DMC

DMC 2 2 0 TERMINAL

OPERATION and MAINTENANCE MANUAL

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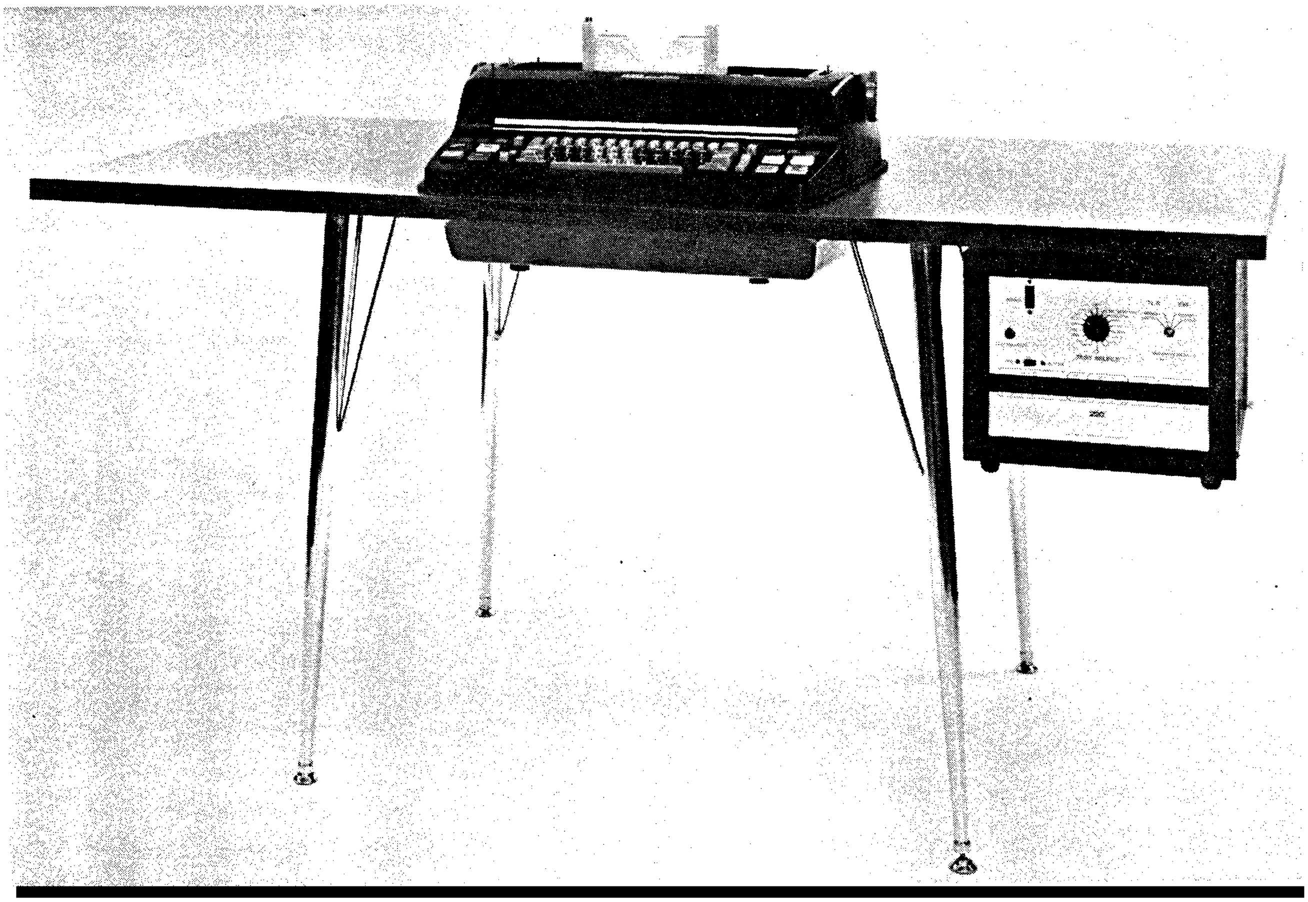


Figure 1-1. DMC 220 Terminal

SECTION I

DESCRIPTION

1-1 INTRODUCTION

This manual provides description, installation, operating, and maintenance information for the DMC 220 Terminal. The emphasis is on diagnostic information which will enable a service technician at a remote location to coordinate system fault diagnosis with an operator at the terminal. Section IV provides troubleshooting information and documents appropriate for further diagnosis at the terminal and for substitution-type repairs.

1-2 GENERAL DESCRIPTION

The DMC 220 Terminal, shown in Figure 1-1, is an input/output device designed to transmit input data and receive output data on hard copy from a Central Processing Unit (CPU) of an IBM System/360 over a communication facility. Output buffering allows the operator to type, verify, and then send data to the CPU. Message verification is performed at each end of the transaction.

The terminal utilizes a DMC 223 typewriter which is an IBM 1980 Model 9 or 12 Selectric as a keyboard-entry and hard-copy printer output mechanism. When the terminal is in the OFF-LINE mode, the unit may function as a standard typewriter.

The DMC 221 Controller provides all the control logic between the keyboard, printer, and communications line. An added feature of the controller is the Remote Service Feature (RSF) which allows non-technical operating personnel to aid service personnel located at the remote maintenance site in diagnosing and isolating system problems.

The controller and typewriter are typically desk mounted as shown in Figure 1-1, however, various desk and counter mount configurations may be encountered.

1-3 APPLICATIONS

The DMC Terminal is primarily used as an input/output device for handling transactions within the consumer-finance industry. The unit is designed for a wide variety of transactions. The operator enters the data on the typewriter on hard copy, makes corrections as necessary, and then transmits the data to the computer. The use of the buffer assures correct data entry and minimizes transmission time to the computer.

1-4 SPECIFICATIONS

Table 1-1 is a summary of specifications for the DMC 220 Terminal.

1-5 OPTIONS

Several options are available for the terminal as outlined below:

Split Platen

The split platen allows the insertion of two separate forms controlled individually.

Ledger Card Feed

Available in 6 inch width or 7-3/8 inch width card sizes.

Mounting

Table, or desk available from DMC. The terminal may be recess-mounted in a desk or counter top, or as a stand alone unit. DMC provides the customer a number of desk options, but the customer may purchase the desk from another source.

Interface

Telegraph line operating at 20 or 60 mA, 75 baud or EIA RS 232 135 baud.

Table 1-1. Specification Summary

PARAMETER	DESCRIPTION
Code:	BCD, odd parity
Speed:	75 or 135 baud, asynchronous
Data Format:	Full addressing and polling capability
Printer:	IBM 1980 Model 9 or 12 Selectric
Interface:	EIA RS-232B or Telegraph Line
Control Unit Weight:	24.5 lbs.
Control Unit Dimensions:	10" x 12" x 16"
Logic:	Transistor-transistor logic (TTL)
Memory:	Metal oxide semiconductor (MOS), 120 char.
Line Voltage:	115V, 60 Hz AC
221 Power Requirements:	100 Watts
1980 Power Requirements:	100 Watts
Service Features:	Remote Service Feature with Display
Display:	Light Emitting Diodes (LED)
Station Address:	Switch Selectable
Ribbon Cartridge	Snap-out ribbon changing
Impression Control	Adjusts striking force to print element
Horizontal Spacing	12 lines/156 characters/inch
Vertical Spacing	6 lines per inch

Memory

120 characters.

Speed

75 or 150 baud.

Distortion Analyzer

Available with telegraph line interface. The analyzer continuously monitors the transmission line for distortion; the LED is lighted when distortion exceeds 20%. The analyzer also allows setting the transmit relay distortion to within ±3%.

Loop Delay

A 5-character loop-back feature permits the testing of a half duplex 75 baud circuit from the central location.

1-6 FUNCTIONAL DESCRIPTION

A data flow chart for terminal operation on communication lines is given in Figure 1-2. Detailed, self-explanatory charts showing multiple-terminal line control operations, special BCD Code character generation, and line and buffer state transition charts are included in Section IV.

The terminal is operational only when the controller power switch is on. When the power switch is off the control unit cannot reply to signals from either the CPU or the typewriter. If the terminal is polled or addressed by the CPU, when the power switch is off, no response is sent from the terminal to the CPU. The CPU then times out and clears the line.

> NOTE
>
> The POWER switch should remain on at all times except during maintenance.

When the power switch is turned on, all electronic controls for the terminal are reset. With the ON-LINE/OFF-LINE switch in the OFF-LINE position, the terminal is in off-line status and the terminal typewriter can be used as a normal typewriter; the motor is on and the keyboard is unlocked. Any interrogation

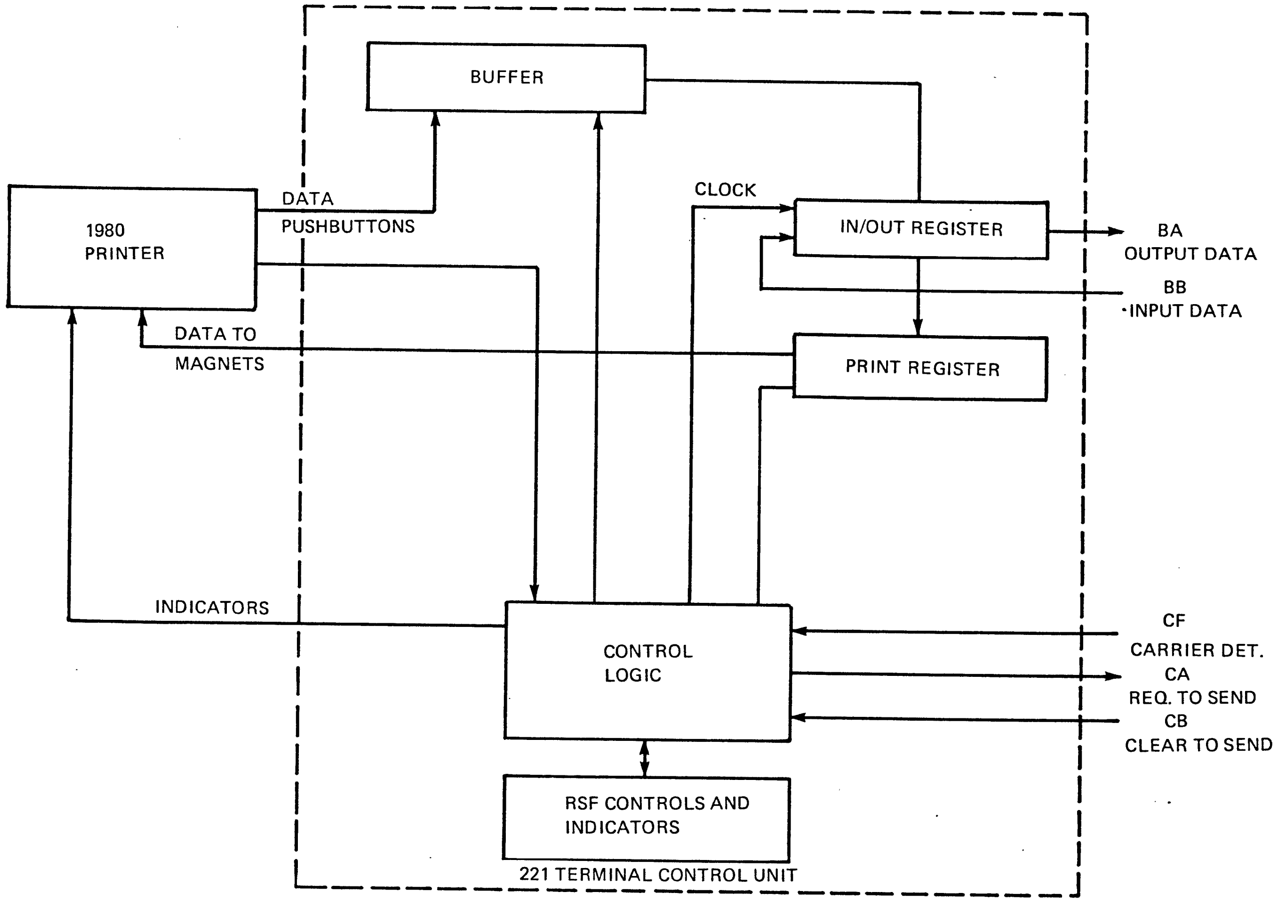


Figure 1-2. DMC 220 BLOCK DIAGRAM

by the CPU will result in a negative response. Characters the operator enters on the keyboard are printed by the typewriter. For test purposes, the operator can press the enter key and characters keyed in on the keyboard (up to 120 characters) are entered into the buffer of the control unit. If the operator presses the SEND key, the contents of the buffer are printed out on the typewriter. The content of the buffer is stored and may be outputted at will or cleared by pressing the CLEAR pushbutton. With the ON-LINE/OFF-LINE switch in the ON-LINE position, the terminal can process input and output messages. If no message activity is taking place the terminal is in the READY mode. If the CPU polls a terminal that is in ready mode, the terminal returns a negative response to the CPU to indicate there is no input message to be transmitted.

An input message for the CPU is first entered into the terminal buffer and then transmitted as a complete message to the CPU. Proper character validity checking is performed at the CPU. Output messages from the CPU are addressed to a specific terminal. Necessary controls are exercised prior to and during receipt of a message by the specified terminal.

Data transmission over the communications line is in half-duplex mode. Data is transmitted serially by character and serially by bit.

Each character is represented by a seven-bit code, six data bits, plus an odd parity bit. To provide synchronization between the sending and receiving units, each character is preceded by a start bit and followed by a stop bit. Thus, each character requires nine bits transmitted serially.

Because the typewriter prints the characters as they are received and has a maximum printing rate of 15.5 characters per second (cps), the maximum bit rate for receiving an output message must not exceed 139.5 (15.5 x 9) bits per second (bps). 134.5 bps is standard. A line with the ability to operate at this speed or more is adequate for use with the terminal. The bit rate for transmitting an input message from the buffer is the same as the receiving speed. Input character speed to the buffer is determined by the keying speed of the operator and varies downward from the 15.5 cps.

The RSF contains a 20 bit display which provides a means of checking terminal functions for isolation of system faults. The buffer and line control states, the communication lines BA, BB, CA, CF, data going in or out of the buffer or line characters, and the 1980 strobe and feedback lines are displayed on the front panel.

The TEST SELECT switch is used to test each magnet in the typewriter. When in the LINE DATA HOLD position, the last generated character is displayed.

The MODEM SELECT switch is used to isolate the terminal from the communications line during system fault isolation.

SECTION II

INSTALLATION

2-1 GENERAL

This section provides the specific unpacking, and installation for the DMC 220 Terminal. Figures 2-1 and 2-2 show the dimensions of the typewriter and controller for those installations which may not use the DMC desk or table.

> CAUTION
>
> Do not attempt to check out the DMC 220 until installation is complete and all interconnections are verified.

2-2 UNPACKING

Before unpacking any equipment, inspect all shipping containers for evidence of damage. Open containers in accordance with instructions on the container, if any. Check the contents against the packing list and inspect for damage. Report any damage that may have occurred in transit according to instructions in the shipping documents.

Normally the DMC 220 is shipped in 3 separate containers; DMC 221 Controller, DMC 223 Typewriter, and the table assembly (optional). Unpacking instructions are supplied in the DMC 223 typewriter carton. Refer to these instructions for unpacking. The 221 controller is generally shipped in a separate container. For ease of installation, the electronics cards are shipped in their respective card slots. The table assembly (optional) contains the table top and four table legs. Two cable cleats used for dressing up the interconnect cables and mounting hardware for securing the controller to the table bottom are included in the carton with the table.

2-3 ELECTRICAL CONNECTIONS

Figure 2-3 shows the electrical connections using the appropriate cables supplied. The data terminal requires access to a 115 VAC power source, with accommodations for 2 power cords: One for the DMC 221 and one for the DMC 223. If a data set is used, a third receptacle is necessary. The service supplied should be a separate 15A, 3 wire clean source with no other equipment or wiring on it (if not complied with, data checks or power on resets will result).

2-4 MECHANICAL INSTALLATION

a. To ease mounting of the 221 Controller to the table assembly, it is recommended that the table assembly be left upside down on the floor. Open the controller and secure with the four 1/4 x 20 machine screws. (Don't forget to space the 221 from the table bottom using the rubber standoffs supplied.)

b. With the 221 secured to the table bottom, mount the four table legs using the enclosed screws (one per leg). After this is accomplished, turn the table to its upright position.

c. With the table in the upright position, drop the interconnect and power cables (DMC 223) through the well and insert the printer.

d. If a data set is to be mounted to the bottom of the table, do it at this time.

e. Interconnection of the DMC 220 involves two cables, the printer and the line interface. In order to install the printer cable, remove the two thumb screws at the rear of the Controller, keeping in mind that the controller will pivot around the front two screws. Slowly lower it to obtain access to the printer connector. Mate the connectors and secure with thumb screws inside the enclosure. Refer to Figure 4-1, in

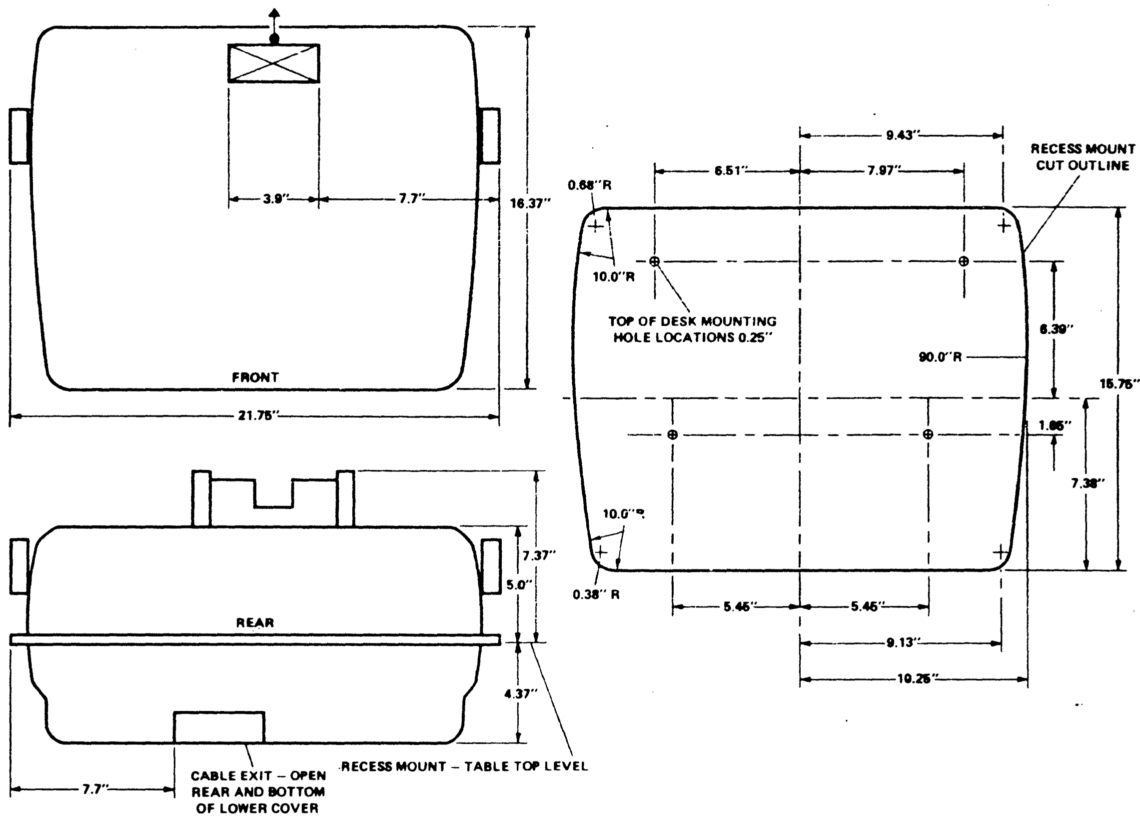


Figure 2-1. Dimensional Drawing of the DMC 223 (IBM 1980, Model 9).

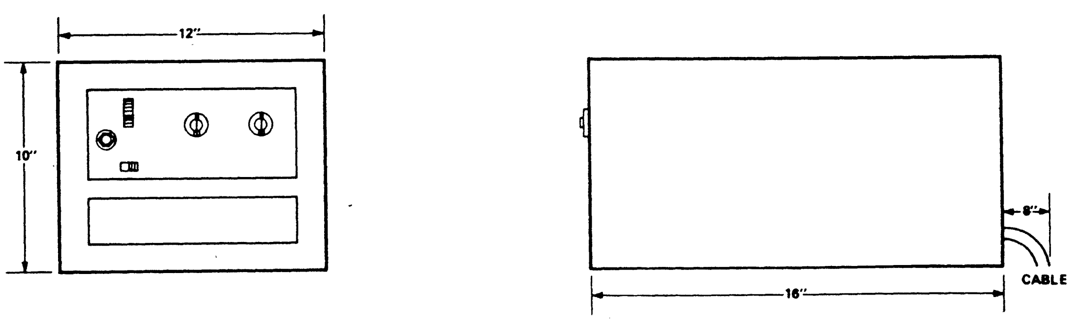
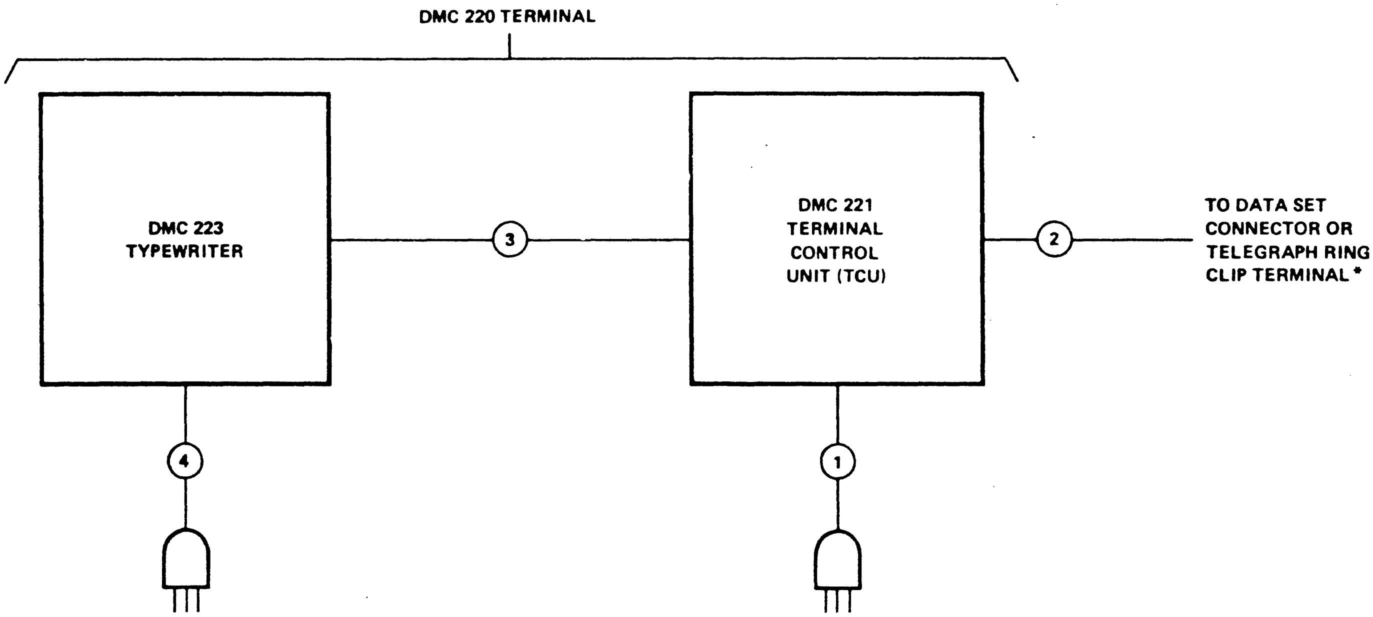


Figure 2-2. Dimensional Drawing of the DMC 221 Terminal Control Unit.



Cable Number	Length Supplied	Cable Diameter	Bending Radius (inches)	Function
1	7.5	0.375	2.0	Power
2	8.0	0.312		Signed
3	10.0	0.750	5.0	Signed
4	8.0	0.375	2.0	Power

*Telegraph ring clip terminal is optional

Figure 2-3. Intercabling Diagram for the DMC 220 Terminal.

the maintenance section. Once this is accomplished, leave the controller in the open, or access position.

f. Connect the line interface cable at this time.

2-5 ADDRESS

Obtain the terminal's address (identification code) from Line Control. This is done by contacting the company supplying the computer service; i.e., ITT, DIAL, BENEFICIAL, etc.

> NOTE
>
> Any information in this area can be obtained by contacting DATA MEASUREMENTS CORPORATION.

Remove the Register Control P.C. card (220-0250-0x). Refer to Figure 4-1 in the Maintenance Section for location. Set the terminal address using the seven toggle switches, which are arranged as follows:

B A 8 4 2 1 Ck

The switch is set for a one bit if the switch arm is away from the card, and a zero if toward the card. When the appropriate address is set, the card should be replaced insuring at this time that all cards are secure in their slots.

At this time, return the enclosure to its upright position, and replace the two thumb screws.

2-6 FINAL INSTALLATION NOTES

If the communication line has been verified and the interconnect cables are properly installed and dressed with cable cleats , the terminal should be ready for operation. Before releasing the equipment for operation, perform the off-line diagnostic test (paragraph 3-8) and the on-line diagnostic test (paragraph 3-9) to verify correct performance.

NOTE

1. If terminal is to be set as a group master, refer to the strap location on board No. 220-0250-0x illustrated in Section IV.
2. The DMC 223 has tab stops set at the factory. Insure the stops are in the correct position for the particular installation. If not, reset them accordingly.
3. The platen knobs on the typewriter require a Bristol wrench. These wrenches are used quite commonly on the Selectric typewriter and should be available for platen adjustments.

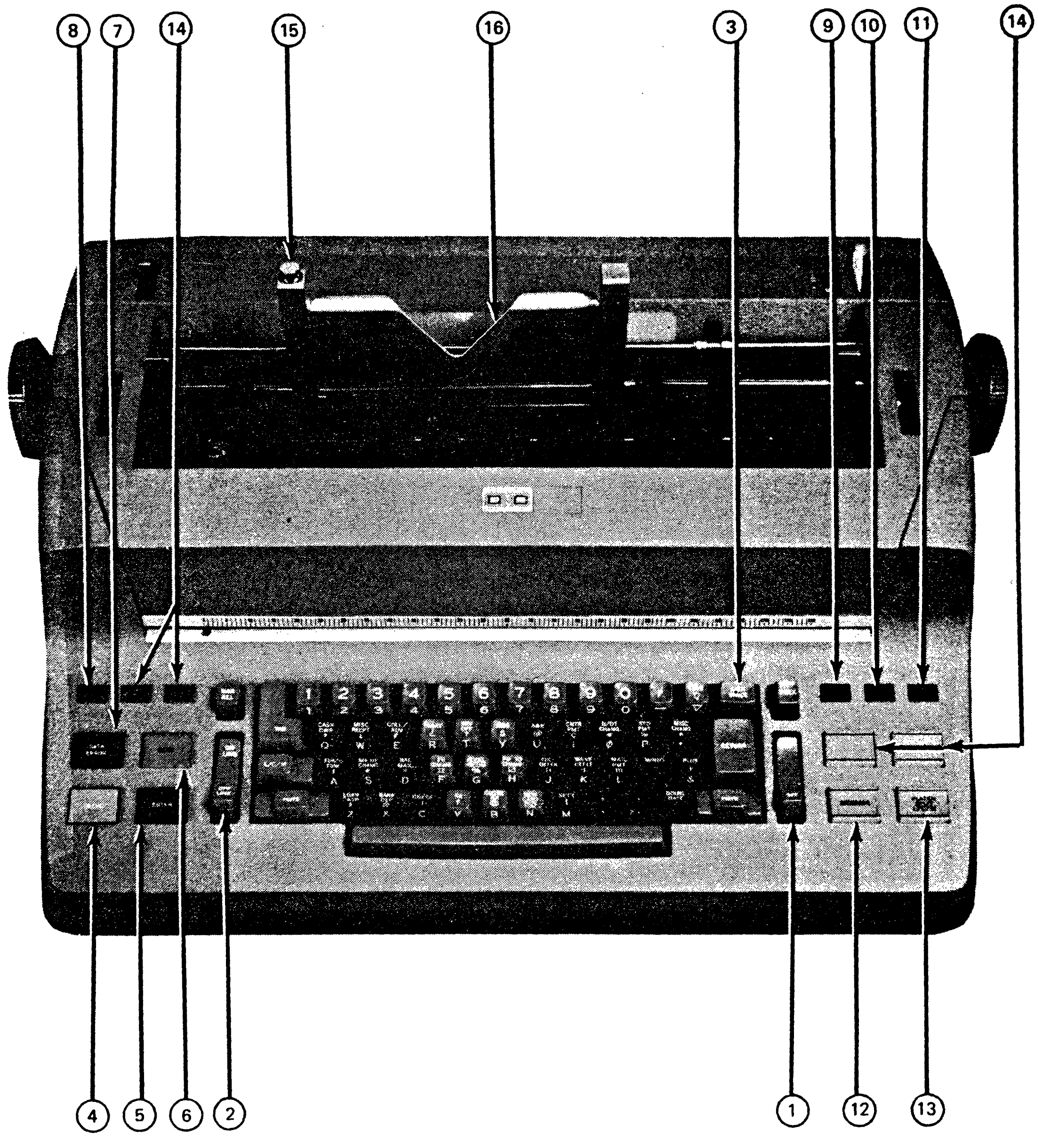


Figure 3-1. DMC 223 Typewriter Controls and Indicators

Table 3-1. Typewriter Controls and Indicators

FUNCTION	DESCRIPTION
1. ON/OFF	Controls AC power. Operation requires that controller POWER is also ON.
2. ON-LINE/ OFF-LINE	In OFF-LINE terminal may be used as a typewriter. MESSAGE light and alarm bell indicates CPU data ready for operator switch to ON-LINE. In ON-LINE the terminal is in communication status and can process input and output messages.
3. BACKSPACE	Print element moves left one space each time key is pressed. If terminal is in ENTER, buffer also moves left allowing corrections.
4. CLEAR	Returns terminal to READY and buffer to first position. Active only in ENTER or SEND if transmission not under way. (Errors such as tab, return, and index require that message be re-entered by pressing CLEAR to return buffer to first position.
5. ENTER Key/Light	Active only when terminal is READY. Messages up to 120 characters are printed and entered in the buffer. At character number 113 the alarm sounds indicating buffer capacity near limit. Keyboard locks at character number 119.
6. SEND Key/Light	Message stored in buffer is transmitted to CPU only if the terminal is in ENTER, ENTER light goes out, TRANSMIT light goes on. If the terminal is not in the SEND mode when polled, the SEND light indicates a negative reply by blinking.
7. DATA ERROR Key/Light	The DATA ERROR light indicates an error has been detected in a CPU input or output message or a parity error during buffer OFF-LINE print. Operator must reset DATA ERROR light by pressing DATA ERROR key before proceeding with the appropriate correction.
8. OFF-LINE Light	Lights when terminal is switched to OFF-LINE.
9. READY Light	Indicates ON-LINE status and that no error condition exists or that no message is being transmitted or received.
10. TRANSMIT Light	Flashing indicates transmission of the buffer contents to the CPU.
11. RECEIVE Light	Flashes whenever the terminal is receiving a polling or addressing sequence and/or a message directed to the terminal.
12. MESSAGE Light	Comes on whenever CPU has a message for the Terminal. Conditions for receiving the message are outlined in Paragraph 3-7.
13. PLATEN SPLIT Light L/C/M	Light comes on when platen is mechanically split indicating operations for the loans, checks, and messages (L/C/M) mode.
14. Blank Keys and Lights	Spare functions
15. Ledger Feed Release	Button must be pushed to release ledger feed device during card insertion and alignment.
16. Ledger Card Feed	Shown in place for card insertion and alignment. Moves back for message activity.

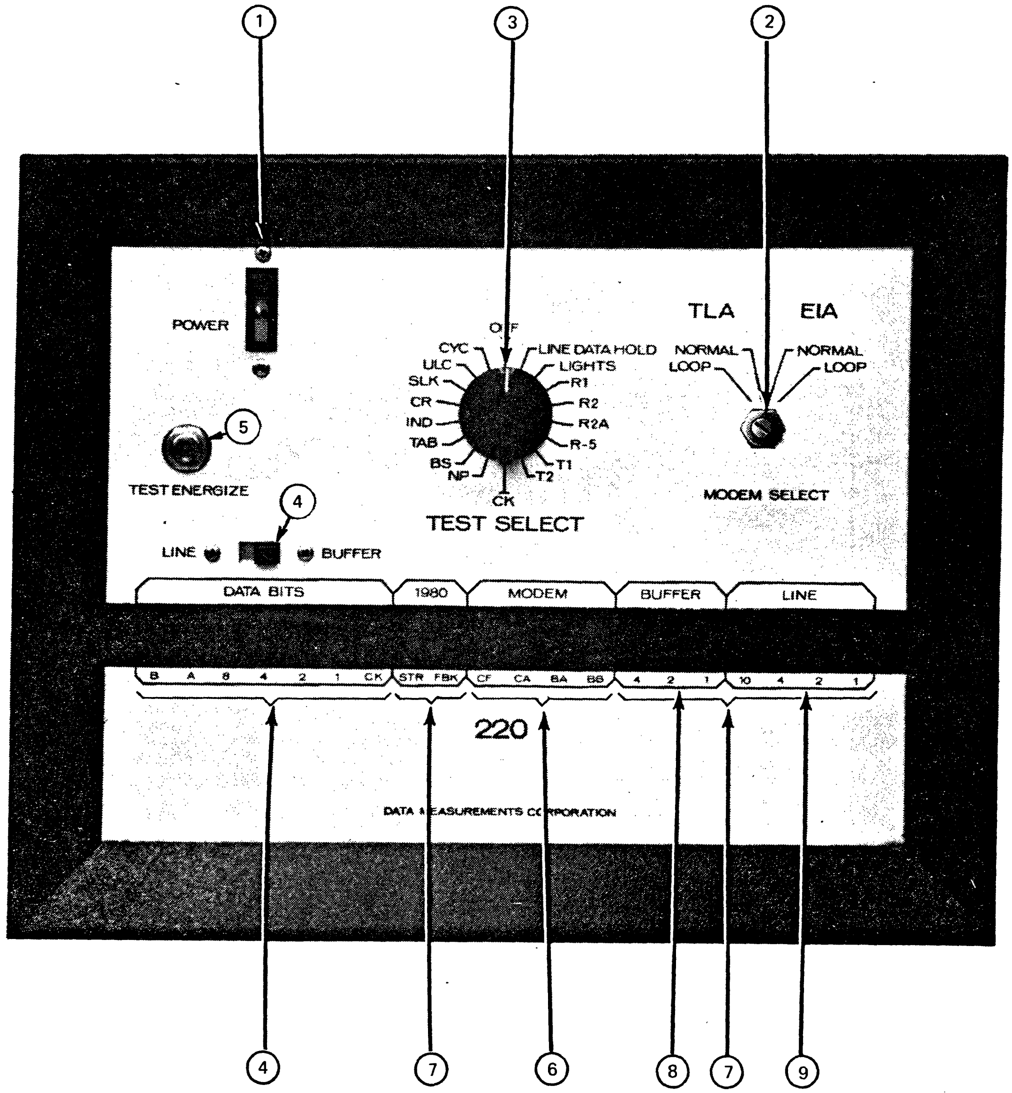


Figure 3-2. DMC 221 Controller Functions.

Table 3-2. DMC 221 Controller Functions

FUNCTION	DESCRIPTION
1. POWER	Main power switch: enables the terminal for on-line or off-line operation.
2. MODEM SELECT	Selects the line interface type and provides a loop which isolates the terminal from the communication line for terminal/line tests.
3. TEST SELECT	Normally OFF. The 18 positions allow off-line tests of the indicator lamps, typewriter magnets and functions. In the DATA HOLD position, the last character from line or buffer will be displayed for evaluation.

Table 3-2. DMC 221 Controller Functions (Continued)

FUNCTION	DESCRIPTION
4. LINE/BUFFER DATA BITS	Selects data going into or out of the buffer or the communications line for display by DATA BITS indicators.
5. TEST ENERGIZE	Enables any test chosen by the TEST SELECT switch.
6. MODEM	In normal operation, CF, is on when the carrier is present. CA lights on a SEND request. BA is transmitted data and lights with a logic 1 on the line; BB is received data and lights with a logic 1.
7. 1980	Two indicators monitor the data strobe (STR) and the feedback (FBK) of the IBM 1980 typewriter.
8. BUFFER	Monitors the 8 buffer states. Refer to the Buffer State chart in Section IV.
9. LINE	Monitors the 16 line states. Refer to the Line State Chart in Section IV.

ERROR key must be reset and the message re-transmitted in the SEND mode or the message itself may be checked for errors and re-entered.

b. If the controller detects a parity error in a message from the computer the terminal sends a negative reply and prints a ϟ character or underscore _. The terminal returns to the READY mode when DATA ERROR is reset.

c. If the Controller unit detects an invalid character entered from the typewriter, the operator can reset the DATA ERROR, backspace one position, and re-enter the character.

d. If the Controller detects a parity error during off-line buffer print the typewriter will print a ϟ character or underscore _ in place of the invalid character.

e. The operator can visually check the printed message for keying errors before pressing the SEND key. A keyed error can be corrected by backspacing through the error character and re-entering the message starting with the corrected character. The buffer location backspaces synchronously when the backspace key is pressed. The backspace character is not stored in the buffer.

3-7 RECEIVING DATA

The DMC 220 Terminal will not accept a message from the computer if:

a. The operator is entering a message (ENTER mode).

b. The terminal is waiting to transmit from its buffer (SEND mode).

c. Paper is not in the typewriter.

d. Typewriter power is off or the typewriter is being used as a normal typewriter (OFF-LINE status).

When any of the above conditions exist, and the computer wishes to send the Terminal a message, the MESSAGE light will light and the alarm bell will sound. Depending on the condition, take the following action:

a. If entering a message, first press the CLEAR pushbutton and then place the terminal in an ON-LINE status as soon as possible (set OFF-LINE/ON-LINE switch to ON-LINE).

b. If the terminal is waiting to transmit a message, the problem is self correcting.

c. If paper is not in the typewriter, the operator must place paper in typewriter, or make sure override is activated.

d. If typewriter power is off, set to ON; or if typewriter is in OFF-LINE status, set to ON-LINE.

3-8 OFF-LINE DIAGNOSTIC TEST

A quick check of terminal performance as an initial operational check or when system trouble is suspected may be made by buffer data entry and retrieval. This off-line test should always precede on-line tests.

Test	Response
1. ON-LINE/OFF-LINE switch to OFF-LINE	Listen for motor
2. Type several characters and use the functions such as tab, space, and backspace.	As typed
3. Push CLEAR, then ENTER	ENTER light comes on
4. Enter complete character set (first in upper then in lower case) and operations with carriage return last.	As typed
5. Push SEND	ENTER light goes out. The character set complete with all operations should print out exactly as entered each time the SEND key is depressed. ENTER comes back on when character set is retrieved.
6. Push CLEAR, then ENTER. Type several characters in lower case then simultaneously hit carriage return and plus (+).	This will force an error. DATA ERROR light comes on and bell rings. Keyboard locks.
7. Depress DATA ERROR (Data Check)	Keyboard unlocks
8. Enter a few more characters, then depress SEND.	The characters entered should print out as before but a lightning bolt ϟ will appear in the error position and the DATA ERROR alarm comes on. This is normal and indicates a correction would be necessary.

Any malfunction in this test indicates terminal problems which must be evaluated by technical personnel at the central site. If the data from the buffer is verified for character and function and an apparent malfunction still exists, the on-line ZDIAG tests of paragraph 3-9 will aid in further isolating the problem.

3-9 ON-LINE DIAGNOSTIC TEST

All installations will have an on-line diagnostic test similar to if not the same as the ZDIAG outlined here. The particular installation will be provided with the exact diagnostic procedures which would be used in place of the reference procedure outlined below.

Be alert for failure patterns. A terminal which responds properly to ZDIAG 05-08 but fails 09 will indicate a specific type of problem. Improper responses in all tests might indicate a line problem.

The ZDIAG test must be entered one at a time in the following format except for ZDIAG 05 which is shown separately.

1. CLEAR
2. ENTER
3. L/C/M
4. ZDIAG
5. SPACE once
6. OX (X = diagnostic test number 4 through 9)
7. SEND

If the format is wrong or the message entered incorrectly one of the responses below will be received and the message must be repeated.

1. THIS TERM NOT CRAS
2. DIAG-MESSAGE INVALID
3. DIAG-TERMINAL NOT CRAS

If the message was sent correctly and there are no system faults the responses to ZDIAG 04-09 will appear as shown.

ZDIAG 04
Terminal/Branch Identification

```
TERM IQT IS ADB,BR ØFF IS 590
```

ZDIAG 06
Roll Test

```
RØLL TEST
‡1Θ/⊥3m?≠5⊠f%7SP⊗⧄8↑Δ*0+ϟ©2d#=4!@□6⧻↓c9¿$.+-,
+.,-9c$¿6□↓⧻4=@!2©#d0*ϟ+8⧄Δ↑7%⊗SP5≠f⊠3⊥m?1‡/Θ
```

ZDIAG 07
Rock Test

```
RØCK TEST
*‡.⊥c≠□%=⧄©+Θ-m¿⊠⧻SP!↑dϟ/,?$f↓⊗@Δ#01+39567482
+1936547280,/$?↓f@⊗#Δϟ-Θ¿m⧻⊠!SPd↑+.‡c⊥□≠=%©⧄*
```

ZDIAG 08
Twist Test

```
TWIST TEST
A+J, -9.2cT¿L$C9E6N↓V⧻0□8=X!P@G4H2Q#Yd6©,*/∇7ϟ50
*1-/4Θ1‡&⊥ZmR?13F5ØfW⊠3≠.%USPM⊗D7B8KΔS↑∇⧄,*/∇7ϟ50
```

ZDIAG 09
Selectric Analyzer

```
SELECTRIC ANALYZER
123456C890 SPACE&BKSP
      C
LF
  1
   2
    3
```

ZDIAG 05
Return Wrap Test

Use the following format:

1. CLEAR
2. ENTER
3. L/C/M
4. ZDIAG
5. SPACE one
6. 05
7. SPACE once
8. Type any message up to 120 characters such as EVERY GOOD BOY DESERVES FAVOR. # ? - = 1234567890? . . .
9. SEND
10. The response should be an exact replica of the message typed in step 8.

Any failures indicates further evaluation and troubleshooting with the precedures of Section IV will be necessary.

SECTION III

OPERATION AND CHECKOUT

3-1 GENERAL

This section provides information and instructions for using the terminal in off-line modes at the operator level and on-line and off-line diagnostic procedures which provide a quick check of system performance when persistent errors suggest the possibility of a system fault.

3-2 DMC 223 TYPEWRITER-CONTROLS AND INDICATORS

Figure 3-1 shows the location of the typewriter controls and Table 3-1 gives a brief functional description.

3-3 DMC 221 CONTROLLER-CONTROLS AND INDICATORS

Figure 3-2 and accompanying Table 3-2 provide the location and a brief functional description of the Controller. Aside from the POWER switch, the primary use of the Controller is for fault isolation. Details of the troubleshooting mode are found in Section IV.

3-4 NORMAL TYPING MODE

In the OFF-LINE mode the DMC 223 may be used as a standard typewriter. All keys and controls function normally. Although no messages can be received in this mode, the MESSAGE light and the alarm bell will sound if the computer has a message for the terminal. As soon as possible after the MESSAGE signal, the operator should switch to ON-LINE.

The controls for normal typing are as follows:

a. Main POWER switch on DMC 221 Controller ON.

b. Typewriter ON/OFF to ON.

c. ON-LINE/OFF-LINE to OFF-LINE.

3-5 DATA ENTRY

On-line data entry is accomplished as follows:

a. Turn on DMC 221 Controller main POWER and typewriter ON.

b. ON-LINE/OFF-LINE switch to ON-LINE.

c. Depress the ENTER key which unlocks the keyboard, starts motor, and lights ENTER key.

d. Type the message, 120 characters of which will be stored in the buffer.

e. When the buffer is full or the message has been completed, push the SEND key. Next time the terminal is polled, the message will be transmitted to the CPU. The CPU will then start the printer motor and output the appropriate response.

> NOTE
>
> It is possible to go to the ENTER mode from the SEND mode when on-line by striking the CLEAR key.

3-6 ERROR CONDITIONS

Error detection occurs in the transmit, receive, and entry modes. In each case, the DATA ERROR light comes on and the alarm sounds. The operator must acknowledge the error condition by striking the DATA ERROR key for reset, and take the appropriate corrective steps.

a. The CPU twice detects an error from the terminal and twice sends a negative reply before the error alarm comes on. At this point, the DATA

SECTION IV

MAINTENANCE AND TROUBLESHOOTING

4-1 GENERAL

Through the use of the RSF, the remote diagnostic procedures of Section III are extended to enable coordination between the operator and remote service personnel to identify problem areas in printer, controller, and line more explicitly before a service call is deemed necessary.

Once remote diagnosis has shown the necessity for a service call, the RSF in combination with the troubleshooting charts and the reference documents included at the end of this section will enable the service technician to make repairs by substitution at the PC board level. Consult the IBM Selectric I/O Keyboard Printer Field Engineering Manual if problems within the 1980/223 unit are indicated.

> NOTE
>
> Care should be taken to insure any replacement P.C. Boards that might be installed are configured to operate in same mode as the cards removed, i.e. group address, master/slave, baud rate, and TLA options.

4-2 RSF TEST MODES

The RSF test modes are described below for reference. An understanding of these test modes will enable the technician to identify problem areas and with the use of the troubleshooting charts repair the terminal by component substitution.

a. CF, CA, BA, BB Indicators

These lights monitor the state of the modem. CF is carrier detected, and the light is on when carrier is present. CA is request to send; BA is transmitted data and the light is on when the data bit is a logic 1; BB is receive data and the light is on when the receive data bit is a logic 1. When the terminal is operating normally, BA, BB, and CA are flashing, and CF is on all the time. In the TLA mode, the CF indicator is used to indicate distortion (if distortion analyzer option installed) greater than ±20%.

b. LINE/BUFFER and LINE DATA HOLD Switches

The LINE/BUFFER switch is used to display either the data going into or out of the 220's buffer or the data on the communication line. With the switch on the LINE position, the data bit portion of the display will show the characters on the line. To capture a character for study, put the TEST SELECT switch in the LINE DATA HOLD position. The LINE/BUFFER switch in the BUFFER position enables the observer to see what is going into or out of the 220's buffer. This is useful in determining whether or not the 1980 is electrically functional. Any character typed will be shown in the display. The bits can be checked, and the typewriter operations verified. For instance, the character A is BA1. Refer to the 1980 keyboard code, Figure 4-6 in the Reference Documents section, for any of the other characters under consideration.

c. BUFFER/LINE Indicators

These seven indicators are divided into two groups of three and four lights. The group of four labeled LINE represent the state of the line control system. The next three represent the state of the buffer. There are 16 line control states and 8 buffer states. These indicators are especially useful in finding problems in the 220. It generally takes a control character to go from one on-line control state to the next. If the character is correct, which can be verified by using the LINE DATA HOLD feature, and the system does not change state, then a failure in the 220 is indicated. Refer to Paragraph 4-4 for the relationship between controls and the line/buffer transition state as indicated in the display.

d. 1980 FBK and STR Indicators

These two indicators monitor the data strobe (STR) and the feedback (FBK) from the 1980. STR is the signal that clocks data from the 1980 into the buffer. FBK is the signal that clears the magnets after a character has been printed. If STR is not present, data will not be entered into the buffer.

e. TEST SELECT/TEST ENERGIZE Switches

The TEST SELECT switch should be OFF for normal operation. The 18 test positions are not operable until the TEST ENERGIZE switch is depressed. If R1 is selected, for example, and the TEST ENERGIZE switch is depressed, 48V is applied to the R1 magnet and a series of "1" is typed in upper case and "C" is typed in lower case. When running the 1980 test, all the test positions except LINE DATA HOLD and LIGHTS should be tested for a complete diagnosis.

The following list shows the desired results of pressing the TEST ENERGIZE pushbutton in each TEST SELECT switch position:

LINE DATA HOLD: The last complete character received will be held in the display.

LIGHTS: All indicators are illuminated.

R1: Lower Case c is printed.

R2: ⌑ is printed.

R2A: ⌑ is printed.

R5: s_p is printed

T1: - is printed

T2: , is printed.

CK: . is printed.

NP: Space is printed

BS: Causes carrier to backspace until TEST ENERGIZE switch is released.

TAB: Causes carrier to tab to next stop.

IND: Causes platen to index to the next line.

CR: Causes an index and a return of the carrier to the left margin stop.

SLK: Causes a lower case shift if in upper case due to "PMTS" Key (Shift latch) having been depressed.

ULC: Causes ball to twist between upper and lower case.

CYC: Causes cycle clutch to engage - enables lower feedrollers.

f. MODEM SELECT Switch

There are four positions on this switch:

EIA NORMAL

EIA LOOP

TLA NORMAL

TLA LOOP

In the NORMAL mode, with either EIA or TLA, BA and BB and the rest of the control lines run from 220 to the modem used. In the LOOP mode, BA is looped back to BB. The other necessary control lines are provided to make the modems function.

Note that tests using the MODEM SELECT switch require someone to be present at both ends of the line.

The loop positions provide a way to remotely test the modems. In most installations, the communications company will provide a loop-back switch on the analog side of the modem, especially if the service is four-wire, full duplex. The communications line is tested initially with the analog switch in the loop position. Measurements of distortion and attenuation can be made and compared to the line specifications. If the line is operating properly, then the analog switch should be put in the normal position, and the Modem Select Switch put in the appropriate loop mode.

The distortion and attenuation tests should be run again. If the communication network is a telegraph circuit, the loop test is more difficult unless the five character loop-back option is available. This feature allows the central site to send and receive any five character group. In this fashion, the circuit can be tested. Unfortunately, it is very difficult to get meaningful distortion characteristics from this test, as the data being transmitted can only be guaranteed as it is leaving the central site. If the data received is the same as the data sent, then the circuit is probably good.

> **NOTE**
>
> Bit time and symmetry are extremely important and violations can be readily detected by means of a dot pattern and oscilloscope.

4-3 TLA FIELD ADJUSTMENT

a. Receive Adjustment for Type 1 TLA, with Opto-electronic Coupler

The TLA is normally supplied for operation on 60 mA circuits. For operation on 20 mA circuits, a 51 ohm resistor must be added in series with the RECEIVE ADJUST potentiometer. For convenience, this resistor is factory-installed over a shorting trace. To insert this resistor, simply open the shorting trace. For adjustment, proceed as follows:

1. Turn RECEIVE ADJUST potentiometer counter-clockwise until BB indicator is extinguished.
2. Carefully turn RECEIVE ADJUST potentiometer clockwise until BB indicator begins to flash.
3. Continue to turn RECEIVE ADJUST potentiometer clockwise 1/2 turn beyond threshold flashing point.

b. Receive Bias Adjustment for Type 2 TLA, with Receive Relay

The TLA is supplied with a receive relay having a bias winding which either aids or opposes the main solenoid field. The bias winding connections are reversed for 60 mA and 20 mA circuits. Several types of bias winding connections may be encountered: (1) switch connection, (2) replaceable jumpers, or (3) hard-wired jumpers.

The TLA is normally factory-connected for correct operation, but a field change between 60 mA and 20 mA circuits will require reversal of the bias winding connections. For 60 mA circuits, both "A" terminal pairs are connected with both "B" terminal pairs open. For 20 mA circuits, both "B" terminal pairs are connected with both "A" terminal pairs open. For adjustment, proceed as follows:

1. Verify that terminal pairs "A" and "B" are properly strapped, as described above.
2. If distortion analyzer is available, use CF indicator in NORMAL position; adjust RECEIVE BIAS potentiometer for minimum distortion point as indicated by having the CF indicator constantly on.
3. If distortion analyzer is not available, set RECEIVE BIAS potentiometer for most reliable operation by adjusting to the extremes of normal operation, then setting the potentiometer to the midpoint of normal operation between the two extremes.

c. Transmit Distortion Adjustment

The transmit adjustment procedure is the same regardless of the type of receive-side device used. If adjustment is required and no distortion analyzer is available, proceed as follows:

1. Set TRANSMIT DISTORTION potentiometer to mid-position by turning full clockwise against the end stop, then turning counter-clockwise 7-1/2 turns.
2. Load buffer and transmit data.
3. Verify that data was received properly.

If using a distortion analyzer, proceed as follows:

1. Load buffer with V's.
2. Set CALIBRATE/NORMAL switch to CALIBRATE.
3. Depress SEND key and wait for poll.
4. Observe CF indicator during transmission of V's. If CF indicator is on and not flashing during transmission, distortion is less than 3% and no adjustment need be made.

> **NOTE**
>
> If CF indicator is on and a distortion condition is nevertheless suspected, a check of line distortion should be made.

5. If the CF indicator flashes during transmission, repeat steps 1 through 4 above. Set the TRANSMIT DISTORTION potentiometer so that the CF indicator remains on without flashing during transmission.

4-4 TROUBLESHOOTING CHARTS

The purpose of the troubleshooting charts is to bring the terminal back to operating status by suggesting substitution of specific PC boards in response to certain diagnoses. The diagnosis may also suggest investigation of possible line problems for which the use of RSF test functions may be indicated.

The PC board layout of the controller is shown in Figure 4-1. In the charts the board part number is abbreviated. For example, board 2200-0230-00 will be abbreviated to 0230.

Figure 4-2 covers off-line troubleshooting procedures and Figure 4-3 covers on-line procedures.

> **WARNING**
>
> 1. Failure to turn controller power off before pulling or inserting PC boards may damage the boards.
>
> 2. If power must be on during some troubleshooting operations, care must be taken to avoid shorting out contacts and damaging boards in the printer I/O mechanism.

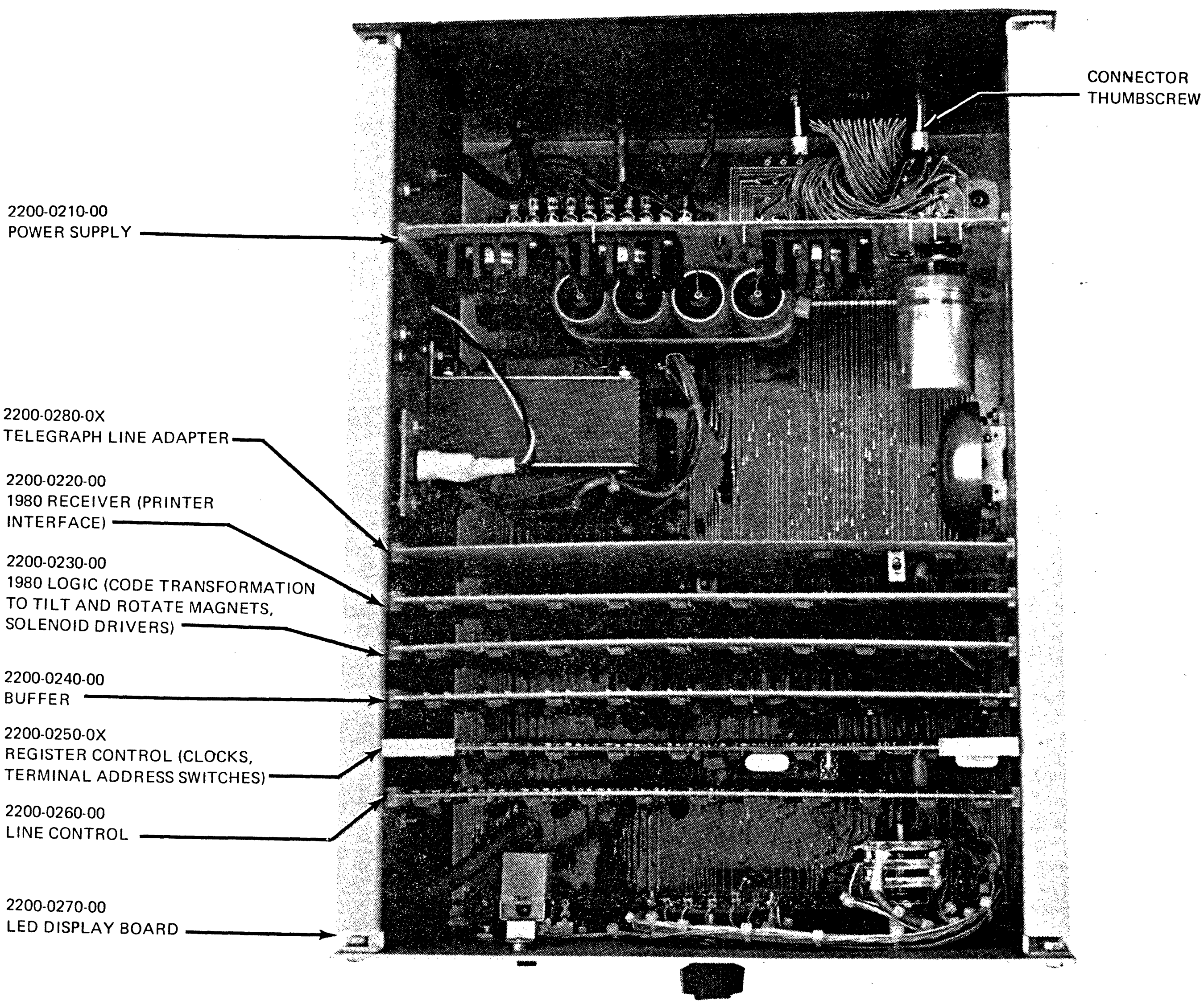


Figure 4-1. Controller PC Board Layout

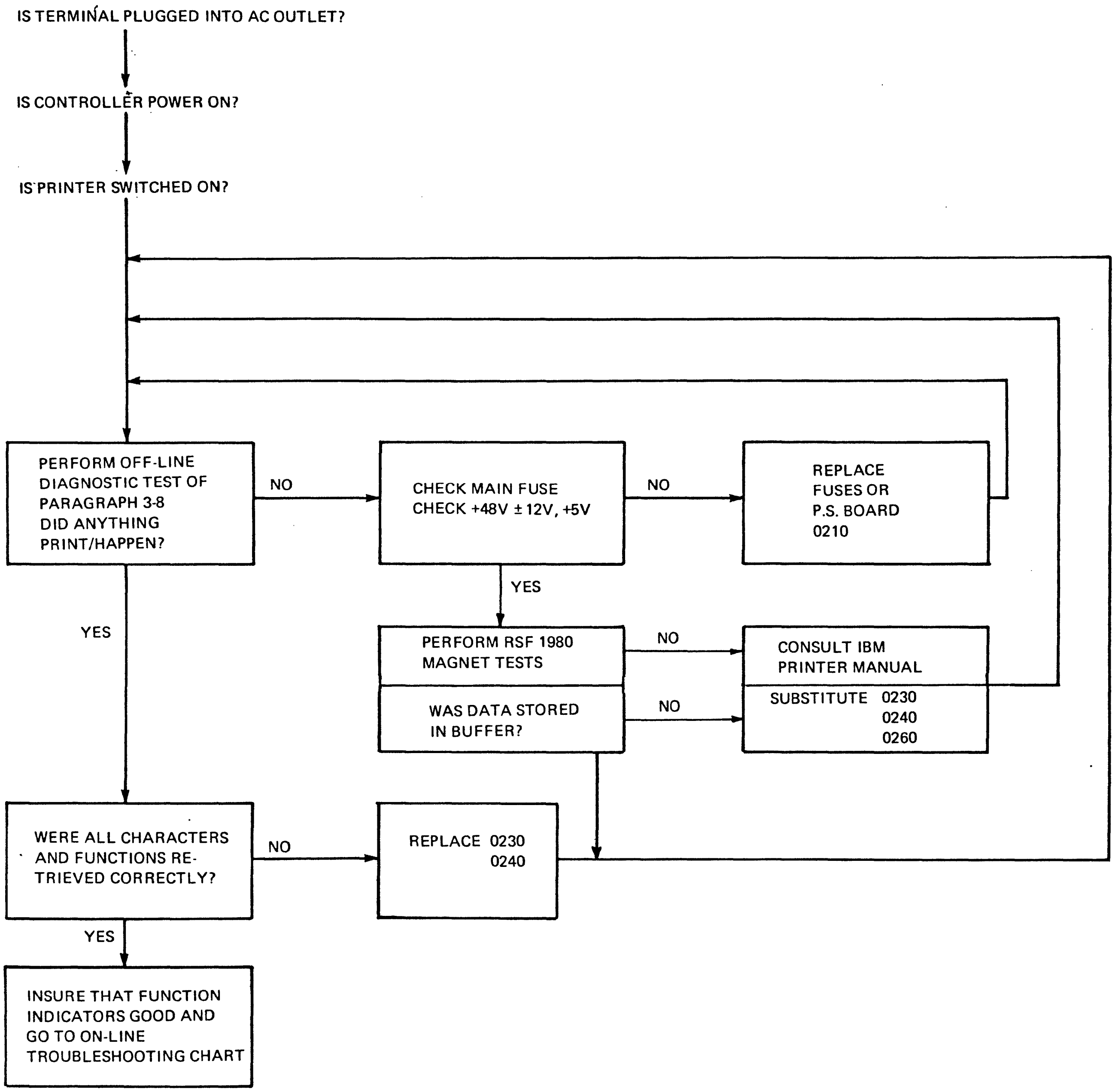


Figure 4-2. Off-Line Troubleshooting Chart

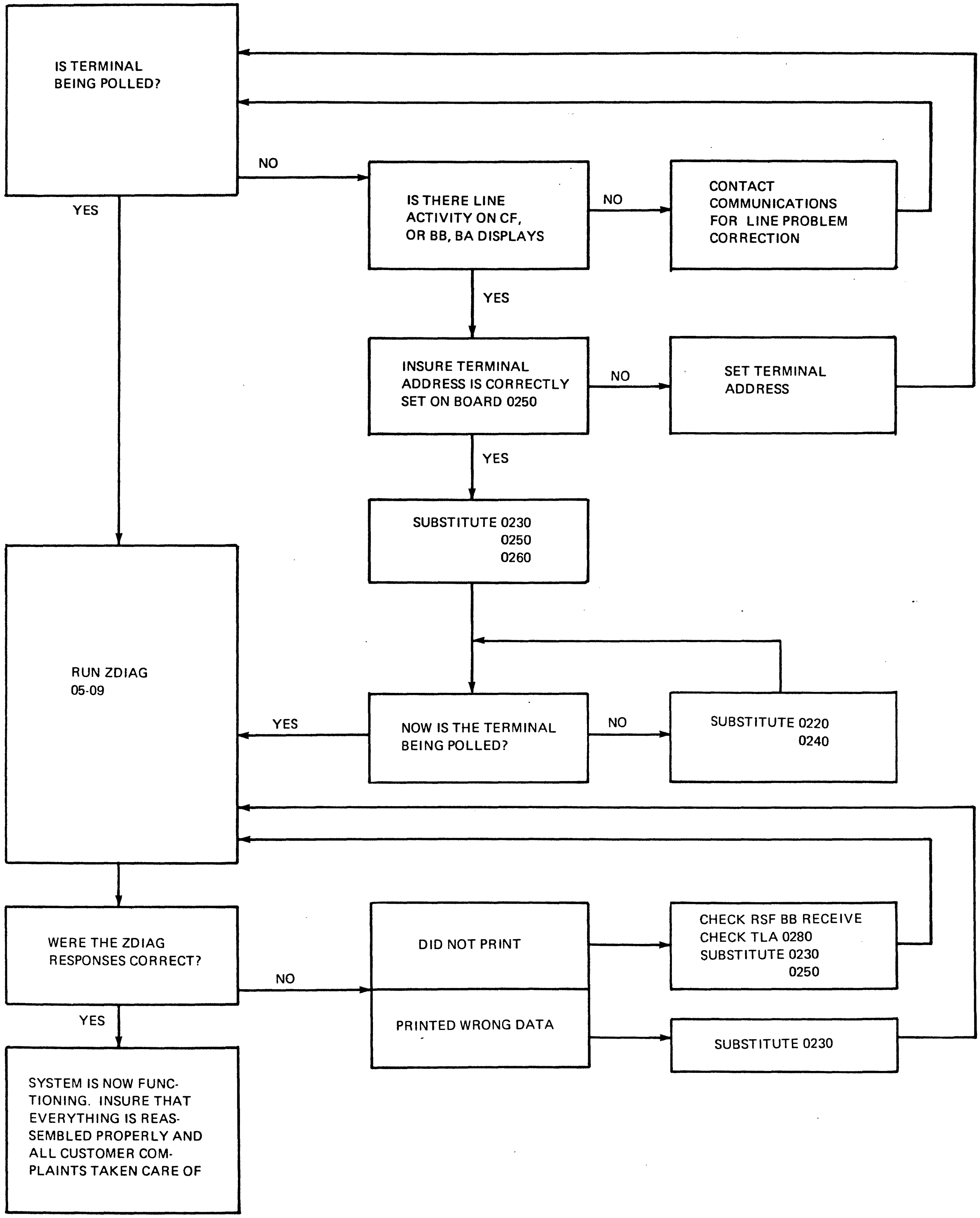


Figure 4-3. On-Line Troubleshooting Chart

4-5 REFERENCE DOCUMENTS

Supplemental reference documents are included as an aid to analyzing terminal and line problems. These include the line/buffer state transition charts, keyboard character code, and line control operations.

Line/Buffer State Transition Charts: The rules for using the line and buffer transition state charts of Figures 4-4 and 4-5 are listed below. Definitions are tabulated in Table 4-1. Use of these charts may be coordinated with the LINE and BUFFER displays of the Controller.

The conditions enabling transition from one state to another are labeled adjacent to the path between states, e.g.:

R B → received B

Inside the state block:

R → terminal is receiving character (s)
T → terminal is transmitting character (s)
I → intermediate state (neither R nor T)

Buffer state is SØB during transmission of Buffer content in S15LC.

DATA CHECK LAMP lights upon receipt of PE during S1ØLC; if a parity error is transmitted during S15LC; if the S16LC/S17LC transition occurs because of R (M after 2X); or if a parity error occurs during ENTER or off-line buffer print (S5B thru S7B).

MESSAGE (or ATTENTION) LAMP lights whenever the 5Ø5LC SØ1LC transition occurs.

Table 4-1. Line/Buffer Transition State Chart Definitions

SYMBOL		DEFINITION
1CPEA11	=	PE on the first character received after the S11LC → S1ØLC transition.
1SD	=	One second delay, initiated by entry into SØ5LC.
1X	=	First S15LC transmission of message.
2X	=	Second S15LC transmission of message.
15SD	=	15 second delay initiated by entry into SØØLC.
ADR	=	Address character for this terminal.
B B	=	B is next character in buffer ready for printing or transmission.
B ST	=	B is stored in buffer.
COP	=	CLEAR push button energized.
CRDY	=	Next buffer character is ready for printing.
E ( )	=	Operation described within ( ) has ended.
EOP	=	ENTER push button energized.
ER	=	PE received during S1ØLC.
$\overline{\text{ER}}$	=	Message received w/o error during S1ØLC.
FBK	=	Typewriter feedback contacts are open indicating print magnets cannot or are not energized.
IDL	=	Idle character.
MA	=	True if station addressed or if terminal is group and/or all stations master.
$\overline{\text{MA}}$	=	Station is group and/or all stations slave.

Table 4-1. Line/Buffer Transition State Chart Definitions (Continued)

SYMBOL		DEFINITION
MCS	=	At least one character has been stored during S1B.
$\overline{\text{MCS}}$	=	No characters stored during S1B.
OLO	=	OFF-LINE/ON-LINE switch is in ON-LINE position.
PE	=	Parity Error
PON	=	Main power switch turned on.
R ( )	=	Terminal received character (s) described within ( ).
S" "B	=	Buffer control state " " is true.
S" "LC	=	Line control state " " is true.
S4B	=	Buffer state is 4, buffer has message for processor.
SOP	=	SEND push button is energized.
SOP*	=	SOP after R (N after 2X), (S16LC S17LC Transition) and prior to EOP.
SP	=	Space character.
STS	=	Terminal has status - able to receive message.
$\overline{\text{STS}}$	=	Terminal cannot receive message, (Note: If paper presence is the only condition preventing STS, receipt of IDL in SØ4LC will set STS true.
TSL	=	ADR + slash (/) + group address character.
UCO	=	Typewriter is in upper case.
.	=	And.
+	=	Or.

Keyboard Character Code: The keyboard code chart Figure 4-6 includes the code for tilt and rotate magnets of the printer as well as the bit configuration for the characters and control functions.

Line Control Operations: A chart showing line control operations is given in Figure 4-7. Refer also to the keyboard character code Figure 4-6 for symbols involved in interpretation.

4-6 SCHEMATICS AND ASSEMBLY DRAWINGS.

Applicable schematics and assembly drawings are inserted at the end of this section in the order listed:

Register Control:

2200-0250-0X

Telegraph Line Adaptor:

2200-0280-0X

Model 220 Block Diagram:

2200-0002-00

Schematic, Power Supply:

2200-0211-00

Schematic, TLA Line Adaptor:

2200-0280-00/01/02/03

Type 1, with Opto-electronic coupler

Type 2, with Receive Relay

Model 220 Printer Wiring:

2200-9001-00

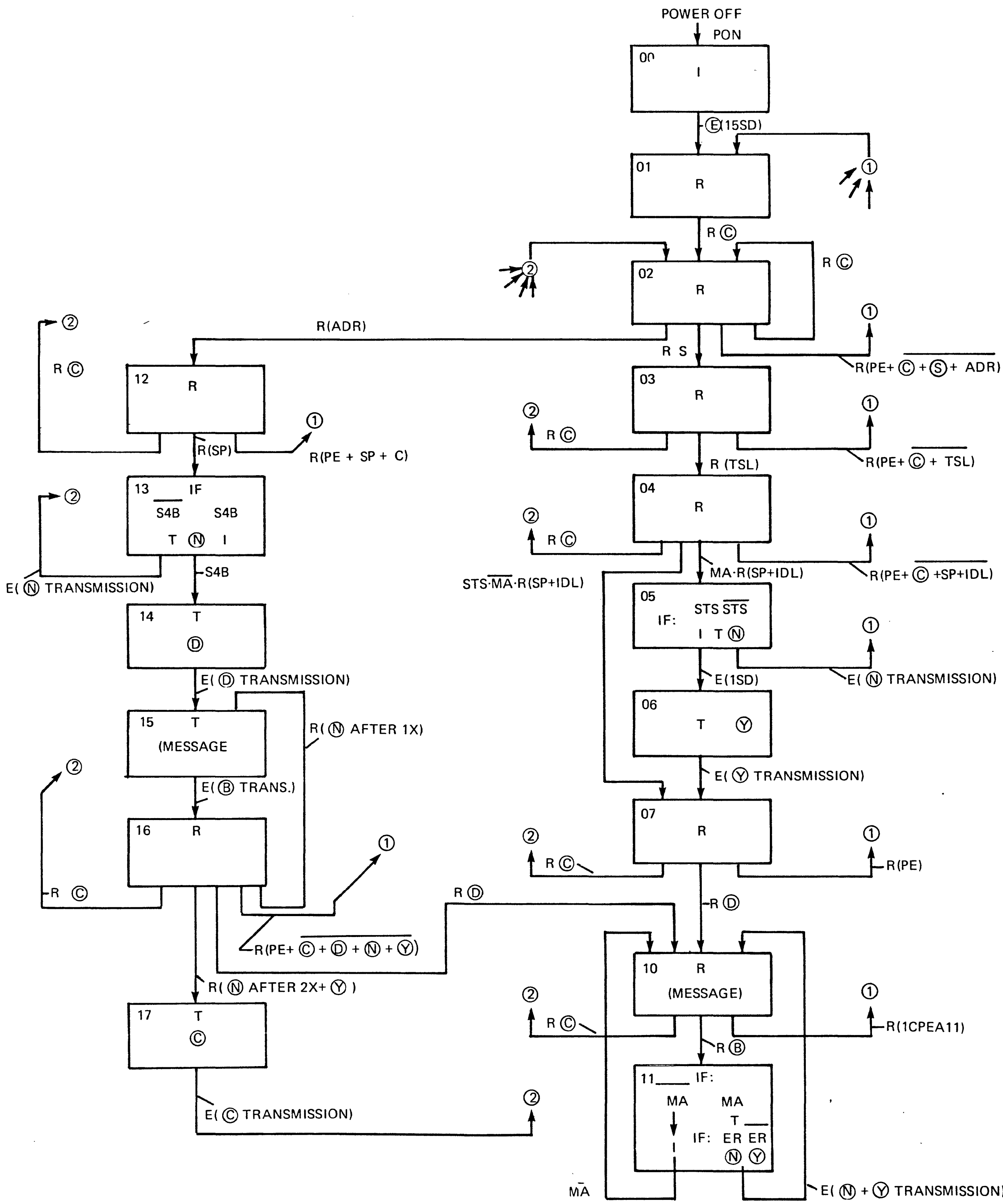


Figure 4-4. Line State Transition Chart

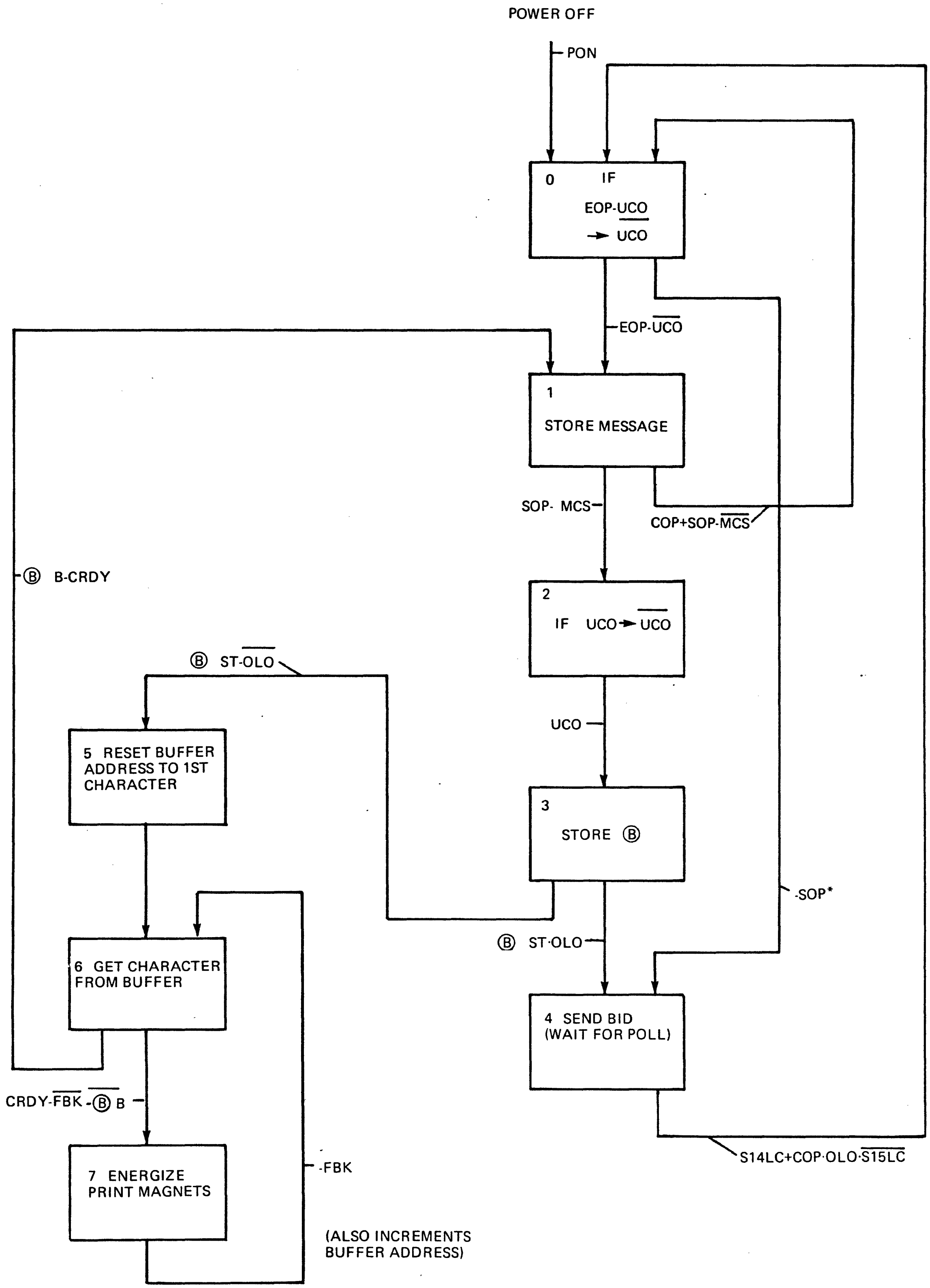


Figure 4-5. Buffer State Transition Chart

BITS AS DISPLAYED BY CONTROLLER LINE/DATA BITS

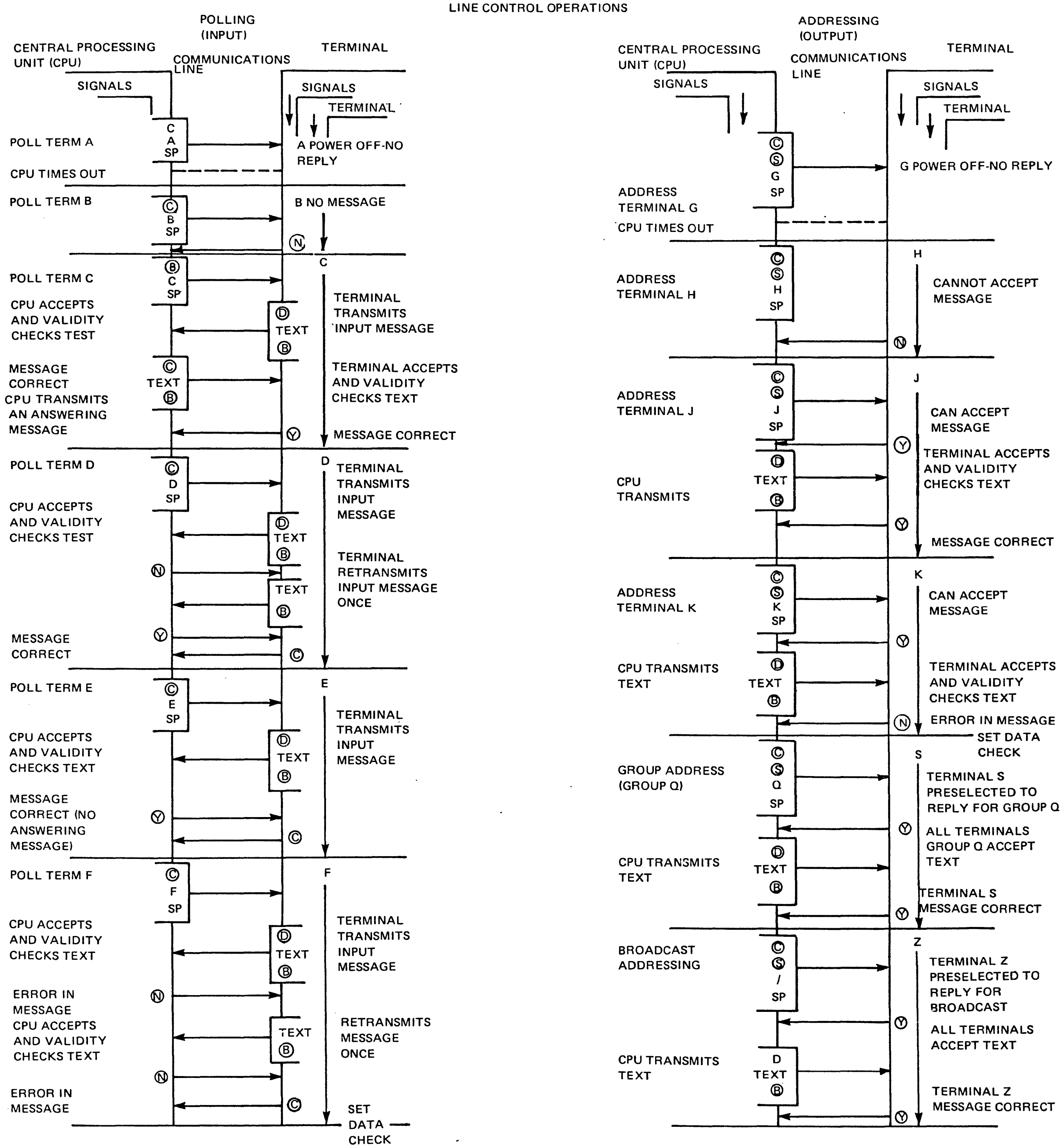
	B	A	8	4	2	1	CK
CHARACTER A=	1	1	0	0	0	1	0
CHARACTER Z=	0	1	1	0	0	1	0
CHARACTER 6=	0	0	0	1	1	0	1

CHECK BIT ADDED WHEN NECESSARY FOR ODD PARITY

	R2A	R2	R1	R-5	0	1	2	3	
DEGREE OF TILT					0	1	2	3	
MAGNET					T_1T_2	T_2	T_1	—	
					- -	- A	B -	B A	
LATCH	0	0	0	0	SP / SP	* / *	Ⓝ / ϟ	∇ / ∇	
MAGNET	1	1	1	0					
	0	0	0	1	1 / 1	/ / /	J / B	A / ‡	- - - 1
	1	1	1	1					
	0	0	1	0	2 / 2	S / #	K / d	B / ®	- - 2 -
	1	1	0	0					
	0	0	1	1	3 / 3	T / ?	L / m	C / ⊥	- - 2 1
	1	1	0	1					
	0	1	0	0	4 / 4	U / @	M / !	D / =	- 4 - -
	1	0	1	0					
	0	1	0	1	5 / 5	V / f	N / ⊠	E / ≠	- 4 - 1
	1	0	1	1					
	0	1	1	0	6 / 6	W / ↓	Ø / ⧺	F / ⌑	- 4 2 -
	1	0	0	0					
	0	1	1	1	7 / 7	X / ⊗	P / s_p	G / %	- 4 2 1
	1	0	0	1					
	1	1	0	1	8 / 8	Y / 🔔	Q / †	H / ⊠	8 - - -
	0	0	1	1					
	1	1	0	0	9 / 9	Z / $	R / ¿	I / c	8 - - 1
	0	0	1	0					
	1	1	1	1	0 / 0	/ IC	/ IC	/ IC	8 - 2 -
	0	0	0	1					
	1	1	1	0	&Ⓓ / +	,Ⓢ / ,	- / -	Ⓨ / .	8 - 2 1
	0	0	0	0					
					IC	IC	IC	IC	8 4 - -
						INDX	CRTN	TAB	8 4 - 1
					UCS	Ⓑ IC	BKSP	LCS	8 4 2 -
					Ⓒ IC	IC	IDLE IC	IC	8 4 2 1

Figure 4-6. Keyboard Character Code

LINE CONTROL OPERATIONS



CONTROL CHARACTERS

POLLING SEQUENCE:
- Ⓒ END OF TRANSMISSION
- A TERMINAL IDENTIFICATION
- SP SPACE CHARACTER

- Ⓒ END OF TRANSMISSSION (EOT)
- Ⓓ END OF ADDRESS (EOA)
- Ⓨ POSITIVE RESPONSE
- Ⓝ NEGATIVE RESPONSE
- Ⓑ END OF BLOCK (EOB)
- Ⓢ START OF ADDRESS (SOA)
- ⓓ POSITIVE ANSWER - INQUIRY

ADDRESSING SEQUENCE:
- Ⓒ END OF TRANSMISSION
- Ⓢ START OF ADDRESS
- G TERMINAL IDENTIFICATION
- SP SPACE CHARACTER

Figure 4-7. Line Control Operations

SECTION V
SPARES LISTS

5-1 INTRODUCTION

Table 5-1 lists suggested spare parts for support of the IBM 1980 printer, giving normal tool and spares recommendations.

Table 5-2 lists spares for a central location in areas where IBM parts are not readily available. Central location spares quantities should be determined on an as-required basis.

Tools required in addition to normal service case tools for proper printer servicing are given in Table 5-3. All parts and tools normally may be ordered locally from IBM.

Table 5-1. Field Engineer's Spare Parts for IBM 1980 Mod 9.

ITEM	QTY	DESCRIPTION	IBM PART NO.
1	3 ea	Tab Stop Clip	1275643
2	1 ea	Shift Clutch	1166381
3	1 ea	Rotate Tape	1134817
4	1 ea	Tilt Tape	1164316
5	1 ea	Coil Assembly, 48v	1135134
6	1 ea	Parts Packet	
		a) Screws	1280701
		b) Screws	1280702
		c) C-Clips	1280703
		d) Springs	1280704
		e) Springs	1280705
		f) Clevis	1280706
		g) Washers & Shims	1280708
7	1 ea	Lever Assembly, Paper Release	1135381
8	1 ea	Lamp, Indicator	1187393
9	1 ea	Cable, Dual Velocity	1141765
10	1 ea	Switch, micro	355343
11	1 ea	Coil, Shift Latch	1128964
12	1 ea	Cord-Carrier Return	1128380
13	1 ea	Cord, Tab	1128379
14	1 ea	Pivot Transport Pulley	1128386
15	1 ea	Slide Transport Pulley	1128385
16	1 ea	Belt Drive	5173811
17	1 ea	Cycle Clutch Spring	1166551
18	1 ea	Screw, Eccentric, esc.	1128225
19	1 ea	Index Stop	1147605
20	1 ea	Shift Brake	1128199
21	1 ea	Spring Tab Governing	1123572
22	1 ea	Pinion, Carrier Return	1123574
23	1 ea	Pinion, Tab Governing	1123571
24	1 ea	Spring, Carrier Return	1175243
25	1 ea	Platen Driver	1187335
26	3 ea	1N4002 Diode or Equivalent	

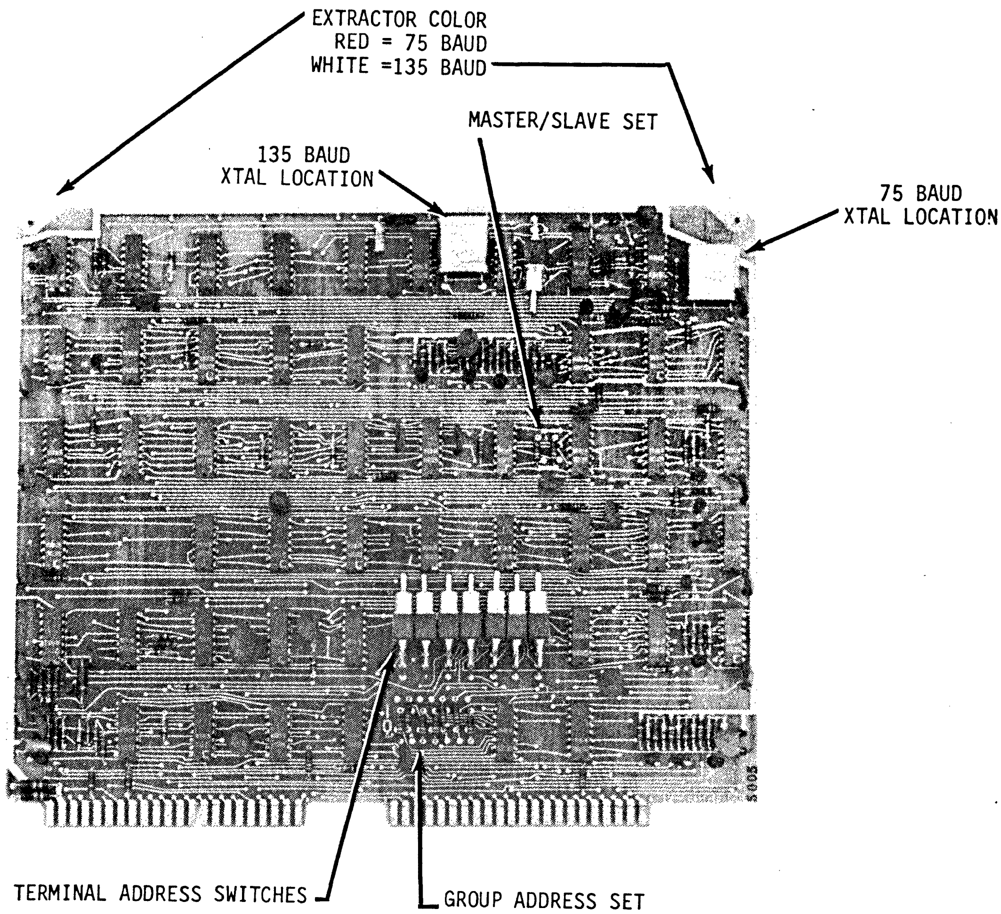
Table 5-2. Central-Location Supplementary Spare Parts for IBM 1980 Mod 9.

ITEM	DESCRIPTION	IBM PART NO.
1	Transmit Contact Assembly	
	a) Contact Assembly - N/C	1159880
	b) Contact Assembly - O/P	1187035
	c) Contact Assembly - N/O	1187036
	d) Contact Assembly - N/C	1187037
	e) Contact Assembly - O/P	1128800
	f) Contact Assembly - N/O	1128812
2	Lever Assembly	1187429
3	Spring - Interposer Latch	1124430
4	Pawl, Index Clutch	1187643
5	Pawl, Assembly Backspace	1187642
6	Pawl, Cam Clutch, 1980	1769123
7	Knob, Platen Gray	1135377
8	Clutch, Release Arm	1187195
9	Clutch, Release Arm	1203291
10	Latch Assembly, Clutch Release	1187364
11	Rotate Spring	1203862
12	Main Spring	1203561
13	Latch Cycle Clutch	1266829
14	Type Ball (964 - ITT)	1167964
	(640 - Dial)	1167640

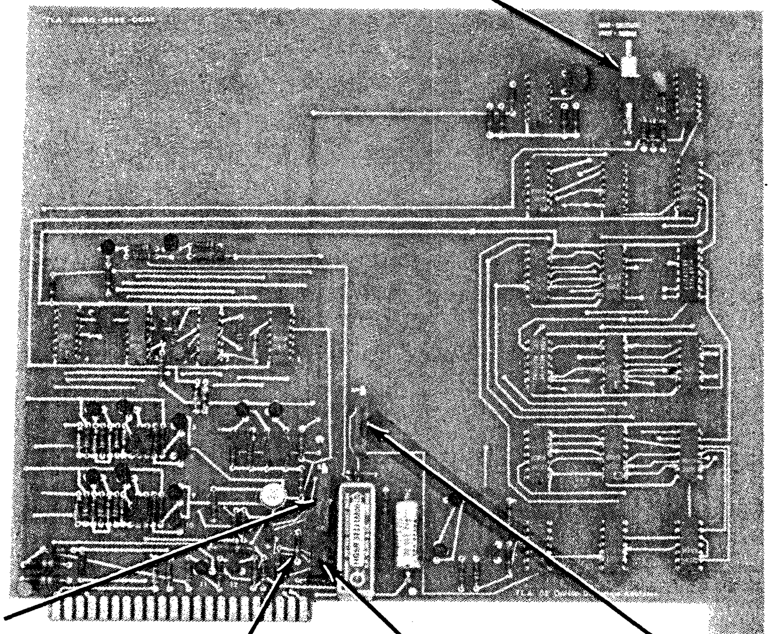
Table 5-3. Special Tools

ITEM	PART NUMBER
SCALE	460870
HOOVEROMETER	9900112
HALF-CYCLE TOOL	9900375
HAND CYCLE TOOL	9900427
WRENCH, SET, BRISTOL	9900419
*GREASE GUN	158645
*GREASE GUN NOZZLE	450813
*IBM #23 GREASE	1280442

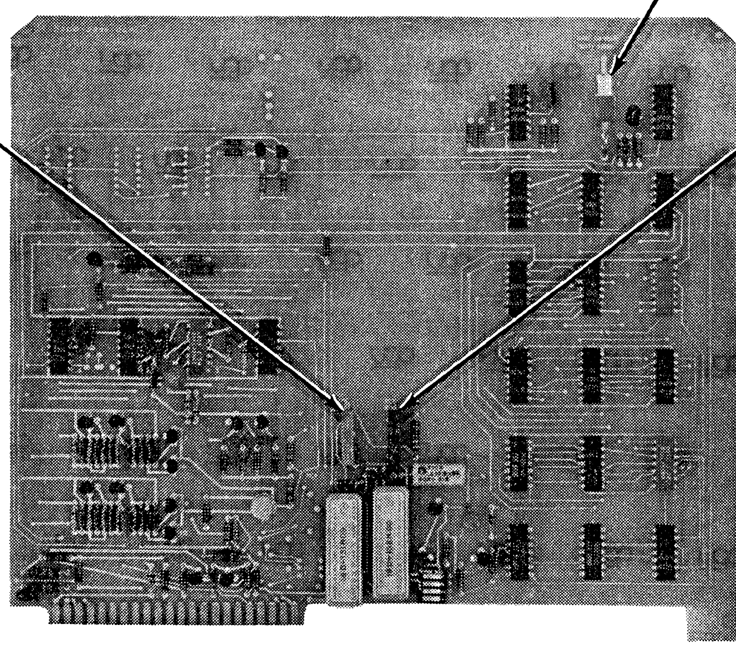
* Suggested replacement is grease #23, 1 oz. 1280441.



Component Layout
Register Control
(Assembly 2200-0250-02)

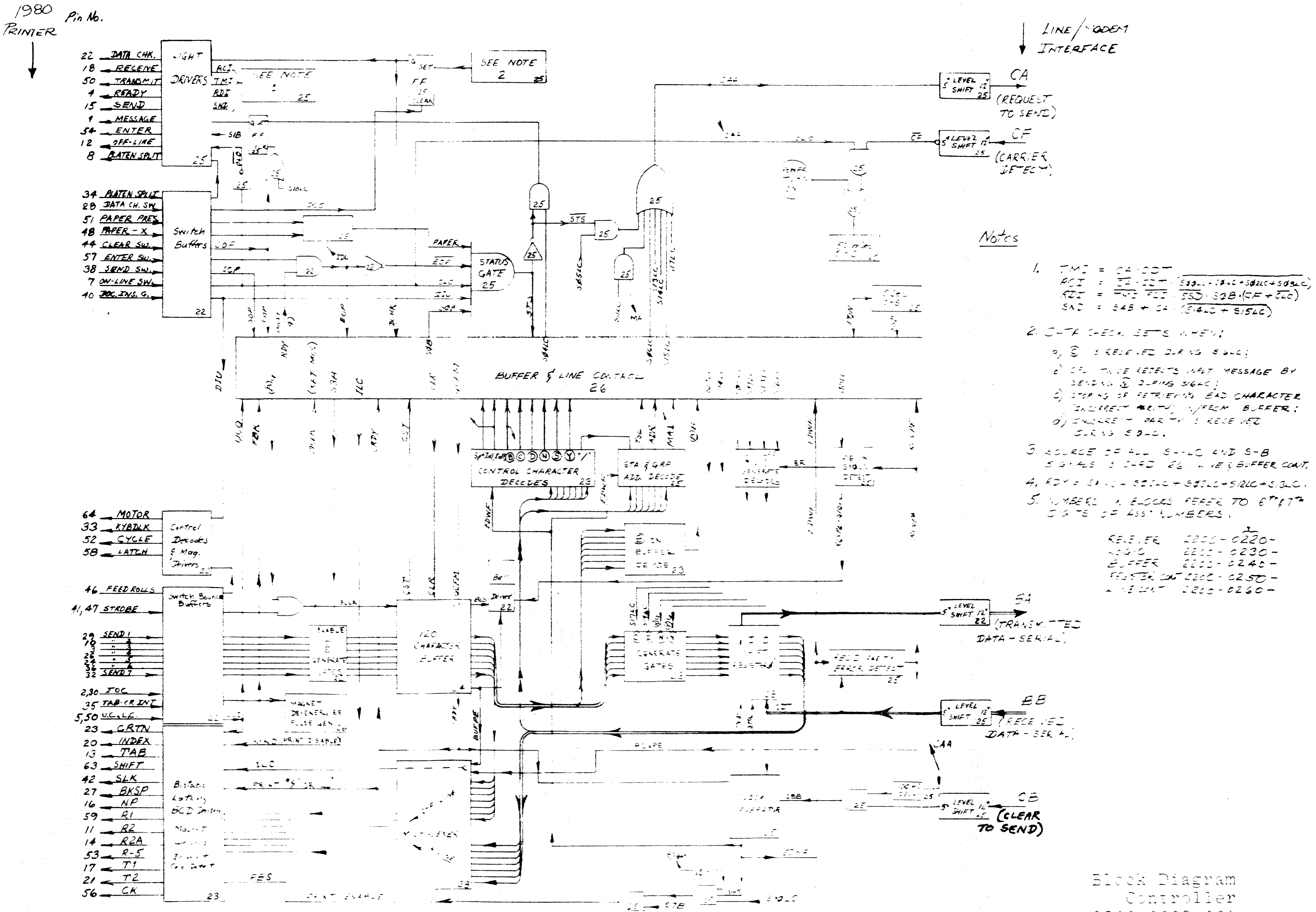


TYPE 1, WITH OPTO ELECTRONIC COUPLER

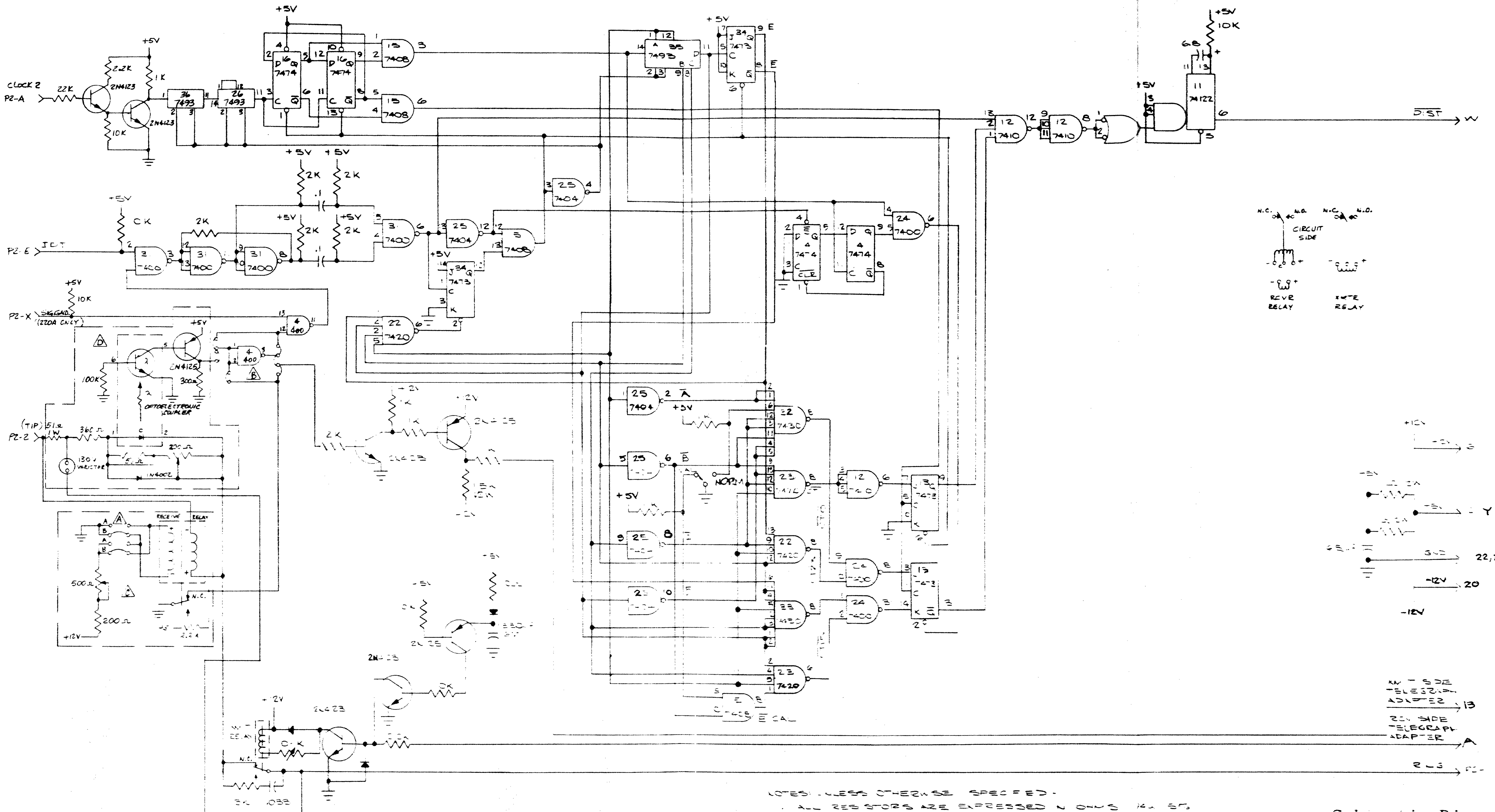


TYPE 2, WITH RECEIVE RELAY

Component Layout
Telegraph Line Adaptor
with all options loaded.
(Assembly 2200-0280-03)



Block Diagram
Controller
(Drawing 2200-0002-00)



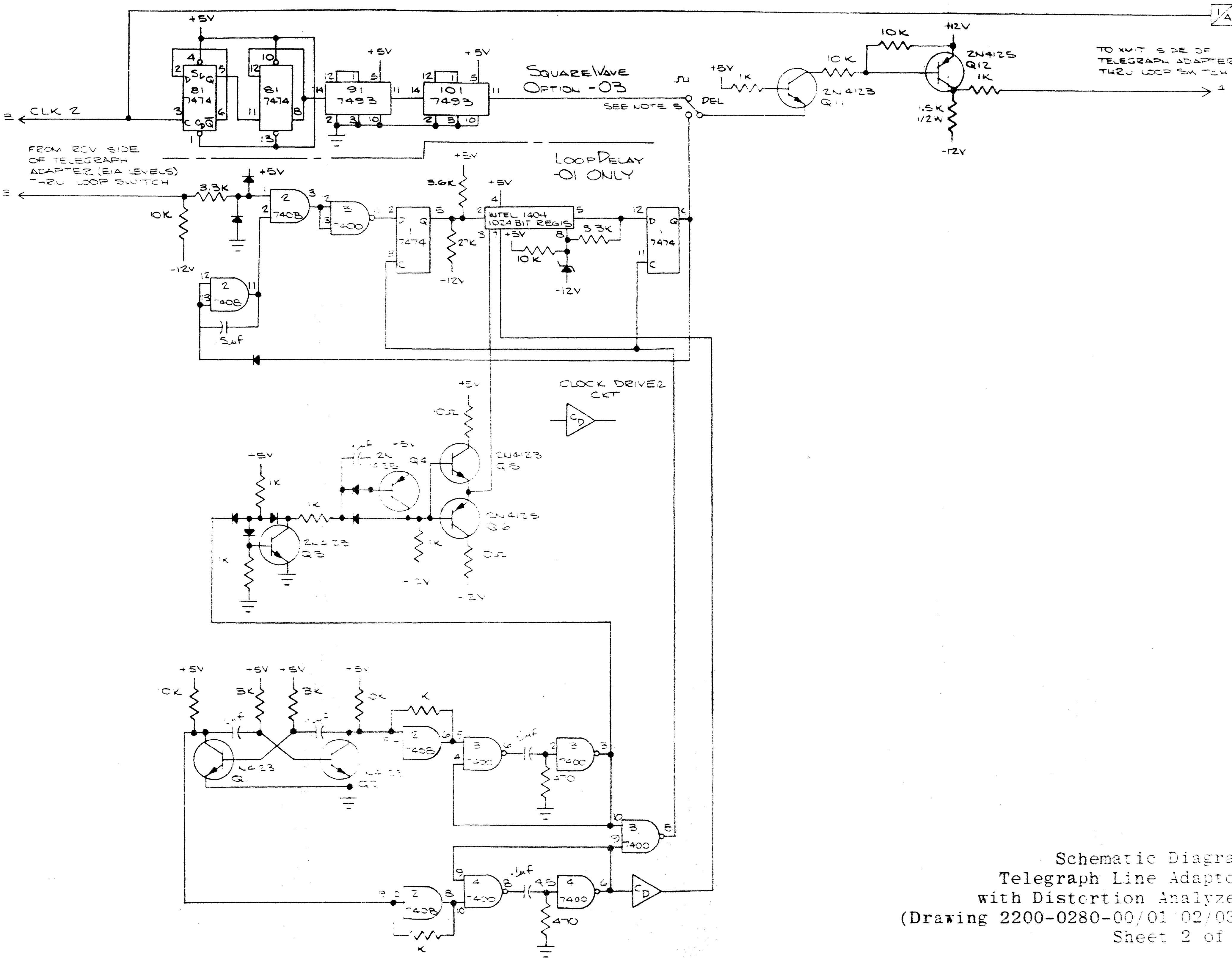
NOTES:

1. A – FOR CIRCUITS REQUIRING 60 AND 20MA CRKTS., A SWITCH WILL BE INSTALLED FOR CONVENIENCE. ALL OTHERS WILL HAVE JUMPERS INSTALLED AT POINTS B.
2. B JUMPERS DENOTED BY SOLID LINES ARE FOR DUAL RELAY CONFIG. JUMPERS DENOTED BY BROKEN LINES ARE FOR ISOLITE CONFIG.
3. C CIRCUITRY OUTLINED BY C INCLUDING A IS USED WITH DUAL RELAY CONFIG.
4. D CIRCUITRY OUTLINED BY D IS USED WITH OPTOELECTRONIC COUPLER CONFIG.

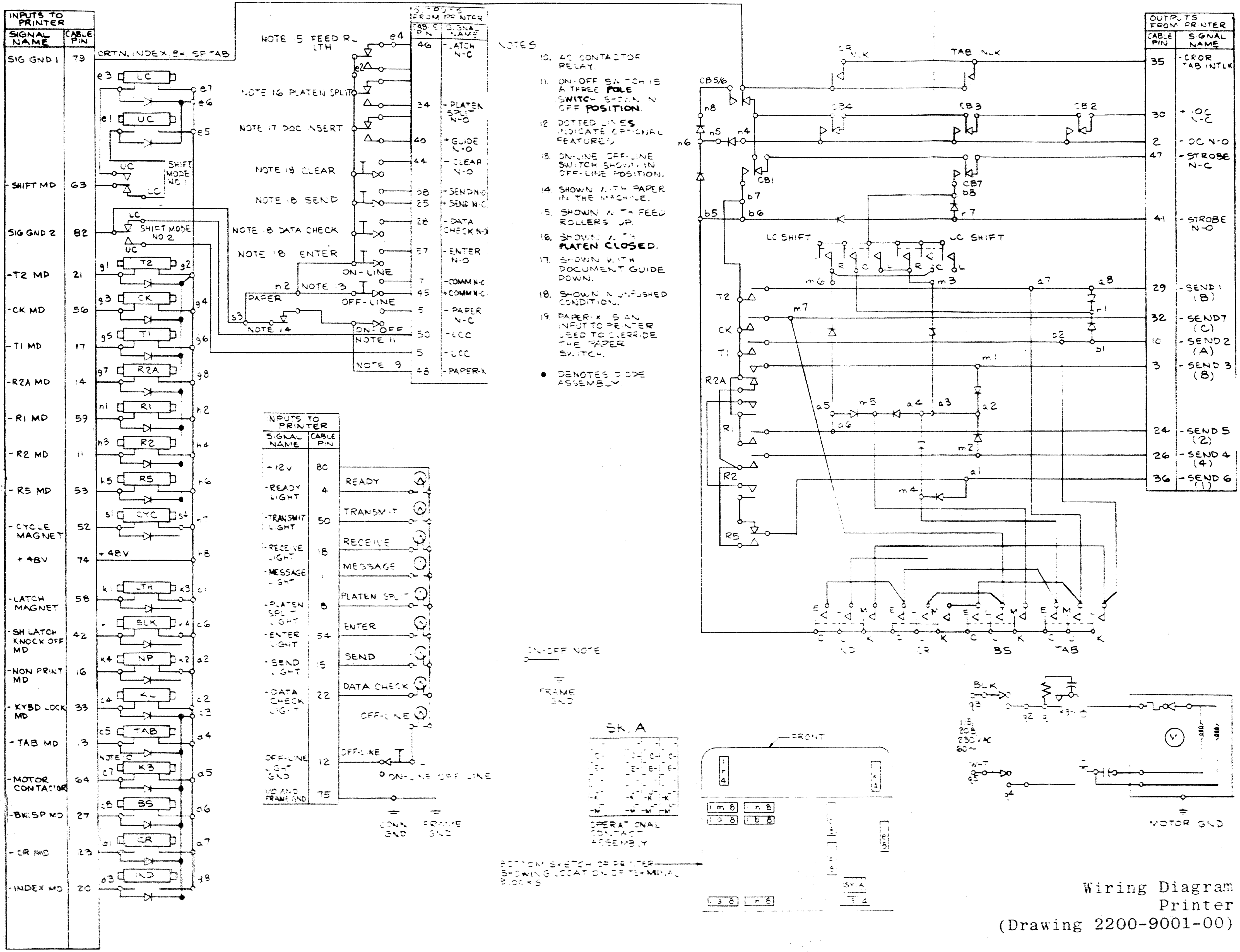
NOTES: UNLESS OTHERWISE SPECIFIED -

1. ALL RESISTORS ARE EXPRESSED IN OHMS 1/4W 5%
2. ALL CAPACITORS ARE EXPRESSED IN MICROFARADS
3. ALL DIODES ARE 1N3064
4. REF: ASSY NO 2200-0280-XX
5. IF -01 AND -03 ARE INSTALLED USE TOGGLE SWITCH- OTHERWISE USE APPROPRIATE JUMPER; Q11 AND Q12 CIRCUITS FOR -01 AND -03
6. CONNECTORS ARE P2

Schematic Diagram
Telegraph Line Adaptor
with Distortion Analyzer
(Drawing 2200-0280-00/01/02/03)
Sheet 1 of 2



Schematic Diagram
Telegraph Line Adaptor
with Distortion Analyzer
(Drawing 2200-0280-00/01/02/03)
Sheet 2 of 2



Wiring Diagram
Printer
(Drawing 2200-9001-00)