; with or without device selection (selection of a device other than the printer will result in a NAK or EOT reply); message associated with Block Checking; two way alternate.

9.100 Message transfer is with replies to Block Check characters; however, replies may be delayed to the end of a succeeding block (through the use of an Intermediate Transmission Block character).

9.101 Block checking utilizes longitudinal redundancy block parity checking for ASCII code structures and cyclic redundancy checking for EBCDIC Code structures.

9.102 In a point-to-point private line application, the station is either in a Control mode waiting for line controls or in the Text mode monitoring and controlling information to the printer from a remote master station.

Control Mode

9.103 The ROP terminal enters the Control mode whenever it receives or generates an EOT sequence. While in the Control mode the terminal monitors the communications line for an ENQ sequence which causes the terminal to enter the Text mode (if the terminal is in service). ENQ sequences are shown below:

ENQ Sequences Sent by LCU
(Refer to Section 582-202-200 for options)

1. Option 171a (with device selection):

```
P  S  S  E  P        P  S  S  S  D
A  Y  Y  N  A  [  ]  A  Y  Y  T  C
D₁ N  N  Q  D₂       D₁ N  N  X  n
```

Note: 1, 2, 3, 4, 5, 6, 7, 8

2. Option 171b (without device selection):

```
P  S  S  E  P        P  S  S  S
A  Y  Y  N  A  [  ]  A  Y  Y  T
D₁ N  N  Q  D₂       D₁ N  N  X
```

Note: 2, 3, 4, 5, 6, 7

Note 1: Device selection is restricted to the printer only at this time. Refer to paragraph 9.80.

Note 2: PAD_1 is a leading character (HEX AA) generated by either the LCU or the ROP terminal preceding the SYN characters at the start of each transmission.

Note 3: The ROP terminal has to receive at least two consecutive SYN characters to establish synchronization.

Note 4: ENQ prepares the terminal to receive. The code combination for ENQ is programmable. Refer to Option 159m.

Note 5: PAD_2 is a trailing character (HEX FF) sent by either the LCU or the ROP terminal to insure that the carrier of the modem is not turned off while the last (nonpad) character is being sent.

Note 6: [ ] represents replies from the ROP terminal. ACK∅ (zero) is required for the sequence to continue. ACK∅ is a two character sequence, DLE ∅ (ASCII) or DLE HEX 70 (EBCDIC) where the code combination for DLE is programmable. Refer to Option 159h and Option 159i. NAK is sent by the ROP terminal when the printer is unable to receive any transmissions except as noted for WACK. The code combination for NAK is a programmable character. Refer to Option 159i. A WACK reply is sent by the ROP terminal when the terminal can not receive any transmissions because the printer is busy (ie, no buffer space is available for the next block). WACK is a two character sequence DLE; (semi-colon) (ASCII) or DLE, (Comma) (EBCDIC) where the code combination for DLE is programmable. Refer to Option 159h. The status reply (ACK∅, NAK or WACK) is preceded by the PAD_1 (See Note 2) and 7 SYN characters and is followed by PAD_2 (see Note 5).

Note 7: STX is the initial character of each block of the message except when using an intermediate transmission block (ITB) character (refer to Paragraph 9.42). STX optionally may be SOH.

Note 8: DC_n represents the device selection character. DC_n must be programmed using Option 159f. The use of 159g to program DC_n is reserved for future applications and may be left unprogrammed; however, if Option 159g is programmed (due to system compatibility) the terminal on receiving a selection sequence containing the character programmed by 159g will respond with an EOT. If the selection sequence fails to include DC_n the terminal will assume that the printer is being addressed. Normally the characters encoded for DC_n are chosen from the DC_1 through DC_4 category. Refer to Options 159f and 159g.

9.104 Upon transmission of the ACK∅ reply to the ENQ of the selection sequence if the ROP terminal is In Service), the ROP terminal will enter the Text mode. Copying of the received message will commence with the initial STX (optionally SOH). Upon completing transmission of the message, the LCU returns the ROP terminal to the Control mode by sending EOT.

9.105 The message format is the same as for multipoint private line applications.

Blind Mode

9.106 In a point-to-point private line environment, only a faulty selection sequence should normally cause entry into the Blind mode.

Point-To-Point Switched Network Operation

9.107 Point-to-point switched network data link control procedures compatible with the Integrated Synchronous DATASPEED 40 ROP Controller are point-to-point; with or without device selection (selection of a device other than the printer will result in a NAK or EOT reply); message associated with Block Checking; two way alternate.

9.108 Message transfer is with replies to BLOCK Check Characters; however, replies may be delayed to the end of a succeeding block (through the use of an Intermediate Transmission Block character).

9.109 Block checking utilizes longitudinal redundancy block parity checking for ASCII code structures and cyclic redundancy checking for EBCDIC Code structures.

9.110 In a switched network application, an "In Service" ROP terminal is in an idle line condition with the printer off, awaiting a Data Set Ready signal. The associated data set should normally be arranged to provide for Auto Answer of the call. Upon completion of the data set handshaking, the ROP terminal will be in the Control mode awaiting initiation of a selection sequence by the calling station. The selection sequences are shown below:

Selection Sequences Sent by LCU
(Refer to Section 582-202-200 for options)

1. Option 171a: (without terminal identification; with device selection):

```
P   S  S  E  P   ⌐   ⌐P   S  S  S  D
A   Y  Y  N  A   [   ]A   Y  Y  T  C
D₁  N  N  Q  D₂  ⌊   ⌊D₁  N  N  X  n
```

Notes: 1, 2, 3, 4, 5, 6, 7, 8

2. Option 171b: (without terminal identification):

```
P   S  S  E  P   ⌐   ⌐P   S  S  S
A   Y  Y  N  A   [   ]A   Y  Y  T
D₁  N  N  Q  D₂  ⌊   ⌊D₁  N  N  X
```

Notes: 2, 3, 4, 5, 6, 7

3. Option 171e: (with terminal identification; with device selection):

```
P   S  S          E  P   ⌐   ⌐P   S  S  S  D
A   Y  Y  αₐ  α_B  N  A   [   ]A   Y  Y  T  C
D₁  N  N          Q  D₂  ⌊   ⌊D₁  N  N  X  n
```

Notes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 11

4. Option 171f: (with terminal identification):

```
P   S  S          E  P   ⌐   ⌐P   S  S  S
A   Y  Y  αₐ  α_B  N  A   [   ]A   Y  Y  T
D₁  N  N          Q  D₂  ⌊   ⌊D₁  N  N  X
```

Notes: 2, 3, 4, 5, 6, 7, 9, 11

5. Option 171h: (with terminal identification; with device selection):

```
P   S  S                          E  P  ⌐  ⌐P   S  S  S  D
A   Y  Y  αₐ  α_B  A₁ B₁ C₁ N  A  [  ]A   Y  Y  T  C
D₁  N  N                          Q  D₂ D₁ N  N  X  n
```

Notes: 1, 2, 3, 4, 5, 6, 7, 8, 10

Note 1: Device selection is restricted to the printer only at this time. Refer to paragraph 9.80.

Note 2: PAD_1 is a leading character (HEX AA) generated by either the LCU or the ROP terminal preceding the SYN characters at the start of each transmission.

Note 3: The ROP terminal has to receive at least two consecutive SYN characters to establish synchronization.

Note 4: ENQ prepares the terminal to receive if it is part of a valid selection sequence. The code combination for ENQ is programmable. Refer to Option 159m.

Note 5: PAD_2 is a trailing character (HEX FF) sent by the LCU to insure that the carrier of the modem is not turned off while the last (nonpad) character is being sent.

Note 6: [ ] represents replies from the ROP terminal. ACK∅ is a two-character sequence, DLE∅ (ASCII) or DLE HEX 70 (EBCDIC) where the code combination for DLE is programmable, refer to Option 159h and i. NAK is sent by the ROP terminal when the printer is

unable to receive any transmissions except as noted for WACK. The code combination for NAK is a programmable character. Refer to Option 159l. A WACK reply is sent by the ROP terminal when the terminal can not receive transmissions because the printer is busy (ie, no buffer space is available for the next block). WACK is a two-character sequence DLE; (semi-colon) (ASCII) or DLE, (comma) (EBCDIC) where the code combination for DLE is programmable, refer to Option 159h. The status reply (ACK$\emptyset$, NAK or WACK) is preceded by PAD_1 (see Note 2) and 7 SYN characters and is followed by PAD_2 (see Note 5).

Note 7: STX is the initial character of each block of the message except when using an intermediate transmission block (ITB) character (refer to Paragraph 9.42). STX optionally may be SOH.

Note 8: DC_n represents the device selection character. The use of Option 159g to program DC_n is reserved for future applications and may be left unprogrammed; however, if Option 159g is programmed (due to system compatibility) the terminal on receiving a selection sequence containing the character programmed by Option 159g will respond with an EOT. If the selection sequence fails to include DC_n, the terminal will assume that the printer is being addressed. Normally the characters encoded for DC_n are chosen from the DC_1 through DC_2 category. Refer to Options 159f and 159g.

Note 9: α_A α_B represents the LCU identity characters. They are not checked.

Note 10: α_A $\alpha_B A_1 B_1 C_1$ are the LCU station identification characters. They are not checked. α_1 α_2 $A_2 B_2 C_2$ precede the status reply and is part of [ ]. α_1 α_2 represents the station identity. Normally α_2 is coded the same as α_1. Refer to Options 159a and 159b. Characters $A_2 B_2 C_2$ represent a security identification sequence. Refer to Options 159c, 159d, and 159e.

Note 11: α_1 α_2 precede the status reply and are part of [ ]. α_1 α_2 represents the station identity. Normally α_2 is coded the same as α_1. Refer to Options 159a and 159b.

9.111 It is possible, using an operator initiated call, for the ROP terminal to originate a call to a distant LCU. It is necessary, however, that the distant LCU act as a master terminal and initiate the necessary selection sequence.

9.112 The message format is the same as for multipoint private line applications.

9.113 Following completion of the message transmission, the ROP terminal can drop the line connection either as the result of reception of a disconnect sequence (DLE EOT), loss of DSR (Data Set Ready) or through a time-out following recognition of loss of carrier (dependent on data set options).

10. Code Charts

TABLE A

ASCII Code Set

BITS			7 →	0				1			
			6 →	0		1		0		1	
			5 →	0	1	0	1	0	1	0	1
4	3	2	1	0	1	2	3	4	5	6	7
0	0	0	0	NUL	DLE	SP	0	@	P	`	p
			1	SOH	DC1	!	1	A	Q	a	q
		1	0	STX	DC2	"	2	B	R	b	r
			1	ETX	DC3	#	3	C	S	c	s
	1	0	0	EOT	DC4	$	4	D	T	d	t
			1	ENQ	NAK	%	5	E	U	e	u
		1	0	ACK	SYN	&	6	F	V	f	v
			1	BEL	ETB	'	7	G	W	g	w
1	0	0	0	BS	CAN	(	8	H	X	h	x
			1	HT	EM	)	9	I	Y	i	y
		1	0	NL	SUB	*	:	J	Z	j	z
			1	VT	ESC	+	;	K	[	k	{
	1	0	0	FF	FS	,	<	L	\	l	|
			1	CR	GS	-	=	M	]	m	}
		1	0	SO	RS	.	>	N	^	n	~
			1	SI	US	/	?	O	_	o	DEL

Note: 1 = Mark   0 = Space

Example: Bits 1 through 7 of the bit permutation for the character M are 1011001, respectively.

NUL — Null	DC1 — Device Control 1
SOH — Start of Heading	DC2 — Device Control 2
STX — Start of Text	DC3 — Device Control 3
ETX — End of Text	DC4 — Device Control 4
EOT — End of Transmission	NAK — Negative Acknowledge
ENQ — Enquiry	SYN — Synchronous
ACK — Acknowledge	ETB — End of Transmission Block
BEL — Bell	CAN — Cancel
BS — Back Space	EM — End of Media
HT — Horizontal Tab	SUB — Substitute
NL — New Line	ESC — Escape
VT — Vertical Tab	FS — Field Separator
FF — Form Feed	GS — Group Separator
CR — Carriage Return	RS — Record Separator
SO — Shift-Out	US — Unit Separator
SI — Shift-In	SP — Space
DLE — Data Link Escape	DEL — Delete

TABLE B

EBCDIC Code Set

Bits 4567	Hex 1	00	00	00	00	01	01	01	01	10	10	10	10	11	11	11	11	← Bits 01
		00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	← Bits 23
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	← Hex 0
0000	0	NUL	DLE	DS		SP	&	-						{	}	\	0	
0001	1	SOH	DC1	SOS				/		a	j	~		A	J		1	
0010	2	STX	DC2	FS	SYN					b	k	s		B	K	S	2	
0011	3	ETX	DC3							c	l	t		C	L	T	3	
0100	4	PF	RES	BYP	PN					d	m	u		D	M	U	4	
0101	5	HT	NL	LF	RS					e	n	v		E	N	V	5	
0110	6	LC	BS	ETB	UC					f	o	w		F	O	W	6	
0111	7	DEL	IL	ESC	EOT					g	p	x		G	P	X	7	
1000	8	GE	CAN							h	q	y		H	Q	Y	8	
1001	9	RLF	EM						`	i	r	z		I	R	Z	9	
1010	A	SMM	CC	SM		¢	!	¦	:								LVM	
1011	B	VT	CU1	CU2	CU3	.	$	,	#									
1100	C	FF	IFS		DC4	<	*	%	@									
1101	D	CR	IGS	ENQ	NAK	(	)	_	'									
1110	E	SO	IRS	ACK		+	;	>	=									
1111	F	SI	IUS	BEL	SUB	|	¬	?	"								EO	

Note 1: All blanks will be printed with an error symbol.

Note 2: Hex 0 represents bits 0, 1, 2, 3; Hex 1 represents bits 4, 5, 6, 7. Example: Hex D4 is the character "M".

Note 3: 1 = Mark   0 = Space
Example: Bits 7 through 0 of the bit permutation for the character M are 00101011, respectively.

NUL — NULL	
SOH — Start of Heading	
STX — Start of Text	
ETX — End of Text	
PF — Punch Off	
HT — Horizontal Tab	
LC — Lower Case	
DEL — Delete	
GE — Graphics Escape	
RLF — Reverse Line Feed	
SMM — Start of Manual Message	
VT — Vertical Tab	
FF — Form Feed	
CR — Carriage Return	
SO — Shift-Out	
SI — Shift-In	
DLE — Data Link Escape	
DC1 — Device Control 1	
DC2 — Device Control 2	

DC3 — Device Control 3
RES — Restore
NL — New Line
BS — Back Space
IL — Idle
CAN — Cancel
EM — End of Media
CC — Cursor Control
CU1 — Customer User 1
IFS — Interchange Field Separator
IGS — Interchange Group Separator
IRS — Interchange Record Separator
IUS — Interchange Unit Separator
DS — Digit Select
SOS — Start of Significance
FS — Field Separator
BYP — By Pass
LF — Line Feed
ETB — End of Transmission Block

ESC — Escape
SM — Set Mode
CU2 — Customer User 2
ENQ — Enquire
ACK — Acknowledge
BEL — Bell
SYN — Synchronous
PN — Punch On
RS — Reader Stop
UC — Upper Case
EOT — End of Transmission
CU3 — Customer User 3
DC4 — Device Control 4
NAK — Negative Acknowledge
SUB — Substitute
SP — Space
LVM — Long Vertical Mark
EO — Eight Ones

TABLE C

48-Character ASCII Code Set

BITS 4	3	2	1	7→	0	0	0	0	1	1	1	1
				6→	0	0	1	1	0	0	1	1
				5→	0	1	0	1	0	1	0	1
					0	1	2	3	4	5	6	7
0	0	0	0		NUL	DLE	SP	0	@	P	@	P
0	0	0	1		SOH	DC1		1	A	Q	A	Q
0	0	1	0		STX	DC2		2	B	R	B	R
0	0	1	1		ETX	DC3	#	3	C	S	C	S
0	1	0	0		EOT	DC4	$	4	D	T	D	T
0	1	0	1		ENQ	NAK	%	5	E	U	E	U
0	1	1	0		ACK	SYN	&	6	F	V	F	V
0	1	1	1		BEL	ETB		7	G	W	G	W
1	0	0	0		BS	CAN		8	H	X	H	X
1	0	0	1		HT	EM		9	I	Y	I	Y
1	0	1	0		NL	SUB	*		J	Z	J	Z
1	0	1	1		VT	ESC			K		K	
1	1	0	0		FF	FS	,	⊐	L		L	
1	1	0	1		CR	GS	-		M		M	
1	1	1	0		SO	RS	.		N		N	
1	1	1	1		SI	US	/		O		O	

Note 1:   All blanks will be printed with an error symbol.

Note 2:   1 = Mark   0 = Space
Example: Bits 1 through 7 of the bit permutation for the character M are 1011001, respectively.

NUL — Null	DLE — Data Link Escape
SOH — Start of Heading	DC1 — Device Control 1
STX — Start of Text	DC2 — Device Control 2
ETX — End of Text	DC3 — Device Control 3
EOT — End of Transmission	DC4 — Device Control 4
ENQ — Enquiry	NAK— Negative Acknowledge
ACK — Acknowledge	SYN — Synchronous
BEL — Bell	ETB — End of Transmission Block
BS — Back Space	CAN— Cancel
HT — Horizontal Tab	EM — End of Media
NL — New Line	SUB — Substitute
VT — Vertical Tab	ESC — Escape
FF — Form Feed	FS — Field Separator
CR — Carriage Return	GS — Group Separator
SO — Shift-Out	RS — Record Separator
SI — Shift-In	US — Unit Separator

TABLE D

48-Character EBCDIC Code Set

		00				01				10				11				← Bits 01
		00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	← Bits 23
Bits 4567	Hex 1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	← Hex 0
0000	0	NUL	DLE	DS		SP	&	-									0	
0001	1	SOH	DC1	SOS				/		A	J			A	J		1	
0010	2	STX	DC2	FS	SYN					B	K	S		B	K	S	2	
0011	3	ETX	DC3							C	L	T		C	L	T	3	
0100	4	PF	RES	BYP	PN					D	M	U		D	M	U	4	
0101	5	HT	NL	LF	RS					E	N	V		E	N	V	5	
0110	6	LC	BS	ETB	UC					F	O	W		F	O	W	6	
0111	7	DEL	IL	ESC	EOT					G	P	X		G	P	X	7	
1000	8	GE	CAN							H	Q	Y		H	Q	Y	8	
1001	9	RLF	EM							I	R	Z		I	R	Z	9	
1010	A	SMM	CC	SM													LVM	
1011	B	VT	CU1	CU2	CU3	.	$	,	#									
1100	C	FF	IFS		DC4	⋈	*	%	@									
1101	D	CR	IGS	ENQ	NAK													
1110	E	SO	IRS	ACK														
1111	F	SI	IUS	BEL	SUB												EO	

Note 1: All blanks will be printed with an error symbol.

Note 2: Hex 0 represents bits 0, 1, 2, 3; Hex 1 represents bits 4, 5, 6, 7. Example: Hex D4 is the character "M".

Note 3: 1 = Mark   0 = Space
Example: Bits 7 through 0 of the bit permutation for the character M are 00101011, respectively.

NUL	— NULL	DC3	— Device Control 3	ESC	— Escape
SOH	— Start of Heading	RES	— Restore	SM	— Set Mode
STX	— Start of Text	NL	— New Line	CU2	— Customer User 2
ETX	— End of Text	BS	— Back Space	ENQ	— Enquire
PF	— Punch Off	IL	— Idle	ACK	— Acknowledge
HT	— Horizontal Tab	CAN	— Cancel	BEL	— Bell
LC	— Lower Case	EM	— End of Media	SYN	— Synchronous
DEL	— Delete	CC	— Cursor Control	PN	— Punch On
GE	— Graphics Escape	CU1	— Customer User 1	RS	— Reader Stop
RLF	— Reverse Line Feed	IFS	— Interchange Field Separator	UC	— Upper Case
SMM	— Start of Manual Message	IGS	— Interchange Group Separator	EOT	— End of Transmission
VT	— Vertical Tab	IRS	— Interchange Record Separator	CU3	— Customer User 3
FF	— Form Feed	IUS	— Interchange Unit Separator	DC4	— Device Control 4
CR	— Carriage Return	DS	— Digit Select	NAK	— Negative Acknowledge
SO	— Shift-Out	SOS	— Start of Significance	SUB	— Substitute
SI	— Shift-In	FS	— Field Separator	SP	— Space
DLE	— Data Link Escape	BYP	— By Pass	LVM	— Long Vertical Mark
DC1	— Device Control 1	LF	— Line Feed	EO	— Eight Ones
DC2	— Device Control 2	ETB	— End of Transmission Block		