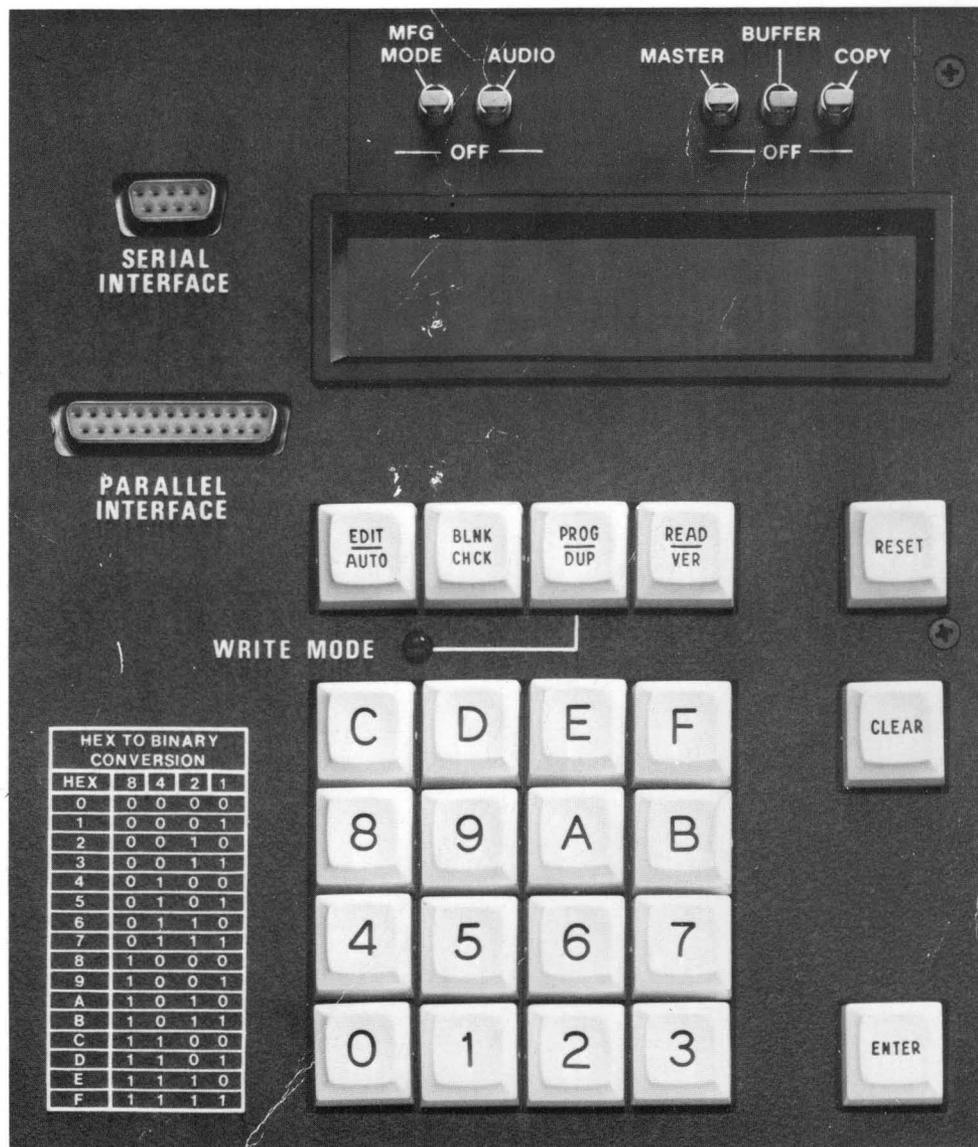# PRO-LOG
CORPORATION

User's Manual
M980
CONTROL UNIT

HEX TO BINARY CONVERSION

HEX	8	4	2	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

The information in this manual has been carefully reviewed and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Furthermore, such information does not convey to the purchaser of the equipment described any license under the patent right of Pro-Log Corporation or others.

The material in this manual is subject to change, and Pro-Log Corporation reserves the right to change specifications without notice.

Table of Contents

Section 21   Documentation

M980 INTERFACE SOFTWARE SELECTION

The M980 contains several software packages to interface the M980 to peripheral equipment. This interface may be directly from the M980 (example: 9812 TTY or 9814 Parallel I/O) or via additional hardware (example: 9811 with M301 Paper Tape Reader, or 9818 with M304 RS232C adapter).

The 9812 TTY Interface uses the 9 Pin "D"-type connector located on the front panel to interface directly to many 20 milliamp TTY machines (ASR-33). The 9814 Parallel I/O uses the 25 Pin "D"-type connector to interface to intelligent equipment via a TTL Parallel I/O handshake interface. This TTL connector is used to drive and read from the M301 Paper Tape Reader or M304 RS232C adapter.

The M980 interface type and format are selected via the hex keyboard. After RESET, the depression of keys 1, 2, 4 or 8 selects either the 9811, 9812, 9814 or 9818 software routines. The interface type selected is displayed in the left-most displays. In the right-most displays a default format number is displayed. The user may elect to use the default format or choose any one of the formats listed at the end of this section. (See SECTIONS 17 through 20 for detailed descriptions of the various formats available for each interface.)

The following is a step-by-step example of the key strokes required for selecting a format:

1. Select the switches as shown. Connect and activate the interface to be selected. The 9811 is act vated by connecting the M301, turning ON the M301 Power and the Reader head. The 9812 is activated by plugging in the RC12 TTY cable or jumpering Pin 2 to Pin 8 on the 9-pin "D" type connector. The 9814 is activated by pulling interlock low on the 25-pin "D" type connector. The 9818 is activated by plugging in the M304, pulling DTR or CTS high, turning M304 ON-LINE and/or Modem ON. (See appropriate section for more detailed information.)

MFG MODE   AUDIO   MASTER   BUFFER   COPY

2. Depress RESET. The 8 hex displays are blank.

RESET
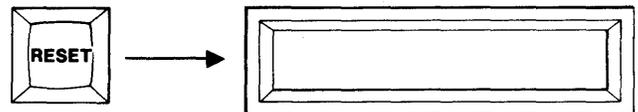
3. Depress 1 for 9811, 2 for 9812, 4 for 9814, or 8 for 9818 (Example is for 9818 RS232C.) The interface selected is displayed in the left-most displays and "01" is displayed in the right-most displays.

9818   01

9818 Interface   Default Format
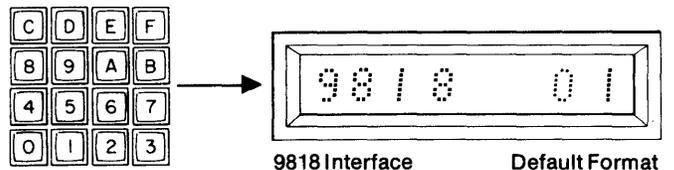
4. If the default format is desired, go to step 5. If a new format is required, use the hex keyboard to key in a new format number. (See format number listing at the end of this section.)

9818   10

9818 Interface   Intel Format
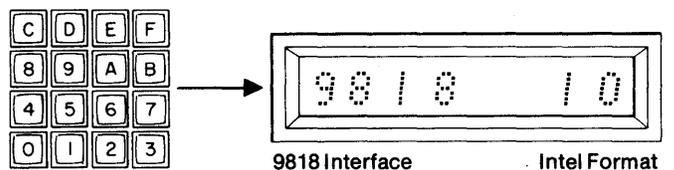
5. Depress ENTER. The displayed format will be accepted. The display will show the format number and "AAA" for active. The interface is now active to receive information remotely. When remotely interfacing with the M980, any output of data will be indicated by a "0" in the left-most display. Any input of data will be indicated by a "1" in the left-most display. Upon completion, the "0" or "1" will be removed from the display. The interface and format will remain active until the M980 is reset. In formats that use checksums, an "E6" error will disable the format until ENTER is depressed.

Intel Format   Active

Output   Intel Format   Active

Intput   Intel Format   Active
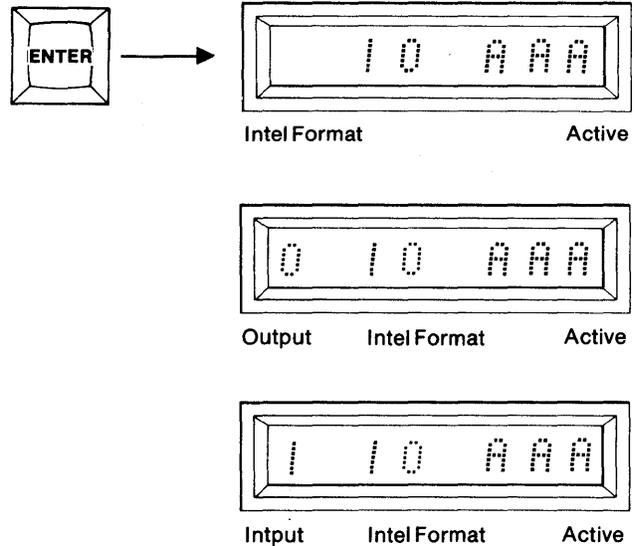
6. For some formats — those not requiring that the address information be sent over the interface — the user may elect to define the Buffer address limits via the hex keyboard. If local address field definition is desired, continue.

7. Depress ENTER. The First and Last Addresses of the Buffer are displayed.

First Address   Last Address
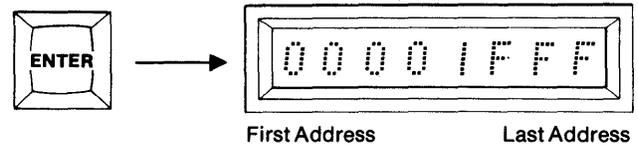
8. If the entire contents of the Buffer are to be operated on, go to step 9. For a limited field, use the hex keybaord to key in a new Start and End Address field for the operation.

Start Address   End Address
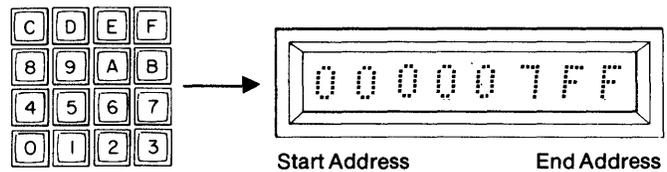
9. Depress ENTER. This initiates the format selected over the indicated address range. A zero or 1 is displayed in the left-most display to indicate output or input as described in step 5.

Output   Intel Format   Active

Input   Intel Format   Active
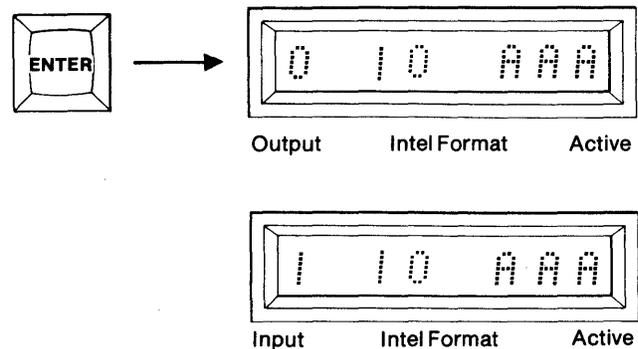
INTERFACE FORMAT NUMBERS

9811 PAPER TAPE READER	
NUMBER	**DESCRIPTION**
00	ASCII Hex Local — Duplicate
01	ASCII Hex Local — Compare
02	BNPF Local — Duplicate
03	BNPF Local — Compare
04	BINARY Local — Duplicate
05	BINARY Local — Compare
06	INTEL MDS — Duplicate
07	INTEL MDS — Compare

9812 TTY	
NUMBER	**DESCRIPTION**
02	Data Only — Remote Duplicate, List, Program, Compare

9814 PARALLEL I/O	
NUMBER	**DESCRIPTION**
00	Parallel — Remote Read, Program (Slave)
01	Parallel — Master Write
02	Parallel — Master Read

9818 RS232C	
NUMBER	**DESCRIPTION**
00	Pro-Log Local Program/Remote : P = Program
01	Pro-Log Local Scroll/Remote : S = Scroll
02	Pro-Log Local List/Remote : L = LIST
03	Pro-Log Local List/Remote : M = LIST
04	Pro-Log Local List/Remote : N = LIST
05	Pro-Log Local List/Remote : X = LIST
06	Pro-Log Local : Program w/CR, LF
07	Unassigned
08	Unassigned
09	Unassigned
10	INTEL Remote : Program
	INTEL Remote : L = List
	INTEL Local : List
11	INTEL Remote : Program Ack/Nak
	INTEL Remote : L = List
	INTEL Local : List
12	INTEL Remote : Program
	INTEL Local : List w/Control Z
	INTEL Remote : L = List
13	Reserved for INTEL
14	TEK HEX Remote : Program
	TEK HEX Local : List
	TEK HEX Remote : L = List
15	Reserved for TEK HEX
16	MOTOROLA Remote : Program
	MOTOROLA Local : List
	MOTOROLA Remote : L = List
17	Reserved for RCA
18	MOS Technology Remote : Program
	MOS Technology Local : List
	MOS Technology Remote : L = List
19	Reserved for Fairchild
20	Reserved for Signetics
21	Unassigned
↓	↓
99	Unassigned

9103A U.V. ERASE LIGHT

Model 9103A is an ultraviolet erase lamp designed to accommodate a quantity of UV Eraseable PROMs. The unit consists of dual high intensity UV lamps mounted in an enclosed case with hinged lid and safety interlock, a presettable 0 - 60 minute timer, ON and OFF controls, and AC power connector.

Model 9103A is designed as an accessory to the Series 90 PROM Programmer attache case.

Model 9103A-1 is a stand-alone erase light unit with a 6-foot power line cord.

Model 9103A-2 is a stand-alone erase light unit with a 6-foot power line cord for 230V.

FEATURES

- **Automatic Shut-off with Presettable Timer**
- **Mounts in Programmer or Stand-alone**
- **Interlock prevents Eye Exposure to UV**
- **Safety View Hole to Check Lamp**
- **Conductive Foam Pad holds Ten 24-pin DIPs**

Figure 16-1   9103A
(Mounted in the M980 Programmer Case)
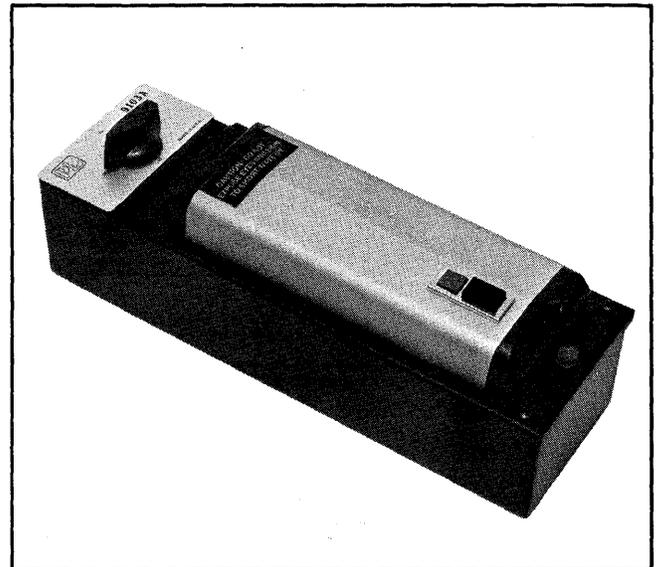
Figure 16-2   9103A
UV Erase Light

PHYSICAL CHARACTERISTICS

- Housed in an 11.5 in. (29.2 cm.) by 3.5 in. (8.9 cm.) by 4 in. (10.2 cm.) aluminum case.
- Weight: 2.5 pounds
- Conductive foam pad for EPROMs is 3.5 in. (8.9 cm.) by 2.5 in. (6.4 cm.) and accepts up to ten 24-pin dual-in-line packages or equivalent.

CONTROLS

- TIMER SET is a rotary control at the top rear of the unit that adjusts the UV lamp on-time from 0 - 60 minutes. The control is continuously variable with dial markings in 15-minute increments. Timer set can be adjusted during operation to lengthen or terminate erasure. Lamp power is removed when the control reaches zero.
- LAMP ON/OFF: LAMP ON (black push button) starts the UV lamp, only if the timer has been set to the desired erase time first (see table). LAMP OFF (red push button) can be used to remove lamp power.
- SAFETY INTERLOCK is an internal switch that removes lamp power when the chamber lid is raised. The lamp must be restarted using LAMP ON after reclosing the lid.

9103A OPERATING INSTRUCTIONS

1. Proper PROM erasure is the result of timed exposure to a UV light source of critical wavelength and intensity.
2. PROMs that are inadequately erased retain partial changes that may affect the data pattern later. The condition of inadequate erasure is often not detectable when the PROM is reprogrammed.
3. Use the Recommended Erase Time table (below) as a minimum timer setting for your PROM type.
4. Place up to ten 24-pin PROMs on the conductive foam pad. PROMs must lie flat on the pad, with the erase window up. To decrease erase time and for added convenience, additional foam pads are included. PROMs to be erased are placed on the loose pad (see Recommended PROM Arrangement diagram below) and then the pad is placed on top of the fixed pad in the 9103A. This places the PROMs closer to the lamp and shortens the erasing cycle.
   It is essential to accurately place the pad containing the PROMs above the fixed pad to achieve the erasing times in the table below. Finally, cleanliness of the PROM window is essential.
5. Close the lid, set the timer, and hold the LAMP ON button down until a blue glow is observed through the view hole near the lid knob. Unit operation will then be automatically terminated by the timer.
6. If the lid is raised before the timer stops the 9103A, LAMP ON must be used to restart the lamp. Readjust timer setting if necessary.
7. Replace the UV lamp yearly with normal use to maintain maximum intensity, or test the lamp with a UV intensity meter such as the Ultra Violet Products Model J-225, Spectronics DM-254N, or equivalent.

Recommended Erase Times			
Minutes	10	15	30
Device Type	1702A 3702 4702A 8702A 9702 58536S	1702 5202A 5203 5204 6834	All 2708's TMS2508, Intel 2758 Intel 2716 (and compatible) TMS2716 (all versions) 8741, 8748, 8755, 8755A IM6603/04, IM6653/54 TMS2532, Intel 2732, 2732A

Figure 16-3
Recommended Erase Times
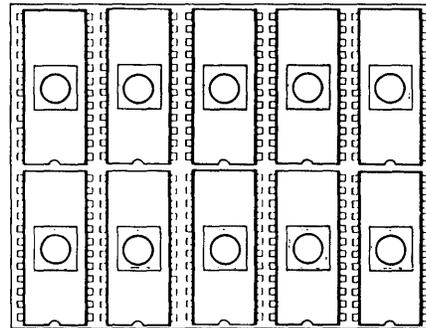
Figure 16-4
Recommended PROM Arrangement

LAMP CHARACTERISTICS

- Unfiltered short wave ultraviolet light
- $\lambda = 254$ nanometers (2540 Angstroms)
- Lamp type: UVS-11 or Spectonics 2537S, 5500 μW/cm^2 (2 required)

POWER REQUIREMENTS

115VAC, 60Hz, 0.20 ampere

CAUTION

ULTRAVIOLET LIGHT IS HARMFUL TO EYES AND OTHER TISSUE. DO NOT DEFEAT THE PURPOSE OF THE 9103A LID INTERLOCK OR OPERATE UNIT IF THE INTERLOCK IS DEFECTIVE.

9811, PAPER TAPE READER

9811, PAPER TAPE READER

The M980 9811 provides an interface with the M301 Paper Tape Reader (PTR).

With the M301 PTR, the M980 can input data at a rate greater than 100 characters per second for use in the Duplicate or Compare Modes.
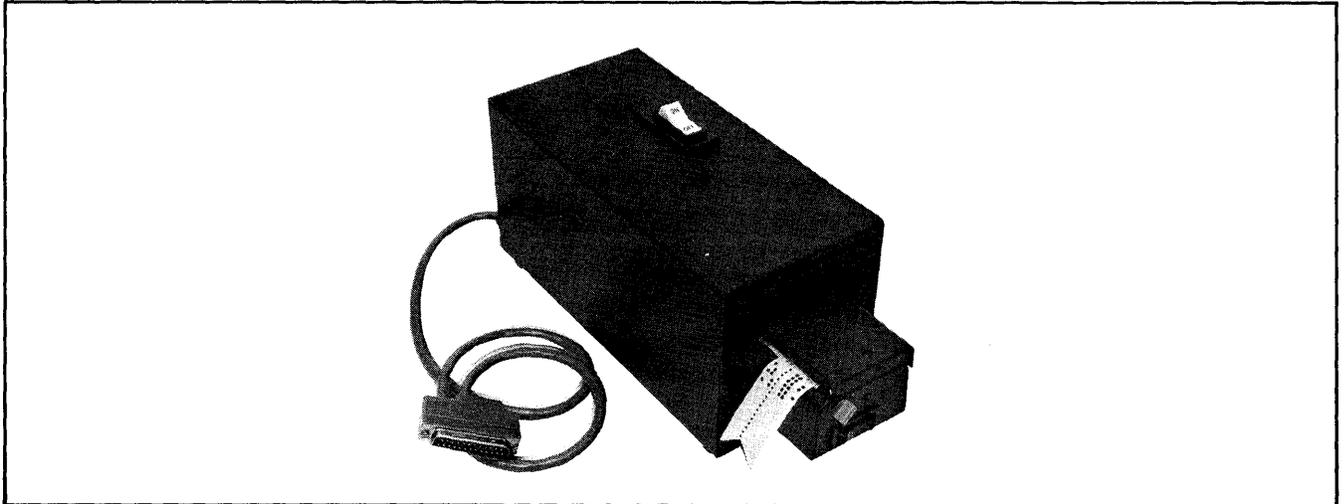
Figure 17-1   M301 Paper Tape Reader

PAPER TAPE CONNECTOR (PARALLEL INTERFACE)

The M301 PTR connects to the M980 programmer via the 25-pin "D"-type connector located in the center of the programmer control panel.

The connector provides four drive lines for reader stepping control, eight data lines, one sprocket line, and logic power connections.
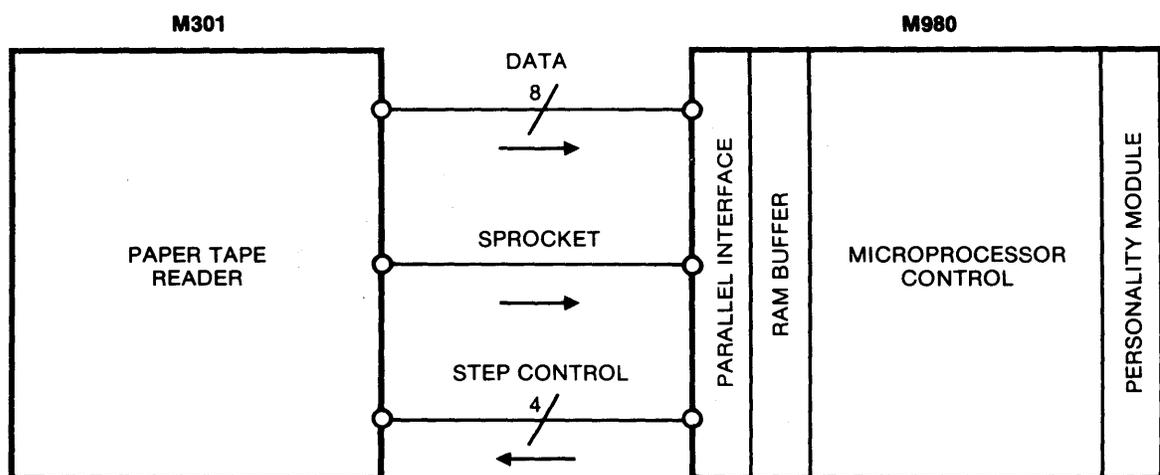
Figure 17-2   Paper Tape Reader Interface

PAPER TAPE CONTROLS

The M301 reader has two switches, READER POWER and READER ENABLE.

READER POWER Switch: A rocker switch on the top side of the reader chassis, it controls the power supply for the reader stepping motor.

READER ENABLE Switch: A rocker switch on the front of the reader mechanism, it enables the light source for the photo-reader in the ON position.

KEY 1: Interface selection key that puts the system into the PTR operating sequence. Active after Power ON or RESET.

PAPER TAPE INDICATOR

Reader Ready: A red indicator located on the reader mechanism. Indicates reader ready condition.

PAPER TAPE FORMATS

ASCII Hex Format (9811-00/01) requires 8-level, ASCII data coding where only the hexadecimal characters represent data to be operated on.
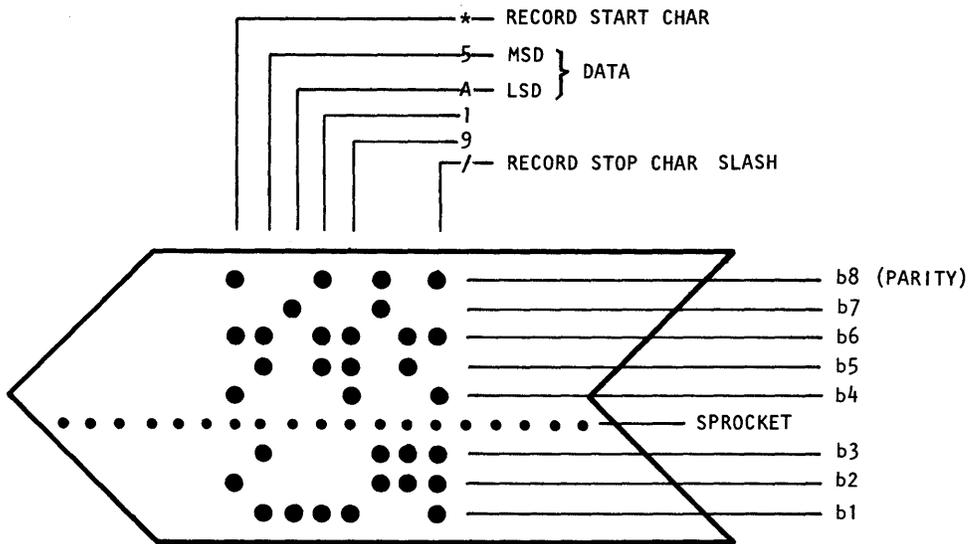
Figure 17-3   ASCII HEX Format

ADDRESS: Address information must not be on the tape. The M980 keeps sequential address count for each location operated on.

8-BIT DATA: Each 8-bit location to be operated on requires two sequential ASCII hex characters on the tape. Non-hex characters are allowed and ignored but must not occur between the two hex data characters to be programmed.

4-BIT DATA: Each ASCII hex character on the tape is loaded to the lower half of the Buffer; the upper half is unaffected.

START CHARACTER: The ASCII character asterisk (*) must occur as the start character at the beginning of the data stream. Header information is allowed on the paper tape, if it precedes the asterisk start character.

END CHARACTER: The Tape Read operation can be terminated by the ASCII character slash (/).

17-2

ASCII BNPF format (9811-02/03) requires 8-level ASCII data coding where the characters B, N, P, and F are used to encode and control binary data words. Other characters are allowed on the tape but must not occur within the data word.
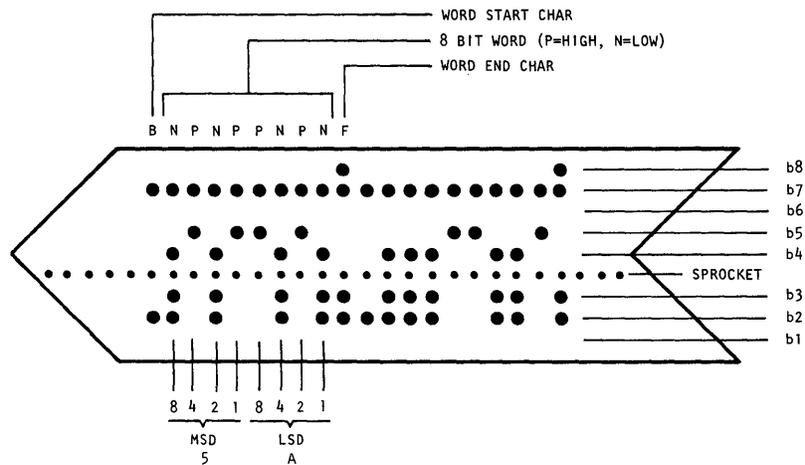
Figure 17-4 ASCII BNPF

ADDRESS: Address information must not be on the tape. The M980 keeps sequential address count for each location operated on.

8-BIT DATA: Eight ASCII P's or N's preceded by a B and followed by an F.

4-BIT DATA: Four ASCII P's or N's preceded by a B and followed by an F.

Binary Tape Format (9811-04/05) requires 8-level, binary characters on punched tape.
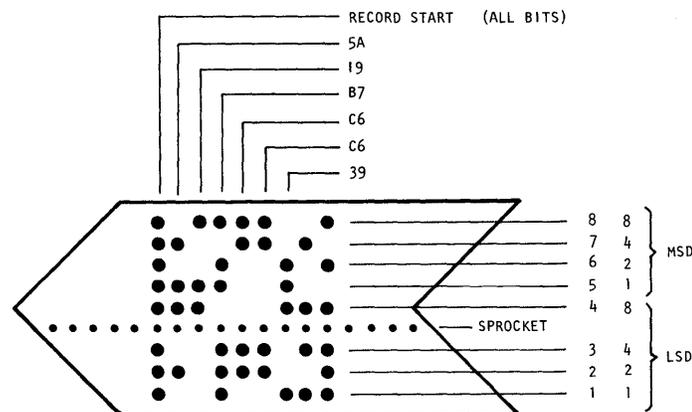
Figure 17-5 Binary Tape Format

ADDRESS: Address information must not be on tape. The M980 keeps sequential address count for each location operated on.

8-BIT DATA: Each 8-bit location is represented by an 8-bit binary character on tape. All binary combinations are legal for data.

4-BIT DATA: Only the lower four bits are stored; the upper half of the Buffer is unaffected.

START CHARACTER: The ASCII character "delete" must occur at the beginning of the data stream. Header information is allowed on the paper tape, if it precedes the "Delete" character. (Note that "delete" is all holes punched.)

ENDING CHARACTER: There is no ending character; the reader continues until the end of the defined field, even if blank tape is installed.

INTEL MDS Format (9811-06/07) provides an interface to the Pro-Log M301 PTR for reading MDS format paper tapes.
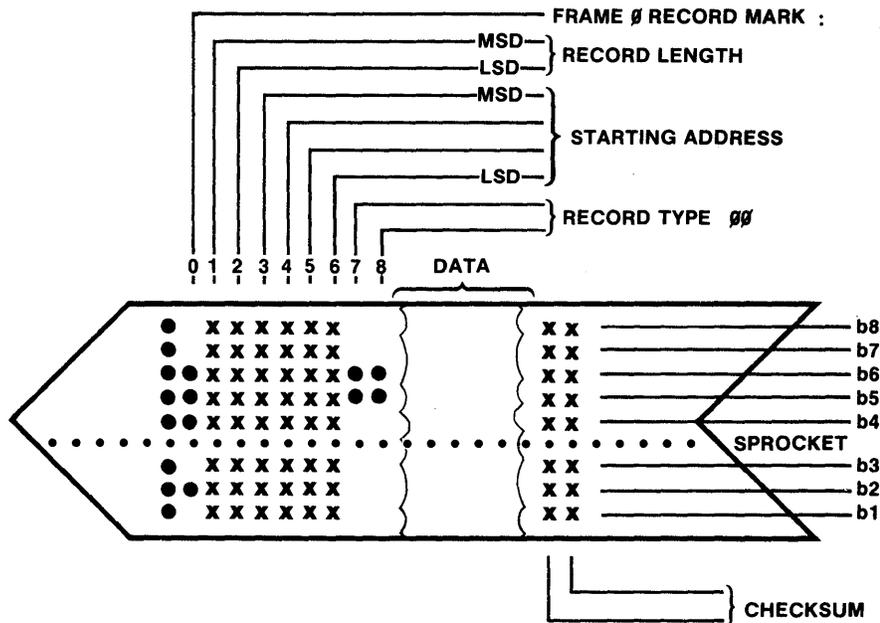
Figure 17-6   MDS Format

MDS-ASCII HEX Format requires 8-level, ASCII data coding where only the hexadecimal characters repre-sent data to be operated on.

ADDRESS: Starting at the tape-defined address, the M980 keeps sequential address count for each location operated on until byte count is exhausted, at which time a new line is searched for. If a Compare error occurs, RAM address and tape data are displayed until ENTER key is depressed, at which time comparing continues.

8-BIT DATA: Each 8-bit location to be operated on requires two sequential ASCII hex characters on tape. Non-hex characters are allowed and ignored but must occur as a start character at the beginning of the block stream. Header information is allowed on the paper tape, if it precedes the start character.

Frame 0
Record Mark = ASCII colon (:) marks the start of a record block.

Frames 1 and 2
Frame 1 = High Order Digit
Frame 2 = Low Order Digit
Record length in hexadecimal count of data bytes in this record block.

Frames 3 through 6 - Load Address
Frame 3 = High Order Digit
Frame 6 = Low Order Digit.
The first data byte will load at this address; next byte in ascending order, etc.

Frames 7 and 8 - Record Type
At this time, all record types are 00. This field may be used for future expansion.

Frames 9 upwards
These are for data digits. Each pair represents one 8-bit data byte in hexadecimal.

Final 2 Frames
These are the checksum. The checksum is the negative of the sum of all 8-bit bytes in the record evaluated modulo 256. The sum of all bytes in the record added to the checksum should be zero.

PAPER TAPE OPERATING SEQUENCES (9811—00 through —05 only)

DUPLICATE operating sequence: In the Duplicate operations (00, 02 or 04) data from the paper tape is programmed into the RAM Buffer in the following sequence:

1. Mount the paper tape, with the pattern to be programmed, on the M301 reader. Note that the tape is loaded with the Bit 1 (b1) row of holes closest to the unit, and feeds from left to right.
2. Turn the Reader Power and Reader Enable switches ON.
3. Depress RESET, the displays are blank.
4. Depress Key 1, "9811—00" is displayed.
5. Key in new format (02 or 04) if desired.
6. Depress ENTER, the First and Last Addresses of the Buffer are displayed.
7. Key in new Start and End Addresses for operation, using the hex keyboard.
8. Depress ENTER, the display indicates "1 FF AAA" for Input-Format-Active.
9. When completed, the display shows "9811—FF" for paper tape format. NOTE: FF = default format "00" or format keyed in during step 5. After "9811—FF" is displayed, a new format can be keyed in (example: Compare "01").

COMPARE operating sequence: In the Compare operations (01, 03 or 05) data from the paper tape is compared with the RAM Buffer in the following sequence:

1. Mount the paper tape with the pattern to be programmed on the M301 reader. Note that the tape is loaded with the Bit 1 (b1) row of holes closest to the unit, and feeds from left to right.
2. Turn the Reader Power and Reader Enable switches ON.
3. Depress RESET, the displays are blank.
4. Depress Key 1, "9811—00" is displayed.
5. Key in new format (~~02 or 04) if desired.~~ (01, 03, or 05) if desired.
6. Depress ENTER, the First and Last Addresses of the Buffer are displayed.
7. Key in new Start and End Addresses for operation, using the hex keyboard.
8. Depress ENTER, the display indicates "0 FF AAA" for Output-Format-Active.
9. When completed, the display shows "9811—FF" for Paper Tape Format. NOTE: FF = default format 00 or format keyed in during step 5.

If a Compare error occurs, RAM address and tape data are displayed until ENTER key is depressed, at which time comparing continues.

PAPER TAPE OPERATING SEQUENCES (9811—06 and 07)

DUPLICATE operating sequence: In the Duplicate operation (06), data from the paper tape is programmed into the RAM Buffer in the following sequence:

1. Mount the paper tape with the pattern to be programmed on the M301 reader. Note that the tape is loaded with the Bit 1 (b1) row of holes closest to the unit, and feeds from left to right.
2. Turn the Reader Power and Reader Enable switches to the ON positions.
3. Depress RESET, the displays are blank.
4. Depress Key 1, "9811—00" is displayed.
5. Key in "06" using the hex keyboard.
6. Depress ENTER, the display indicates "1 06 AAA" for Input-Intel MDS-Active.
7. When completed, the display shows "9811—06." NOTE: When "9811—06" is displayed, a new format may be keyed in (example: Compare "07").

COMPARE operating sequence: In the Compare operation (07) data from the paper tape is compared with the RAM Buffer in the following sequence:

1. Mount the paper tape, with the pattern to be programmed on the M301 reader. Note that the tape is loaded with the Bit 1 (b1) row of holes closest to the unit, and feeds from left to right.
2. Turn the Reader Power and Reader Enable switches ON.
3. Depress RESET, the displays are blank.
4. Depress Key 1, "9811—00" is displayed.
5. Key in "07" using the hex keyboard.
6. Depress ENTER, the display indicates "0 07 AAA" for Output-INTEL MDS-Active.
7. When completed, the display shows "9811—07." NOTE: When "9811—07" is displayed, a new format may be keyed in.

ERROR INDICATION

If a Checksum error should occur during Duplicate operation, an "E6" is displayed. A warbling tone sounds if the Audio switch is ON.

If a Compare error occurs, RAM address and tape data are displayed until ENTER key is depressed, at which time comparing continues.

9812-02 TTY INTERFACE

9812 Auto-Baud TTY

The 9812 to the M980 programmer provides an ASCII hex coded TTY interface with automatic baud rate selection from 1 to 300 baud.

Auto-Baud
- Data Rate Range: 1 to 300 baud.
- Auto-baud sense character: Carriage Return or any character with an odd hex code (B, D, F, H...1, 3, 5 etc.).

Electrical Interface (Serial Interface Connector)
- Keyboard input: Polar, 20 mA; input resistance 5.1kΩ; open circuit voltage (pins 5 and 9 to pin 4); 18.2V maximum.
- Printer output: Polar, 20 mA; output resistance 220 ohms; output current forcing compliance voltage +5.8V maximum.
- Relay Driver: Connector pin 1 supplies -12.4V to relay coil; connector pin 6 sinks up to 60 mA maximum relay coil current.
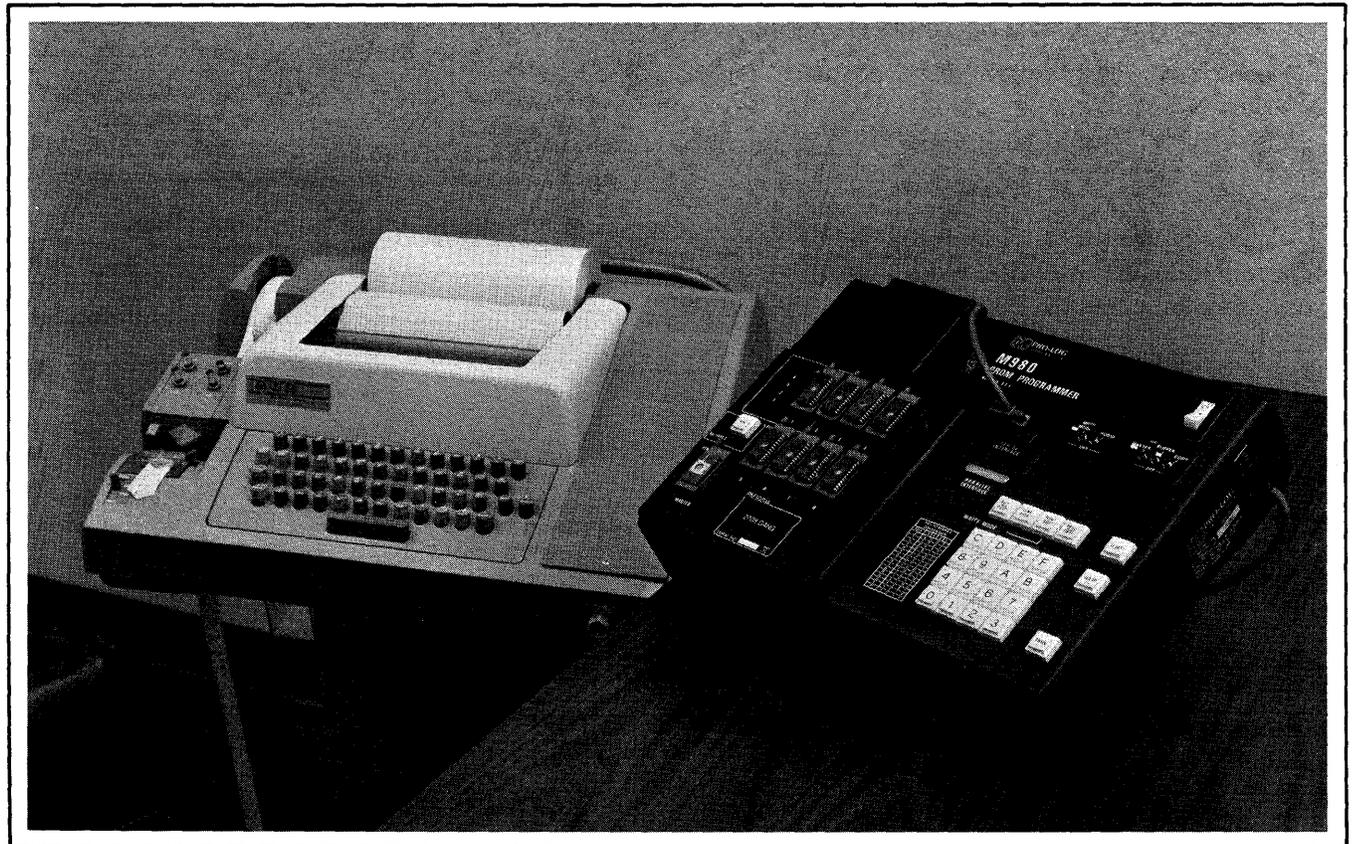
Figure 18-1   M980 with TTY

TTY CONTROLS AND INDICATORS

Mode Switch: A three position rotary switch located to the lower right of the TTY keyboard.
- LOCAL position allows local TTY control.
- OFF position disables the TTY.
- LINE position allows remote control of the TTY and is the setting for operating with the M980

READER CONTROL SWITCH: A multi-position switch located on the TTY Paper Tape Reader. Manual and Automatic readers have different controls.

Manual Reader: A three position lever switch.
- ON is the reader on position
- OFF is the reader off position
- FREE is the position for loading and unloading paper tape

Auto Reader: A four position lever switch.
- MANUAL START is a momentary contact to start the reader in Local.
- AUTO is the normal position for remote operation.
- MANUAL STOP is a momentary contact to stop the reader in Local.
- FREE is the position for loading and unloading paper tape.

Punch Controls: Four push-buttons located on the punch.
- ON enables the punch.
- OFF disables the punch.
- RELEASE disengages the punch drive for tape loading.
- BACK SPACE moves tape backward one character.

TTY PAPER TAPE FORMAT (9812–02)

Requires 8 level, ASCII data coding where the hexadecimal characters represent data to be operated on. When a tape is generated in the List Mode the actual format becomes: Data, Space, Data... with sixteen locations followed by a Carriage Return and Line Feed.

ADDRESS: Address information must not be on the tape. The M980 keeps sequential address count for each location operated on.

8-BIT DATA: Each 8-bit location to be operated on requires two sequential ASCII hex characters on tape. Non-hex characters are allowed and ignored but must not occur between the two hex data characters to be programmed.

4-BIT DATA: Each 4-bit location to be operated on requires one ASCII hex character on tape. Non-hex characters are allowed and ignored.

ENDING CHARACTER: The data stream can be terminated by the ASCII character slash (/) if less than a full PROM is to be operated on.

TTY KEYBOARD COMMANDS

Commands to the M980 from the TTY keyboard consist of a 4-digit hex Start Address followed (without spaces) by a 4-digit hex End Address, followed by a single letter command which designates an operation.

The Start and End Addresses define the portion of the RAM Buffer to be operated on. This may be as small as one location, in which case the Start and End Addresses are the same, or as large as the entire Buffer.

After the user types the desired Start and End Addresses, the M980 types a space and waits for one of the following single letter operation codes:

L = List (M980 — TTY)
P = Program (TTY — M980)
D = Duplicate (Tape — M980)
C = Compare (Tape — M980)
T = Tape Punch (M980 — Punch)

The M980 can operate without a Personality Module installed. The PROM data width (generally 4 bits or 8 bits) is defined by the Personality Module, which in turn defines the width of the RAM Buffer.

If no Personality Module is installed, the data width is 8 bits. If a 4-bit Personality Module is installed, the M980 regards one Buffer location as a 4-bit word, which is the equivalent of one hex character. Thus the M980 prints and accepts one hex character per Buffer location with 4-bit Personality Modules. The four Least significant Buffer bits are used at each location.

8-bit Personality Modules establish an 8-bit data width (one byte) for the Buffer. Thus the M980 prints, and accepts two hex characters per Buffer location when an 8-bit Personality Module is installed.

TTY KEY	MODE	9812-02 OPERATION
L	LIST	Prints the content of the Buffer from the Start address to the End Address. Sixteen Buffer locations are printed on each line, with the content of each location separated by a space. Leading spaces are inserted on the first line to maintain the hex address orientation of the printout. Buffer memory pages are separated by a blank line.
P	PROGRAM	Loads the Buffer from the Start Address to the End Address with hex data typed from the TTY keyboard. The current Buffer Address is printed by the M980, followed by a Space. The user then types the hex data to be loaded into the Buffer, and the M980 responds with Carriage Return-Line Feed and proceeds to the next Address.
D	DUPLICATE	Loads the Buffer with ASCII-hex data from a paper tape. The M980 recognizes all ASCII-hex characters as data and stores them sequentially beginning at the Start Address and finishing when End Address or a /(slash) is reached. Non-hex characters are ignored.
C	COMPARE	Compares Buffer content to paper tape ASCII-HEX data. The tape data is compared Address by Address to the data in the Buffer beginning at the Start Address and finishing at the End Address or a / (slash) is reached.
T	TAPE PUNCH	This Mode is similar to List but is used with the Tape Punch turned ON. A 64-character leader and a second ★ (Asterisk) precedes the data printout, which is followed by additional leader. Tape memory pages are separated by 16 null Characters to improve readability of the paper tape.

Figure 18-2   Operating Modes

TTY OPERATING SEQUENCES (DATA ONLY) 9812-02

The TTY takes control of the M980 whenever the following sequence is followed.
1. Connect TTY machine to 9 Pin "D"-type connector as shown on Figure 18-1.
2. Depress RESET on M980. The 8 hex displays are blank.
3. Depress Key 2. 9812-02 is displayed.
4. Depress ENTER. The display will show "A 02 AAA" for Auto-Baud.
5. Send CR from TTY. The M980 responds with a CR, LF, A̶s̶t̶e̶r̶i̶s̶k̶(̶★̶)̶, and displays"02 AAA".

At this point, the user has established contact with the M980 and has selected the Format and Baud rate.

LIST OPERATING SEQUENCE:

1. Type in the hex characters that define the Starting and Ending Addresses of the field to be listed, from the TTY keyboard.
2. The TTY responds with a Space (SP).
3. Type in an "L" (upper case). The TTY does a CR, LF, and begins to automatically list the Buffer contents over the previously defined Address field. The display shows "0 02 AAA" to indicate Output-02 Format-Active.

    If it is desired to punch a tape, the Punch should not be turned ON after the entry of the last character in the field definition. This ensures that the field information will not be on the tape where it would be interpreted as valid data.

5. When the TTY reaches the end of the field, it does a Space (SP), Slash (/), CR, LF.

EXAMPLE of 9812–02 List:
00000013 L
00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 /

PROGRAM OPERATING SEQUENCE: *PROGRAMMED*

1. Type in hex characters that define the Starting and Ending Addresses of the field to be ~~listed~~, from the TTY keyboard.
2. The TTY responds with a Space (SP).
3. Type in a "P" (upper case). The TTY does a CR, LF, and prints the First Address and another Space (SP).
4. Type in the data to be programmed, MSD first, the M980 responds with a CR, LF, and prints the next sequential Address.
5. When the End Address is reached, the TTY does a Space (SP), Slash (/), CR, LF.

EXAMPLE of 9812–02 Program:
01000106 P
0100 00
0101 01
0102 02
0103 03
0104 04
0105 05
0106 06 /

DUPLICATE OPERATING SEQUENCE:

1. Load the paper tape to be duplicated on the TTY Paper Tape Reader.
2. Place the Paper Tape Reader Control Switch in the AUTO position.
3. Type in the hex characters that define the Starting and Ending Addresses for the field to be Duplicated from the TTY keyboard. The TTY responds with a Space (SP).
4. Type the letter "D" (upper case) on the TTY keyboard. The reader begins to read the data information. The M980 automatically increments the Address. (If the TTY is not equipped with a modification for Tape Reader Control, it must be manually started at this point.)
5. The Duplicate operation ends with the TTY printing a Slash (/), CR, LF.

EXAMPLE of 9812–02 Duplicate:

000003FF D/

COMPARE OPERATING SEQUENCE:

1. Load the paper tape to be compared to the Buffer.
2. Place the Paper Tape Reader Control Switch in the AUTO position.
3. Type in the hex characters that define the Starting and Ending Addresses for the field to be compared from the TTY keyboard. The TTY responds with a Space (SP).
4. Type the letter "C" (upper case) from the TTY keyboard. The Reader begins to read the data information and compares it to the data in the Buffer, one Address at a time from Start to End. (If the TTY is not equipped with a modification for reader tape control, the Reader should be manually started). The M980 automatically increments the Address. If the data on the tape and the Buffer data do not compare, the TTY prints the Buffer Address and data. The Compare operation does not stop on non-compares.
5. The Compare operation ends with the TTY printing a Slash (/), CR, LF.

EXAMPLE of 9812—02 Compare:
000007FF C
0100 D9   Location 0100 does not compare with the tape.
/   Data shown is from Buffer.

TTY ERRORS

If a Duplicate or Compare error occurs, and the Paper Tape Reader modification is not installed, the tape continues to step and the M980 displays the address and data of the tape. The tape runs until the end and the M980 ignores any information past the error location.

"E5" is displayed if the TTY cable is not connected when the Interface is selected.

"E6" is displayed if the Baud rate of the CR sent is below 1 Baud (possibly a shorted cable) or above 300 Baud.

Any non-hex character sent during the address field definition will cause the M980 to respond with a ?, CR, LF. The address field may now be redefined.

Any non-hex character sent during the ~~address field definition~~ DATA TRANSMISSION causes the M980 to respond with a CR, LF, and reprint the Current Address to be programmed, and a Space (SP).

TTY OPTIONS AND MODIFICATIONS

The TTY interface requires the following options and modification in the teletype unit:

1. 20 milliamp current loop option
2. Full duplex option
3. Remote reader control modifications

The 20 milliamp current loop and the full duplex connection are options available on the teletype unit. The remote reader control requires the addition of a 12 to 15 volt DC relay capable of switching the high voltage reader circuit inside the TTY.

A number of mini-computers specify a similar interface; thus, many teletypes already have the required configuration. Detailed instructions for modifying a TTY to this configuration are given in the following paragraphs.

REMOVING THE TTY HOUSING

It is necessary to remove the TTY housing to inspect or modify the TTY options.

1. Unplug the TTY from any power source.
2. Remove the roll of TTY printer paper from its cradle.
3. Remove the manual paper feed knob by pulling firmly.
4. Remove the mode select knob located on the right front by pulling firmly.
5. Remove the metal trim panel behind the mode select knob by prying downward.
6. Remove the 4 screws under the metal trim panel.
7. Remove the screw on the left side of the paper tape reader housing.
8. Remove the four knurled knobs along the lower rear edge of the housing.
9. Lift upward on the housing to remove, being careful of the controls on the Paper Tape Reader as they clear their openings in the housing.
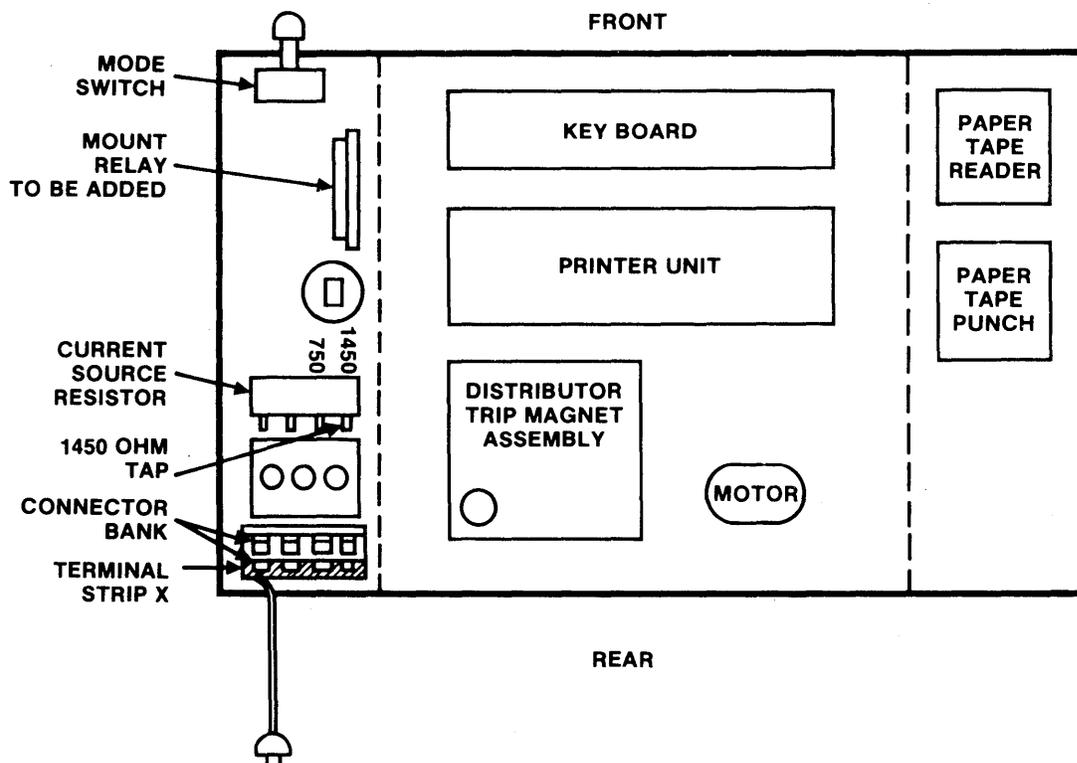
Figure 18-3   Top View - TTY with Housing Removed

18-6
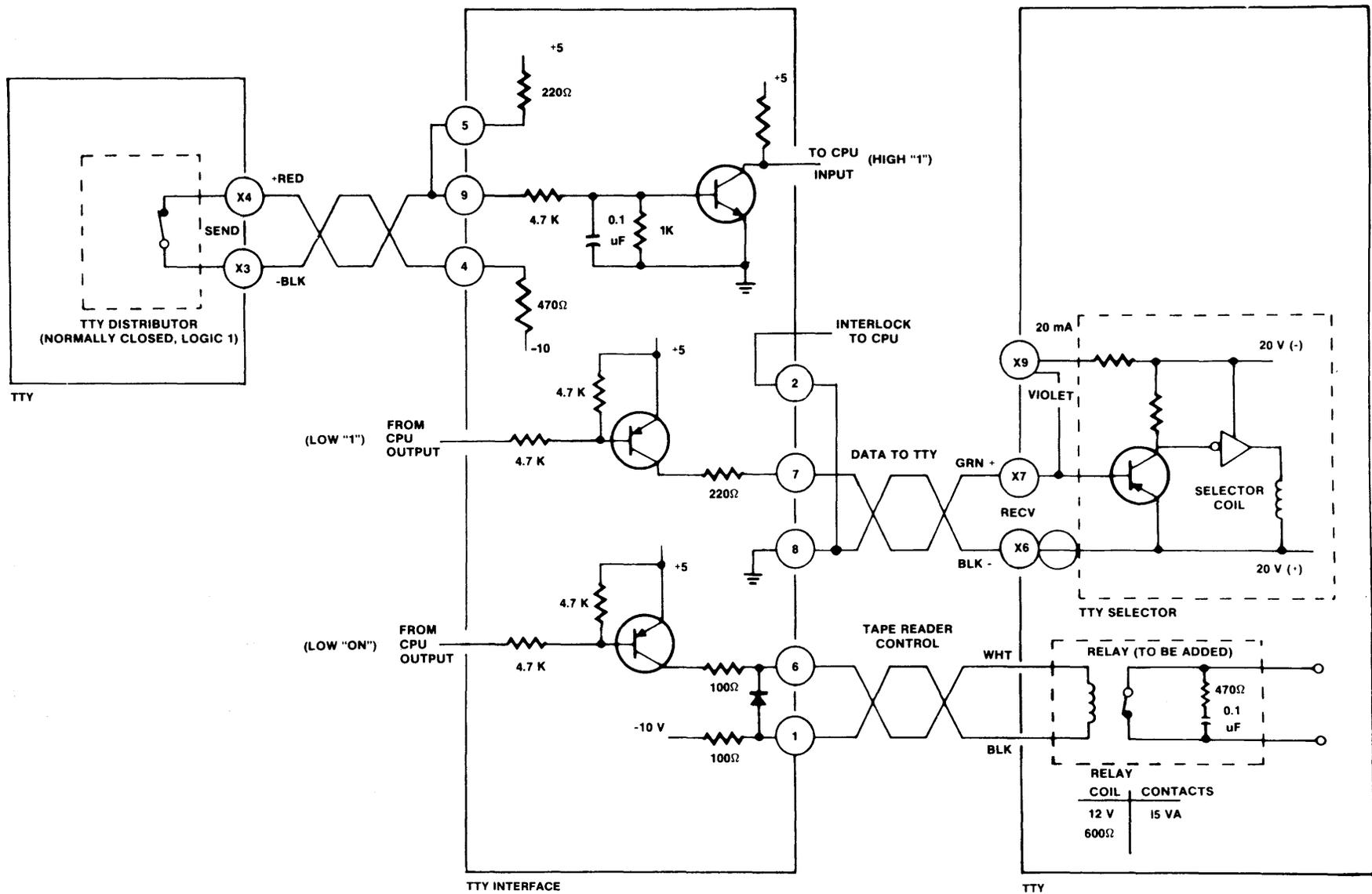
Figure 18-4   TTY Interface Circuit

Current Loop Option

The TTY Send and Receive Current Loop can be optionally selected to work from either 20 milliamp or 60 milliamp. When the selection is made, both the Internal Current Source and the Selector Drive Current Bias must be modified to be compatible.

Internal Current Source

The Internal Current Source is set to 20 milliamp by putting the blue wire on the 1450 ohm tap of Power Resistor R1 located on the right side of the TTY.

Selector Drive Current Bias

The Selector Drive Current Bias is set to 20 milliamp by optional wiring on Terminal Strip X located below the Connector Bank in the right rear corner of the TTY. In making this change various wiring configurations may be encountered as shown in Figure 18-5 depending on whether the unit has an Elapsed Time Meter.

TTY Without Elapsed Time Meter

If wired as 1A: Do nothing; this is the correct connection for 20 milliamp without an Elapsed Time Meter.

If wired as 1B: Remove the violet wire from Terminal X8 and move it to X9 with the yellow wire.
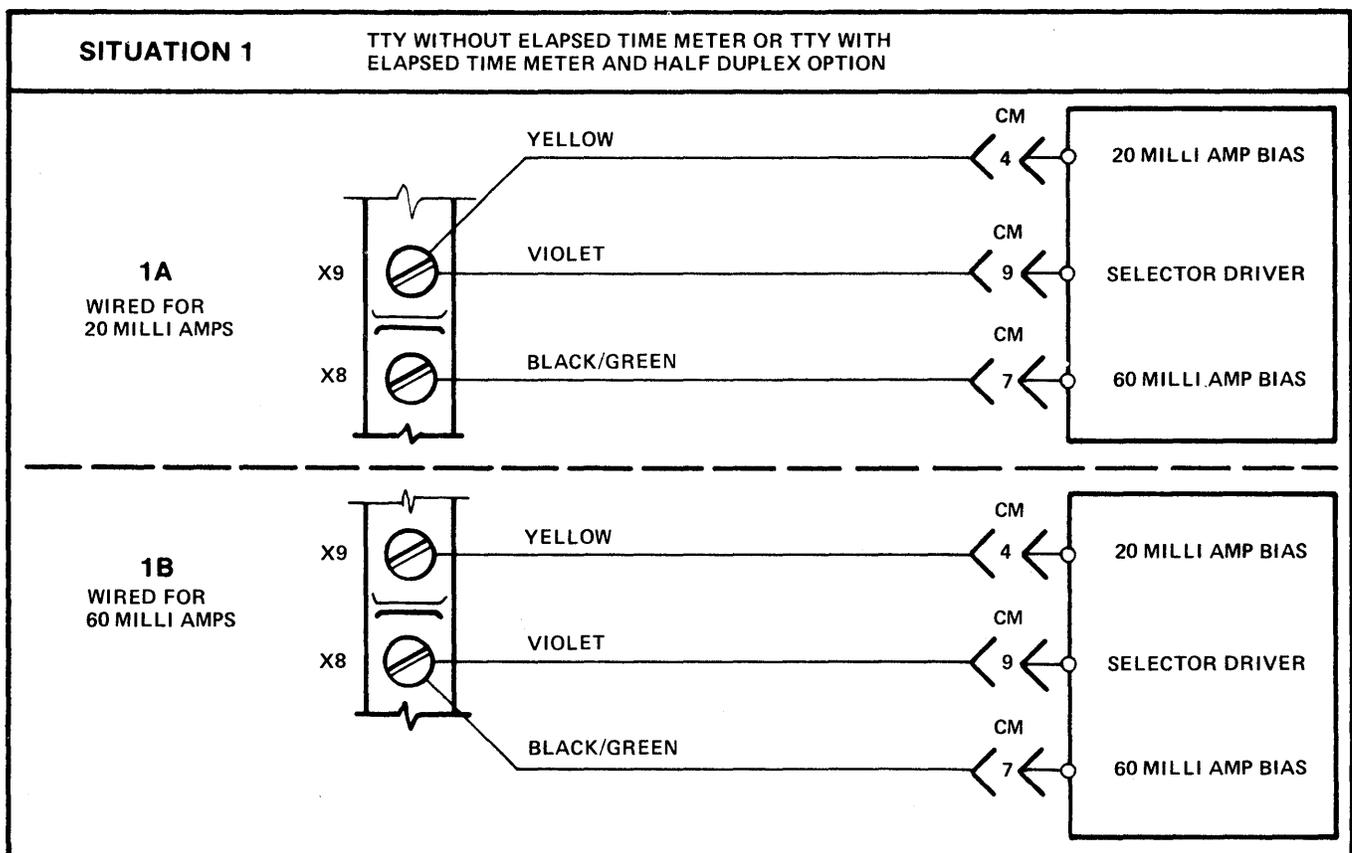
Figure 18-5   Current Loop Option

MODE SWITCH

CONNECTOR BANK

P1 P2 P3 P4

P5 P6 P7 P8

RELAY TO BE ADDED

CURRENT SOURCE
RESISTOR R1

TERMINAL STRIP X
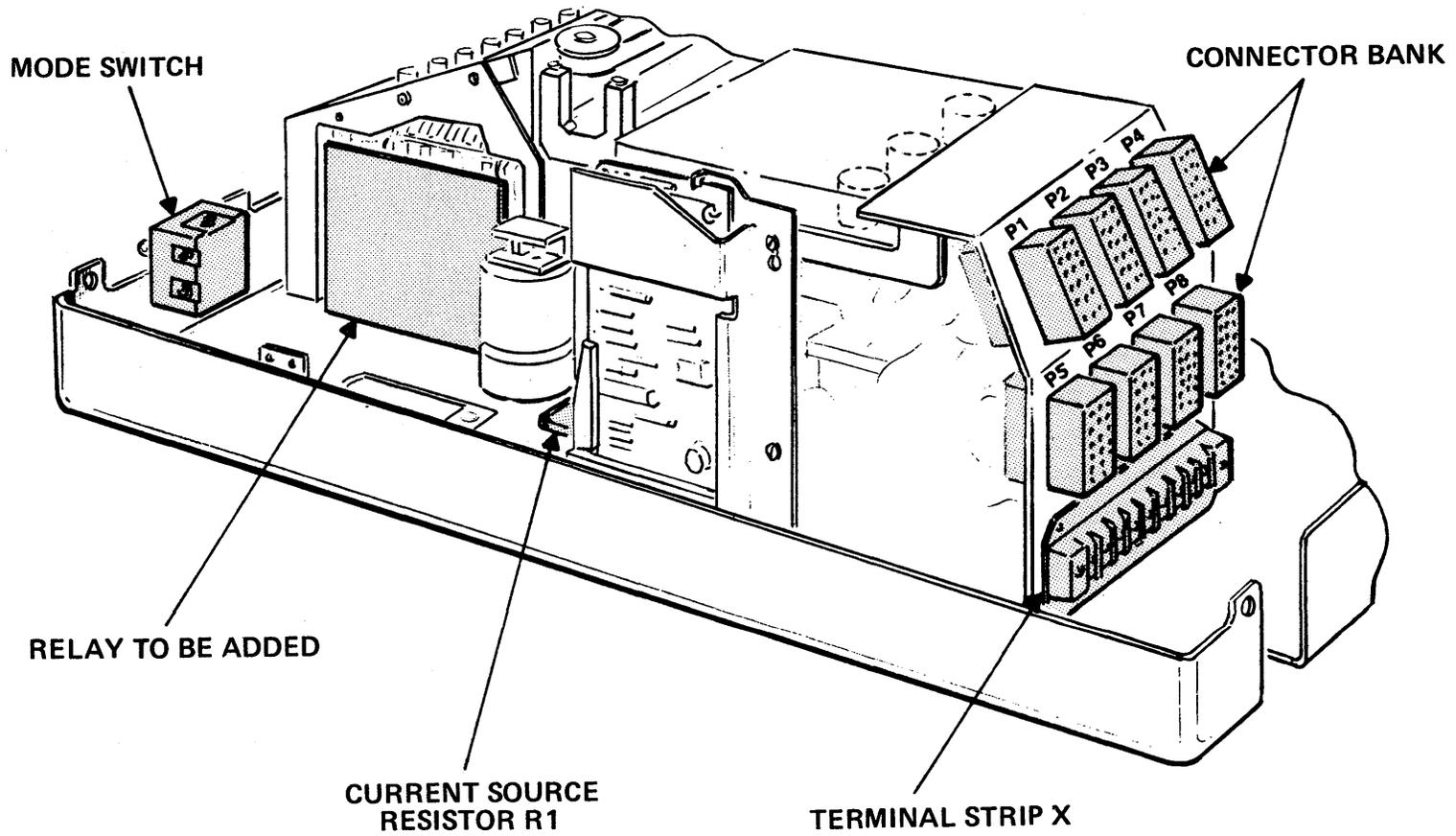
Figure 18-6   Side View - TTY with Housing Removed
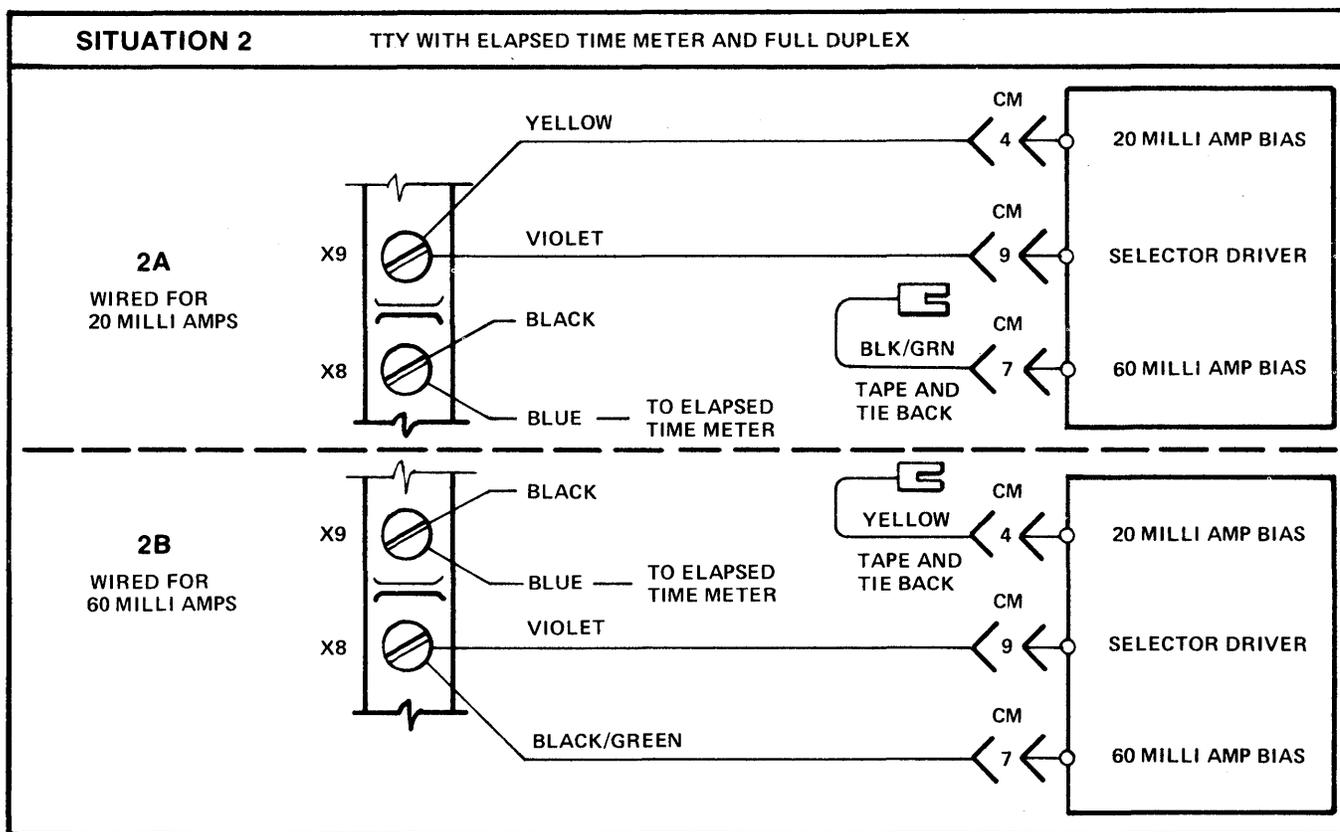
Figure 18-7   Current Loop Option

TTY With Elapsed Time Meter

A TTY with an elapsed time meter may be wired as 1A, 1B, 2A or 2B. To modify for 20 milliamp:

If wired as 1A: Remove the black/green wire from X8, tape the exposed end and tie-back into the wire bundle. Locate a black wire and a blue wire on terminal X5. Move both wires from X5 to terminal X8.

If wired as 1B: Remove the violet wire from X8 and move it to X9. Remove the black/green wire from X8; tape the exposed end and tie-back into the wire bundle. Locate a black wire and a blue wire connected on terminal X5. Move both wires from X5 to X8.

If wired as 2A: Do nothing; this is correct connection for 20 milliamp with an elapsed time meter.

If wired as 2B: Remove the black wire and blue wire from X9. Remove the violet wire and black/green wire from X8. Connect the black wire and blue wire to X8. Connect the violet wire to X9. Locate the yellow wire taped back in the wire bundle. Connect the yellow wire to X9. Tape the exposed and of the black/green wire and tie-back into wire bundle.

18-10

Full Duplex Option

The full duplex option is wired into the TTY on Terminal Strip X located below the Connector Bank in the right rear corner of the unit.

If the TTY is wired for Half-Duplex, Terminal Strip X should appear as in Figure 18-8.

If the TTY is wired for Full-Duplex, Terminal Strip X should appear as in Figure 18-9.
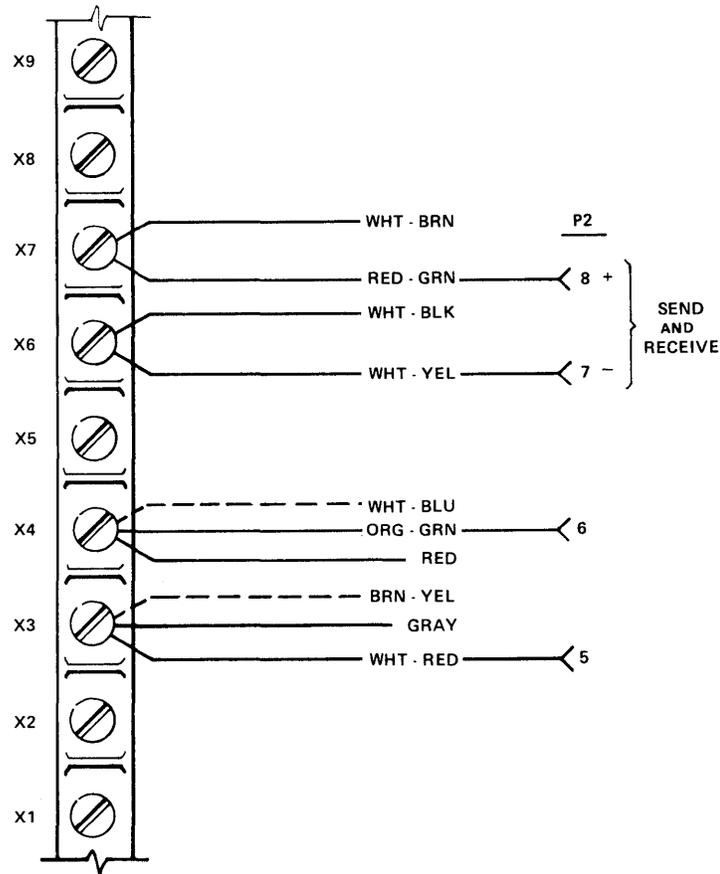
Figure 18-8   TTY Half-Duplex Option

To convert from half-duplex to full-duplex:

1. Confirm that screw lug X5 has no wires connected. If there is a BLACK wire and a BLUE wire on X5 an elapsed time meter is installed. Refer to the CURRENT LOOP option for instructions on moving the black wire and blue wire from X5 to X8.

2. Move the white/blue wire from screw lug X4 to X5.

3. Move the brown/yellow wire from screw lug X3 to X5.
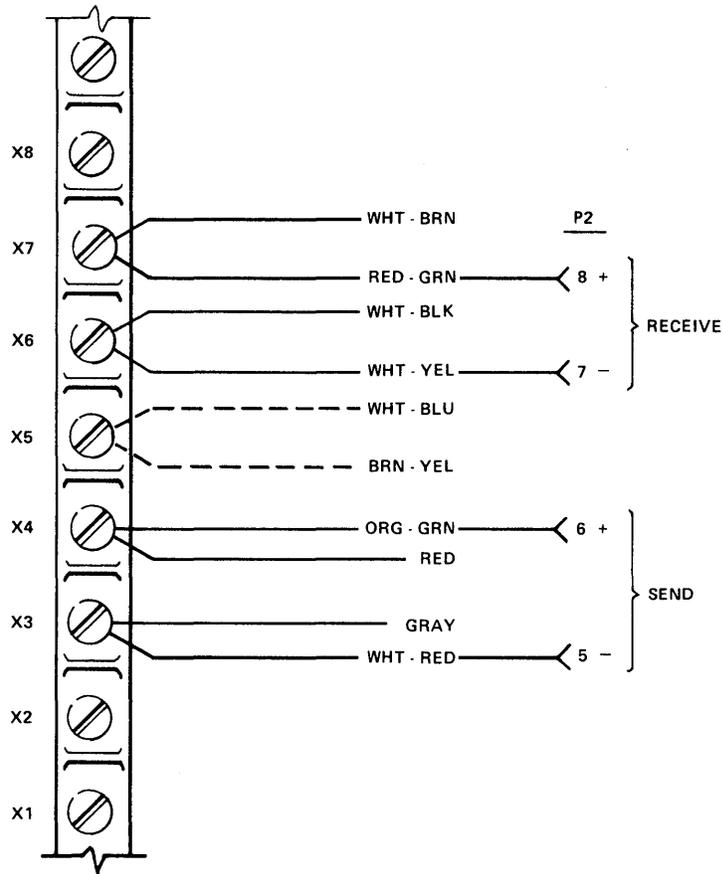
Figure 18-9   TTY Full-Duplex Option

Remote TTY Reader Control

The wiring of standard teletype does not allow the TTY paper tape reader to be used remotely as a stand-alone input device. By modifying the distributor trip circuit for remote operation the TTY reader can be advanced one character at a time for total reader control.

TTY circuits operate from 115 VAC or 48 VDC requiring remote logic control circuits to be relay buffered. Two basic reader circuits will be encountered in TTY reader modification, Manual and Automatic. The Manual and Automatic readers are identified by the reader control switch located on the Paper Tape reader. The Manual reader has a three position switch labeled ON, OFF, FREE. The automatic reader has a four position switch labeled MANUAL START, AUTO, MANUAL STOP, FREE.

Manual Reader Operation

The 115 VAC Manual Reader Circuit is operated in either the Line or Local Modes by the ON-OFF switch located on the Reader.

The Manual Reader Circuit can be controlled remotely by adding a relay to control the reader trip coil in the Line Mode. Modifying the reader circuit as shown in Figure 18-10 allows normal operation in the Local Mode and remote control in the Line Mode.

Manual Reader Modification

1. Locate Plug P4.
   Locate the blue wire connection P4 pin 3 and P4 pin 11.
   Locate the orange wire on screw lug L1 of the Mode switch.
   Locate the L2 of the Mode switch (no wires).
   Locate the orange/gray wire on screw lug 1 of the Mode switch.
   If the wire colors do not agree, do not proceed with this modification unless the connections can be verified to agree with those of Figure 18-10.
2. Cut the blue wire near P4 pin 3.
3. Splice wire A from the new Relay to the portion of the blue wire still connected to P4 pin 11.
4. Connect wire B to screw lug L1 of the Mode switch.
5. Connect wire C to screw lug L2 of the Mode switch.
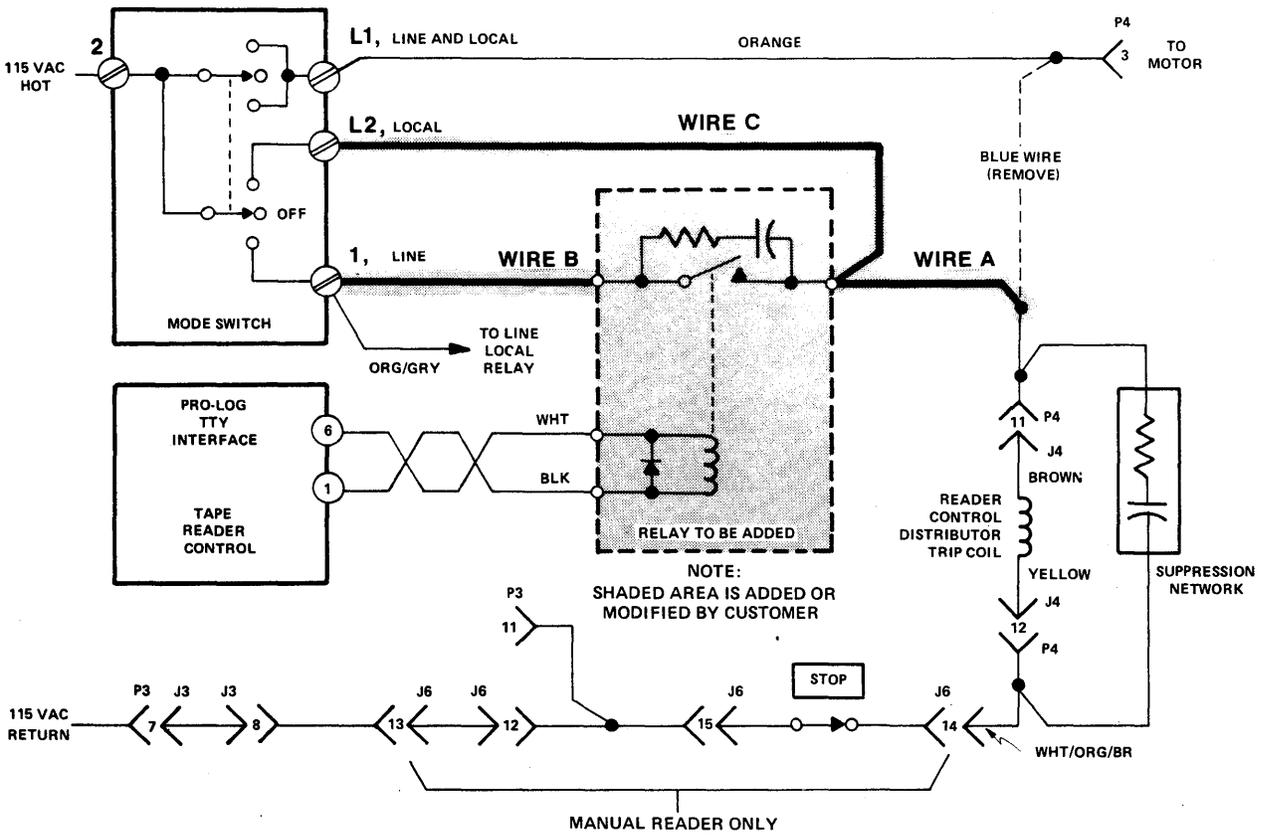
Figure 18-10   TTY Modification (Manual Reader)

Auto Reader Operation

The 115 VAC Automatic Reader Circuit is normally open due to the TDC Relay contact. The 48 VDC TDC Relay can be operated by the momentay Manual Start switch on the Reader or by the DC1 data function. Once the TDC Relay operates, it holds itself energized until the momentary Manual Stop switch on the Reader is activated. The DC3 and ENQ data functions will also stop the Reader.

The Automatic Reader circuit can be controlled remotely by adding a Relay to control a contact closure in parallel across the TDC Relay contact as shown in Figure 18-11.

18-13

Auto Reader Modification

1. Locate jack J6 connected to plug P6.
   Locate the yellow/green wire at J6-13.
   Locate the blue wire at J6-14.
   If the wire colors do not agree, do not proceed with this modification unless the connection can be verified to agree with those of Figure 18-11.
2. Connect wire A from the new Relay to the blue wire at J6-I4.
3. Connect wire B from the new Relay to the yellow/green wire at J6-13.
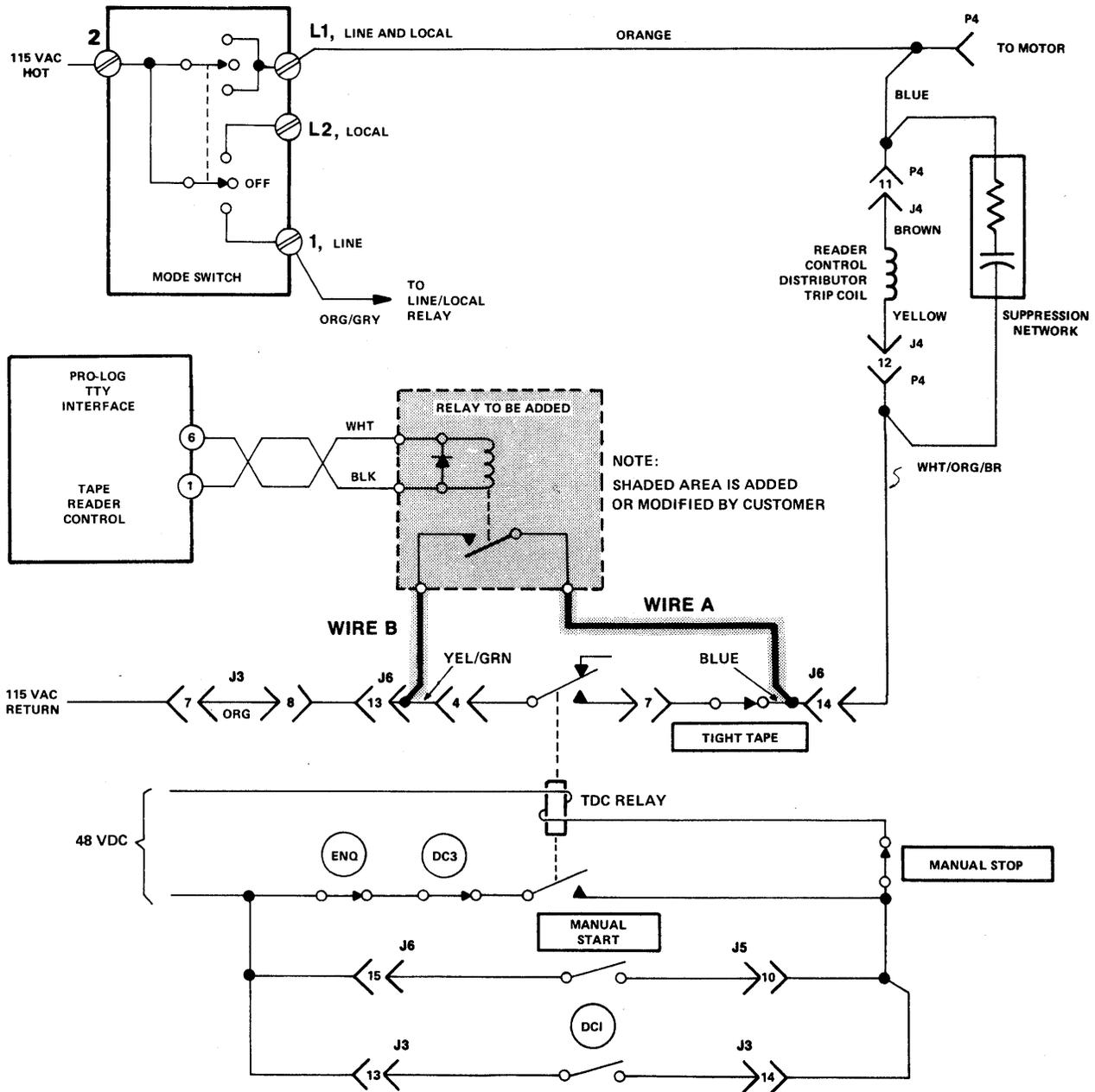
Figure 18-11   TTY Modification (Auto Reader)

9814, COMPUTER INTERFACE

9814 Computer Interface

The 9814 computer interface provides an 8-bit parallel data path for transferring data to or from a computer and to or from the M980 RAM Buffer.

NOTE: M304 ADAPTER IS NOT NEEDED TO USE THE 9814 COMPUTER INTERFACE.
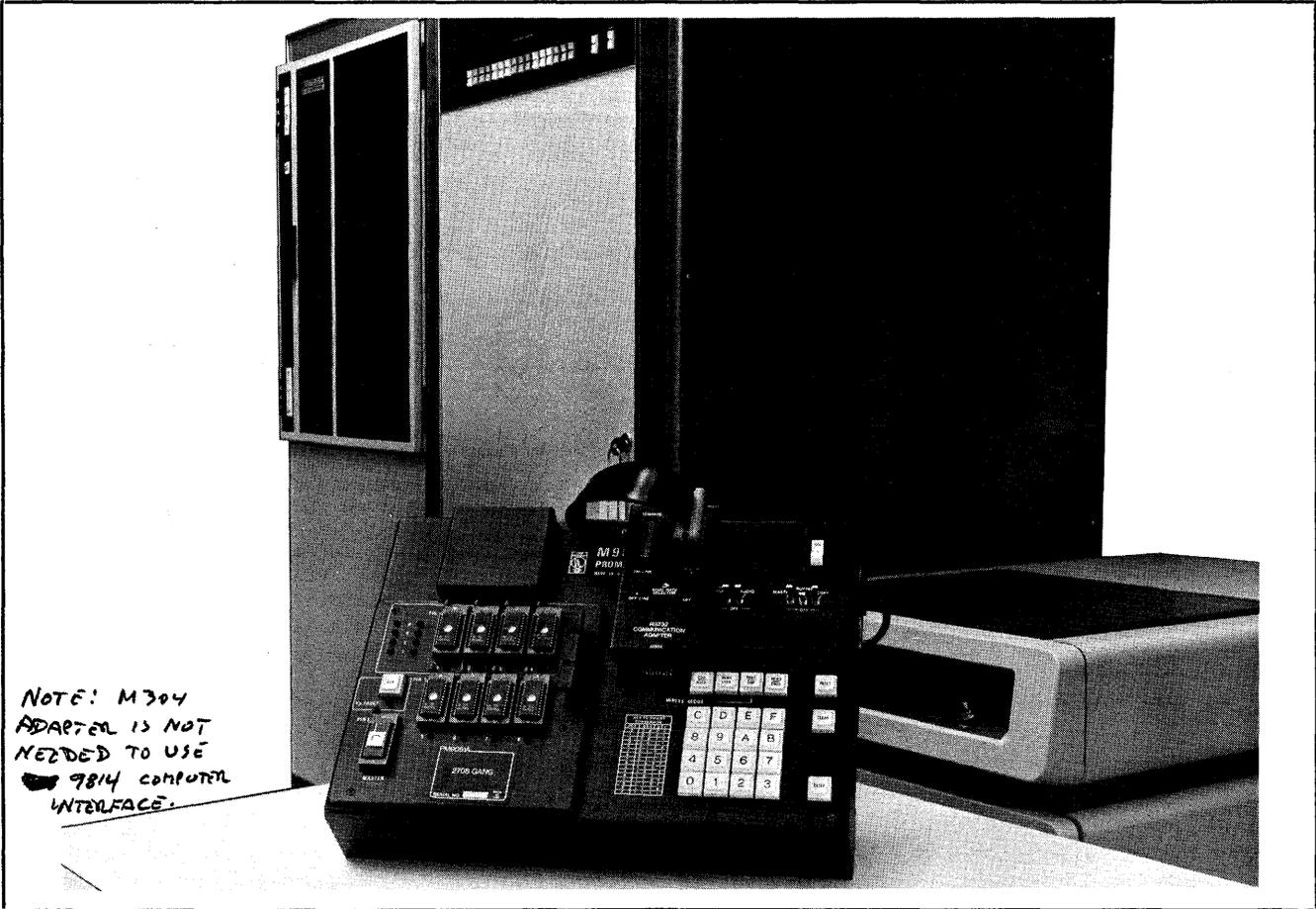
Figure 19-1   Computer Interface

Master or Slave Operation

The M980, through its parallel interface, can be configured as a Master Controller or a Slave Unit to a remote computer. The configuration is controlled by the cable interconnection and the keyboard selected formats of the M980, shown in the figure below.

FORMAT	CONFIGURATION
9814-00	Slave Unit (default format)
9814-01	Master Controller write to Slave unit.
9814-02	Master Controller read from Slave unit.

Figure 19-2   9814 Format Selection

9814—00, M980 Slave Unit Operation

The default format 9814—00 configures the M980 as a Slave Unit, allowing a remote Master Controller to either write data to the M980 Buffer or read data from the M980 Buffer. This configuration puts the remote computer in command of the M980.
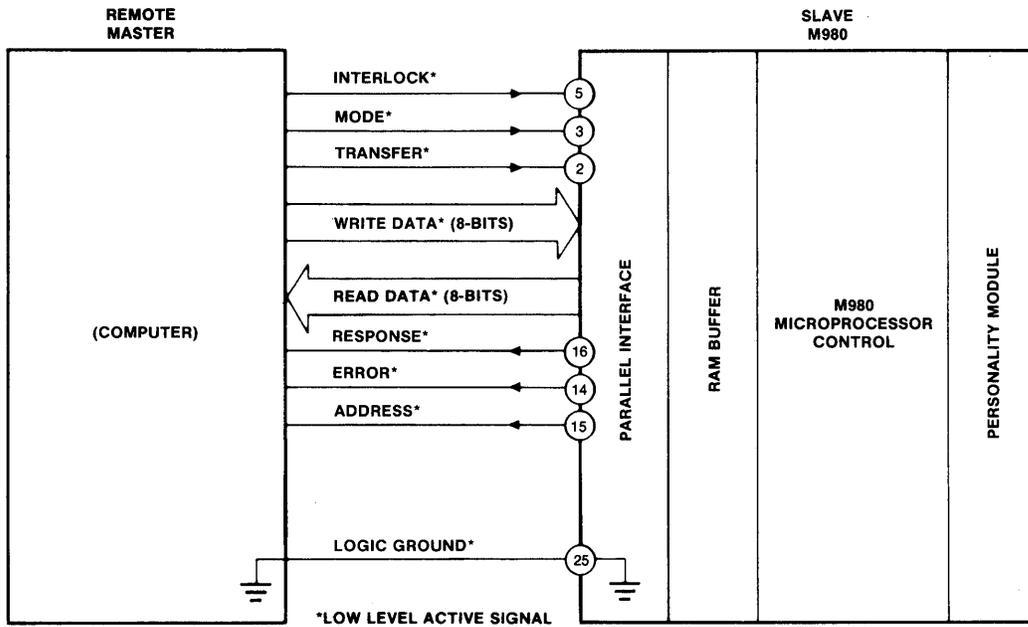
Figure 19-3   M980 Configured as a Slave Unit

9814—01 and 9814—02, M980 Master Controller Operation

Master formats 9814—01 and 9814—02 allow the M980 to be configured as a Master Controller, to send data from its Buffer to a remote Slave Unit or to receive data into its Buffer from a remote Slave Unit. This configuration puts the M980 in command of the remote computer.
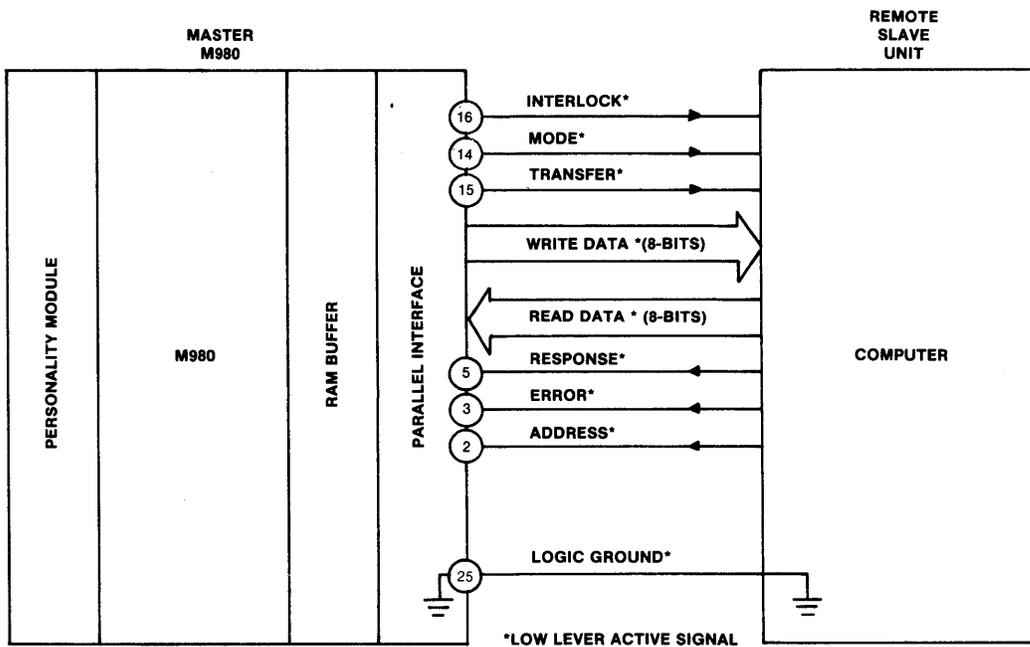
Figure 19-4   M980 Configured as a Master Controller

19-2

SUMMARY OF OPERATION

The Master Controller sends a Start Address and an End Address to the Slave Unit, to define the field size for the M980 Buffer memory. When address field definition is completed, the Master Controller selects either the Write or Read Mode and initiates the data transfer between the M980 Buffer and the remote computer. Eight bits of data are transferred for each address location.

When the complete field of data has been transferred, the M980 Slave Unit resets to the address field definition for the next operation. The M980 Master Controller returns to select another format or repeat the same format.

Address Field Definition

The address field of the M980 Buffer must be defined, with a Start Address and an End Address, by the Master Controller for each operation. The address field is sent as eight hexadecimal characters, in which each hex character represents four bits of the binary address. In the 8-bit character sent to the M980 for field definition, the low-order 4 bits contain the hex address character.

PARALLEL I/O
WRITE DATA SIGNALS
FOR ADDRESS FIELD DEFINITION
AND DATA TO BE PROGRAMMED

		START ADDRESS MOST SIG. CHAR.				END ADDRESS MOST SIG. CHAR.			DATA	
SIGNAL	PIN	0	0	0	0	3	F	F	F	E5	B6
WRITE DATA 8*	8	◄— —	— — —	— — —	— ·NOT USED—	— — —	— — —	— — ►	L	L
WRITE DATA 7*	6	◄— —	— — —	— — —	— ·NOT USED—	— — —	— — —	— — ►	L	H
WRITE DATA 6*	13	◄— —	— — —	— — —	— NOT USED —	— — —	— — —	— — ►	L	L
WRITE DATA 5*	10	◄— —	— — —	— — —	—·NOT USED—	— — —	— — —	— — ►	H	L
WRITE DATA 4*	9	H	H	H	H	H	L	L	L	H	H
WRITE DATA 3*	7	H	H	H	H	H	L	L	L	L	L
WRITE DATA 3*	12	H	H	H	H	L	L	L	L	H	L
WRITE DATA 1*	11	H	H	H	H	L	L	L	L	L	H

HIGH ORDER { WRITE DATA 8*, WRITE DATA 7*, WRITE DATA 6*, WRITE DATA 5* }
LOW ORDER { WRITE DATA 4*, WRITE DATA 3*, WRITE DATA 3*, WRITE DATA 1* }

MSB ▲ ... LSB — 4-BIT PROM / 8-BIT PROM

ABBREVIATIONS:
H ....HIGH LEVEL TTL SIGNAL
L ....LOW LEVEL TTL SIGNAL
MSB .....MOST SIGNIFICANT (DATA) BIT
LSB .....LEAST SIGNIFICANT (DATA) BIT

Figure 19-5 Data Signals for Address Definition

M980/M900B Recognition Code ("0A")

The M980 Slave places an "0A" (binary 0000 1010) on the read data lines to signify that this unit is a 9814 option, as opposed to a 9114 option used on the M900B programmer.

The "0A" occurs just before Address goes low and remains during the address portion of the operation.

The M980 requires 8 characters to define the address field, whereas the M900B only requires 6 characters. The "0A" recognition code allows the Master Controller to identify which model is connected. The recognition code can be ignored if M900B compatibility does not matter.

9814—00 Operating Procedure (M980 Slave Unit)

Connect the Master Controller to the M980 via the parallel interface connector. Depress Key 4 on the M980 keyboard. The M980 display shows "9814 00." Ensure that the Master Controller is conditioned to hold the INTERLOCK signal low. Depress the ENTER key. The display shows "A 00 AAA." If the interface connection is unsuccessful, the display shows "E5" to indicate Not Ready and you must verify that the Master Controller is holding the INTERLOCK low. The left-most display "A" indicates that the interface is looking for the controller to send a 4-digit hex Start Address, followed by a 4-digit End Address; this defines the Buffer address range to be operated on.

The Master Controller selects either the Read Mode to read data from the Buffer, or the Write Mode to send data to the Buffer.

The display on the Slave M980 shows "1 00 AAA" to indicate that it is inputting data to the Buffer in the Write Mode. The display shows "0 00 AAA" to indicate that it is outputting data from the Buffer in the Read Mode. When the operation is completed, the display shows "1 00 F" for Write Mode finished and "0 00 F" for Read Mode finished.

After the M980 Slave has recognized the interface, by raising INTERLOCK the M980 displays "A 00 E5" to indicate Not Ready. By lowering INTERLOCK, the M980 returns to the Address field definition phase of the operation and displays "A 00 AAA." Waveform diagrams and flow charts for the controller are shown on the following pages. (See Figures 19-7 through 19-12.)

9814—01 and 9814—02 Operating Procedure (M980 Master Controller)

Connect the Slave Unit to the M980 via the parallel interface connector. Depress Key 4 on the Master keyboard. The M980 display shows "9814 00." Key in the "01" format for sending to the Slave Unit, or "02" format for receiving from the Slave Unit. Depress ENTER. At this point, the M980 Master activates the INTERLOCK line. The M980 display shows the Start and End Addresses of the RAM Buffer. The desired Start and End Address of the field to be transfered can now be entered from the M980 keyboard. Depress ENTER to accept the address field. The display shows "A XX AAA," where "XX" is format "01" or "02." If the Slave Unit is ready, the display shows "0 01 AAA" for data output to the Slave, and "1 02 AAA" for data input from the Slave.

When the operation is completed, the display shows "0 01 F" for Write Mode finished, and "1 02 F" for Read Mode finished.

The M980 Master releases the INTERLOCK after each operation.

9814—00 M980 Slave Unit Display Messages		
9814	00	Slave Unit selected.
00	E5	Slave Unit finds INTERLOCK not ready. Reselect option.
A 00	E5	Slave Unit reset by INTERLOCK. Normal waiting state.
		Slave Unit waiting for INTERLOCK.
A 00	AAA	Slave Unit ready to receive address from Master Controller.
1 00	AAA	Slave Unit receiving data.
0 00	AAA	Slave Unit sending data.
A 00	E3	Mode line error during address field definition. Reselect option.

9814—01 M980 Master Controller Display Messages (Write)		
9814	01	Master Controller Selected (Write).
A 01	AAA	Master Controller waiting for Slave Unit to accept address.
A 01	E3	Master Controller senses incorrect Address or Error line from Slave Unit.
0 01	AAA	Master Controller sending data.
0 01	F	Write Operation completed.
0 01	E1	Master Controller senses Error line during data transfer.

9814—02 M980 Master Controller Display Messages (Read)		
9814	02	Master Controller Selected (Read).
A 02	AAA	Master Controller waiting for Slave Unit to accept address.
A 02	E3	Master Controller senses incorrect Address or Error line from Slave Unit.
1 02	AAA	Master Controller receiving data.
1 02	F	Read operation completed.Master
1 02	E1	Controller senses Error line during data transfer.

9814 INTERFACING
The 9814 interface is a TTL signal compatible interface as defined in the connector tables of Figure 19-5 and 19-6. You must choose the correct cable connection, depending on whether the unit is to be a Master Controller or a Slave Unit.

You can make two M980s talk to each other using a cross-wired cable with each end appropriately wired. With a cross-wired cable, either of the M980s may take the role of Master Controller. Do not connect a straight-wired cable between two M980s, since it may damage the interface circuitry.

We have included signal definitions, timing diagrams, and flow-charts to assist you in designing the remote interface.

INPUTS (active low level logic, 1 TTL load)

PIN	SIGNAL	INPUT PORT ADDRESS	COMMENT
8	WRITE DATA 8*	IN 2-8	MSB
6	WRITE DATA 7*	IN 2-4	
13	WRITE DATA 6*	IN 2-2	
10	WRITE DATA 5*	IN 2-1	
9	WRITE DATA 4*	IN 3-8	
7	WRITE DATA 3*	IN 3-4	
12	WRITE DATA 2*	IN 3-2	
11	WRITE DATA 1*	IN 3-1	LSB
2	TRANSFER*	IN 4-8	
3	MODE*	IN 4-4	
5	INTERLOCK*	IN 4-1	

OUTPUTS (active low level logic, 10 TTL load drive)

PIN	SIGNAL	OUTPUT PORT ADDRESS	COMMENT
22	READ DATA 8*	OUT 4-8	MSB
21	READ DATA 7*	OUT 4-4	
24	READ DATA 6*	OUT 4-2	
23	READ DATA 5*	OUT 4-1	
18	READ DATA 4*	OUT 5-8	
17	READ DATA 3*	OUT 5-4	
20	READ DATA 2*	OUT 5-2	
19	READ DATA 1*	OUT 5-1	LSB
15	ADDRESS*	OUT 6-8	
14	ERROR*	OUT 6-4	
16	RESPONSE*	OUT 6-1	

POWER OUTPUTS

PIN	SIGNAL	COMMENT
1	+5 volts	No connection
25	LOGIC GROUND	Connect for reference only
4	-12 volts	No connection

* low level active indicator

Figure 19-6   Connector Interface Pin List for M980 Slave Unit

INPUTS (active low level logic, 1 TTL load)

PIN	SIGNAL	INPUT PORT ADDRESS	COMMENT
8	READ DATA 8*	IN 2-8	MSB
6	READ DATA 7*	IN 2-4	
13	READ DATA 6*	IN 2-2	
10	READ DATA 5*	IN 2-1	
9	READ DATA 4*	IN 3-8	
7	READ DATA 3*	IN 3-4	
12	READ DATA 2*	IN 3-2	
11	READ DATA 1*	IN 3-1	LSB
2	ADDRESS*	IN 4-8	
3	ERROR*	IN 4-4	
5	RESPONSE*	IN 4-1	

OUTPUTS (active low level logic, 10 TTL load drive)

PIN	SIGNAL	OUTPUT PORT ADDRESS	COMMENT
22	WRITE DATA 8*	OUT 4-8	MSB
21	WRITE DATA 7*	OUT 4-4	
24	WRITE DATA 6*	OUT 4-2	
23	WRITE DATA 5*	OUT 4-1	
18	WRITE DATA 4*	OUT 5-8	
17	WRITE DATA 3*	OUT 5-4	
20	WRITE DATA 2*	OUT 5-2	
19	WRITE DATA 1*	OUT 5-1	LSB
15	TRANSFER*	OUT 6-8	
14	MODE*	OUT 6-4	
16	INTERLOCK*	OUT 6-1	

POWER OUTPUTS

PIN	SIGNAL	COMMENT
1	+5 volts	No connection
25	LOGIC GROUND	Connect for reference only
4	-12 volts	No connection

* low level active indicator

Figure 19-7   Connector Interface Pin List for M980 Master Controller

SIGNAL DEFINITIONS

INTERLOCK is a signal line from the Master Controller that causes the Slave Unit to recognize the Remote interface. The Master Controller acquires control of the Slave Unit by holding INTERLOCK low, and it can then use the INTERLOCK to reset the Slave Unit to the Address field definition phase of the operation if any error is detected.

MODE is a signal line from the Master Controller that indicates to the Slave Unit the direction of data transfer. It must be held low during Address field definition and in the Write Mode, and it must be held high in the Read Mode of operation.

TRANSFER is a signal line from the Master Controller which indicates to the Slave Unit that the Remote Controller is ready to effect a data transfer either to or from the Slave Unit, as indicated by the MODE line. The TRANSFER line must not change from high to low unless RESPONSE is high; it should be held low until the Master Controller detects a low RESPONSE signal. If the Master Controller is sending data to the Slave Unit, the WRITE DATA lines must be stable before TRANSFER occurs. If data is being requested by the Master Controller, the READ DATA lines should be read after the RESPONSE signal goes low and before TRANSFER is removed (high signal).

RESPONSE is a signal sent by the Slave Unit as a response to the TRANSFER line. During Address field definition, it indicates that the Address character has been accepted. RESPONSE remains low until the last address character has been accepted. In the Write Mode, RESPONSE indicates that data has been accepted and stored by the Slave Unit. In the Read Mode, RESPONSE indicates that data is available on the READ DATA lines.

ADDRESS is a signal sent by the Slave Unit to indicate that Address field definition is required. It occurs in response to detection of the INTERLOCK signal, whenever the 9814 is selected. ADDRESS remains active until all field definition characters have been transferred to the Slave Unit. It terminates prematurely if the MODE line is in the incorrect state (high).

ERROR is a signal sent by the Slave Unit to indicate an error condition. ERROR occurs in combination with RESPONSE and ADDRESS to indicate Error Mode during Address field definition. It may also occur in combination with RESPONSE, to indicate error during data transfer.

WRITE DATA consists of eight data lines from the Master Controller for transferring Address information and data information to the Slave Unit. Address information is sent as a series of hex characters. The low-order data lines send the hex address characters. Data to be written is sent as binary data. All 8 data lines are used for 8-bit words and the low-order 4 lines are used for 4-bit data. The most significant character is sent first, when defining the address.

READ DATA consists of eight data lines to the Master Controller for transferring data from the Slave Unit. Data is sent as binary data. All 8 data lines are used for 8-bit words and the low-order 4 lines are used for 4-bit data.
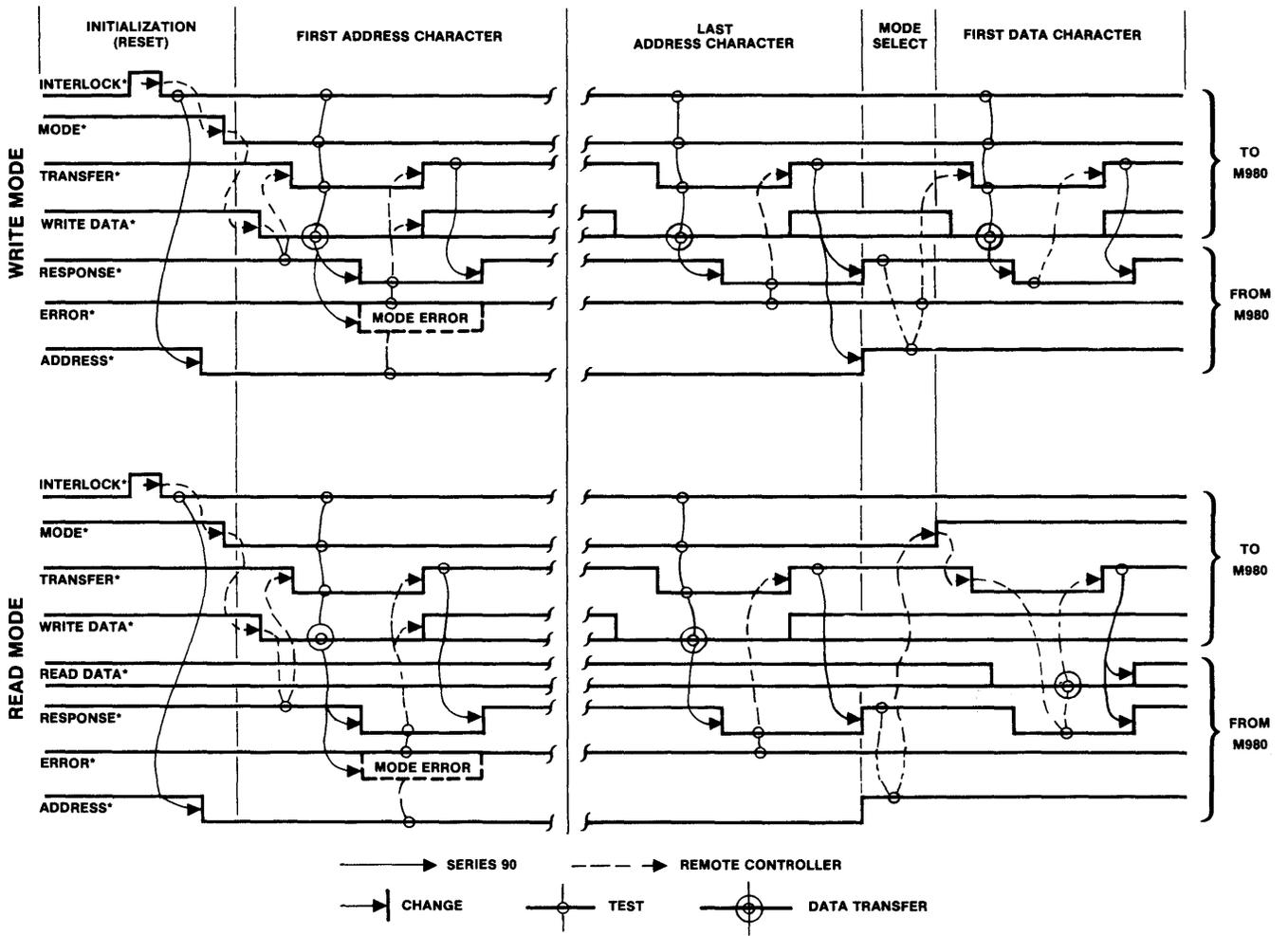
Figure 19-8   Data Transfer Waveforms

The following flow diagrams represent the required sequence a remote controller must use for Read and Write operations. Note: All signals are low-level active TTL signals.

START

SET
INTERLOCK
ACTIVE < *AND node*

NOTE:DEPRESS RESET *& KEY 4*
OBSERVE ~~0114~~ IN DISPLAY.
9814

NO — ADDRESS
ACTIVE?

YES

SET
MODE
ACTIVE

A
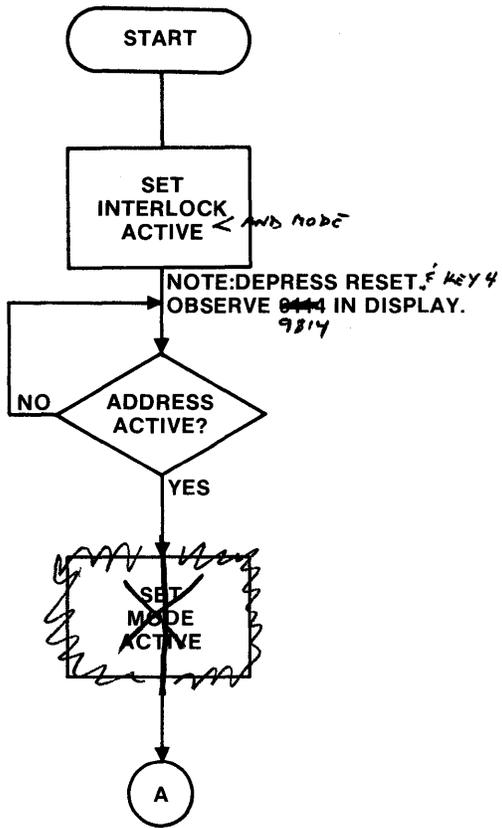
Figure 19-9   Initialization

M

NO — RESPONSE
INACTIVE?

YES

SELECT
A
MODE

W ← SELECT A MODE → R

Figure 19-10   Mode Select

A

NO — RESPONSE
INACTIVE

YES

WRITE
ADDRESS
CHARACTER

SET
TRANSFER
ACTIVE

NO — RESPONSE
ACTIVE

YES

ERROR
INACTIVE — NO → MODE ERROR
DURING FIELD
DEFINITION
(OPTIONAL EXIT)

YES

SET
TRANSFER
INACTIVE

YES — ADDRESS
ACTIVE

NO

M
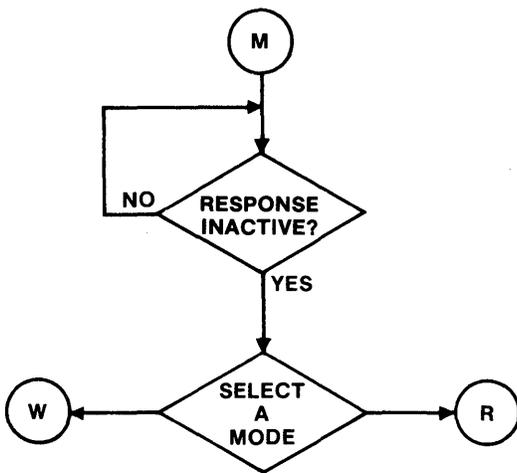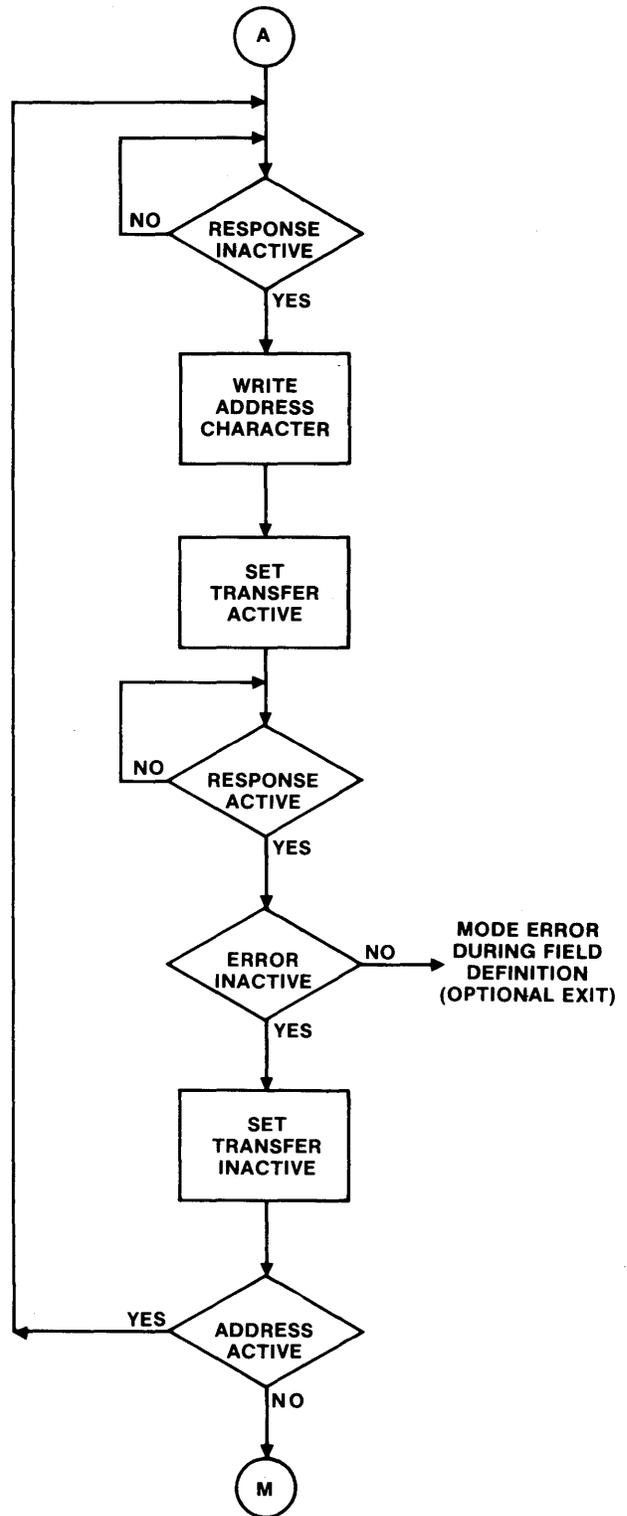
Figure 19-11   Address Definition
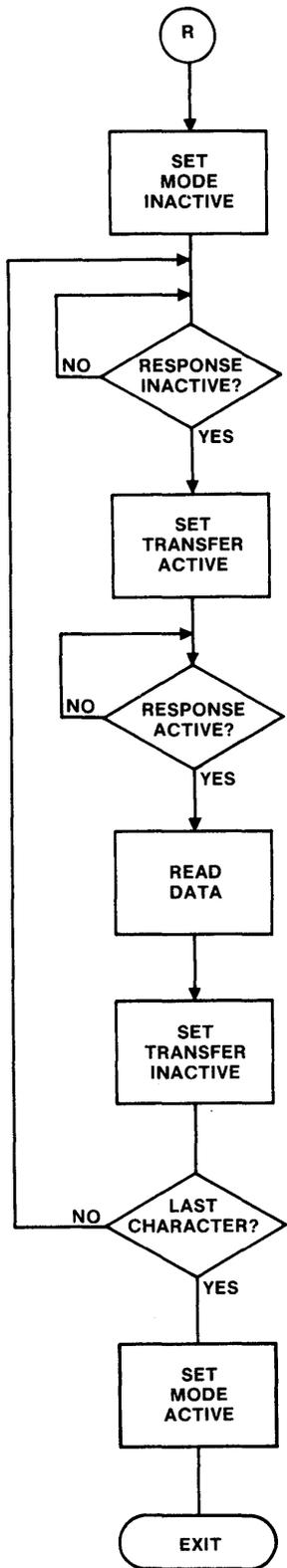
Figure 19-12   Basic Read
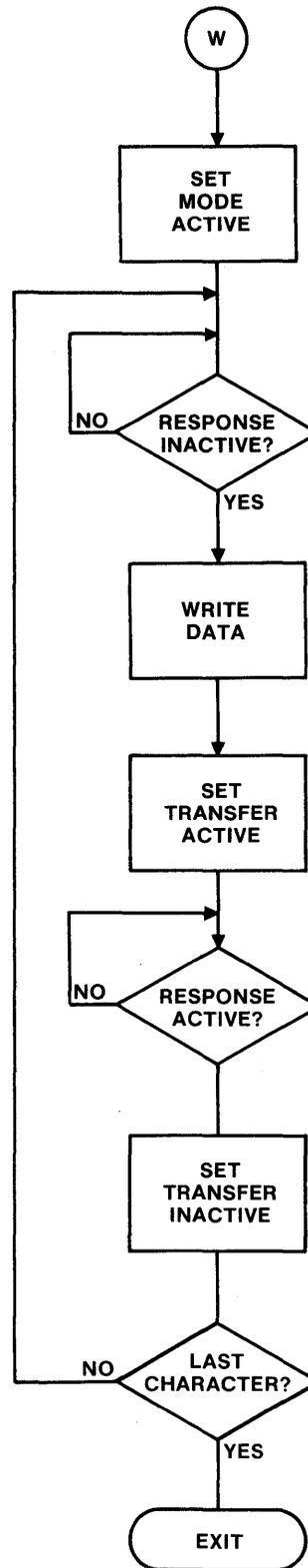
Figure 19-13   Write

9818-RS232C, SELECTABLE BAUD RATE INTERFACE

Functional Description

The 9818 uses the M304 adapter as an RS232C interface between the M980 programmer and a terminal and/or a modem. In the M304, a 25-pin D-type male connector for the terminal and a 25-pin D-type female connector for the modem permit simultaneous communication between the M980 and both connectors.

Features of the M304/9818 are:
• Switch-selectable baud rate from 50 to 9600
• Program Buffer from terminal and/or modem
• List buffer to terminal and/or modem

The 9818 consists of two functional elements: the Control Program located in the M980 Control Unit, and the M304 Adapter, which plugs into the parallel interface socket on the M980. The M304 adapter interfaces the TTL level ports of the M980 with the RS232C-type levels of a terminal/computer and/or a modem/computer. Along with signal-level conversion, the M304 adapter provides switching capabilities for baud-rate selection, and for switching the modem and/or M980 On-Line or Off-Line.

Figure 20-1   M304, RS232 Communication Adapter

M304 Panel Description

ON-LINE/OFF-LINE Switch (S1)
This switch controls the Data Terminal Ready (DTR) line from the terminal connector, the Clear-to-Send (CTS) line from the modem connector, and data flow from terminal and modem to the M980 inputs.

In the On-Line position, data is connected between the terminal and/or modem connectors to the input of the M980. In the Off-Line position, the DTR line from the terminal connector and the CTS line from the modem connector are in the low state. Since the M980 samples these lines when active, a DTR or CTS low causes an error indication of "E5" (Option not ready).

MODEM ON/OFF Switch (S3)

This switch controls data flow to and from the modem connector. In the OFF position, the modem computer is isolated from the data path between the terminal and the M980. However, since modem control lines are unaffected by S3, the modem can remain active.

BAUD—RATE SELECTOR Switch (S2)

The baud-rate selector switch is a 16-position rotary switch, recessed behind the panel on the M304 adapter, and requiring a screwdriver to rotate it. As the switch rotates, a hex-coded number appears in the window just above the screwdriver slot. Refer to the table below for baud-rate versus position. Note: Some formats will not operate at 9600 baud.

BAUD-RATE SELECTION

POSITION (S2)	D	C	0	B	1	A	2	9	4	5	8	3	6	7
BAUD RATE	50	75	110*	134.5	150*	200	300*	600	1200	1800	2400	2400*	4800	9600

*These positions cause the software to insert a 200-ms delay (in List Mode) after appropriate carriage returns and line feeds to accommodate mechanical terminals.

Typical Applications (General)

Terminal to Computer and M980,
M980 to Terminal and Computer,
Computer to M980 and Terminal
(On-Line and modem ON)
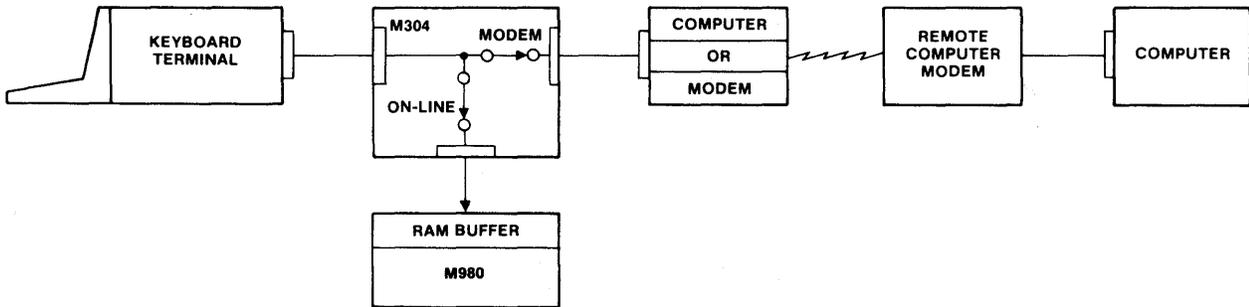
Terminal to M980,
M980 to Terminal
(On-Line and modem OFF)
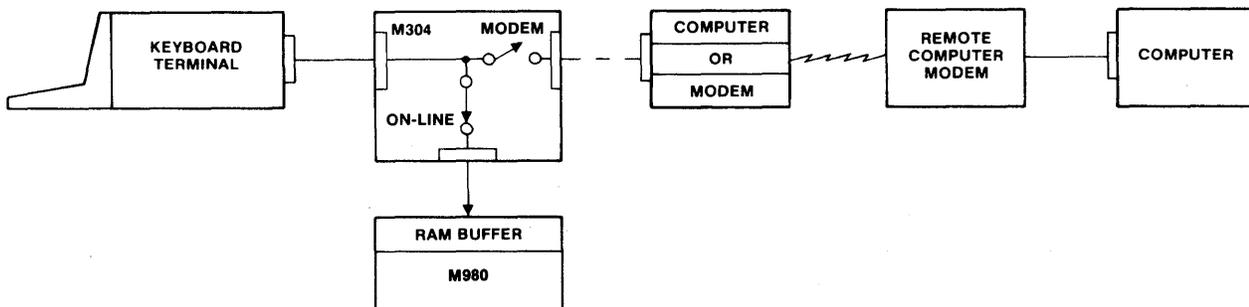
Terminal to Computer,
Computer to Terminal
(Off-Line and modem ON or OFF)
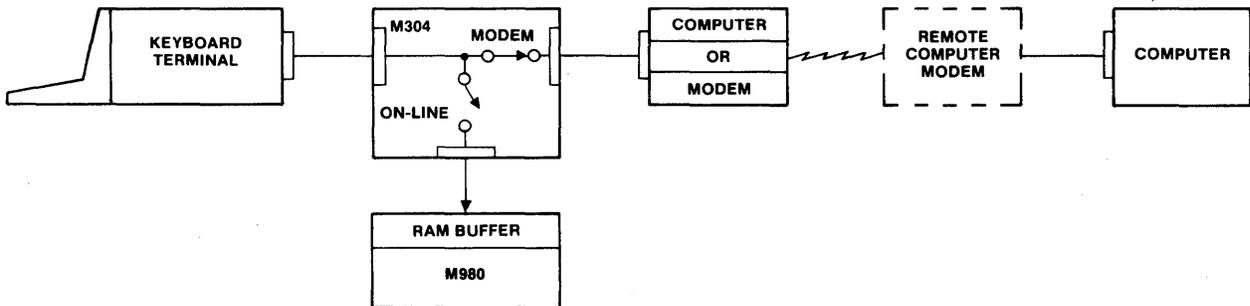
Keyboard Selection of 9818 Interface and Formats

For a detailed description of key strokes to select 9818 interface and its formats, see SECTION 15.

1. Install M304 adapter (power must be OFF while installing the M304), plug in terminal and/or modem, turn M304 On-Line, and turn modem on if attached.
2. RESET M980.
3. Depress Key 8.
4. Key in format number (see table in SECTION 15).
5. Depress ENTER.* An "E5" at this time indicates that the on-line switch is OFF or no CTS or DTR.
6. If remote interfacing is to be used, no further keyboard action is needed. At this time, the remote controlling unit has control.
7. Depress ENTER. The First and Last Address of the M980 RAM Buffer are shown.
8. Using the hex keyboard, key in the starting and ending address range to be acted upon, if different from the default.
9. Depress ENTER. The List Modes automatically start transmitting data to the interface. In the Program Mode, the M980 waits for data to be transmitted to it via the terminal or modem connections. In the Pro-Log format "06," a CR/LF is sent at this time.*

---

* When the M980 determines whether List or Program Mode is selected, the left-most display shows an "0" for a List Mode and a "1" for a Program Mode.

Format Descriptions

The formats described here are standard with the M980 control unit. For some time, Pro-Log has had several formats that can be assessed remotely by equipment or via the M980 keyboard. These formats allow several forms of listing and programming. All Pro-Log formats can be remotely performed when any of the Pro-Log formats are active. All formats, when controlled remotely, have the following recognition format: When active, all formats sample the data lines TD and RD for an ASCII hex character. When the first ASCII hex character is found, it is accepted as the first character (digit) of the Start Address of the Buffer that is to be acted upon. The first eight ASCII hex characters are accepted as the Start and End Addresses of the operation to be performed. The first four characters are accepted as the Start Address, Most Significant Digit (MSD) first. The next four characters are accepted as the End Address, MSD first. The M980 then looks for a command character to determine the type of operation to be performed. The present valid command characters are: "P", "S", "L", "M", "N", and "X." Their descriptions follow.

9818-00 Pro-Log Local Program/Remote : "P" Program

This format, when selected via the hex keyboard or via remote interface, accepts ASCII hex characters as data, MSD first.

Remotely: Select 9818-00 via the hex keyboard, using the procedure on this page. Send eight ASCII hex characters for the Start and End Addresses. Send an ASCII "P" (upper case). Send the data characters, MSD first. Non-hex ASCII characters may be sent between data characters for control. AFter receiving the last data character, the M980 will respond with CR, LF.

Locally: Select 9818-00 via the hex keyboard, using the procedure on this page. Key in the Start and

and End Address, using the hex keyboard. Depress ENTER. The M980 is now active to ac
cept ASCII hex characters as data (MSD first) to be programmed into the Buffer. Initiate data
transfer. Non-hex ASCII characters may be sent between characters for control.

9818-01 Pro-Log Local Scroll/Remote : "S" Scroll

This format, when selected via the hex keyboard or via remote interface, lists the Buffer in ASCII hex
characters, formatted in 256-byte blocks for display on a CRT screen. Each block of data is preceded by a
header and each line of output by the starting address of the line. Each line of data consists of data bytes
separated by spaces. When the entire block is displayed, the CRT cursor remains to the right of the last line
displayed. The M980 outputs the next block of data when a Space (SP) is received, or ENTER is depressed. The
operation terminates when the specified End Address is reached, the M980 is RESET, or any key except the
space bar is depressed. The cursor returns to the left side of the CRT screen when the operation is terminated.

Remotely: Select 9818-01 via the hex keyboard, using the procedure on page 20-3. Send eight ASCII
                  hex characters for the Start and End Addresses. Send an ASCII "S" (upper case). The
                  operation commences as described.

Locally: Select 9818-01 via the hex keyboard, using the procedure on page 20-3. Key in the Start and
                  End Addresses, using the hex keyboard. Depress ENTER. The operation commences as
                  described.

Example Remote:

INPUT   03E904F4S

OUTPUT   0   1   2   3   4   5   6   7   8   9   A   B   C   D   E   F

                  /03E0 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
                  /03F0 F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF
                                                     .
                                                     .
                                                     .

INPUT (Space) /4D0 D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF ∎

OUTPUT   0   1   2   3   4   5   6   7   8   9   A   B   C   D   E   F

                  /04E0 E0 E1 E2 E3 E4 E5 E6 E7 E8 E8 EA EB EC ED EE EF
                  /04F0 F0 F1 F2 F3 F4
                  ∎

9818-02 Pro-Log Local List/Remote : "L" List

This format, when selected via the hex keyboard or via remote interface, lists the Buffer in ASCII hex
characters, MSD first, 16 bytes per line, a Space (SP) after every byte, and a Carriage Return (CR) and Line
Feed (LF) after each line, starting with the Start Address and ending with the End Address.

Remotely: Select 9818-02 via the hex keyboard, using the procedure on page 20-3. Send eight ASCII
                  hex characters for the Start and End Addresses. Send an ASCII "L" (upper case). The
                  operation commences as described.

Locally: Select 9818-02 via the hex keyboard, using the procedure on page 20-3. Key in the Start and
                  End Addresses, using the hex keyboard. Depress ENTER. The operation commences as
                  described.

Example Remote:

INPUT   00000015L
OUTPUT   00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
                   10 11 12 13 14 15

9818-03 Pro-Log Local List/Remote : "M" List

This format, when selected via the hex keyboard or via remote interface, lists the Buffer in ASCII hex characters, formatted exactly as described in the 9818-01 format. However, at the end of each block, a Space (SP) is not required by the M980 to advance to the next block, but it continues until the End Address is reached.

Remotely: Select 9818-03 via the hex keyboard, using the procedure on page 20-3. Send eight ASCII hex characters for the Start and End Addresses. Send an ASCII "M" (upper case). The operation commences as described.

Locally: Select 9818-03 via the hex keyboard, using the procedure on page 20-3. Key in the Start and End Addresses, using the hex keyboard. Depress ENTER. The operation commences as described.

Example Remote:

INPUT   00E501F8M

OUTPUT

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
/00E0	E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	EA	EB	EC	ED	EE	EF
/00F0	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	FA	FB	FC	FD	FE	FF

.
.
.

| /01D0 | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | DA | DB | DC | DD | DE | DF |

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
/01E0	E0	E1	E2	E3	E4	E5	E6	E7	E8	E8	EA	EB	EC	ED	EE	EF
/01F0	F0	F1	F2	F3	F4	F5	F6	F7	F8							

■

9818-04 Pro-Log Local List/Remote : "N" List

This format, when selected via the hex keyboard or via remote interface, lists the Buffer in ASCII hex characters, MSD first, until the End Address is reached.

Remotely: Select 9818-04 via the hex keyboard, using the procedure on page 20-3. Send eight ASCII hex characters for the Start and End Addresses. Send an ASCII "N" (upper case). The operation commences as described.

Locally: Select 9818-04 via the hex keyboard, using the procedure on page 20-3. Key in the Start and End Addresses, using the hex keyboard. Depress ENTER. The operation commences as described.

Example Remote

INPUT   07C30822N

OUTPUT   C3C4C5C6C7C8C9CACBCCCDCECFD1D2D3D4D5D6D7D8D9DADBDCDDDEDFE1E2
E3E4E5E6E7E8E9EAEBECEDEEEFF1F2F3F4F5F6F7F8F9FAFBFCFDFEFF000102030405
060708090A0B0C0D0E0F101112131415161718191A1B1C1D1E1F202122

9818-05 Pro-Log Local List/Remote : "X" List

This format, when selected via the hex keyboard or via remote interface, lists the Buffer in ASCII hex characters, outputted in 16-byte lines with a Space separating each data byte and a Carriage Return and Line Feed following each line. The M980 outputs one line of data each time an XON character is received (XON is a Control Q from an ASCII keyboard). The operation terminates when the End Address is reached.

Remotely: Select 9818-05 via the hex keyboard, using the procedure on page 20-3. Send eight ASCII hex characters for the Start and End Addresses. Send an ASCII "X" (upper case). The operation commences as described.

Locally: Select 9818-05 via the hex keyboard, using the procedure on page 20-3. Key in the Start and End Addresses, using the hex keyboard. Depress ENTER. The operation commences as described.

Example Remote:

INPUT	07E50815X

OUTPUT	E5 E6 E7 E8 E9 EA EB EC ED EE EF F0 F1 F2 F3 F4
INPUT	XON
OUTPUT	F5 F6 F7 F8 F9 FA FB FC FD FE FF 00 01 02 03 04
INPUT	XON
OUTPUT	05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14
INPUT	XON
OUTPUT	15

9818-06 Pro-Log Local Program w/ CR LF

This format, when selected via the hex keyboard outputs a Carriage Return, Line Feed, and then accepts ASCII hex characters as data, MSD first.

Locally: Select 9818-06 via the hex keyboard, using the procedure on page 20-4³. Key in the Start and End Addresses to be programmed. Depress ENTER. The M980 outputs a Carriage Return and Line Feed and is ready to accept ASCII hex characters as data, MSD first.
AFTER RECEIVING LAST DATA CHARACTER, THE M980 WILL RESPOND WITH CR, LF.

9818-07 Reserved for Future Format.

9818-08 Reserved for Future Format.

9818-09 Reserved for Future Format.

9818-10 Intel Local List/Remote : "L" List and Program (*4000 BAUD MAXIMUM*)

This format, when selected via the hex keyboard ~~or via remote interface~~, lists or programs the Buffer in INTEL-HEX formatted data. See a description of the INTEL-HEX format on page 20-7.

Locally: Select 9818-10 via the hex keyboard, using the procedure on page 20-3. Key in the Start and End Addresses, using the hex keyboard. Depress ENTER. The data located between the Start and End Addresses is outputted in the INTEL-HEX format until the Last Address is reached. The M980 outputs only 16-byte lines; if the Last Address is reached before a line is completed, zeros are sent to complete the line.

Remote "L": Select 9818-10 via the hex keyboard, using the procedure on page 20-3. Send an ASCII "L" (upper case). Send four ASCII hex characters for the Start Address of the 16-byte line to be sent. The M980 sends, starting with the address sent, 16 bytes of data in the INTEL-HEX format.

Remotely: Select 9818-10 via the hex keyboard, using the procedures on page 20-3. The M980 is now active to accept data in the INTEL-HEX format to be programmed into the Buffer.

Example Remote : "L" List:

INPUT	L0010
OUTPUT	:1000100000E3E1F579174F7827477D176F76176768

9818-11 Intel Local List/Remote : "L" List and Program   *AND A CR, LF,*

This format, when selected via the hex keyboard ~~or via remote interface~~ /lists or programs the Buffer with INTEL-HEX formatted data. In the program operation, an "ACK" or "NAK"^indicates to the sending unit that the received checksum is correct or incorrect for the data sent. It is up to the sending unit to resend a line of data if it is not received correctly. The Local List and Remote "L" are the same as those described in the 9818—10 format. See INTEL-HEX format description on page 20-3.

Remotely: Select 9818-11 via the hex keyboard, using the procedure on page 20-3. The M980 is now ready to accept data in the INTEL-HEX format. An "ACK" or "NAK" is sent after receiving each line. *No "ACK" or "NAK" is sent after receiving end-of-record.*

9818-12 Intel Local List w/Control Z, Remote : "L" List, Remote Program *(4800 BAUD MAXIMUM)*

This format, when selected via the hex keyboard ~~or via remote interface~~, lists or programs the Buffer with INTEL-HEX formatted data. In the local list operation, a Control Z character is transmitted after the end-of-file record is outputted. This is required by the INTEL MDS to terminate the Copy Mode. The remote program and remote "L" list are the same as those described in the 9818-10 format.

Locally: Select 9818-12 via the hex keyboard, using the procedures on page 20-3. Key in the Start and End Addresses, using the hex keyboard. Depress ENTER. The list operation begins. After the end-of-file record is sent, a Control Z is sent.

9818—13 Reserved for Future Format

INTEL—HEX FORMAT DESCRIPTION

Intel hexadecimal format is a method for encoding data in ASCII form. The two types of records permitted in INTEL-HEX are data records and end-of-file records.

Data Record Format

RECORD MARK	RECORD LENGTH	STARTING LOAD ADDRESS	RECORD TYPE	DATA	CHECKSUM

Record Mark	ASCII colon (:).
Record Length	Two hex digits indicating the number of data bytes in the record.
Starting Load Address	Four hex digits indicating the starting address of the block of data to be transferred.
Record Type	Two hex digits. Data records are signified by record type 00.
Data	2 to 64 hex digits (32 data bytes) coded as ASCII 0-9 or A-F.
Checksum	A two-digit hex number representing the two's complement of the 8-bit sum (modulo 256) of the 8-bit bytes that result from converting each pair of ASCII hex digits to one byte of binary, from the record length field to the last data byte, inclusive.

EXAMPLE:

```
:10001 00000E3E1F579174F7827477D176F7617676 8
```
(annotations: *16* *bytes*)

           └─ Record Type   └── Checksum *(68)*
          └──── Starting Load Address   └───── Data
        └────── Record Length
      └──────── Record Mark
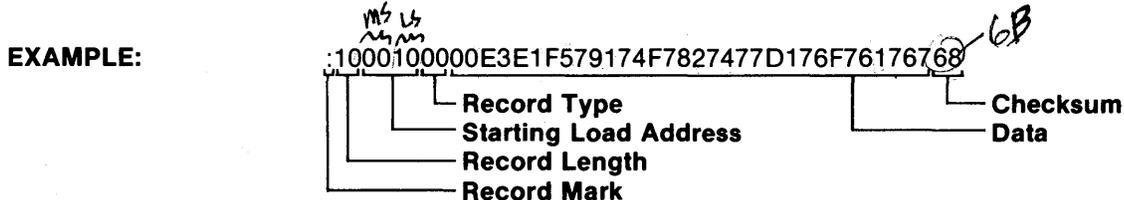
End-of-File Record Format

RECORD MARK	RECORD LENGTH	STARTING LOAD ADDRESS	RECORD TYPE	CHECKSUM

Record Mark	ASCII colon (:).
Record Length	Always 00, identifies the end-of-file record.
Starting Load Address	Four hex digits (zeros).
Record Type	Always 01, identifies the end-of-file record.
Checksum	A two-digit hex number representing the two's complement of the 8-bit sum (modulo 256) of the 8-bit bytes that result from converting each of the preceding pairs of ASCII hex digits to one byte of binary.

Example:

```
:00000001FF
```

- Checksum
- Record Type
- Starting Load Address
- Record Length
- Record Mark
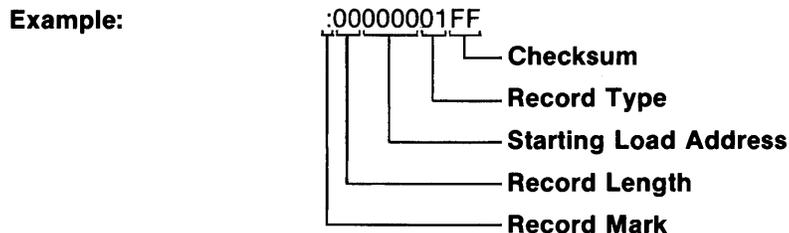
9818-14 TEK HEX Local List/Remote : "L" List and Program (4800 baud maximum)

This format, when selected via the hex keyboard lists or programs the Buffer with TEK HEX formatted data. See description below.

Locally: Select 9818-14 via the hex keyboard, using the procedures on page 20-3. Key in the Start and End Addresses to be listed, using the hex keyboard. Depress ENTER. The data located between the Start and End Addresses are outputted in the TEX HEX format until the last address is reached. The M980 outputs only 16-byte lines; if the Last Address is reached before a line is completed, zeros are sent to complete the line.

Remote "L": Select 9818-14 via the hex keyboard, using the procedures on page 20-3. Send an ASCII "L" (upper case). Send four ASCII hex characters for the Start Address of the 16-byte TEX HEX line to be sent. The M980 sends, starting with the address sent, 16 bytes of data in the TEX HEX format.

Remotely: Select 9818-14 via the hex keyboard, using the procedures on page 20-3. The M980 is now active to accept data in the TEX HEX format to be programmed into the Buffer. If a Checksum error is found, an "E6" is displayed. The M980 and sending unit must then be reset and the operation performed again.

9818—15 Reserved for Future Format.

TEK—HEX FORMAT DESCRIPTION

Tektronix hexadecimal format is organized as a set of message blocks for encoding data in ASCII form. These message blocks are grouped into three categories: data, termination, and abort.

Data Block Format

Header	Location	Byte Count	First Checksum	Data	Second Checksum	CR

Header	ASCII slash (/).
Location	Four hex digits indicating the Start Address of data in PROM memory.
Byte Count	Two hex digits indicating the number of data bytes to be transferred.
First Checksum	A two-digit hex number representing the hex sum of the preceding six hex digits.
Data	2 to 64 hex digits coded as ASCII 0-9 or A-F.
Second Checksum	A two-digit hex number representing the sum (modulo 256) of the hex digits comprising the data.

Example:

```
/ 0000 10 01 25D1E2D 7E2DFE2228F5157D7E2D0E2C0 EF
```

- First Checksum
- Byte Count
- Location
- Header
- CR
- Second Checksum
- Data

20-8

Termination Block Format

This block specifies end-of-data transmission, that is, no further data blocks follow.

Header	Transfer Address	Byte Count	Checksum	CR

Header	ASCII slash (/).
Transfer Address	Four hex digits indicating the starting execution address of the code represented in the data block.
Byte Count	Always 00, which identifies the termination block.
Checksum	A two-digit hex number representing the sum (modulo 256) of the preceding six hex digits.
Example:	

```
/ 0020 0002
            └── CR
         └────── Checksum
      └────────── Byte Count
   └────────────── Transfer Address
└──────────────── Header
```
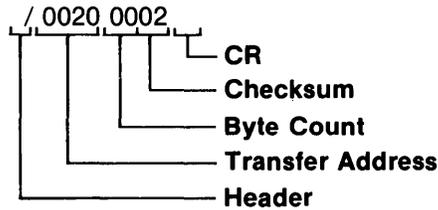
Abort Block Format

This block specifies abnormal data termination, and is designed to accommodate error message conveyance.

Header	Header	Message	CR

Header	ASCII slash (/).
Header	ASCII slash (/). Identifies the abort block.
Message	A maximum of 69 ASCII characters comprising a programmer-defined message string.

9818-16 MOTOROLA (4800 Baud maximum)

This format, when selected via the hex keyboard or via remote interface, lists or programs the Buffer with Motorola-formatted data.

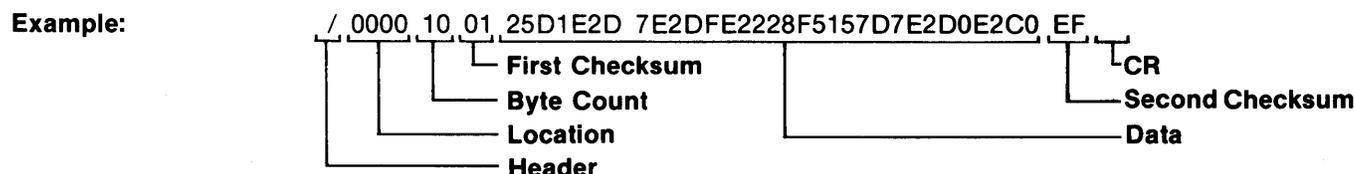|	
Locally:	Select 9818-16 via the hex keyboard, using the procedures on page 20-3. Key in the Start and End Addresses to be listed, using the hex keyboard. Depress ENTER. The data located between the specified Start and End Addresses is outputted in the Motorola format until the last address is reached.
Remote L:	Select 9818-16 via the hex keyboard, using the procedures on page 20-3. Send an ASCII "L" (upper case). Send four ASCII hex characters for the Start Address of the 16-byte Motorola line to be sent. The M980 sends, starting with the address sent, 16 bytes of data in the Motorola format.
Remotely:	Select 9818-16 via the hex keyboard, using the procedures on page 20-3. The M980 is now active to accept data in the Motorola format to b programmed into the Buffer. If a Checksum error is found, an "E6" is displayed. The M980 and sending unit must then be reset and the operation performed again.

The Motorola format has three types of records as described below:

Header Record (Not used by the M980.)

```
                                    ┌──────────── Byte add to checksum one's compliment
                            ┌───────┐
        S0  BC  AAAA  DD...DD  CS
        └┘  └┘  └──┘  └────┘  └┘
                                 └─ Checksum
                             └──────── Data
                        └──────────── Address
                    └──────────────── Byte count
                └────────────────────── Header: Header record
```

Data Record

```
                                    ┌──────────── Checksum one's compliment of byte adds
                            ┌───────┐
        S1  10  AAAA  DD...DD  CS
        └┘  └┘  └──┘  └────┘  └┘
                                 └─ Checksum
                             └──────── Data
                        └──────────── Address
                    └──────────────── Byte count
                └────────────────────── Header : Data
```

End-of-File Record

```
                                  ┌──────────── Checksum one's compliment of byte adds
                          ┌───────┐
        S9  03  0000  FG
        └┘  └┘  └──┘  └┘
                           └─ Checksum
                       └──────── Address
                   └──────────── Byte Count
               └──────────────── Header: EOF
```
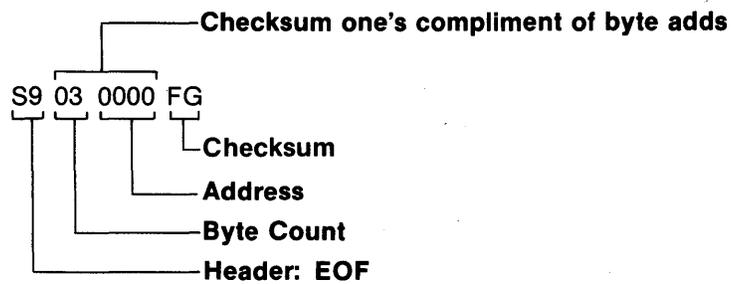
EXAMPLE:
```
S0080000058 42473241A3
S11BF0007E F2AE7EF045 7EF06F 7EF0D 57EF 0D97 EF 08 87EF1 187 EF22AA5
S11BF0187E F0B37EF 0AF 7EF0AD7EF03 A7EF 02D7 EF 0 2F7EF0B1 8DF2A6 5F
S11BF03000 81 0427378 DE1 082 0F5860D8DDA86UH8DD64F 20D3CEFB99C5
S10CF0488DE3CEFF0ABDF6042 598
S9030000FC
```

9818—17 Reserved for RCA

9818—18 MOS TECHNOLOGY Local List/Remote "L" List and Program
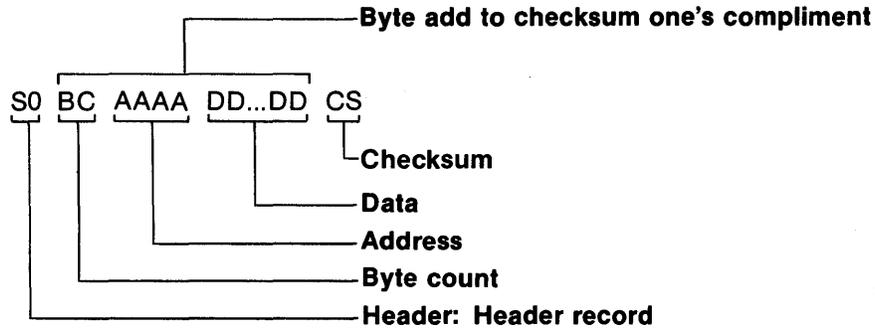
This format, when selected via the hex keyboard ~~or via remote interface~~, lists or programs the Buffer with MOS TECHNOLOGY formatted data. See description on the following pages.
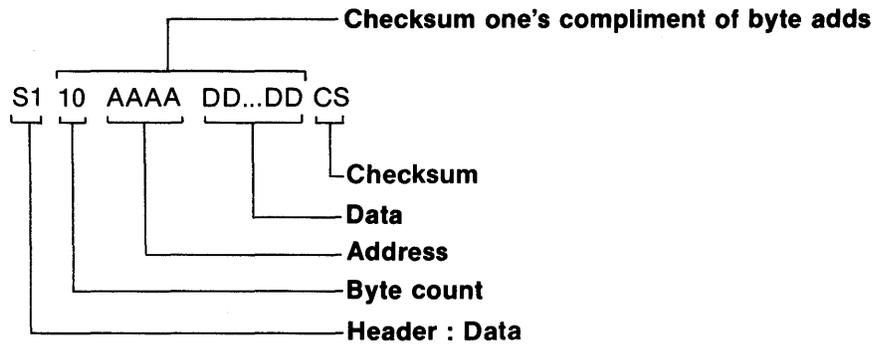
Locally: Select 9818-18 via the hex keyboard, using the procedures on page 20-3. Key in the Start and End Addresses to be listed, using the hex keyboard. Depress ENTER. The data located between the specified Start and End Addresses is output in the MOS-TECHNOLOGY format until the last address is reached.

Remote "L": Select 9818-18 via the hex keyboard, using the procedures on page 20-3. Send an ASCII "L" (upper case). Send four ASCII hex characters for the Start Address of the 16-byte MOS TECHNOLOGY line to be sent. The M980 sends, starting with the address sent, 16 bytes of data in the MOS TECHNOLOGY format.

Remotely: Select 9818-18 via the hex keyboard, using the procedures on page 20-3. The M980 is now active to accept data in the MOS TECHNOLOGY format to be programmed into the Buffer. If a Checksum error is found, an "E6" is displayed. The M980 and sending unit must then be reset and the operation performed again.

MOS TECHNOLOGY FORMAT DESCRIPTION (4800 Baud maximum)

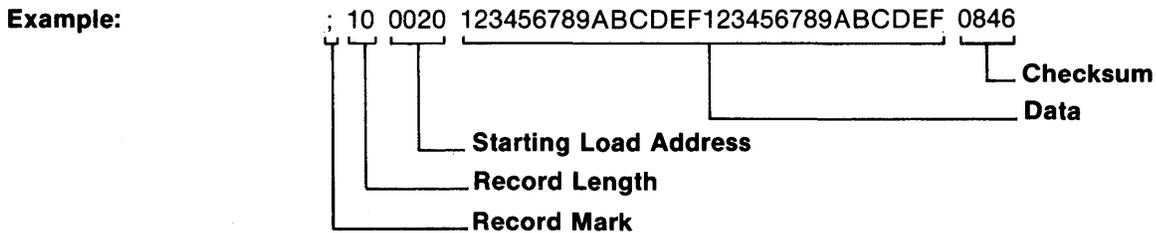The MOS TECHNOLOGY format is a method for exchanging data in ASCII form. The two types of records permitted in MOS TECHNOLOGY format are data records and end-of-file records.

Data Record Format

RECORD MARK	RECORD LENGTH	STARTING LOAD ADDRESS	DATA	CHECKSUM

Record Mark ASCII semicolon (;).
Record Length Two hex digits indicating the number of data bytes in the record.
Starting Load Address Four hex digits indicating the Start Address of the block of data to be transferred.
Data Up to 64 hex digits, (32 data bytes) coded as ASCII 0-9 or A-F.
Checksum A 4-digit hex number representing the sum of the 8-bit bytes that result from converting each pair of ASCII hex digits to one byte of binary, from the record length field to the last data byte inclusive.

Example:


```
; 10 0020 123456789ABCDEF123456789ABCDEF 0846
```
— Checksum
— Data
— Starting Load Address
— Record Length
— Record Mark

End-of-File Record Format

RECORD MARK	RECORD LENGTH	STARTING LOAD ADDRESS	CHECKSUM
;	00	0000	0000

Example

Record Mark ASCII semicolon (;).
Record Length Always 00, which identifies the end-of-file record.
Starting Load Address Four hex digits.
Checksum Four hex digits.

M980 REMOTE CONTROL

The M980 Remote Control Mode allows an external device, via the M304 RS-232C adapter, to gain control of the M980 and perform the following functions:

When one of the 9818 formats is in the active state, the external device can obtain control by sending the ASCII characters "QX," followed by the command code.

		COMMAND CODE
DUPLICATE	Master to Buffer over defined field	DMssss eeee
DUPLICATE	Master to Buffer over PROM field	DMX
DUPLICATE	Buffer to Copy over defined field	DBssss eeee
DUPLICATE	Buffer to Copy over PROM field	DBX
DUPLICATE	Copy PROM to Buffer over PROM field	DC
PASS	Sound pass tone and display "F"	Y
FAIL	Sound fail tone and display "E7"	N

Where "ssss" equals the Start Address, the number of required digits depends on the PM address field. Where "eeee" equals the End Address, the number of digits corresponds to the End Address of the PM field.

Remote Control Operation

1. Control switches:

   Position MFG MODE and AUDIO switches as shown. Since the operation will be under remote control, the MASTER, BUFFER, and COPY switches are not used.
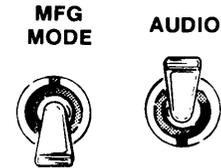
2. Install M304 adapter and select format (9818-10 shown as example) per instructions on page 20-3.

   After the format is selected by the operator, the M980 is ready to receive the command line.
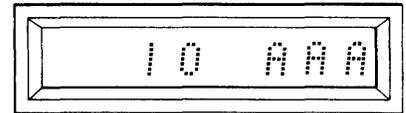
3. While responding to the remote commands, the M980 displays a "D" on the left side of the display.

   When any remote-command duplicate function has been completed, the M980 responds by sending:
   "Y," "BELL," Carriage Return/Line Feed, if function is successful, or
   "N," "BELL," Carriage Return/Line Feed, if error occurs.
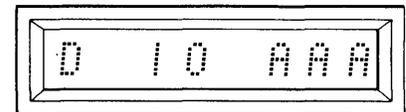
4. After the M980 completes the required remote commands, the remote controller causes the M980 to display an "F" and sound the pass tone, or display an "E7" and sound the fail tone.
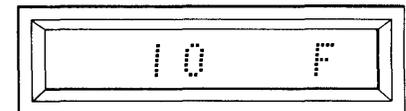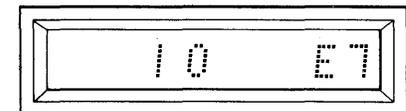
   Keying ENTER after the QXY or QXN command returns the M980 to last the active 9818 format.

MFG MODE   AUDIO

10   AAA

Active

D 10   AAA

Active

10   F

Finished

10   E7
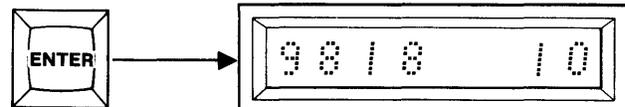
ENTER → 9818   10

Typical Operation

1. Select 9818-10 and insert PROM to be programmed in Copy socket.

```
9 8 1 0        1 0
```
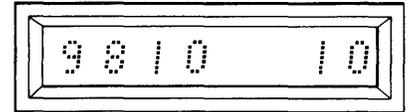
2. Depress ENTER.

ENTER →
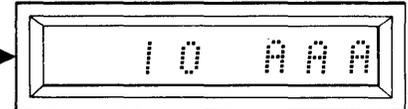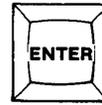
```
1 0     A A A
```
Active

3. Remote device inputs data to Buffer in INTEL HEX format.
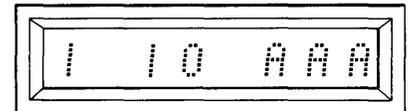
```
I   1 0    A A A
```
Active

4. Remote device sends "QXDBX." M980 takes data just written to the Buffer and duplicates it to the Copy PROM. When duplication is complete, M980 sends "Y," "BELL," "CRLF."
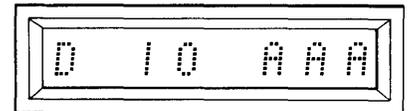
```
D   1 0    A A A
```
Active

5. Remote device sends command "QXY." M980 displays "F" and sounds the pass tone when operation is complete.
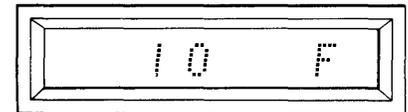
```
1 0      F
```
Finished

9818 RS232 INTERFACE APPLICATIONS

The various 9818 formats can be used to connect to almost any development system. Some representative examples follow describing specific applications. If you have a system that uses any of the supplied formats, apply the following examples as a guide. Contact Pro-Log if you require assistance.

INTEL MDS

OR M304 ADAPTER

Interfacing the M980/9818-12 with the INTEL MDS for downloading to the M980 requires the addition of one jumper to the MDS IOB. This jumper addition allows downloading to the M980 at 110 baud. Two methods can increase the baud rate, if faster data transfer is required. One method is via the software, the other is via the monitor firmware. These changes (the jumper and baud rate) allow the M980 to accept data from the MDS in INTEL-HEX format. If the user wishes to upload data from the M980 Buffer to an MDS file, the 9818-12 Local List transmits a Control Z, which is required by the MDS to terminate the Copy Mode.

Configuring the Serial Interface

As shipped from Intel, J2 (Serial 1) is jumpered for a standard TTY terminal configuration. This is used for 9818—12. Serial 2 is not used by the 9818—12. See figure below for interconnect information.
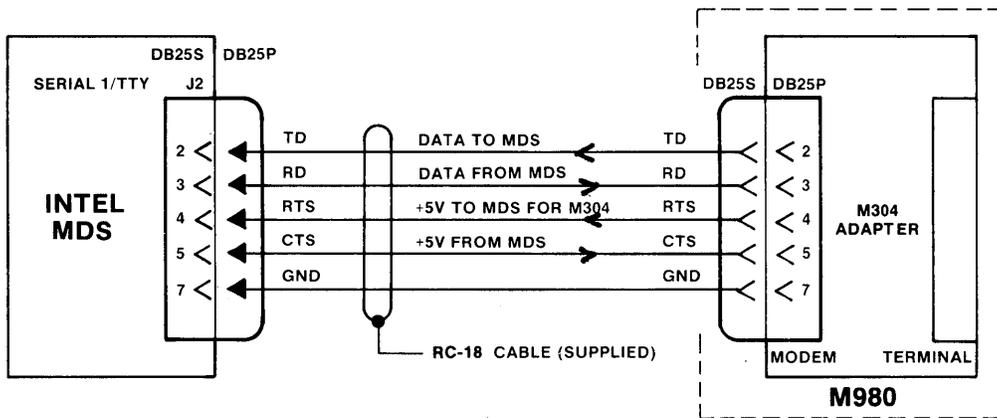
Figure 20-2   M304/MDS Interconnect

The jumpers for configuring the MDS Serial Interface are located at the top right corner of the IOC board and are accessible by removing the main-chassis top cover. The figure below shows the lines and jumpers as they are shipped from Intel. We recommend that the user determine if the jumpers are as shown. The jumper between W5B and W5D must be installed at this time. (Refer to Intellec Series II Installation and Service Manual A1/A2 for further information.) The added jumper causes the CTS signal used by the M980 to be supplied by the RTS line, which is normally held high by the M304 adapter.
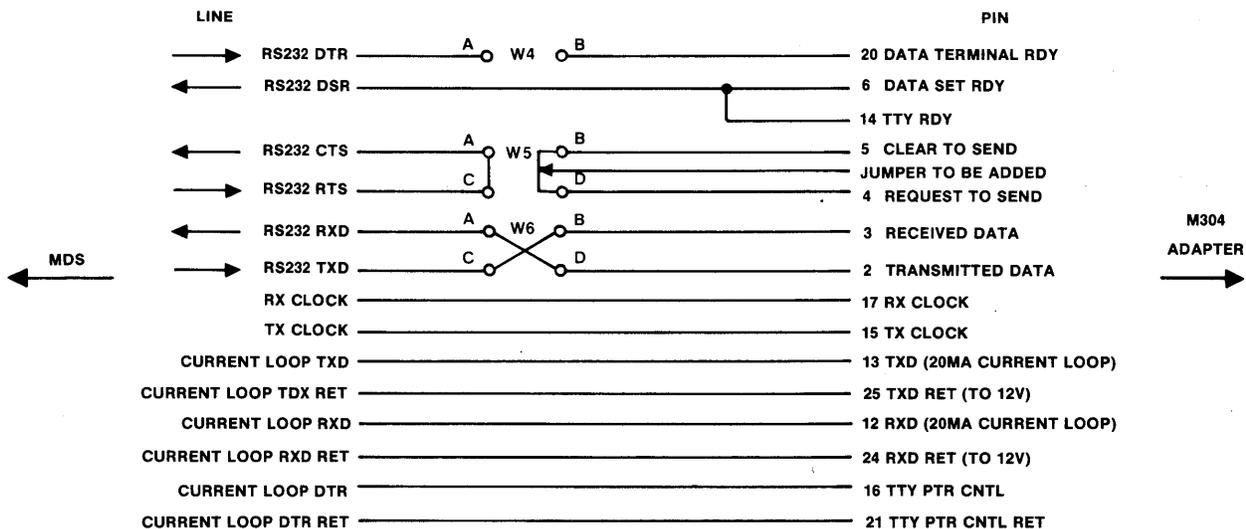
Figure 20-3   Serial CH1 Lines and Jumpers

20-14

Baud Rate

As supplied from Intel, the Serial 1 port is set for TTY, 110 baud. However, if a higher rate is desired, there are two methods by which the MDS may be modified to achieve a higher baud rate.

One method consists of inputting, assembling, linking, loading, and executing a baud-rate program at each power-on or system reset. This program writes the control words to change the baud rate of the Serial 1 UART. However, the UART is recoded back to 110 baud by the system monitor at each system reset or power-on. Contact Intel for a listing of the baud-rate change program.

The second method to achieve a higher baud rate entails changing the monitor program UART constants in the Monitor PROM. With this change in effect, the MDS initializes to the new baud rate each time it is reset or turned on. To accomplish this, unplug the MDS and remove its front panel by turning both mounting screws one-half turn counterclockwise. Remove the IPB board. This is the top board in the rack with the interrupt and reset switches mounted on its front edge. Locate IC A57, a 2716 or equivalent. Duplicate this PROM with the appropriate changes. (These changes apply to Intellec Series II Boot/Monitor Version 1.2.)

For MDS-H 235 use A82 #2732
For MDS #230 Addresses E89A (o9A), E89B (o9B), E9A3 (043).

LOCATION	DOWNLOAD ONLY 110 BAUD (As Supplied)	UP/DOWNLOAD 110 BAUD	UP/DOWNLOAD 1200 BAUD	DOWNLOAD ONLY 4800 BAUD
E886 (086)	BA	BA	10	10
E887 (087)	02	02	00	00
E88F (08F)	CE	4E	4F	4E

NOTE: Each time the MDS is initialized, the message "failure boot checksum" is displayed to serve as a reminder that the firmware has been changed, thereby affecting the checksum of the monitor program.

It is suggested that an EPROM duplicate of the Monitor be made (with changes) and the original be kept, so that 110 baud will still be available by changing PROMs, whenever required.

Operating Sequence:
NOTE: Do not plug M304 adapter into M980 unless power is off.

1. Implement jumper and baud rate changes as previously described.
2. Install M304 adapter in M980 parallel interface connector. Plug RC-18 cable or equivalent into M304 modem connector, the other end to (J2) Serial 1/TTY connector on back of MDS. Turn M980 on.
3. Set M304 to desired baud rate. Switch M304 On-Line, modem switch on. Download from the MDS or upload to the MDS according to the following instructions.

To Download to M980
To download a source program that has been assembled, first convert the source program from executable binary to INTEL-HEX format ASCII characters. Intel has provided a utility program called OBJHEX to convert from object code to INTEL-HEX. To implement:

1. Input to MDS:

        OBJHEX :F?:XXXX.OBJ to :F?: YYYY.HEX (CR)
        Where :F?: = Drive F0, F1
        XXXX.OBJ = Source
        YYYY.HEX = New INTEL HEX file

    This generates a new file in INTEL HEX, ready to download to the M980.
2. Select 9818-12 Active " 12 AAA" See procedure on page 20-3.
3. Input to the MDS: Copy :F?:YYYY.HEX to :TO: (CR)

Data transfers as previously described. Upon completion of the Copy operation, the MDS displays COPIED :F?: YYYY.HEX to :TO:. If a checksum error occurs, an "E6" is displayed on the M980. The M980 and MDS must then be reset and the operation performed again.

Note: The MDS also downloads to :TO: (M980) from MDS RAM using the Monitor Write command "W". Input to the MDS   "WAAAA, BBBB (CR)."
The "W" command writes to Serial 1 port, in INTEL HEX format, the RAM contents starting at AAAA and ending at BBBB.

To upload to MDS
1. Enter to MDS: COPY :TI: to :F1:NNEW.FIL (CR)
2. On the M980, depress key 8 to select 9818, key 1, key 2 to select 9818-12, depress ENTER twice.
3. Key in a Start and End Address for the field to be uploaded.
4. Depress ENTER.
5. Data transfers as previously described. Upon completion of the copy operation, the MDS displays: COPIED :TI: to F1:NNEW.FIL.
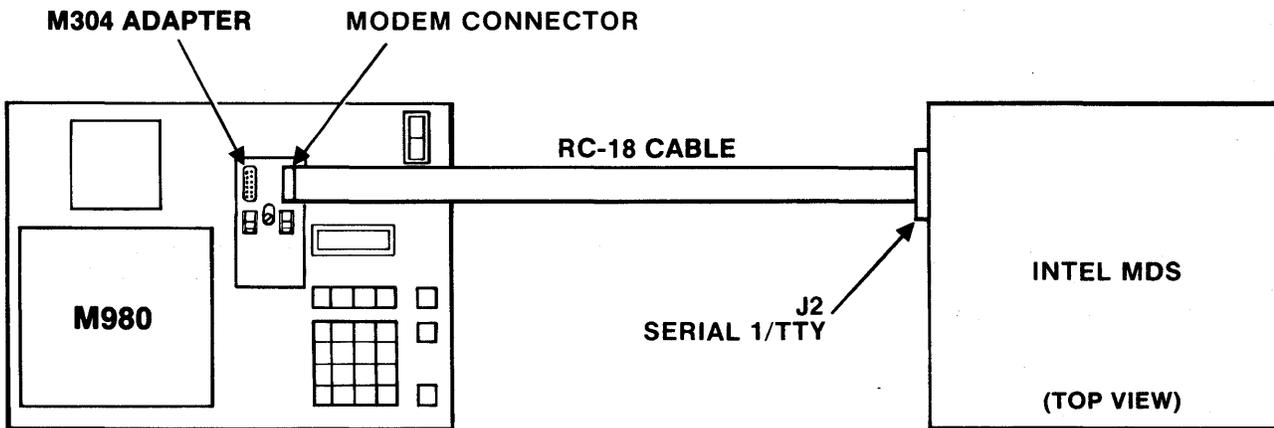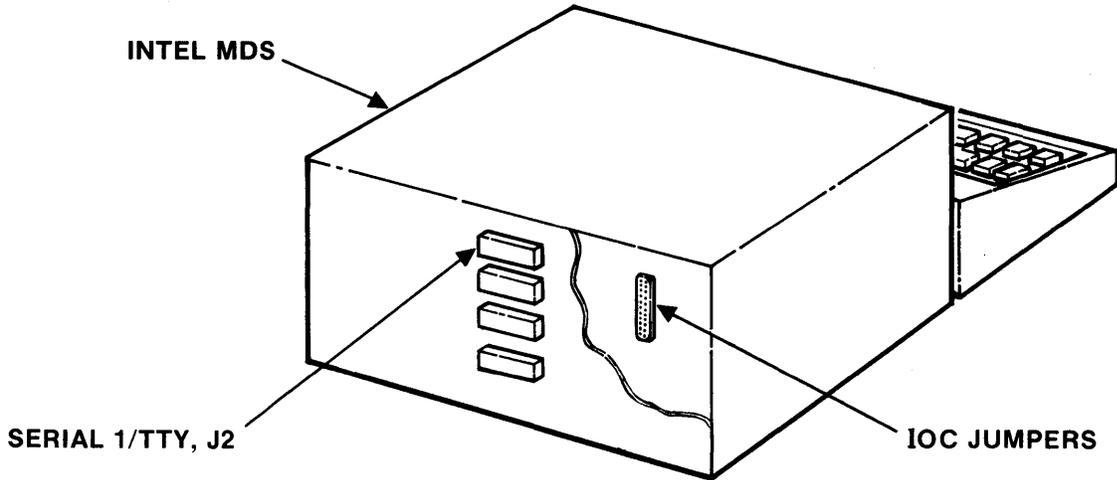
Figure 20-4   Connecting to MDS

MOTOROLA EXORCISER II

You can transfer data between the M980 and the EXORciser II in two ways. One utilizes EXbug and system memory; the other uses MDOS and disk files. Both interface with the M980's Motorola format (9818-16).

To perform the following operations, you will need Motorola's user manuals on EXbug and EXORdisk. For EXbug, an understanding of the commands PNCH and LOAD is necessary. For EXORdisk/MDOS, you require a knowledge of the COPY and BINEX operations.

The Motorola data-record format contains the Start Load Address as part of the header on each data record. This address is the absolute location at which data will begin to sequentially store in the M980's RAM Buffer.

Interfacing the M980/9818-16 with the EXORciser II for data transfer to the RAM Buffer requires the M304 adapter, an RC-18 cable, and an additional RS-232 cable. The M980/M304 is "T" connected in the data path between the EXORciser II system and the system terminal. *see diagram below*.

The additional RS-232 cable requires one end to have a DB25P connector, so that it can plug into the terminal connector on the M304 adapter. The other end needs the appropriate connector for the system terminal. Refer to the M304 schematic and the back of this section for additional information.
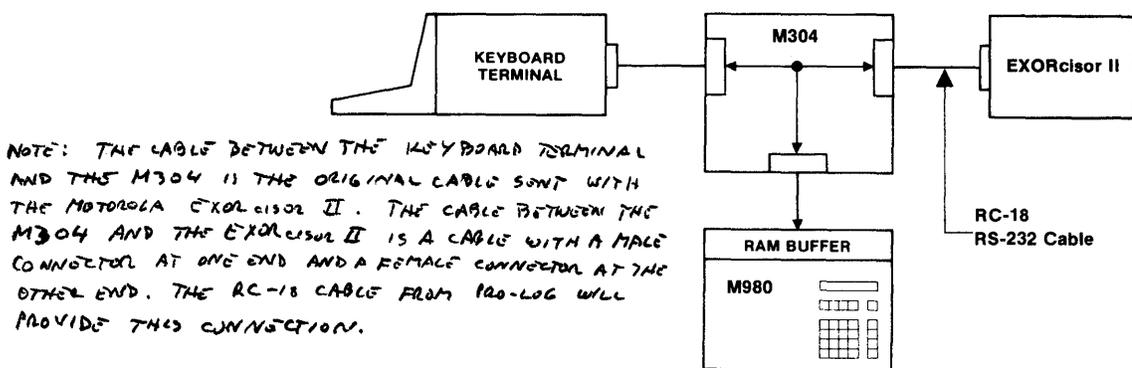
NOTE: The cable between the keyboard terminal and the M304 is the original cable sent with the Motorola Exorcisor II. The cable between the M304 and the Exorcisor II is a cable with a male connector at one end and a female connector at the other end. The RC-18 cable from Pro-Log will provide this connection.

Set all units to 4800 baud. On the M304 adapter, set ON LINE and MODEM switches ON.

To down-load with EXbug, use the PNCH command:

1. Select 9818-16 and key ENTER. The M980 displays "16 AAA," showing that it is in the Motorola-format active state.

2. Enter the PNCH command in the system terminal as follows:

```
EXbug 2.1
*E PNCH
BEG  0300              (Key in Start Address)
END  03FF              (Key in End Address)
HDR =          (No header required, key return)
```

Data in the system memory is down-loaded to the M980's Buffer over the operator-defined field.

A "1" appearing on the left side of the M980 display, as each line is written to the Buffer, confirms that data is being transferred. If a checksum error occurs, an "E6" is displayed; to continue, RESET the EXORciser II and the M980 and restart the operation.

To up-load with EXbug, use the LOAD command:

1. On the M304 adapter, turn the ON LINE switch OFF and the MODEM switch ON.

2. On the system terminal, enter:

```
EXbug 2.1
*E LOAD
S/C  S   (S = single record, C = continuous record)
```

The EXORciser II is now ready to receive data in the Motorola format.

3. On the M304 adapter, turn the ON LINE switch ON.

4. Select 9818-16, key ENTER twice.

5. On the M980, key in Start and End addresses of data block you wish to up-load.

6. On the M980, key ENTER.

   Data is transferred to the EXORciser memory in 16-byte lines in Motorola format. As the EXORciser II echos all data, the system terminal displays invalid and garbled information during the data transfer. When the transfer is complete, the last information displayed is "*E."

   During data transfer, the M980 shows a "0" in the left of the display.

To up-load the M980 Buffer to a disk file, complete the previous six steps under EXbug. Turn ON-LINE switch OFF, key in MDOS, and use the ROLLOUT command to create a UFN.LO file. Use the BINEX command to create a UFN.LX file. The UFN.LX file is now on disk, and can be down-loaded, if desired, as follows:

7. *E MDOS
   = Rollout UFN
   Start Address 3000
   End Address 30FF
   Are you sure (Y, N, Q)?
   Y

8. Use BINEX UFN.LO to create a down-loadable file. See the example on down-loading disk files in the EXORdisk section.

Operation Instructions for Using the EXORdisk II/III—Operating system to transfer data to the M980 RAM Buffer.

Before down-loading, convert the source data files that are to be written to a PROM to the Motorola record format, using the Motorola conversion program BINEX. The conversion is of the form:

> BINEX < NAME 1 > [, < NAME 2 >
> WHERE NAME 1 = File to be converted
> NAME 2 = Newly created file

We suggest that you read the section on BINEX in Motorola's advanced MDOS user's guide, before using BINEX. (UFN = Unambiguous file name.)

EXAMPLE :   = BINEX UFN.CM, UFN
results in the creation of UFN.LX, which is ready to be down-loaded to the M980 as follows. The command line:
= COPY UFN.LX, #CN
down-loads, in Motorola format, the file UFN.LX to the M980 Buffer as well as to the system terminal. The down-load operation is as follows:

1. On the M304, set the ON-LINE switch OFF and the MODEM switch ON.

2. Prepare the file to be down-loaded, using BINEX.

3. On the system terminal, key in the command line:
   = COPY UFN.LX, #CN (do not key return).

4. On the M304, turn ON-LINE switch ON.

5. Select 9818-16 and key ENTER. The M980 displays "16 AAA," indicating that it is in the Motorola-format active state.

6. Key RETURN on the system terminal. Data in the file UFN.LX now transfers to the M980 RAM Buffer.

   A "1" appearing on the left side of the M980 display, as each line is written to the Buffer, confirms that data is being transferred. If a checksum error occurs, an "E6" is displayed. To continue, RESET the EXORciser II and the M980 and restart the operation.

TEKTRONIX 8002A MDL

Interfacing the M980/9818-14 to the Tektronix 8002A MDL requires no modifications to either unit. Select baud rate (up to 4800); make sure both units have same baud rate.

Operating Sequence
Note: Do not install M304 adapter with M980 power ON.

1. Install M304 adapter in the parallel interface connector. Connect the terminal connector to J101 of the Tektronix 8002A MDL via a RC-18 cable or equivalent.
2. Switch power ON, On-Line, modem on.
3. Select 9818-14 via the hex keyboard, using the procedure on page 20-3.

To Download to M980.
The 8002A executes the WHEX command, to dump the file to J101 and thereby to the M980 RAM Buffer.

Enter to the 8002A: WHEX (Start Address) (End Address) 00 REMO.

Data in the program memory from the Start Address to the End Address inclusive transfers in TEK-HEX format to the M980 RAM Buffer, one line at a time. If a checksum error occurs, an "E6" is displayed. The M980 and 8002A must then be reset and the operation performed again. When the operation is completed, the 8002A prints: *WHEX* EOJ

To Upload to 8002A
Execution of the RHEX command by the 8002A before a local list operation will initiate the upload operation.

1. Enter to the 8002A: RHEX REMI.
2. ~~Key in Start and End Address using the hex keyboard on the M980.~~ *USING THE INSTRUCTIONS ON P. 20-3, SELECT THE ADDRESS FIELD TO BE UPLOADED FROM THE M980 RAM BUFFER.*
3. Depress ENTER.

The M980 outputs the RAM Buffer data located between the Start and End Addresses to the 8002As system memory, line by line in TEK HEX format. When uploading is completed, the 8002A prints: *RHEX* EOJ.
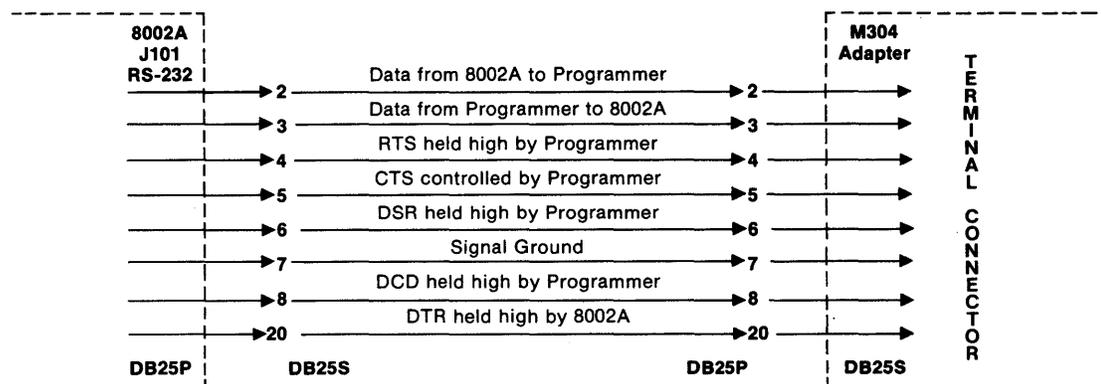
Figure 20-5   M980/8002 Interconnect

INTERFACING WITH CP/M-BASED SYSTEMS

Systems using Digital Research's CP/M DOS interface via any available system RS-232C port. CP/M assemblers create hexadecimal files that are compatible with the M980's 9818-10 Intel Hex format.

To be able to select 9818-10, the DTR signal (pin 20) on the M304 adapter terminal connector, or the CTS signal (pin 5) on the modem connector, must be held high. If the selected system port does not provide this signal, refer to page 20-15 for "Special Hook-up for DTE and DCE."

NOTE: Do not install the M304 with the M980 power ON.

Operation
1. Install M304 adapter on the M980, using RC-18 cable or equivalent.
2. Connect to system via M304 terminal or modem connector, whichever is appropriate.
3. Turn On-Line switch on.
4. Key in 9818-10, using procedure on page 20-3.
5. Press ENTER. Display shows "10 AAA." The M980 is ready to receive in Intel HEX. To download, continue with step 6. To upload, go to step 7.

6. On system keyboard, key in TYPE UFN.HEX Control P Return. The M980 display shows "1 10 AAA," with the "1" flashing as each line of data is downloaded to the Buffer; or use PIP as follows: on system key board, key in PIP (Port) = UFN.HEX Return. The M980 responds as above.

7. To upload, key in the following to the system terminal: PIP UFN.HEX = (port) Return. Depress ENTER on M980. It displays the address field of the Buffer. Key in the address field to be uploaded. Depress ENTER. The M980 displays "0 10 AAA," indicating it is outputting data to your system. When the upload is complete, the display shows "10 AAA."

DTE AND DCE OPERATION

The combination of the M304 RS-232-C adapter and the M980 Interface software turns the M980 into either DTE (Data Terminal Equipment) or DCE (Data Communication Equipment). The terminal connector connects like a Data Communications piece of equipment, and the modem connector connects like a Data Terminal piece of equipment. When both DTE and DCE are connected, the M980 is transparent. The M980 monitors both TD (Transmit Data) and RD (Receive Data) for valid data. These two lines are OR'd together to form the M980's receive data line. Therefore, only one piece of equipment may be sending data at any given time for the M980 to correctly recognize it as valid data. Likewise, the M980 transmits data on both TD (towards the modem) and RD (towards the terminal), so that when the M980 transmits, neither DTE nor DCE can transmit at the same time. Some DTE and DCE require DTR (Data Terminal Ready) or CTS (Clear to Send) in order to operate. The M980 provides these signals if needed. On the other hand, the M980 must see either DTR or CTS to recognize that a DTE or DCE is connected. In the cases where the user's equipment does not or cannot provide these signals, a jumper scheme shown ~~below~~ is used.
IN FIG. 20-7

The simplified logic diagram (below) shows the M304 adapter and how the interconnecting signals are used. The pins not shown are as follows: pin 7 is chassis-ground; pins 9 through 19, and 11 through 25 are connected directly across from the terminal to the modem connector; pins 6 and 8 are pulled up to +VCC on the modem connector. (See the Schematic and Assembly drawings in SECTION 21 for further details.)
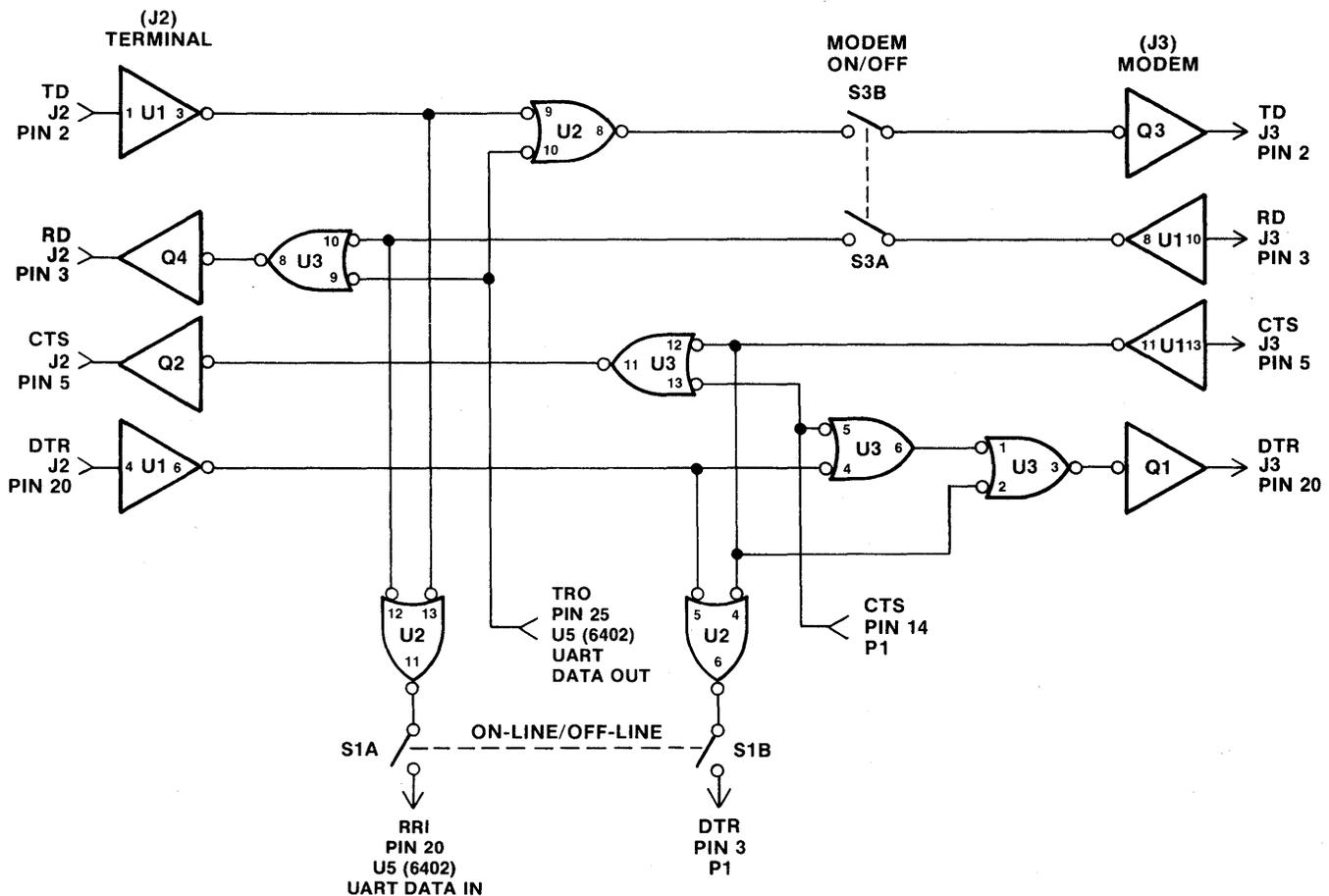
Figure 20-6 M304 Signal Paths

Special Hook-Up for DTE and DCE

Some DTE (Data Terminal Equipment) and DCE (Data Communication Equipment) cannot provide the signals DTR (Data Terminal Ready) or CTS (Clear to Send), which are needed by the M980 to recognize that a connection has been made. The followings examples show how to connect these to the M304 adapter.

EXAMPLE 1: This example shows a DCE (modem) that cannot source CTS. CTS must be pulled high (active) so that the M304 adapter recognizes it.

EXAMPLE 2: This example shows a DTE (terminal) that cannot source DTR. DTR must be pulled high (active) so that the M304 adapter recognizes it.
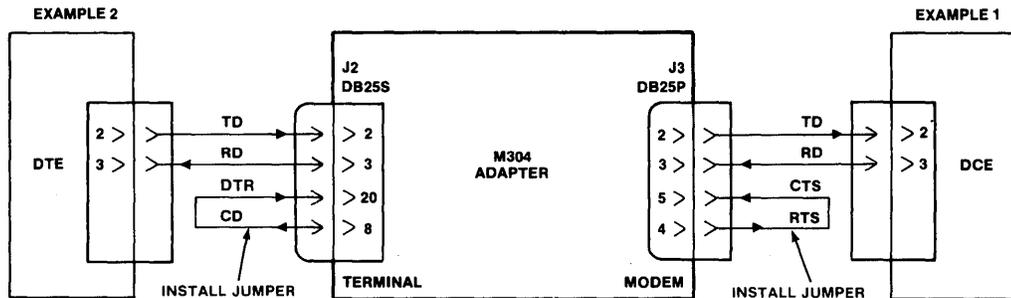
Figure 20-7   Hook-Up for DTE and DCE

JUMPER-SELECTED PARITY AND STOP BITS

In addition to the three panel switches, there are 9 user-accessible jumpers located on the top of the M304 adapter board. These are provided for special configuring by the user, if needed, but will rarely be changed. To change a jumper, unscrew the three mounting screws and remove the cover of the M304; the jumpers that are in place are unsoldered and can be removed or clipped with side cutters. To install a new jumper, solder short pieces of insulated wire in place. A functional description of each jumper follows.

M304 character format as shipped from Pro-Log is shown in the figure below. Even parity is generated and sent. However, on Receive, parity is not used but must be sent (either odd, even or fixed) to provide the proper timing for the stop-bit position.
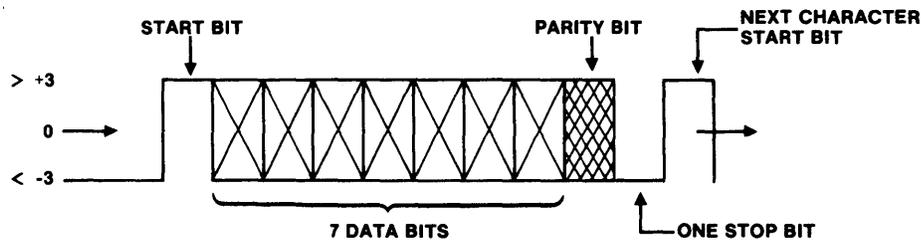
Figure 20-8   Character Format

Even Parity Enable (EPE) - Selects whether even or odd parity is generated. The M304 is shipped in the even parity enable position. To select odd parity, remove jumper between E19, E20, and install between E20, E21. Parity is not used by the M980 when receiving. However, it must be sent either ODD, EVEN, or fixed.

Stop-Bit Select (SBS) - Selects whether there are one or two stop bits sent or required when receiving. The M304 is shipped in the one-stop-bit mode. To select two stop bits, remove jumper between E17, E16, and install between E17, E18. When transmitting to the M980, the stop bit can be of any length, provided that it is a minimum length of one bit in the ones position and two bits in the twos position.

Parity (P1) - Selects whether parity is generated or not. The M304 is shipped in the parity enable mode. To inhibit parity generation, remove jumper between E14, E15, and install between E14, E13.

By selecting jumper positions, the following character variations are possible (See Schematic #104875):

1. One start bit, seven data bits, one stop bit (E16, E17) (E14, E13).
2. One start bit, seven data bits, two stop bits (E17, E18) (E14, E13).
3. One start bit, seven data bits, one stop bit, even parity (E20, E19) (E17, E16) (E14, E15).
4. One start bit, seven data bits, two stop bits, even parity (E17, E18) (E20, E19) (E14, E15).
5. One start bit, seven data bits, one stop bit, odd parity (E16, E17) (E14, E15) (E20, E21).
6. One start bit, seven data bits, two stop bits odd parity (E17, E18) (E14, E15) (E21, E20).
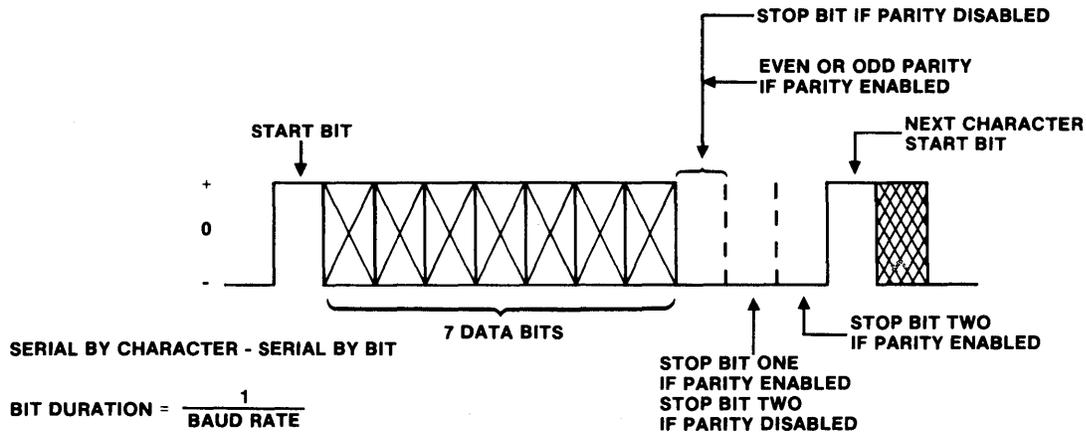
Figure 20-9   Character Variations Using Jumper

Please refer to the M304 schematic for the following jumper descriptions:

(E12-E11) (E10-E9)
These jumpers affect the Request To Send (RTS) line. The M304 is shipped with this line forced high by direct connection to +5V through a resistor. This line is not used by the M980. However, most modems require this line to be high to allow the modem to transmit. If this line is required by protocol or other requirements to be directly connected from the modem through to the terminal, remove jumper between E11, E12 and install between E10, E9.

(E1-E2) (E3-E4)
These jumpers affect the Carrier Detect (CD) line. The M304 is shipped with this line forced high by direct connection to +5V through a resistor. This line is not used by the M980. However, some terminals may require this line to be high for operation. If this line is required by protocol or other requirements to be directly connected from the modem through to the terminal, remove jumper between E1, E2 and install between E3, E4.

(E5-E6) (E7-E8)
These jumpers affect the Data Set Ready (DSR) line. The M304 is shipped with this line forced high by direct connection to +5V through a resistor. This line is not used by the M980. However, some terminals may require this line to be high for operation. If this line is required by protocol or other requirements to be directly connected from the modem through to the terminal, remove jumper between E5, E6 and install between E7, E8.

Signal Discipline

The RS-232-C signals provided by the M304 are used by the 9818 as follows:

TRANSMIT DATA is used by the terminal to send address, control and data characters to the M980 and/or modem. It is also used by the M980 to send data to the modem.

RECEIVE DATA is used by the M980 to send control and data characters to the terminal. It is also used by the modem to send data to the terminal and M980.

REQUEST TO SEND is held high by the M304 for the modem if required, or can be connected by jumper through to the terminal.

CLEAR TO SEND is used by the M980 to indicate to the terminal it is ready to receive characters. This line is used to indicate the M980 is in the Receive Mode. CTS is also used by the modem.

DATA TERMINAL READY is used by the M980 to determine that the 9818 is installed and ready to operate. This line should be held continuously high. Operation with the M980 can be aborted by dropping this signal low.

CARRIER DETECT is not used, but is held high by the M304 or can be connected by jumper through to the terminal.

DATA SET READY is not used, but is held high by the M304 or can be connected by jumper through the modem.

M304 ADAPTER		RS232C INTERFACE CONNECTORS		
PIN NUMBER			PIN NUMBER	
SIGNAL				SIGNAL
	1	14		
TRANSMIT DATA*	2	15		
RECEIVE DATA*	3	16		
REQUEST TO SEND	4	17		
CLEAR TO SEND	5	18		
DATA SET READY	6	19		
SIGNAL GROUND	7	20		DATA TERMINAL RDY
CARRIER DETECT	8	21		
	9	22		
	10	23		
	11	24		
	12	25		
	13			

*Designates Low Level Logic

Figure 20-10   Signal Discipline

ELECTRICAL SPECIFICATIONS

The M304 is designed to work with a high input level of from +3V to +25V and a low input of from -3V to -25V. The output levels of the M304 are approximately +4V for high level and -4V for low level. The signals used and the pin assignments for the terminal and modem connectors may be found in the Signal Discipline Section. Signal lines not listed are wired directly from the terminal connector to the modem connector by the M304 adapter.

The M304 provides connection for one modem and connection for one terminal, along with the following Baud rates: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600.

MECHANICAL SPECIFICATIONS

Height App. 1 inch
Length 6 inches
Width 3.1 inches

ENVIRONMENTAL SPECIFICATIONS

Temperature:
   Operating: 0°C to +50°C
   Storage: -20°C to +60°C

PARAMETER		MIN	MAX	UNITS	NOTE
VOH	High level output voltage	+3	4.6	V	1
VOL	Low level output voltage	-6.6	-3	V	
IOS	Output short circuit current, output connected to ±12V (duration 1 second max.)		80	mA	
CL	Output load capacitance		2500	pF	2
Tr Tf	Output rate of change		30	V/μs	
VIH	Input high level voltage	+3	+25	V	
VIL	Input low level voltage	-3	-25	V	
IIH	Input high level current	+0.5	+8.5	mA	
IIL	Input low level current	-0.5	-8.5	mA	
EL	Output termination bias	-2.0	+2.0	V	
	BAUD rate (bits/second)	50	9600	baud	
	Recommended cable length		50 16	feet meters	
VO	Driver open circuit output voltage	-12	+5	V	
RO	Driver output resistance, power off	300		ohms	
RL	Input load resistance	3K	7K	ohms	

NOTES: 1. Minimum load resistance 3K ohms
2. Includes cable and terminator capacitance

Figure 20-11   Terminal/Modem I/O Specifications
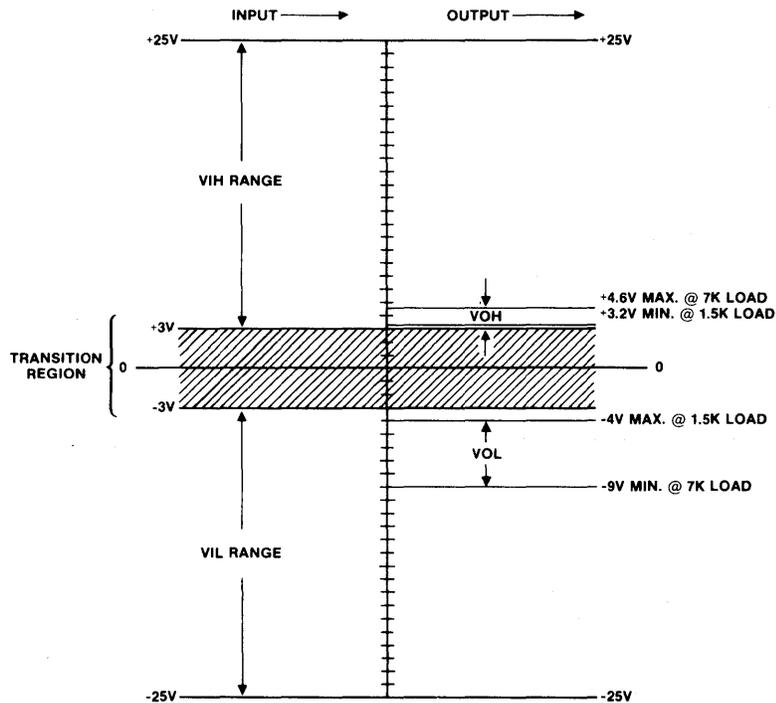
Figure 20-12   M304 I/O Specification

ASCII 7 Bit Parity One Stop Bit
Serial by Bit/Serial by Character
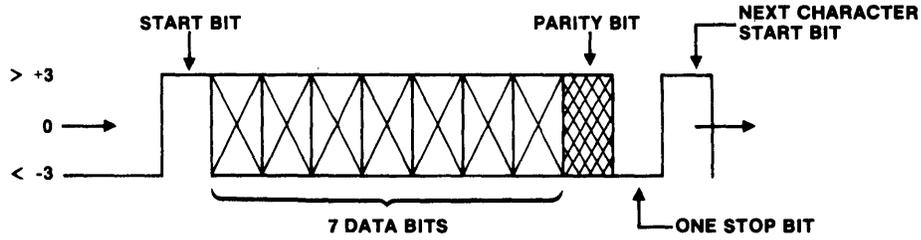
Figure 20-13   Character Format RS-232C
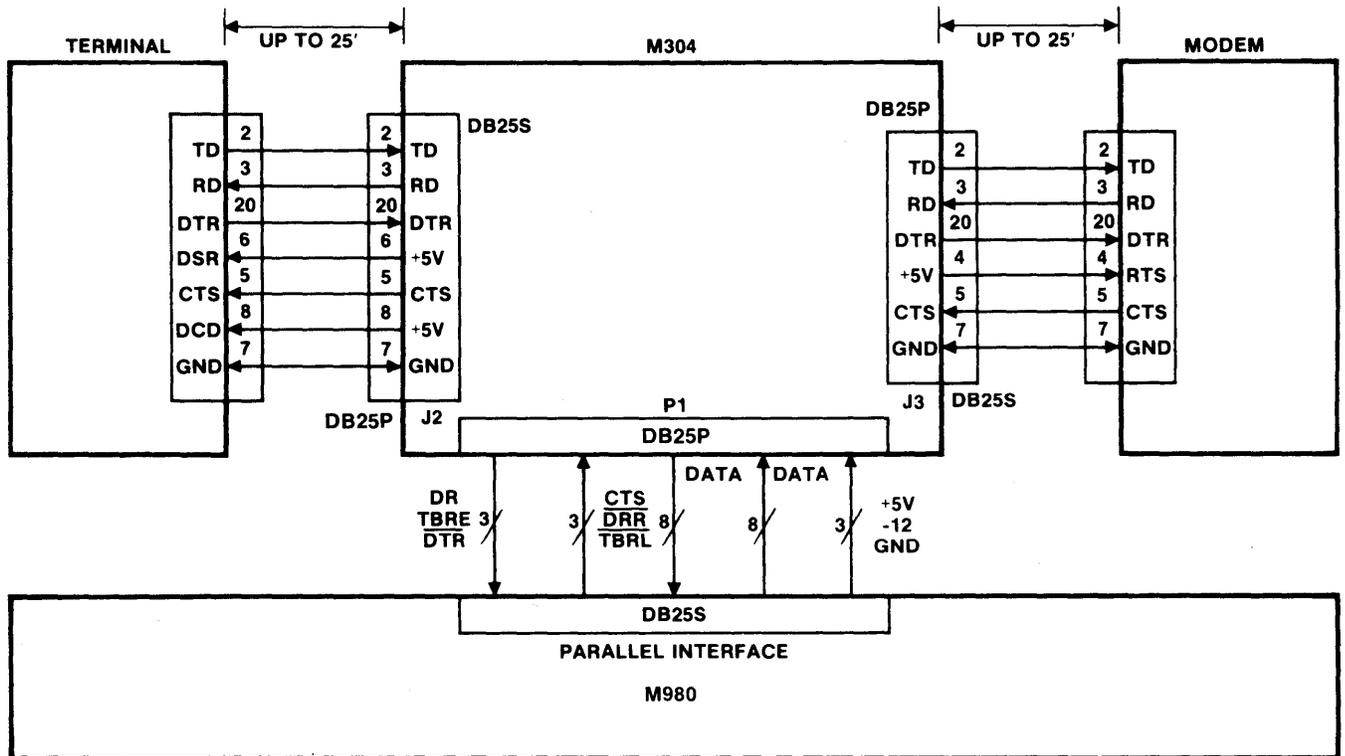
Figure 20-14   Typical System Interconnection

It is to be understood that direct connection to a computer via RS-232-C could be substituted for either the terminal or modem as long as the control and data lines were connected appropriately.

DOCUMENTATION

Figure 21-1   Schematic, M980 Programmer Power and Interconnect

NOTES: UNLESS OTHERWISE SPECIFIED

1. SOME VIEWS SHOWN WITHOUT BOTTOM COVER.
2. SOME VIEWS ARE BROKEN AWAY FOR CLARITY.
3. TREAT ALL FASTENER THREADS WITH LOCTITE #242 AT ASS'Y.
4. PARTS LIST FOR THIS ASSEMBLY IS NO. 106753
5. THESE ITEMS COMPLY WITH U.L. LISTING. DO NOT LOCTITE
6. SCALE : 1/1
7. TOL : .XX = ± .03, .XXX = ± .010.
8. ITEMS 2 AND 56 ARE LISTED ON P/L BUT NOT SHOWN ON ASS'Y. FOR CLARITY

WIRE TABLE

FROM			TO		
ITEM NO.	TERMINAL NO. / LUG	WIRE COLOR AND LENGTH	ITEM NO.	TERMINAL NO. / LUG	WIRE COLOR AND LENGTH
18	PWR. CORD	GRN 3.25	5	DETAIL A	GND	SAME
18	PWR. CORD	WHT 2.75 FEM	6	XFMR 1	WHT 7.50 MALE
18	PWR. CORD	BLK 3.25 FEM	15	CIRC.BRK. LINE	SAME
6	XFMR 4	BLK 10.50 FEM	15	CIRC.BRK. LOAD	SAME
6	+5 TERM	RED 8.50 FEM	15	CIRC.BRK. 3	SAME
6	COM TERM	BLK 10.50	5 DETAIL C	GND	SAME
6	XFMR 4	BLK 4.00 MALE	5	FAN	BLK 2.00 FEM
6	XFMR 1	BLK 4.00 MALE	5	FAN	BLK 2.50 FEM
6	D.C. OUT	TWISTED TRIPLE CABLE	14	CPU J7	CONN
6	XFMR 2	WHT 7.50 FEM	16	CONVENIENCE OUTLET	WHT 3.50 MALE
6	XFMR 3	BLK 8.25 FEM	16	CONVENIENCE OUTLET	BLK 4.00 MALE
16	CONVENIENCE OUTLET	GRN 2.50	5 DETAIL C	GND	SAME
15	CIRC. BRK. 4	BLK 3.50	5 DETAIL C	GND	SAME
13	KEY BOARD	TWISTED TRIPLE CABLE	14	CPU J10	CONN
13	KEY BOARD J3	RIBBON CABLE	14	CPU J4	CONN
14	CPU J3	ITEM #56	11	BUF J4	CONN
11	BUF J3	ITEM #57	11	BUF J3	CONN

PRO-LOG CORPORATION

M980 PROM PROGRAMMER
MADE IN U.S.A.

ON / OFF

MFG MODE   AUDIO   MASTER   COPY
BUFFER
OFF   OFF

SERIAL INTERFACE

PARALLEL INTERFACE

WRITE MODE

EDIT AUTO   BLNK CHCK   PROG DUP   READ CMPR

RESET
CLEAR
ENTER

C D E F
8 9 A B
4 5 6 7
0 1 2 3

4 REQ'D.

REF. THIS END UP
4 REQ'D.

REF.
3 REQ'D.

VIEW **B-B**
ROTATED 90° C.W.

PRO-LOG CORPORATION

ASS'Y. SERIES 90, PROM PROGRAMMER (115 VAC) 16K MEMORY

R. BOAZ 6-17-80

D | 106754 | REV A | SHT 1 OF 2

REVISIONS

ASSY/PART REV	DOC REV	DESCRIPTION	DATE	APPR
	A	INITIAL RELEASE PCN#1047		

Figure 21-2   Assembly, Series/90 PROM Programmer, 16K Memory (115VAC)—View A

Figure 21-3 Assembly, Series/90 PROM Programmer, 16K Memory (115VAC)—View B

NOTES: UNLESS OTHERWISE SPECIFIED

1. SOME VIEWS SHOWN WITHOUT BOTTOM COVER.
2. SOME VIEWS ARE BROKEN AWAY FOR CLARITY.
3. TREAT ALL FASTENER THREADS WITH LOCTITE #242 AT ASS'Y.
4. PARTS LIST FOR THIS ASSEMBLY IS NO. 106751
5. THESE ITEMS COMPLY WITH U.L. LISTING. DO NOT LOCTITE
6. SCALE : 1/1
7. TOLERANCE : XX = ± .03 , .XX = ±.010
8. ITEMS 2 AND 56 ARE LISTED ON P/L BUT NOT SHOWN ON ASS'Y FOR CLARITY.

WIRE TABLE

FROM		TO			
ITEM NO.	TERMINAL NO./LUG	WIRE COLOR AND LENGTH	ITEM NO.	TERMINAL NO./LUG	WIRE COLOR AND LENGTH
18	PWR. CORD	BLUE 2.75 FEM	6	XFMR 1	BLUE 7.50 MALE
18	PWR. CORD	GRN/YEL 3.25	3 DETAIL A	GND	SAME
18	PWR. CORD	BRN 3.25 FEM	15	CIRC. BRK. LINE	SAME
6	XFMR 6	BRN 10.50 FEM	15	CIRC. BRK. LOAD	SAME
6	+5 TERM.	RED 8.50 FEM	15	CIRC. BRK. 3	SAME
6	COM TERM.	BLK 10.50	3 DETAIL C	GND	SAME
6	XFMR 4	BLK 4.00 MALE	5	FAN	BLK 2.00 FEM
6	XFMR 1	BLK 4.00 MALE	5	FAN	BLK 2.50 FEM
6	D.C. OUT	TWISTED TRIPLE CABLE	14	CPU J7	CONN.
6	XFMR 1	WHT 7.50 FEM	16	CONVENIENCE OUTLET	WHT 3.50 MALE
6	XFMR 2,3	BLK 8.25 FEM	16	CONVENIENCE OUTLET	BLK 4.00 MALE
16	CONVENIENCE OUTLET	GRN 2.50	3 DETAIL C	GND	SAME
15	CIRC. BRK. 4	BLK 3.50	3 DETAIL C	GND	SAME
13	KEY BOARD J3	TWISTED TRIPLE CABLE	14	CPU J10	CONN.
13	KEY BOARD J	RIBBON CABLE	14	CPU J4	CONN.
14	CPU J3	ITEM #56	11	BUF J4	CONN.
11	BUF J3	ITEM #57	11	BUF J3	CONN.

Figure 21-4   Assembly, Series/90 PROM Programmer, 16K Memory (220VAC)—View A

VIEW B-B
ROTATED 90° C.W.

M980
PROM PROGRAMMER
MADE IN U.S.A.

PRO-LOG CORPORATION

ASS'Y. SERIES 90, PROM PROGRAMMER (220V) 16K MEMORY

R. BOAZ

D | 106752

Figure 21-5   Assembly, Series/90 PROM Programmer, 16K Memory (220VAC)—View B

Figure 21-6   Schematic, M980 I/O Control Board
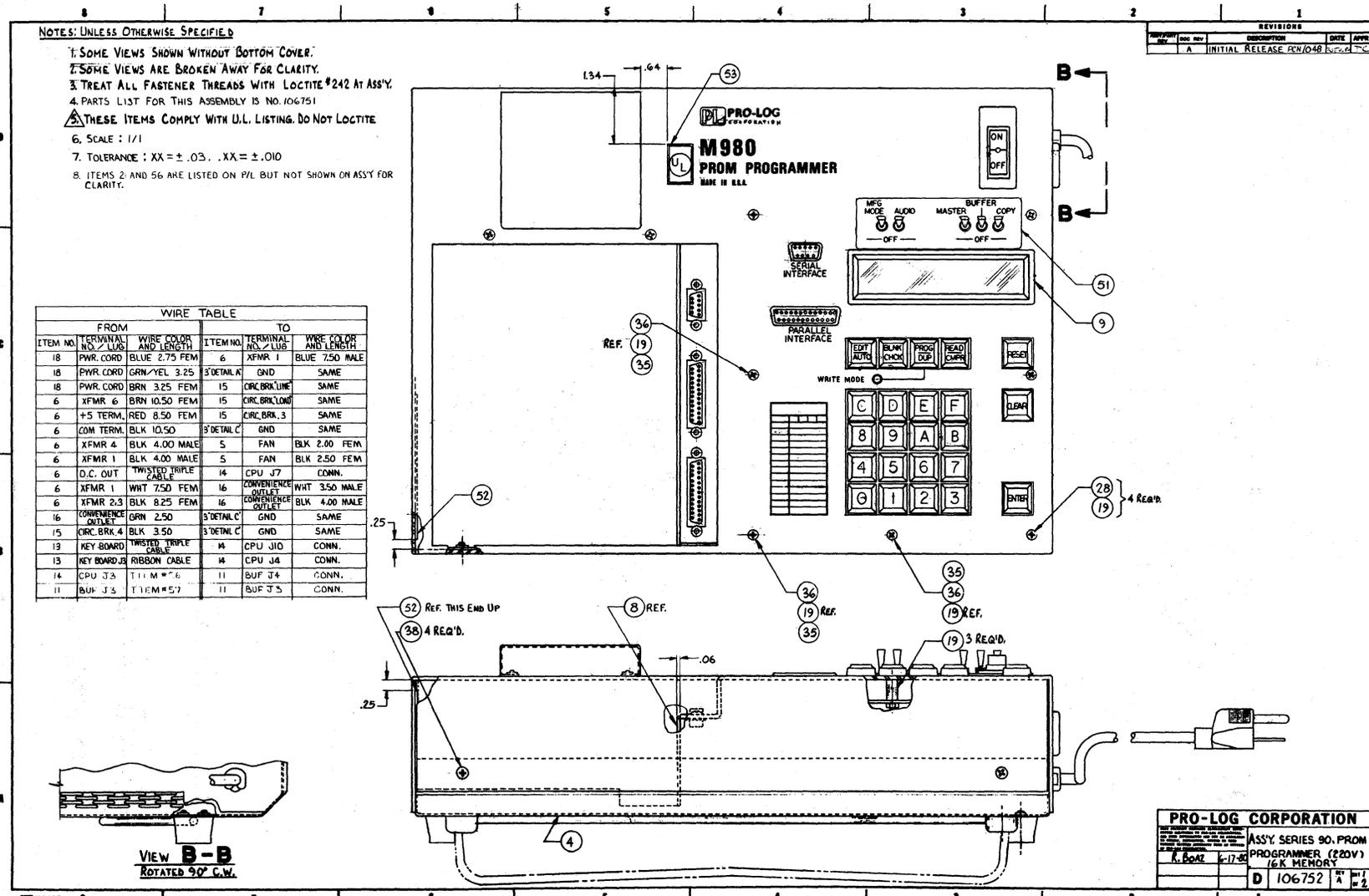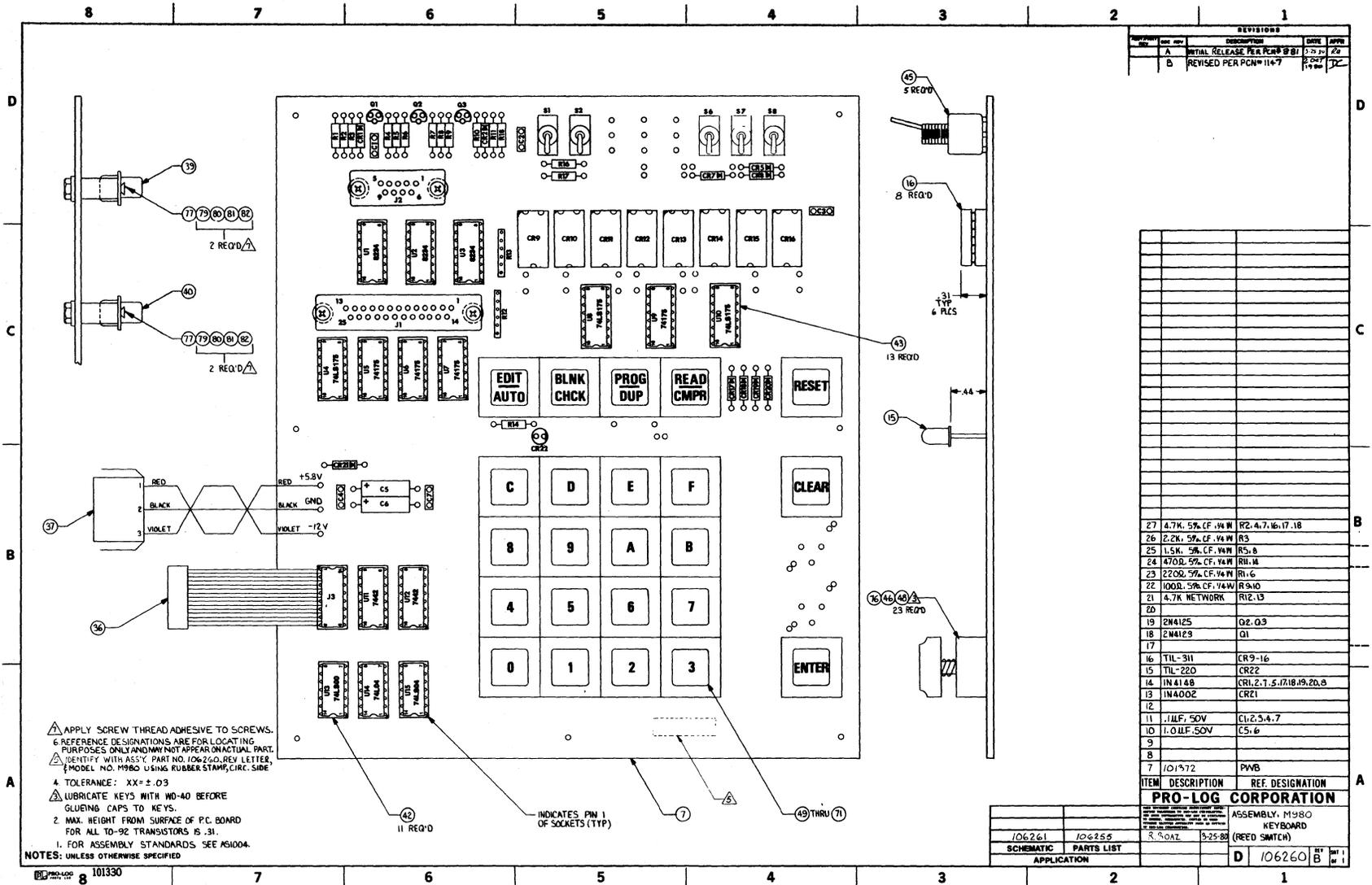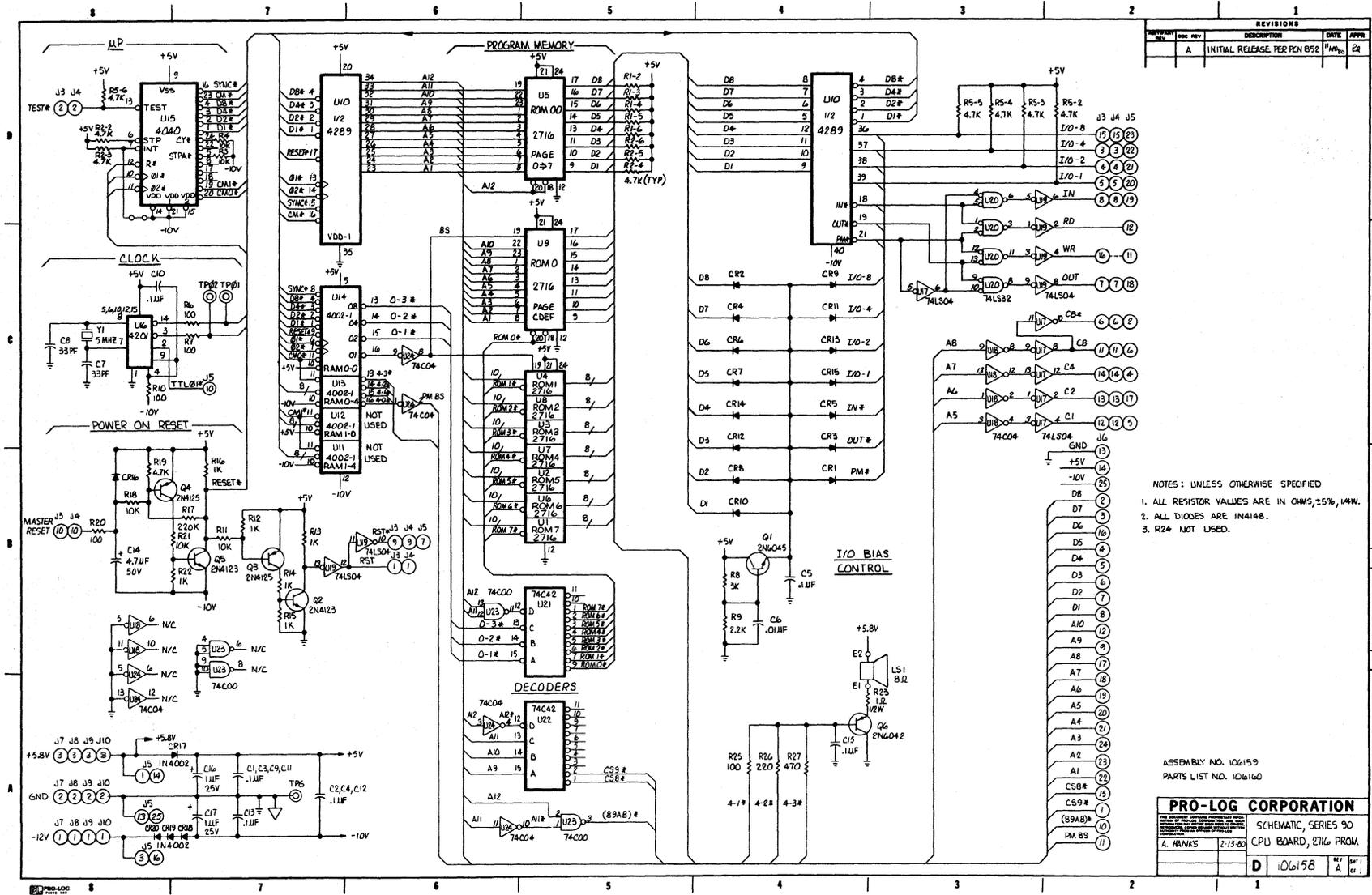
NOTES: UNLESS OTHERWISE SPECIFIED

⚠ APPLY SCREW THREAD ADHESIVE TO SCREWS.
6. REFERENCE DESIGNATIONS ARE FOR LOCATING PURPOSES ONLY AND MAY NOT APPEAR ON ACTUAL PART.
⚠ IDENTIFY WITH ASS'Y. PART NO. 106260. REV LETTER, MODEL NO. M980 USING RUBBER STAMP, CIRC. SIDE
4. TOLERANCE: XX = ±.03
⚠ LUBRICATE KEYS WITH WD-40 BEFORE GLUEING CAPS TO KEYS.
2. MAX. HEIGHT FROM SURFACE OF P.C. BOARD FOR ALL TO-92 TRANSISTORS IS .31.
1. FOR ASSEMBLY STANDARDS SEE AS1004.

INDICATES PIN 1 OF SOCKETS (TYP)

ITEM	DESCRIPTION	REF. DESIGNATION
27	4.7K, 5% CF .¼W	R2,4,7,16,17,18
26	2.2K, 5% CF .¼W	R3
25	1.5K, 5% CF .¼W	R5,8
24	470Ω 5% CF .¼W	R11,14
23	220Ω 5% CF .¼W	R1,6
22	100Ω 5% CF .¼W	R9,10
21	4.7K NETWORK	R12,13
20		
19	2N4125	Q2,Q3
18	2N4123	Q1
17		
16	TIL-311	CR9-16
15	TIL-220	CR22
14	1N4148	CR1,2,7,5,17,18,19,20,8
13	1N4002	CR21
12		
11	.1µF, 50V	C1,2,3,4,7
10	1.0µF, 50V	C5,6
9		
8		
7	101372	PWB

PRO-LOG CORPORATION

ASSEMBLY, M980 KEYBOARD (REED SWITCH)

106261	106255	R.30AZ	3-25-80	
SCHEMATIC	PARTS LIST			
APPLICATION		D 106260 B

REVISIONS

		DESCRIPTION	DATE	APPR
	A	INITIAL RELEASE PER PCN# 881	3-25-80	
	B	REVISED PER PCN# 1147		

Figure 21-7   Assembly, M980 Keyboard

Figure 21-8   Schematic, Series/90 CPU Board, 2716 PROM
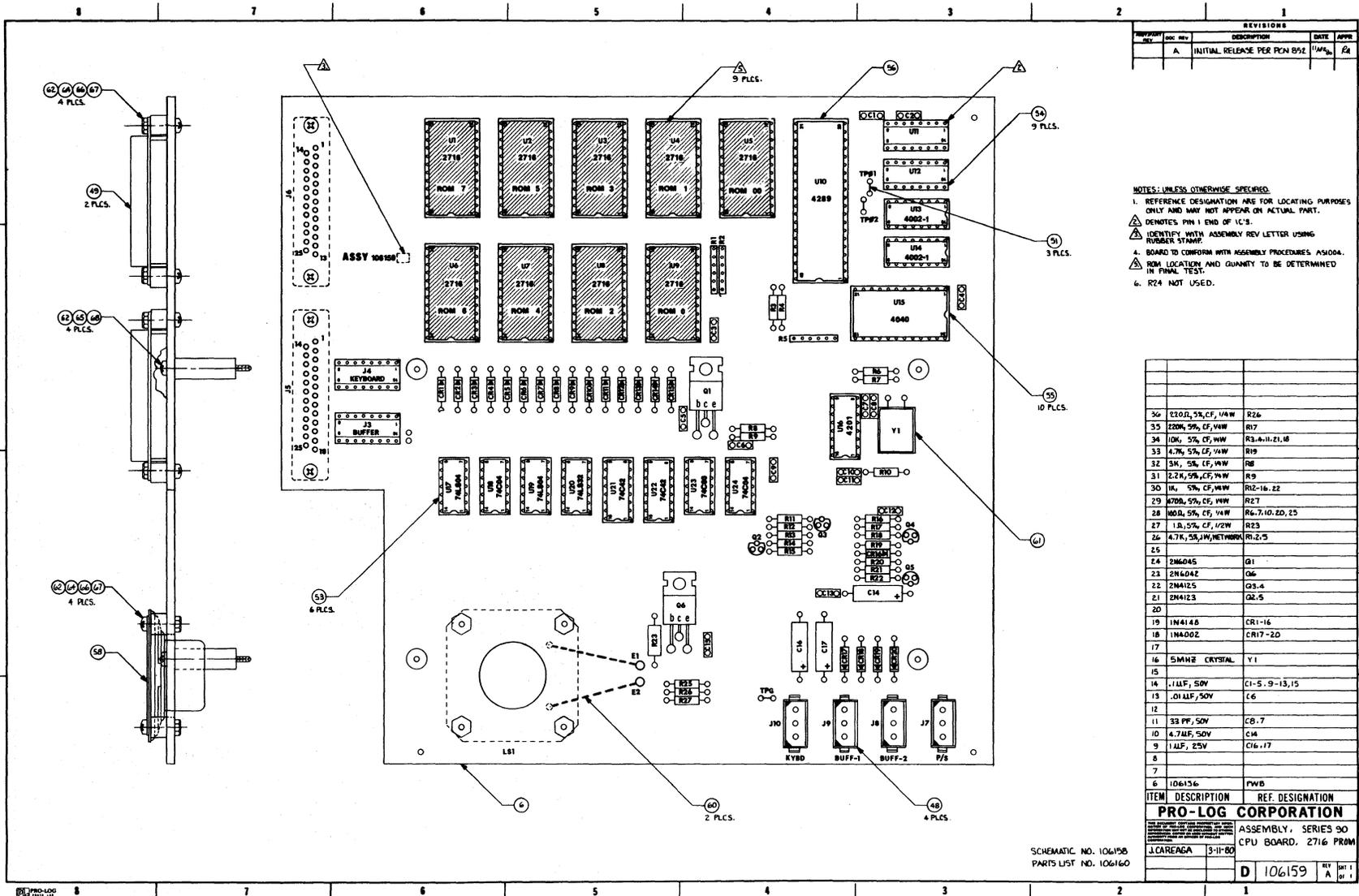
Figure 21-9 Assembly, Series/90 CPU Board, 2716 PROM

REVISIONS

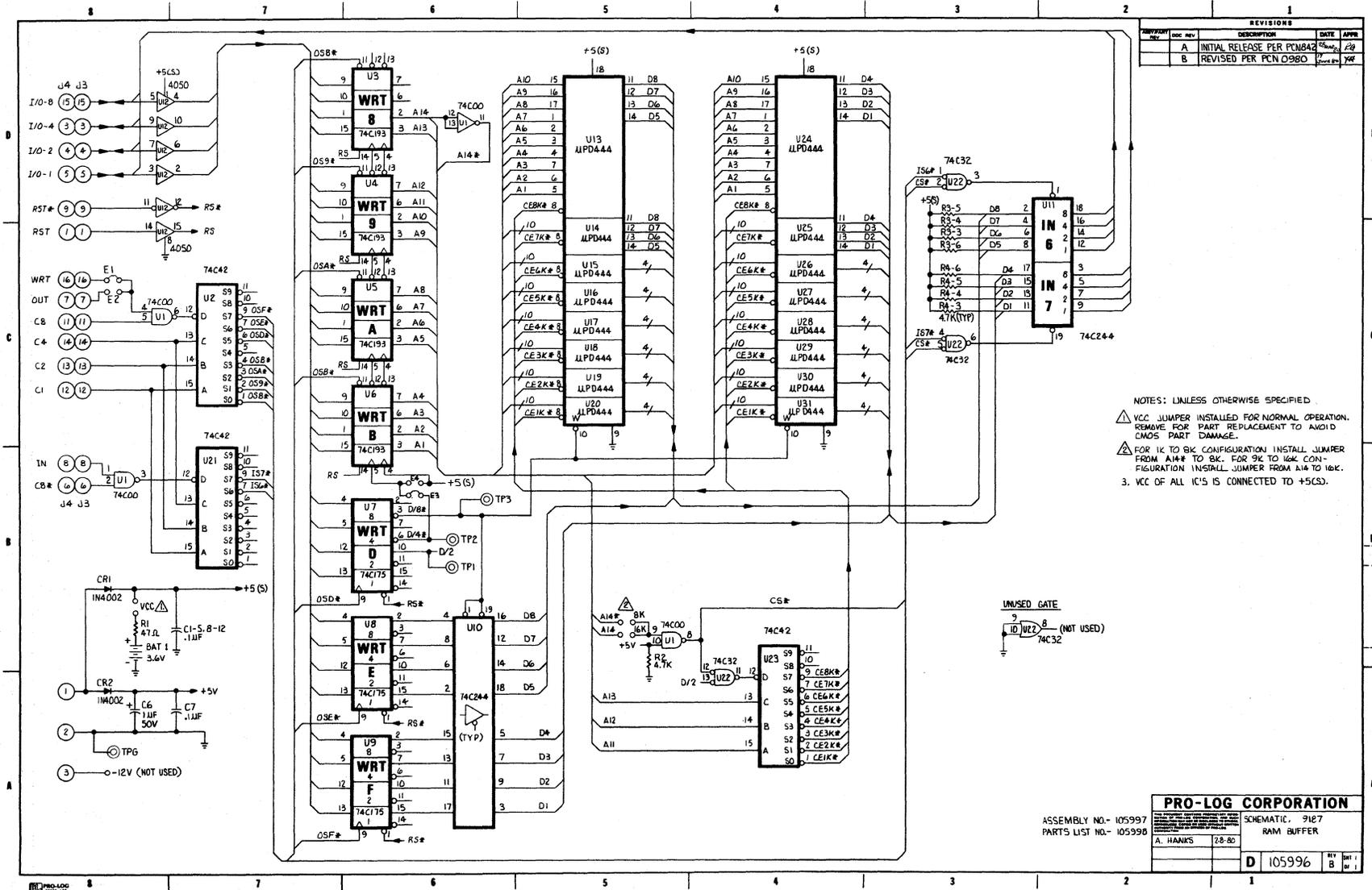| TEST/PART REV	DOC REV	DESCRIPTION	DATE	APPR
	A	INITIAL RELEASE PER PCN 852	11/16/80	RA

NOTES: UNLESS OTHERWISE SPECIFIED.
1. REFERENCE DESIGNATION ARE FOR LOCATING PURPOSES ONLY AND MAY NOT APPEAR ON ACTUAL PART.
2. DENOTES PIN 1 END OF IC'S.
3. IDENTIFY WITH ASSEMBLY REV LETTER USING RUBBER STAMP.
4. BOARD TO CONFORM WITH ASSEMBLY PROCEDURES AS1004.
5. ROM LOCATION AND QUANTITY TO BE DETERMINED IN FINAL TEST.
6. R24 NOT USED.

ITEM	DESCRIPTION	REF. DESIGNATION
36	220Ω, 5%, CF, 1/4W	R26
35	220K, 5%, CF, 1/4W	R17
34	10K, 5%, CF, 1/4W	R3,4,11,21,18
33	4.7K, 5%, CF, 1/4W	R19
32	3K, 5%, CF, 1/4W	R8
31	2.2K, 5%, CF, 1/4W	R9
30	1K, 5%, CF, 1/4W	R12-16,22
29	470Ω, 5%, CF, 1/4W	R27
28	100Ω, 5%, CF, 1/4W	R6,7,10,20,25
27	1Ω, 5%, CF, 1/2W	R23
26	4.7K, 5%, 1W, NETWORK	R1,2,5
25		
24	2N6045	Q1
23	2N6042	Q6
22	2N4125	Q3,4
21	2N4123	Q2,5
20		
19	1N4148	CR1-16
18	1N4002	CR17-20
17		
16	5MHZ CRYSTAL	Y1
15		
14	.1µF, 50V	C1-5,9-13,15
13	.01µF, 50V	C6
12		
11	33 PF, 50V	C8,7
10	4.7µF, 50V	C14
9	1µF, 25V	C16,17
8		
7		
6	106156	PWB

PRO-LOG CORPORATION

ASSEMBLY, SERIES 90
CPU BOARD, 2716 PROM

J.CAREAGA 3-11-80

D 106159 REV A SHT 1 of 1

SCHEMATIC NO. 106158
PARTS LIST NO. 106160

PRO-LOG

Figure 21-10 Schematic, 9187 RAM Buffer

DETAIL A
4 PLCS.

REVISIONS

ZONE REV	DOC REV	DESCRIPTION	DATE	APPR
	A	INITIAL RELEASE PER PCN 842		
	B	REVISED PER PCN 0980		

NOTES: UNLESS OTHERWISE SPECIFIED

1. REFERENCE DESIGNATIONS ARE FOR LOCATING PURPOSES ONLY AND MAY NOT APPEAR ON ACTUAL PART.

2. DENOTES PIN 1 END OF IC'S.

3. IDENTIFY WITH APPLICABLE MODEL NO. ON CIRC. SIDE, AS SHOWN, WITH RUBBER STAMP.

4. BOARD TO CONFORM WITH ASSEMBLY PROCEDURES AS1004.

5. INSTALL TY-WRAP WITH CLASP OF TIE TO THE INSIDE AS SHOWN.

6. FOR 1K TO 8K CONFIGURATION INSTALL JUMPER IN 8K POSITION. FOR 9K TO 16K CONFIGURATION INSTALL JUMPER IN 16K POSITION.

7. VCC JUMPER INSTALLED FOR NORMAL OPERATION. REMOVE FOR CMOS PART REPLACEMENT.

8. THE ITEMS DESCRIBED ON THIS DOCUMENT ARE ASSIGNED INDIVIDUAL PART NUMBERS AS NOTED ON TAB BLOCK. IDENTIFY EACH ASS'Y. WITH APPLICABLE ASS'Y. NUMBER AND REVISION LETTER USING RUBBER STAMP ON CIRC. SIDE.

ASS'Y.NO.	REV.	PARTS LIST	MEMORY SIZE	MODEL NO.	IC'S REMOVED
106659	B	10599B	2K	9187-2	U13-18,24-29
106660	B	106669	4K	9187-4	U13-16,24-27
106661	B	106668	8K	9187-8	n/a

ITEM	DESCRIPTION	REF. DESIGNATION
17	4.7K,5%, CF, ¼W	R2
16	47Ω,5%, CF, ¼W	R1
15	4.7K,5%,1W NETWORK	R3,4
14		
13	1N4002	CR1,2
12		
11	.1 µF, 50V	C1-5,7-12
10	1 µF, 50V	C6
9		
8	3.6V .45A HRS	BAT 1
7		
6	105995	PWB

PRO-LOG CORPORATION

ASSEMBLY, 9187 RAM BUFFER

J. CAREAGA 2-20-80

D 105997 REV B SHT 1 of 1

SCHEMATIC NO.- 105996

Figure 21-11 Assembly, 9187 RAM Buffer

Figure 21-12   Schematic, Power Supply

Figure 21-13 Assembly, Series/90 Power Supply
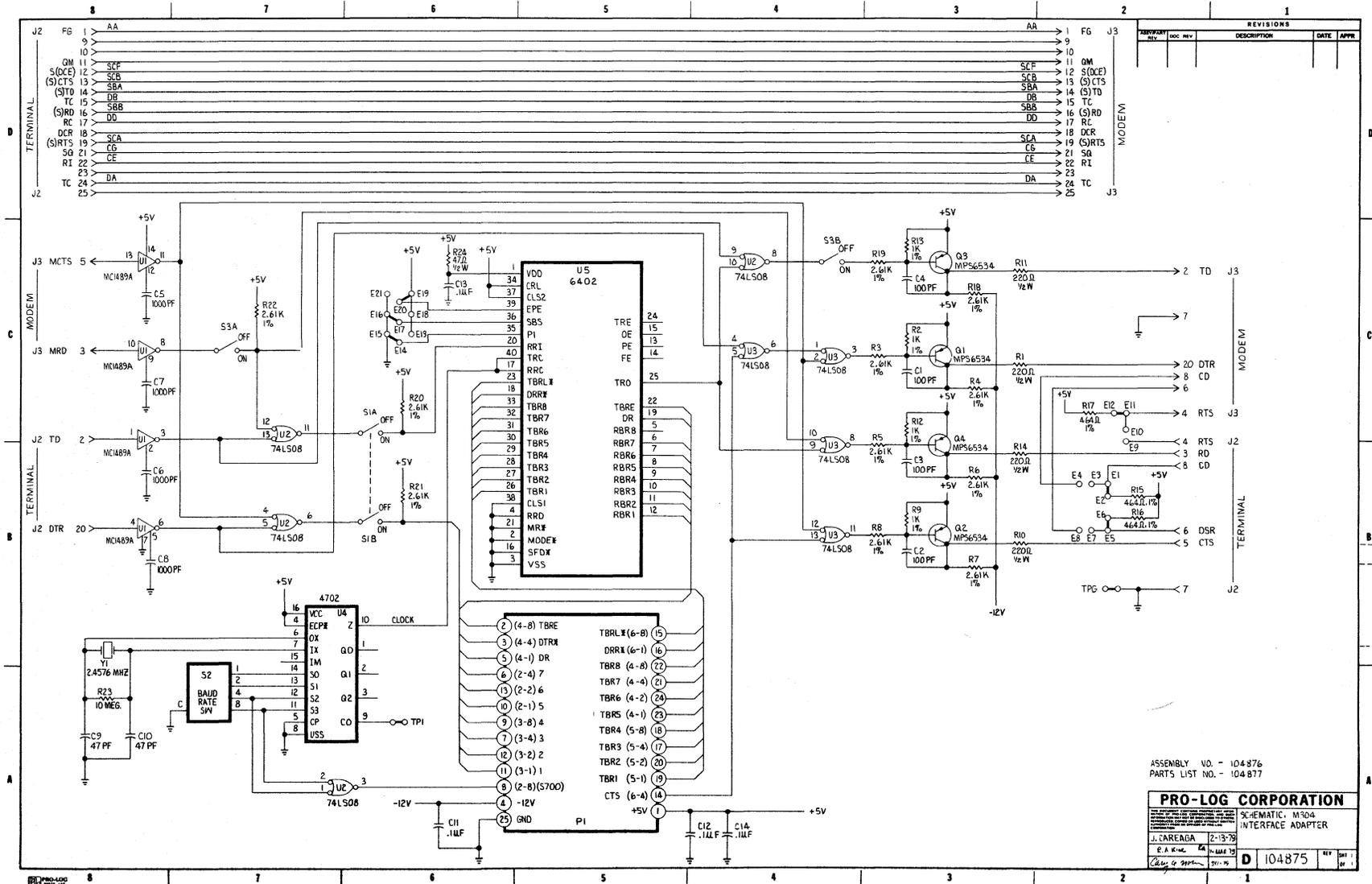
Figure 21-14   Schematic, M304 Interface Adapter

REVISIONS

REV/ECN REV	DOC REV	DESCRIPTION	DATE	APPR
	A	REMOVED DETAIL A PCR 0416	8 May 79	R4
	B	UPDATE PER PCR 0524		R4

(43)(45)(51)

(37) REF   (36) REF   (43)(47)(49)(50) 4 PLCS.

Q1
R1
R2 C10
R3
R4
Q2
R11
25 13
13 25
E1 E3 E4   E5 E7 E8
E2   E6
E9 E10 E11
E12
14 1   14 1
U1 MC1489A
U2 74LS08   U3 74LS08
(39) 3 PLCS
INDICATES PIN 1 OF SOCKET (TYP)
S1   S2   S3
C4
R21   R22   TP1
E13
E14   U4 4702   Y1
E15
(40)
E16
E17
E18   U5 6402
E19
(55) E20   25 13
8 PLCS.   E21   1
R24   P1
(41)
TPG
(36)   (6)

(37)   (36)
(53) 2 PLCS.
(26)
(43)(46)(48)(51)
(36) REF

ITEM	DESCRIPTION	REF. DESIGNATION
26	2.4576 MHZ	Y1
25		
24	47Ω, CC, 5%, ½W	R24
23	220Ω, CC, 5%, ¼W	R1,10,11,14
22	10MEG,CC/CF,5%,¼W	R23
21	2.61K, MF, 1%, ¼W	R3-R8, R18-R22
20	1K, MF, 1%, ¼W	R2,9,12,13
19	464Ω, MF, 1%, ¼W	R15-R17
18		
17	MPS6534	Q1-4
16		
15		
14		
13	.1µF, 50V	C11-C14
12	47PF, 50V	C9,10
11	100PF, 50V	C1-C4
10	1000PF, 50V	C5-C8
9		
8		
7	104874	PWB
6		
5		
4	104967	FAB FRONT PANEL

PRO-LOG CORPORATION

ASSEMBLY, M304 INTERFACE ADAPTER

104875	104877	J. CAREAGA	2-13-79
SCHEMATIC	PARTS LIST		
	APPLICATION		

D 104876 REV B SHT 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
1. FOR ASSEMBLY PROCEDURE SEE A51004.
2. DO NOT EXPOSE S1, S2, S3 AND CRYSTAL PAD TO FLUX OR CLEANING VAPOR.
3. S1 AND S3 ARE INSTALLED AFTER 74LS08 IC'S, U2,U3 AND CRYSTAL WITH PAD.
4. CUT PINS 1 THRU 20 ON U5 AND LEADS ON C13 AND R24, FLUSH TO BOARD.

PRO-LOG   101330

Figure 21-15 Assembly, M304 Interface Adapter

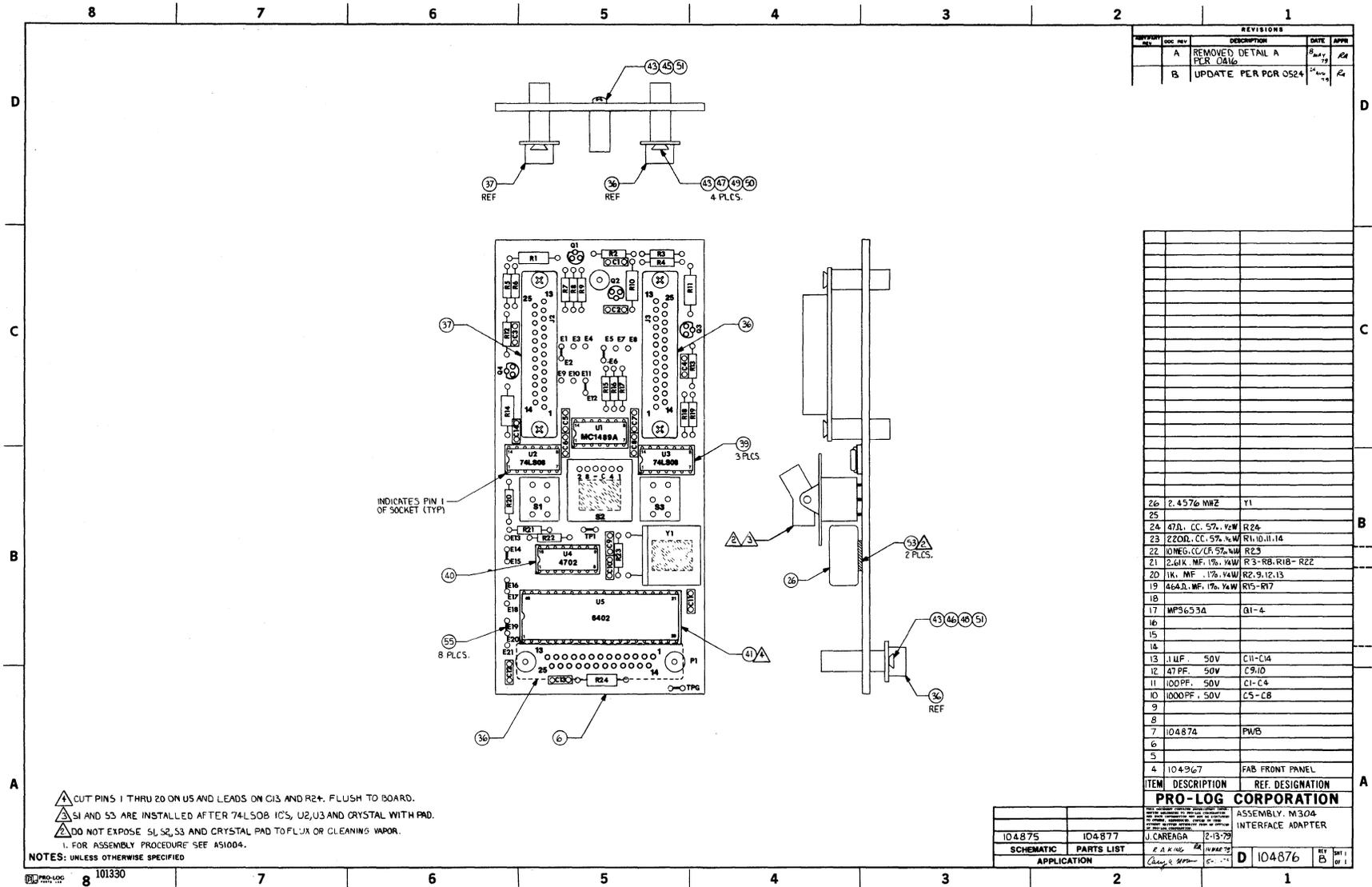| HEX				MSD	p = 1	8	9	A	B	C	D	E	F
					p = 0	0	1	2	3	4	5	6	7
	BITS				b8	p	p	p	p	p	p	p	p
					b7	0	0	0	0	1	1	1	1
					b6	0	0	1	1	0	0	1	1
LSD	b4	b3	b2	b5 / b1		0	1	0	1	0	1	0	1
0	0	0	0	0		NUL	DLE	SP	0	@	P	`	p
1	0	0	0	1		SOH	DC1	!	1	A	Q	a	q
2	0	0	1	0		STX	DC2	"	2	B	R	b	r
3	0	0	1	1		ETX	DC3	#	3	C	S	c	s
4	0	1	0	0		EOT	DC4	$	4	D	T	d	t
5	0	1	0	1		ENQ	NAK	%	5	E	U	e	u
6	0	1	1	0		ACK	SYN	&	6	F	V	f	v
7	0	1	1	1		BEL	ETB	'	7	G	W	g	w
8	1	0	0	0		BS	CAN	(	8	H	X	h	x
9	1	0	0	1		HT	EM	)	9	I	Y	i	y
A	1	0	1	0		LF	SUB	*	:	J	Z	j	z
B	1	0	1	1		VT	ESC	+	;	K	[	k	{
C	1	1	0	0		FF	FS	,	<	L	\	l	|
D	1	1	0	1		CR	GS	–	=	M	]	m	}
E	1	1	1	0		SO	RS	.	>	N	^	n	~
F	1	1	1	1		SI	US	/	?	O	___	o	DEL

CONTROL CHARACTERS

NUL	Null	FF	Form Feed	CAN	Cancel
SOH	Start of Heading	CR	Carriage Return	EM	End of Medium
STX	Start of Text	SO	Shift Out	SUB	Substitute
ETX	End of Text	SI	Shift In	ESC	Escape
EOT	End of Transmission	DLE	Data Link Escape	FS	File Separator
ENQ	Enquiry	DC1	Device Control 1	GS	Group Separator
ACK	Acknowledge	DC2	Device Control 2	RS	Record Separator
BEL	Bell (audible or attention signal)	DC3	Device Control 3	US	Unit Separator
BS	Backspace	DC4	Device Control 4 (Stop)	DEL	Delete
HT	Horizontal Tabulation (punched card skip)	NAK	Negative Acknowledge		
LF	Line Feed	SYN	Synchronous Idle		
VT	Vertical Tabulation	ETB	End of Transmission Block		

ASCII Code Assignments