# M900B

# Buffered Universal PROM Programmer

# Operating Manual


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# M900B Buffered Universal PROM Programmer

# Operating Manual

PRO-LOG CORPORATION

# M900B
# BUFFERED UNIVERSAL
# PROM PROGRAMMER

## TABLE OF CONTENTS

# SECTION 1

# M900B SUMMARY

The M900B Programmer is a portable, intelligent PROM programming instrument with pluggable personality modules. The plug-in personality modules allow the basic instrument to program a wide range of MOS and bipolar PROMs. The M900B is microprocessor-controlled, providing interaction with the operator to guide him through each operation. The microprocessor also interacts with the PROM, assuring rapid and accurate device programming. The M900B is equipped with a Buffer Memory, which affords editing capability and permits direct or indirect duplication and programming operations.

## OPERATING FEATURES

### M900B Control Unit

- PROGRAM, LIST, DUPLICATE and VERIFY modes of operation
- Automatic BLANK check in all non-buffered modes
- Hexadecimal Keyboard and Displays (0-9, A-F)
- Data Invert Switch
- DUPLICATE and VERIFY Master-to-Buffer, Master-to-Copy and Buffer-to-Copy

### Series 90 Personality Modules

- Individual Zero Insertion Force PROM sockets for Master and Copy PROMs
- Binary Data Display for Copy PROM (4 or 8 bits)
- Control Switches as required to enable special functions

## OPTIONAL EQUIPMENT AND CAPABILITY

**9103 - ERASE LIGHT SYSTEM** - Ultra-Violet light source with timer for erasing MOS PROMs.

**9108 - RS-232-C COMPUTER/TERMINAL/BUFFER INTERFACE** - Uses M303 Adapter.

**9111 - PAPER TAPE READER** - Provides interface between M900B and M301 Paper Tape Reader. Allows DUPLICATE and VERIFY operations from paper tape.

**9112-2 - TTY INTERFACE** - ASCII-HEX coded TTY Interface with automatic Baud rate selection.

**9114 - COMPUTER INTERFACE** - Parallel data and handshake I/O - High speed. Allows remote controller to PROGRAM or LIST the Buffer using 8-bit parallel data transfer bus.

**9115 - RS-232-C INTERFACE TO M900B RAM BUFFER** - Allows LIST and PROGRAM functions.

**9118 - TERMINAL/MODEM/COMPUTER MULTIBAUD INTERFACE** - ASCII/RS-232-C compatible.

**9119 - CHECKSUM OPTION** - Allows unique identification and confidence check of coded PROMs and buffer.

## HEXADECIMAL NOTATION

Hexadecimal notation is a convenient way to represent 16 combinations of four bits of information with a single character for each combination. The most popular character set for displaying hexadecimal data consists of the characters 0 through 9 to represent the binary combinations 0 through 9 and the characters A, B, C, D, E and F to represent the number combinations 10 through 15:

| HEXADECIMAL CHARACTERS | BINARY BITS 8 4 2 1 | DECIMAL CHARACTERS |
|---|---|---|
| 0 | 0 0 0 0 | 0 |
| 1 | 0 0 0 1 | 1 |
| 2 | 0 0 1 0 | 2 |
| 3 | 0 0 1 1 | 3 |
| 4 | 0 1 0 0 | 4 |
| 5 | 0 1 0 1 | 5 |
| 6 | 0 1 1 0 | 6 |
| 7 | 0 1 1 1 | 7 |
| 8 | 1 0 0 0 | 8 |
| 9 | 1 0 0 1 | 9 |
| A | 1 0 1 0 | 10 |
| B | 1 0 1 1 | 11 |
| C | 1 1 0 0 | 12 |
| D | 1 1 0 1 | 13 |
| E | 1 1 1 0 | 14 |
| F | 1 1 1 1 | 15 |

Figure 1-1 Conversion Table

As an extension of this technique, all 256 combinations of 8 bits can be represented by two hexadecimal characters, as shown in the following examples.

| HEXADECIMAL CHARACTERS | BINARY BITS | DECIMAL CHARACTERS |
|---|---|---|
| 00 | 0000 0000 | 0 |
| 01 | 0000 0001 | 1 |
| 3E | 0011 1110 | 62 |
| 42 | 0100 0010 | 66 |
| E1 | 1110 0001 | 225 |
| FF | 1111 1111 | 255 |

Figure 1-2 Conversion Table

Going further, all 4096 combinations of 12 bits can be represented by three hexadecimal characters. This technique can be extended indefinitely by adding one hexadecimal character for each four bits of information.

SECTION 2

# ADDRESS FIELD DEFINITION

All of the keyboard operations and some of the remote control options allow the operator to select a partial address field to operate on. If the operator does not select a partial field all addresses will be operated on.

### FULL ADDRESS OPERATION

Whenever a mode is selected the hexadecimal display indicates the FULL PROM size to the operator by automatically displaying the FIRST address and the LAST address. The FIRST address is always all zeros and the LAST address is always all ones represented in hexadecimal. The hexadecimal indications for the FIRST and LAST addresses of all PROMs are given in Table 2-1.

| PROM SIZE | HEXADECIMAL FULL PROM FIELD ADDRESS | |
|---|---|---|
| | FIRST ADDRESS | LAST ADDRESS |
| 16 by X | 0 | F |
| 32 by X | 00 | 1F |
| 64 by X | 00 | 3F |
| 128 by X | 00 | 7F |
| 256 by X | 00 | FF |
| 512 by X | 000 | 1FF |
| 1024 by X | 000 | 3FF |
| 2048 by X | 000 | 7FF |
| 4096 by X | 000 | FFF |

Figure 2-1 Prom Size Field Definition

The FULL address field indicates to the operator that all addresses of the PROM will be operated on. The operator may accept the full address or select a partial address.

### PARTIAL ADDRESS OPERATION

The operator has the option of changing the FULL address to a PARTIAL field before initiating the operation. A PARTIAL field may be as small as a single location and as large as the FULL address field.

When FIRST address and LAST address appear in the hex display the operator can re-define the field by keying in a START address and an END address. The START and END addresses define the new field to be operated on. If the START address is greater than the END address the operation will begin at the START address and stop at the LAST address. If the START and END addresses are equal a single location will be operated on.

SECTION 3

# OPERATING PANEL DESCRIPTION

The operating panel shown in Figure 3-1 has all the controls and indicators necessary for keyboard operation plus the connectors for operating with remote control options. All data and addressing information is represented in hexadecimal notation. A convenient HEX to BINARY conversion table is printed on the control panel to assist the operator. A Dedicated Personality Module is shown plugged into the control unit.

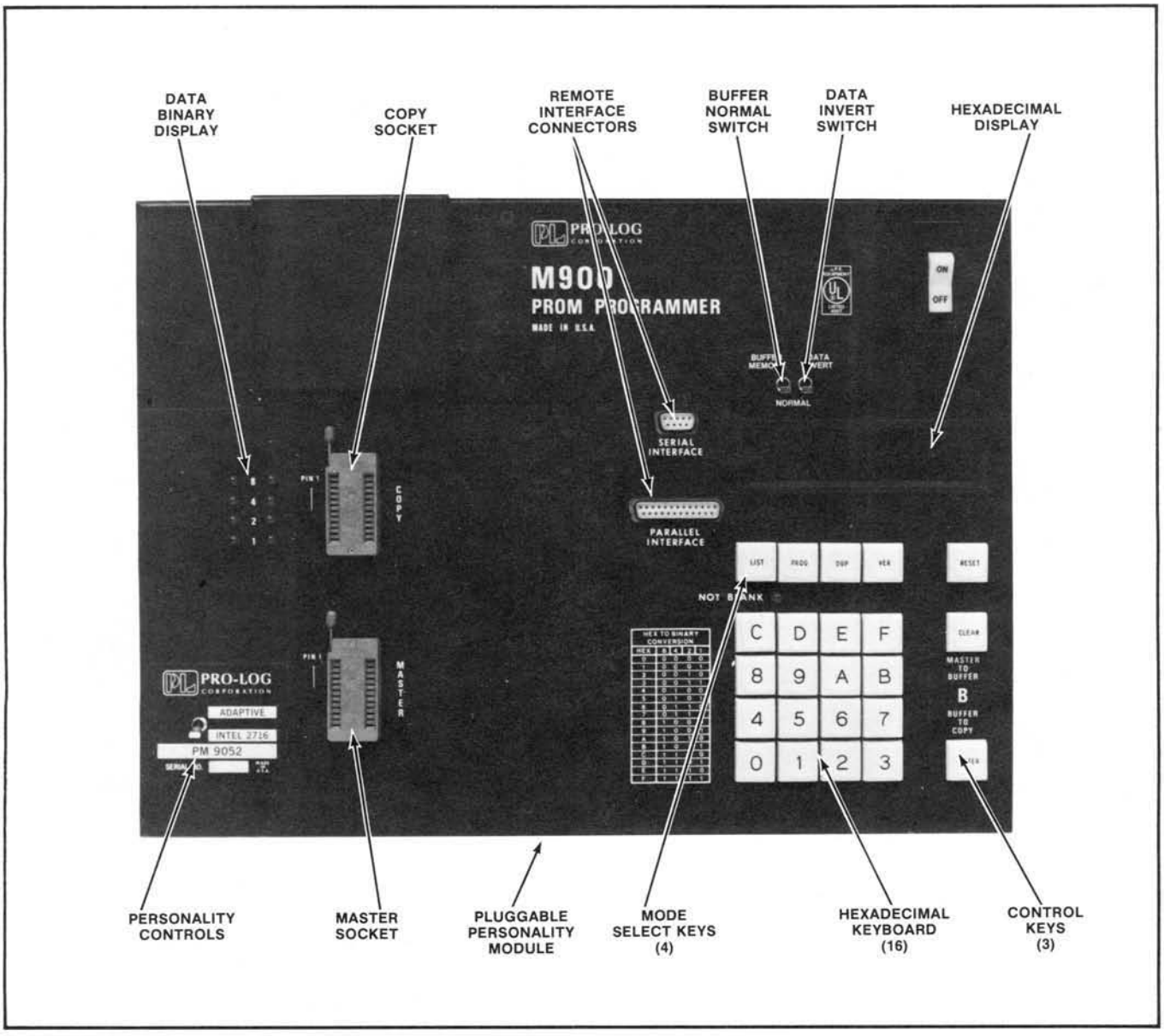



Figure 3-1 M900B Operating Panel

## DISPLAYS AND INDICATORS

Not Erased Indicator: An individual indicator located above the keyboard which lights if the address field in the Copy PROM is not completely blank. Pressing the ENTER button during definition of the address field in any non-buffered mode initiates a BLANK check.

Hexadecimal Display: A six-digit character display capable of showing the Hex characters 0-9, A, B, C, D, E, F. This display is located above the keyboard and is used for indicating both address information and data.

The leftmost characters represent address information. The rightmost characters can be: address information, which appears during the field definition phase at the beginning of all operating sequences; coded operating questions, which appear in the duplicating mode as a guide to entering changes; data at all other times. In LIST, this data is the Hex equivalent of the Binary Data Display; in PROG, it is the data to be loaded into the Copy PROM; in VER and DUP, it is the data stored in the Master PROM (in this case, the Binary Data Display simultaneously indicates the data in the Copy PROM).

Binary Data Display: Located in personality module. Will display data depending on mode.

## KEYBOARD

Hexadecimal Keys: Sixteen keys labeled 0-F and arranged in four rows of four keys. Each key corresponds to the Hex equivalent of a 4-bit binary number. (See Hexadecimal Notation) These keys are used to enter data or to define the address field to be operated upon.

## TOGGLE SWITCHES

Data Invert Switch: Located above the Hex display. This switch affords the capability of inverting data during operation in any mode.

Buffer Memory Switch: Located above the Hex display. Placed in the NORMAL position, this switch permits data transfers directly from Master to Copy without alteration of Buffer contents. In the BUFFER MEMORY position, the Buffer is the object of data transfers from Master or to Copy.

## CONTROL KEYS

LIST Key: A mode control key which permits the sequential display of any or all Copy PROM or Buffer locations on both Binary Data Display and Hex Display.

PROG Key: A mode control key which permits the sequential loading of any or all Copy PROM or Buffer locations from the keyboard.

VER Key: A mode control key used for high-speed verification of data loading. Verifies that data has been copied correctly into Copy PROM or Buffer.

DUP Key: A mode control key which selects high-speed loading of Buffer from Master or of Copy from Master or Buffer.

RESET Key: A control key which cancels operation in progress, without altering Buffer. RESET clears the Hex display and indicates on the binary Data Display the data in address zero of the Copy PROM or Buffer. A mode control key (LIST, PROG, VER, DUP) must be pressed before system will operate after RESET.

ENTER Key: A dual function key used to initiate operations or specify Buffer-to-Copy programming.

CLEAR Key: A dual function key used to clear data entries manually or specify Master-to-Buffer data transfers.

## REMOTE OPTION CONNECTORS

Serial Interface: The SERIAL INTERFACE connector is a 9-pin "D" type connector located in the center of the control panel. This connector provides a six circuit, two wire current loop interface for the 9112 TTY option.

Parallel Interface: The PARALLEL INTERFACE connector is a 25-pin "D" type connector located in the center of the control panel. This connector provides 11 TTL input and output lines for implementing options such as 9108, 9111, 9114, 9115, 9118.

SECTION 4

# PERSONALITY MODULE DESCRIPTIONS

Plug-in personality modules for the M900 PROM Programmer include three types: Dedicated, Generic and Gang. Dedicated Modules are configured to program one or more devices with the same pinout. Generic Modules utilize Pinout Adapters and configurators to program any of a manufacturer's Generic line of PROMs. Gang Modules program multiple PROMs (usually 8) simultaneously.

In all cases, the Personality Module interfaces with the Control Unit to provide the various voltages required to program and read a particular PROM, accommodating the various interface options of the Control Unit automatically.

Each module plugs into a Control Unit, using three D-type connectors. These connectors are proven and reliable. Each module has one (or more) COPY sockets and one MASTER socket. Programming voltages are never applied to the MASTER socket, protecting the PROM.

## DEDICATED MODULES

These modules are configured to program one or a few PROMs with identical pinouts. In some cases, a switch is used to permit one module to program two PROMs of the same family (e.g. 256x4 and 512x4), when the pinouts are compatible. In a few cases, the switch is used to set the operating conditions to satisfy one manufacturer's product which differs from others with similar products (e.g. PM9001A).

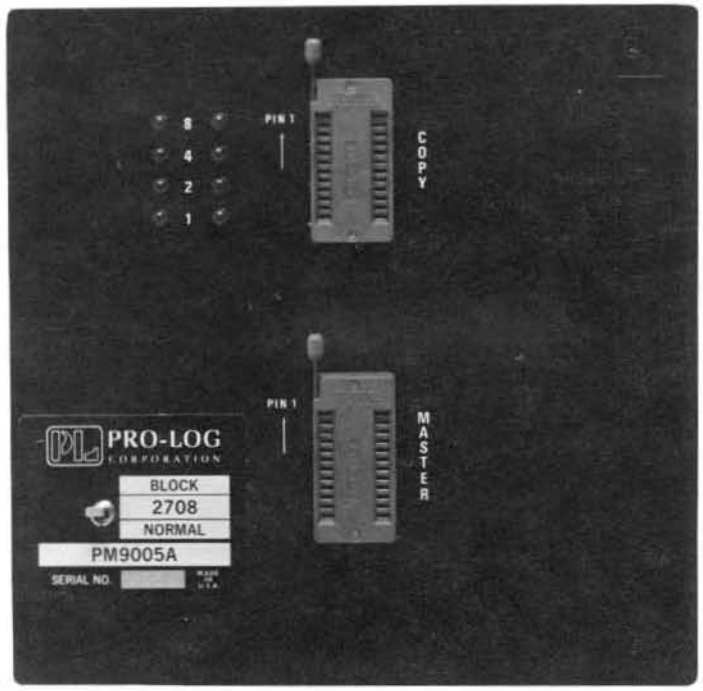



Figure 4-1 Dedicated Personality Module

The COPY socket is located on the upper half of the module mounting plate; pin 1 is located next to the locking lever on the zero insertion pressure (ZIP) socket. Binary lights are located to the left of the COPY socket and display the contents of the COPY socket. Either 4 or 8 lights are used, depending on the configuration of the PROM to be programmed. The MASTER socket is located on the lower half of the module mounting plate; its ZIP socket is indexed the same way as the COPY socket.

The handle affixed to the Personality Module plate is designed to assist in insertion and removal of the module from the Control Unit, by being mounted coaxially with the D-type connectors. Removal of the module is accomplished with a direct upwards pull or slight back-and-forth motion. Insertion is the reverse, except that care should be exercised to ensure that the D-type connector shells are mated properly before applying force to seat the module. When properly seated, the module plate is flat on the top of the Control Unit.

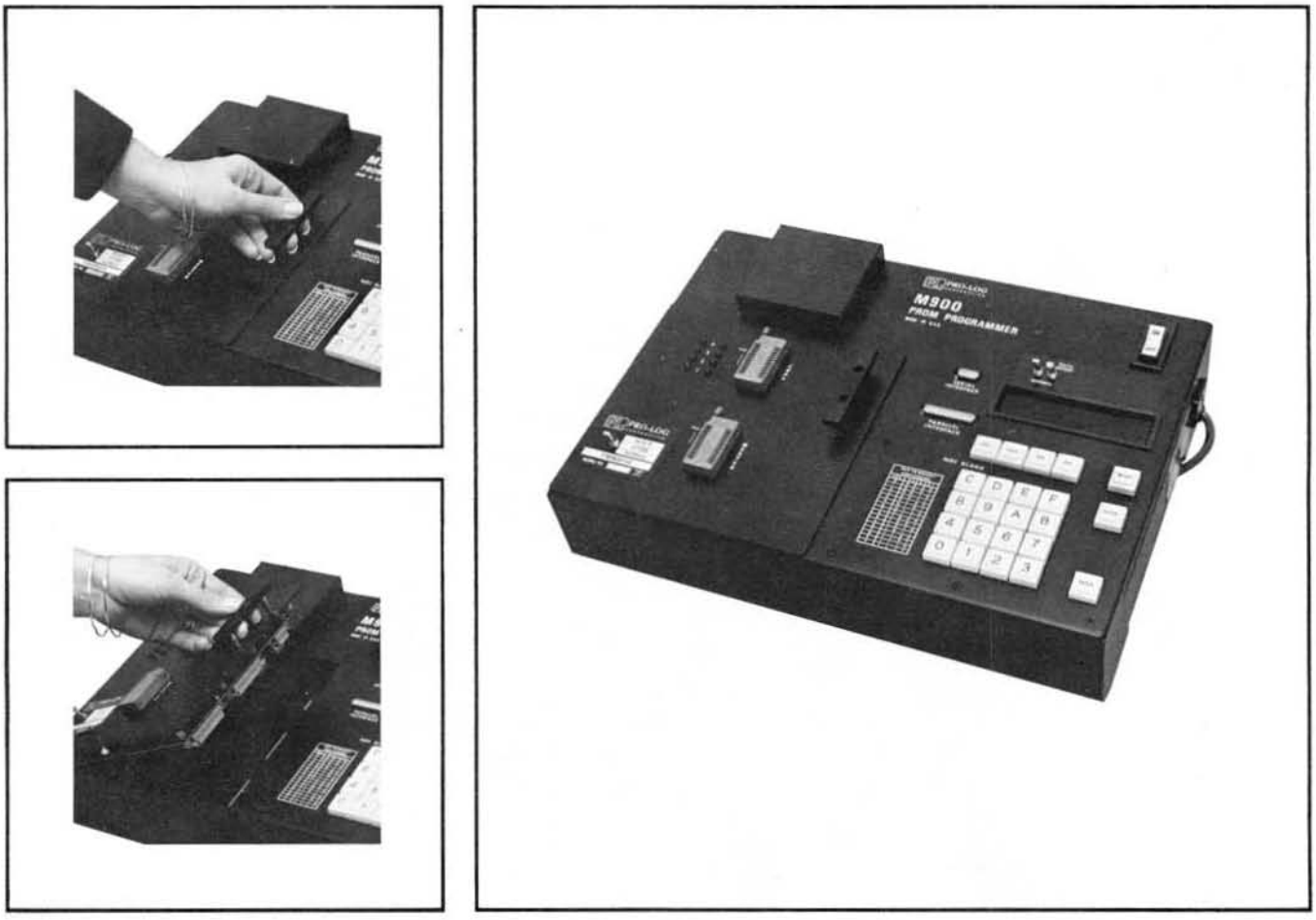



Figure 4-2 Installation and Removal of Personality Module

Certain dedicated modules have special features or functions, and therefore have special Operating Instructions. These are provided with each module.

## GENERIC MODULE

Generic Modules are designed to program all PROM types of a particular manufacturer, using adapters to conform to specific pinouts and configurators which allow the Control Unit to automatically accommodate different sizes and types of PROMs (i.e. 512x4 or 1024x8). The polarity of unprogrammed PROM locations and the type (bipolar or MOS) is also contained in the configurator. (Refer to the PROM User's Guide for specific Pinout Adapter and Configurator types for particular PROM types.)

Signals are passed from the base module to the Pinout Adapter via two 25 pin D-type connectors, the same reliable type used to connect the Personality Module to the Control Unit. The configurator is mounted via a ZIP connector located on the bottom right of the module mounting plate. The configurator must be mounted as shown below in order for the module to function properly. It should also be the proper size and type (e.g. 2048x8 (EH) for a 2716).

With the proper Pinout Adapter and Configurator installed, the Generic Module functions identically to a Dedicated Module of the same type. Additional Pinout Adapters and Configurators are constantly being added to accommodate the everbroadening line of PROMs being manufactured.

Each Generic Module is furnished with a Configurator chart, detailing the various Pinout Adapters and Configurators required to Program the manufacturer's line of PROMs. Those modules having special features or requiring special operating techniques are furnished with special operating instructions.

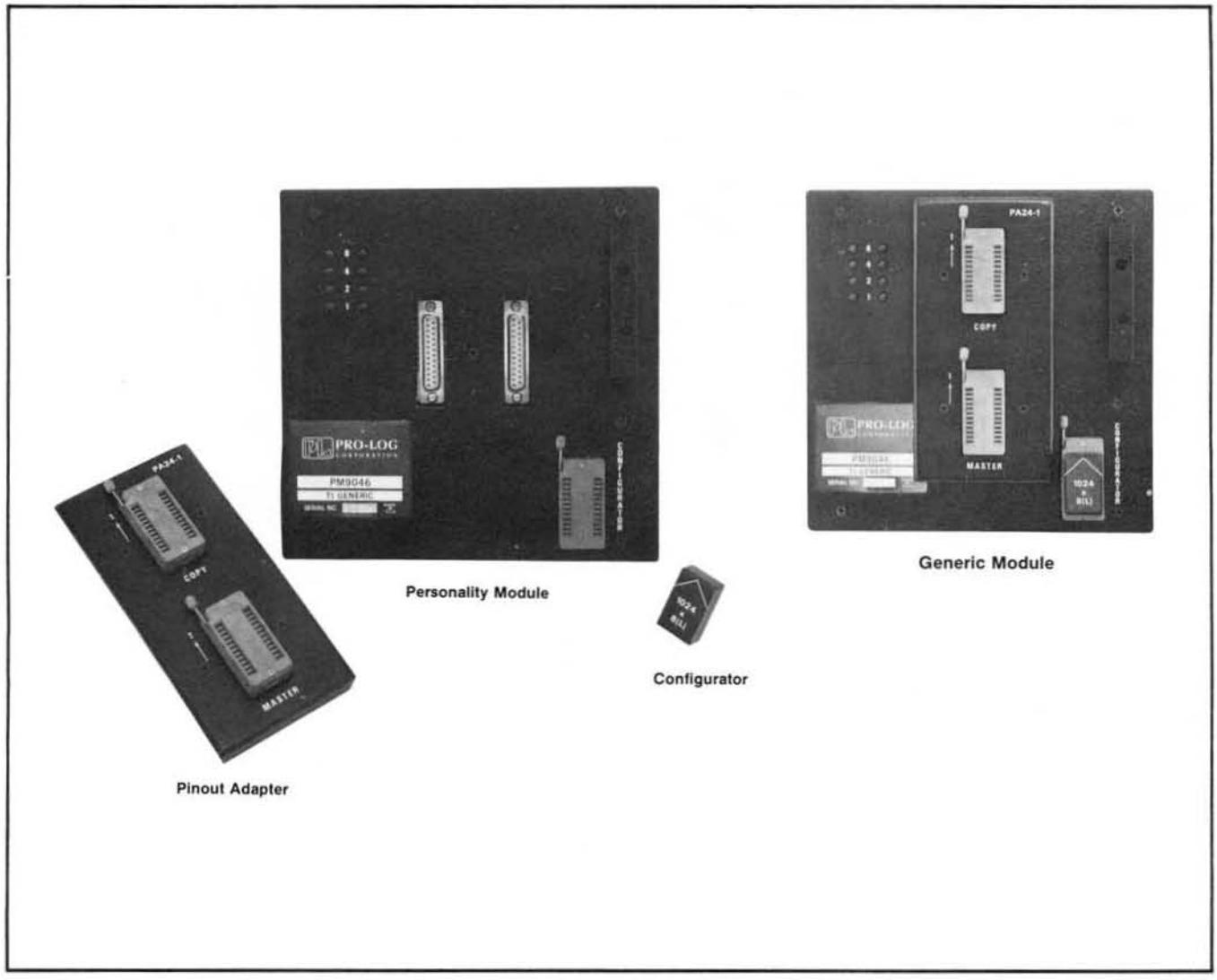



Figure 4-3 Generic Personality Module

## GANG MODULES

Gang Modules are designed to program multiple PROMs simultaneously. The operation of each one is tailored to the PROM being programmed, and each one has its own special Operating Instructions.

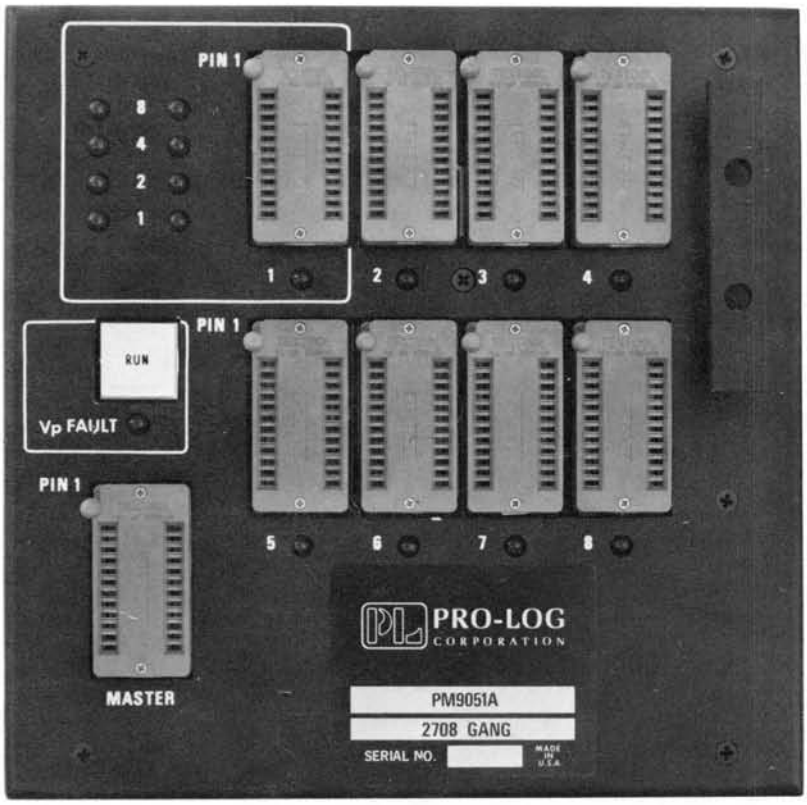



Figure 4-4 Gang Personality Module

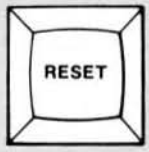
SECTION 5

# M900B NON-BUFFERED OPERATION

In LIST or PROG modes, the M900B displays or programs the Copy PROM according to the operator's keyed instructions. The M900B prompts the operator with the Copy PROM address range and waits until the ENTER key is depressed or until new start and stop addresses are keyed in. At that point, the display shows stored data at the first location (in LIST mode) or waits for data to be stored at the first location (in PROG). The M900B proceeds on command to the next location and continues until the stop address is reached, a new mode is selected, or the programmer is RESET.

In DUP and VER modes, the operator is prompted to select the desired PROM address range as start and stop addresses. From that point the duplication or verification operation is fully automatic.

**RESET: Halt All Operation**




The RESET key is an overriding input to the M900B which halts all operations and returns the programmer to the idle state. The effect is the same as turning power on.

RESET can be used to stop the automatic operation VER once it has started running. The current location may not program correctly if RESET occurs during the DUP operation.

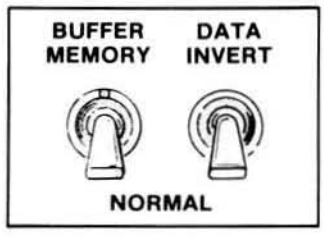
**CLEAR: Correct Miskeyed Address/Data**


In all modes the M900B provides default address setup information when needed, but gives the operator the opportunity to key in new address information prior to performing the selected operation. If the operator elects to key in this information and a mistake is made, the CLEAR button may be used to clear the display one digit at a time so that correct information can be keyed in. The addresses or address/data in the display at the time ENTER is pressed will be used by the M900B, so CLEAR must be used prior to ENTER.

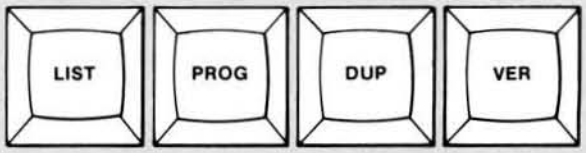
In PROG mode, the CLEAR key may also be used to alter the address sequence at any time so that blocks of Copy PROM locations may be skipped over during manual Copy programming. Note that if the address sequence is changed and replaced with an address that is higher than the specified end address, the M900B cannot stop the PROG mode automatically. Either a new mode must be selected or RESET used to terminate the PROG mode in this case.

**BUFFER SELECTION**

When the BUFFER/NORMAL toggle switch is in the BUFFER position, the Mode keys specify Buffer operations rather than normal Personality Module operations. In the NORMAL position, the buffer is deselected but its data content is unaltered. For buffered operation refer to Section 6. The M900B will not recognize a change in the position of the BUFFER/NORMAL toggle switch until a Mode key is pressed.



## MODE KEYS




In Non-Buffered operation, the Mode keys provide the following types of operation:

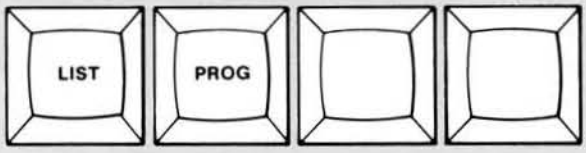
LIST any or all Copy PROM locations in the display.
PROGram any or all Copy PROM locations from the keyboard.
DUPlicate any portion of Master PROM into the corresponding Copy PROM location.
VERify any operation by comparing the data content of Master and Copy PROMs.

RESET must be pressed before new mode selection. While in LIST or PROG mode, reset may be depressed and a new mode selected any time operation on an individual location is completed. In DUP or VER mode, operation must be executed on the entire address range before new mode selection.

When a mode key is pressed all setup information for the previous mode is cleared and a new setup must be made.

The M900B will not recognize a change in the position of the BUFFER/NORMAL toggle switch until a Mode key is pressed.

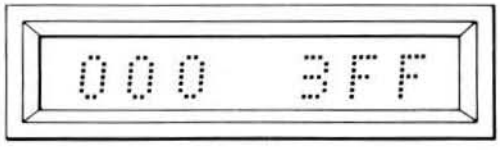
## MANUAL MODES




These modes give the operator keyboard control over reading data stored in any portion of the Copy PROM (LIST) or programming new keyboard data into any portion of the Copy PROM (PROG).

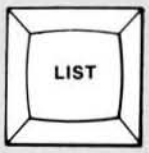
***Address Range Definition***

When LIST or PROG key is pressed the M900B display shows the first and last Hex addresses of the Copy PROM (2 or 3 digits depending on PROM type). This prompts the operator to select the first and last Copy PROM addresses to be operated on.



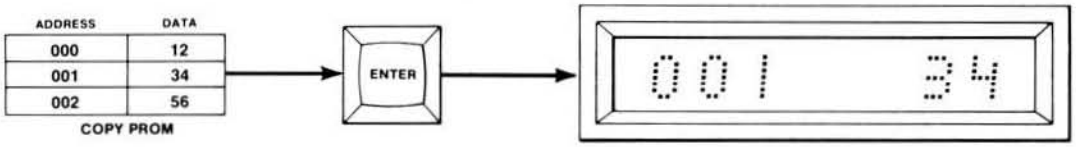

1. Press ENTER to specify the entire Copy PROM, or
2. Key in new first and last addresses to LIST or PROG a smaller block or Copy location. Then press ENTER. (Use CLEAR to correct a miskeyed address prior to ENTER.)

## LIST MODE




In LIST mode, the display now shows the address specified to be the start location, and the data currently stored in the Copy PROM at that location. The M900B refers to the Personality Module installed to determine the number of data digits to display: one digit for 4-bit PROMs, or two digits for 8-bit PROMs.

Press ENTER to step to the next sequential Copy PROM location and continue until the last specified address location is displayed (or select a new Mode or RESET any time). When the last Copy PROM location has been displayed, the next ENTER causes the display to show "F" (Finished).



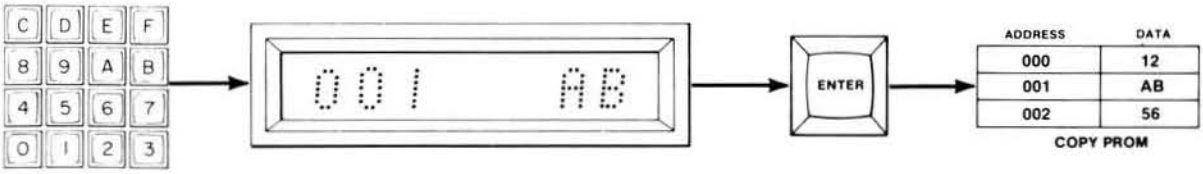

## PROG MODE


In PROG mode, the display now shows the address specified to be the start location, and awaits an operator entry of data from the keyboard.

1. Press ENTER to step over the location without altering it; or
2. Press CLEAR one, two, or three times to clear the Copy PROM address, enter new address and proceed to a different area in the Copy PROM; or
3. Key in data to be stored at the Copy address location now in the display (use CLEAR to correct miskeyed data), then ENTER to store the displayed data at the displayed address and step to the next location.
4. Repeat until the last specified address has been programmed, at which time the display will show "F" (Finished), or RESET at any time.

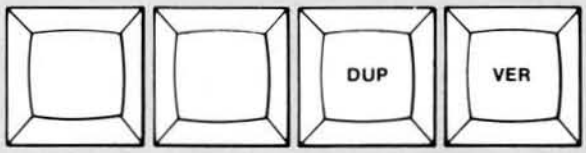
If any of the bits at a Copy location will not successfully program, the M900B will stop at that location and display "E" (Error) preceding the data in the display. The binary Data Display indicates the actual pattern in the Copy PROM. Operator should proceed as follows:

Fusible PROMs: As it attempts to program the bad location, the unit typically takes less than a second before indicating error, although delays of up to 12 seconds are possible. With most PROMs the operator may retry the failed location by pressing ENTER (check PROM manufacturer's specifications to ascertain whether retry is permissible). The display will indicate next sequential address if retry is successful; if not, "E" will reappear in the display. If it is desired to step over the failed location, the operator must reset and redefine the address field, using the address after the failed location as start address.




UV PROMs: Following an unsuccessful attempt at programming, the hex keyboard is locked out, preventing any new data entry, however, pushing enter steps over failed location allowing PROG to proceed. The operator can use a failed PROM in the DUPLICATE mode to generate a good PROM. DO NOT TRY TO REPROGRAM A FAILED UV ERASABLE PROM WITHOUT COMPLETE ERASURE since this will result in a marginal data condition.

## AUTOMATIC MODES




DUP and VER are automatic, high-speed load and compare modes which can be used to program a blank Copy PROM from Master or verify a programming operation. Specify first/last PROM addresses.

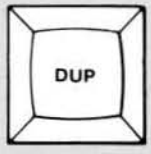
Once the operation has been keyed in, the M900B begins running at high speed. A PROM programming operation proceeds at a reduced speed according to the PROM manufacturer's programming and duty cycle specifications.

**Address Range Definition**
When the DUP or VER key is pressed, the M900B display shows the first and last Hex addresses of the Copy PROM. This prompts the operator to select the first and last PROM addresses to be operated on.

1. Press ENTER to specify the entire Copy PROM, or
2. Key in new first and last addresses to DUP and VER a smaller block of Copy locations, according to PROM type from the following table. Then press ENTER. (Use CLEAR to correct miskeyed address prior to ENTER.)

| PROM SIZE | HEXADECIMAL FULL PROM FIELD ADDRESS | |
|---|---|---|
| | FIRST ADDRESS | LAST ADDRESS |
| 16 by X | 0 | F |
| 32 by X | 00 | 1F |
| 64 by X | 00 | 3F |
| 128 by X | 00 | 7F |
| 256 by X | 00 | FF |
| 512 by X | 000 | 1FF |
| 1024 by X | 000 | 3FF |
| 2048 by X | 000 | 7FF |
| 4096 by X | 000 | FFF |

## DUP MODE




In DUP mode, the display now shows C0, which prompts the operator to key in any desired changes in Master content before duplication.

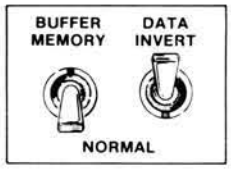
1. Key in desired address and new data (use CLEAR to correct any miskeyed data), then press ENTER. Display now shows C1.
2. Next desired change may be entered as above. (Up to 16 corrections may be made), or
3. Press ENTER to initiate DUP process. The display shows each PROM address (and the corresponding data) in sequence. At completion, display shows "F" (Finished) unless an error has been encountered.

If any of the bits at a Copy location will not successfully program, the M900B will stop at that location and display "E" (Error) preceding the data in the display. The Binary Data Display indicates the actual pattern in the Copy PROM. Operator should proceed as directed in PROG section.

## VER MODE

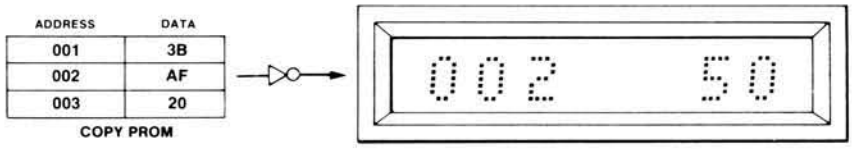

In VER mode, after address definition, the M900B performs high-speed comparison of Master to Copy. The display shows Copy PROM addresses and corresponding Master location data in sequence. Copy data is displayed in the Binary Display. If a mismatch occurs the M900B display will HALT showing address of mismatch and master data. Pressing ENTER will cause VERIFICATION to proceed.

### DATA NORMAL/DATA INVERT

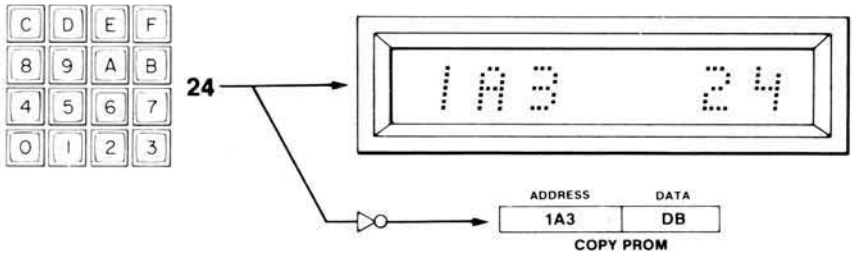



The DATA NORMAL/INVERT toggle switch is functional in all modes. In the NORMAL position, data transfers to the display and the Copy PROM are unaltered. In INVERT position, the operations are affected as follows:

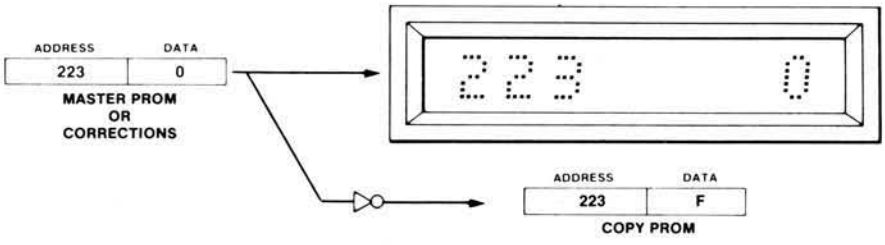
1. **LIST Copy PROM Content**
   The data content at each Copy location is inverted prior to being displayed.



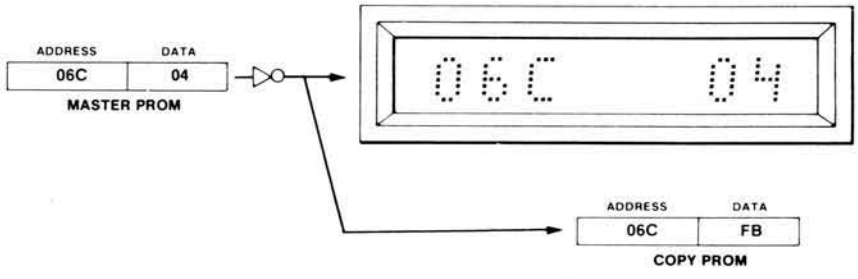

2. **PROGRAM Copy PROM**
   Keyboard data is displayed in true form but inverted prior to being programmed into Copy.




3. **DUPLICATE Master to Copy**
   True Master PROM and corrections displayed; inverted data programmed into Copy.




4. **VERIFY Master to Copy**
   Copy content compared to inverted Master Content. True Master data displayed on Hex display, Copy data on Binary Display.



# SECTION 6

# M900B BUFFERED OPERATION

The CMOS RAM Buffer included in the M900B provides a workspace (2Kx8 standard; 4Kx8 optional) where PROM code can be accumulated and manipulated prior to programming a blank PROM. The Buffer can be loaded from the M900B keyboard, from the Master PROM or from remote options 9108, 9111, 9112, 9114, 9115 and 9118. The Copy PROM can then be programmed directly from any portion of the Buffer. The M900B features "Data Displacement" during Buffer input and output operations, providing editing capability. Code can be inserted, deleted, moved and changed. the M900B power can be switched off for at least sixty seconds without losing Buffer data. Using this feature, a user may copy data to the Buffer from one type of PROM (For example the 1702A) turn power off, change personality modules (for example, to the PM9005A for 2708), turn power on and program the new PROM type with contents of the Buffer.

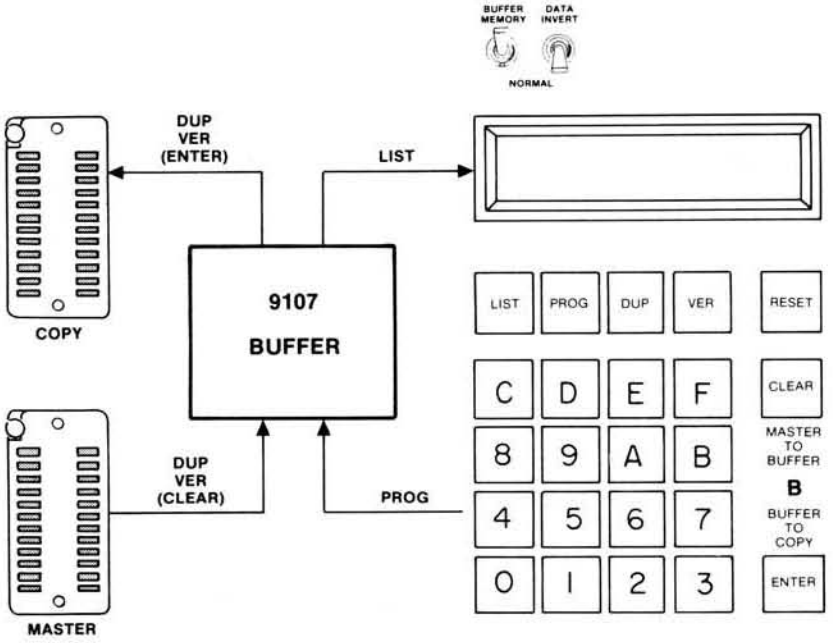



Figure 6-1 M900B Control Panel

## OPERATION SUMMARY

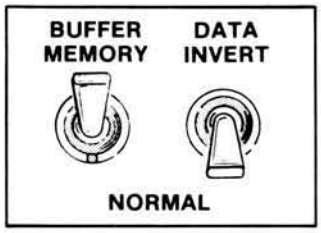
In LIST and PROG modes, the M900B displays or loads the Buffer according to the operator's keyed instructions. The M900B prompts the operator with the address range (000-7FF if 2K, 000-FFF if 4K) and waits until the ENTER key is depressed or until new start and stop addresses are keyed in. At that point, the display shows stored data at the first location (in LIST mode) or waits for data to be stored at the first location (in PROG). The M900B proceeds on command to the next location and continues until the stop address is reached or the programmer RESET.

In DUP and VER modes, the operator is prompted to select the PROM address range of interest as Start and Stop addresses, the first buffer location of interest, and whether the Master PROM and Buffer, or the Buffer and Copy PROM are to be operated on. At that point, the Buffer load, PROM programming, or verification operation is fully automatic.

For operation with Buffered options, refer to the specific option. Although each option varies somewhat in operating procedure, the data obtained from the remote source is stored in the buffer. Once the data is in the buffer, it is usable as described herein.

## BUFFER SELECTION

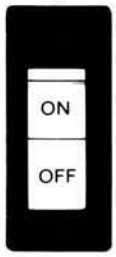
When the BUFFER/NORMAL toggle switch is in the BUFFER position, the Mode keys specify Buffer operations rather than normal Personality Module operations. In the NORMAL position, the buffer is deselected but its data content is unaltered. For NORMAL operation refer to Section 3. The M900B will not recognize a change in the position of the BUFFER/NORMAL toggle switch until a Mode key is pressed.



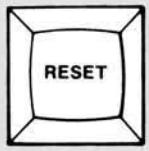

## POWER OFF/ON BUFFER CHARACTERISTICS

The Buffer's data content is random at initial power-on. It is recommended that the Buffer be cleared to the erased state of the PROM type used prior to loading valid data into the Buffer. See the procedure for "Clearing the Buffer", page 6-8.

The M900B power may be switched off for at least 60 seconds without losing the Buffer's content. This facilitates changing Personality Modules so that buffer data accumulated from one PROM type can be programmed into another type of PROM. Removing Personality Modules with power applied to the instrument is not recommended.



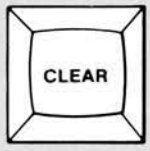

## RESET: Halt All Operations




The RESET key is an overriding input to the M900B which halts all operations and returns the programmer to the idle state. The effect is the same as turning the power on except that the Buffer's data content is protected from RESET.

RESET can be used to stop the automatic operation VER once it has started running. The current location may not program correctly if RESET occurs during the DUP operation.

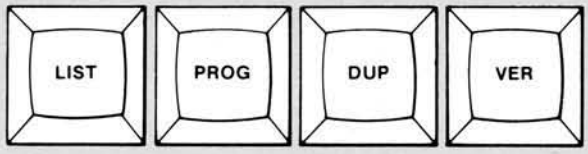
## CLEAR: Correct Miskeyed Address/Data




In all modes the M900B provides default address setup information, however when needed, the operator has the opportunity to key in new address information prior to performing the selected operation. If the operator elects to key in this information and a mistake is made, the CLEAR button may be used to clear the display one digit at a time so that correct information can be keyed in. The addresses or address/data in the display at the time ENTER is pressed will be used by the M900B so CLEAR must be used prior to ENTER.

In PROG mode, the CLEAR key may also be used to alter the address sequence at any time so that blocks of Buffer address locations may be skipped over during manual Buffer loading. Note that if the address sequence is changed and replaced with an address that is higher than the specified end address, the M900B cannot stop the PROG mode automatically. Either a new Mode must be selected or RESET used to terminate the PROG mode in this case.

## MODE KEYS




With the RAM Buffer selected, the Mode keys provide the following types of operations:

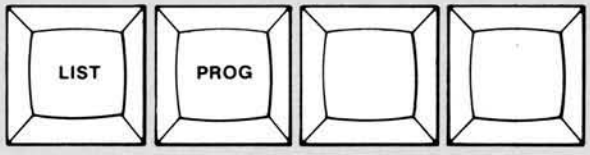
- LIST any or all Buffer locations in the display
- PROGRAM any or all Buffer locations from the keyboard
- DUPLICATE any portion of the Master PROM into the Buffer, displaced to any Buffer location
- DUPLICATE Buffer data, displaced from any Buffer location, into any portion of a blank Copy PROM.
- VERIFY any operation by comparing Buffer data with the data content of the Master or Copy PROM.

RESET must be pressed before each new mode selection. While in LIST mode, a new mode may be selected any time operation on an individual location is completed. In DUP mode, operation must be executed on the entire address range before new mode selection. In PROG or VER mode, the RESET key may be used to terminate the operation.

When a Mode key is pressed all setup information for the previous mode is cleared and a new setup must be made.

The M900B will not recognize a change in the position of the BUFFER/NORMAL toggle switch until a Mode key is pressed.

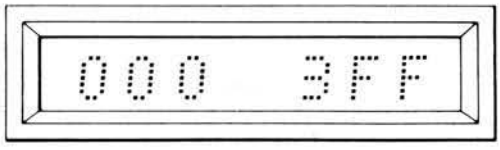
## MANUAL MODES




These modes give the operator keyboard control over reading data stored in any portion of the Buffer (LIST) or loading new keyboard data into any portion of the Buffer (PROG).

### Address Range Definition

When LIST or PROG is pressed the M900B display shows the first (000) and last (7FF or FFF) hexadecimal addresses of the buffer. This prompts the operator to select the first and last Buffer addresses to be operated on.




1. Press ENTER to specify the entire buffer, or
2. Key in new 3-digit first and last addresses to LIST or PROG a smaller block of Buffer locations. Then press ENTER. (Use CLEAR to correct a miskeyed address prior to ENTER.)

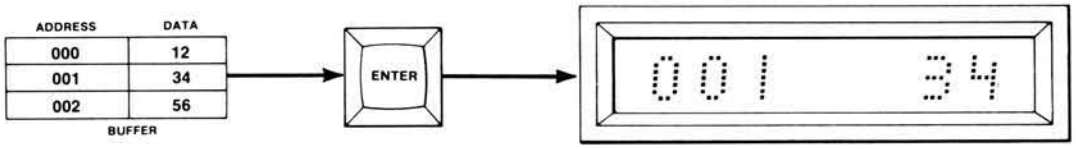
## NOT ERASED 

The NOT ERASED indicator is not functional with the RAM Buffer selected. To determine whether or not the Copy PROM is erased switch to NORMAL mode and refer to Section 4.

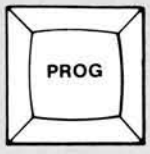
## LIST MODE


In LIST mode, the display now shows the 3-digit address specified to be the start location, and the data currently stored in the Buffer at that location. The M900B refers to the Personality Module installed to determine the number of data digits to display: one digit for 4-bit PROMs or two digits for 8-bit PROMs.

Press ENTER to step to the next sequential Buffer location and continue until the last specified address location is displayed (select a new Mode or RESET anytime). When the last Buffer location has been displayed, the next ENTER causes the display to show "F" (Finished).

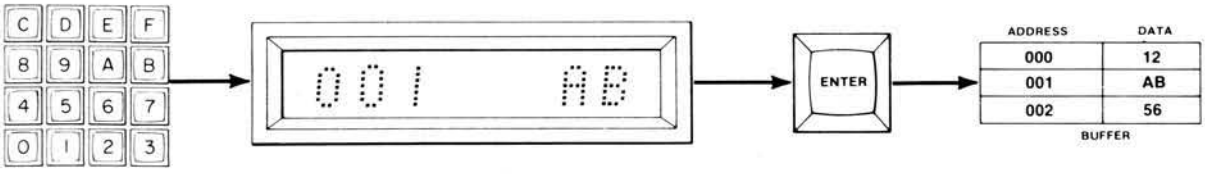



## PROG MODE

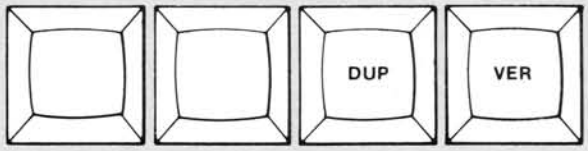



In PROG mode, the display now shows the 3-digit address specified to be the start location, and awaits an operator entry of data from the keyboard.

1. Press ENTER to step over the location without altering it, or
2. Press CLEAR one, two or three times to clear the Buffer address, enter new address and proceed to a different area in the Buffer, or
3. Key in data to be stored at the Buffer address location now in the display (Use CLEAR to correct miskeyed data), then ENTER to store the displayed address and step to the next location.
4. Repeat until the last specified address has been loaded, at which time the display will show "F" (Finished). Depress RESET before selecting a new mode. RESET may also be used at any time programming is complete on a location.



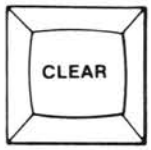
## AUTOMATIC MODES




DUP and VER are automatic, high-speed load and compare modes which can each be used for two distinctly different types of operations:

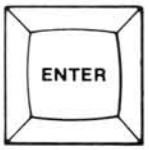
**Master-to-Buffer**

1. Transfer or compare Master PROM data into the Buffer. Specify first/last Master PROM addresses (and thus the number of locations to transfer), and where to load the data in the Buffer. The CLEAR key specifies a master-to-buffer operation.




**Buffer-to-Copy**

2. Program a blank Copy PROM with buffer data, or verify a programming operation. Specify first/last Copy PROM addresses to be programmed or compared and where to find the data in the Buffer. The ENTER key specifies a buffer-to-copy operation.



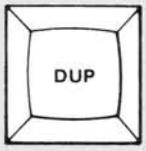

Once the operation has been keyed in to the M900B, it begins running at high-speed. A PROM programming (Buffer-to-Copy) operation proceeds at a reduced speed according to the PROM manufacturer's programming duty cycle specification.

## ADDRESS RANGE DEFINITION

When DUP or VER is pressed, the M900B shows the first/last address range of the Personality Module (Master or Copy PROM) according to PROM type from the following table. This prompts the operator to select the first and last addresses to be operated on.

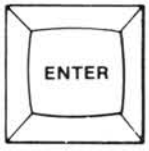
| PROM SIZE | HEXADECIMAL FULL PROM FIELD ADDRESS | |
|---|---|---|
| | FIRST ADDRESS | LAST ADDRESS |
| 16 by X | 0 | F |
| 32 by X | 00 | 1F |
| 64 by X | 00 | 3F |
| 128 by X | 00 | 7F |
| 256 by X | 00 | FF |
| 512 by X | 000 | 1FF |
| 1024 by X | 000 | 3FF |
| 2048 by X | 000 | 7FF |
| 4096 by X | 000 | FFF |

**LOAD BUFFER WITH MASTER PROM DATA (Master-to-Buffer)**

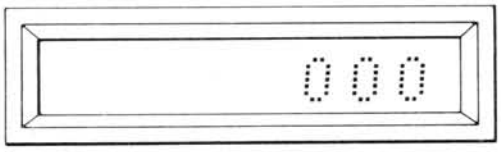



1. Select the block of data to be loaded into the Buffer by specifying the first/last Master PROM addresses.

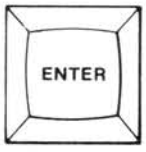
   Press ENTER to specify the entire Master PROM; or Key in new first/last address (CLEAR corrects miskeyed addresses), then press ENTER.




2. The M900B display now shows the first Buffer memory location,000. This prompts the operator to tell the M900B where to begin loading the block of data from the Master PROM.



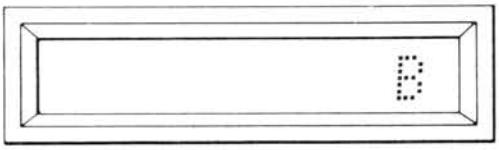

   Press ENTER to cause the first Master PROM address location to be loaded at Buffer address 000, or key in a new 3-digit Buffer address (use CLEAR to correct mistakes) then press ENTER.



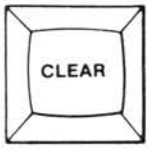

## CAUTION

Step 1 above established both the start/stop Master PROM addresses and the number of Master locations to be moved to the Buffer; Step 2 established the address displacement (start-load) location in the Buffer. If the displacement is high enough that the Buffer's last location is loaded and there is still more data to move from the Master, the next transfer will cause Buffer address wraparound; the M900B will load data in Buffer address 000 and continue from that point until the specified number of Master locations have been moved.

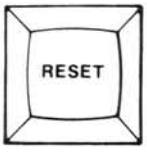
3. The M900B display now shows "B" (Buffer function). The CLEAR key now assumes its alternate function, Master-to-Buffer transfer.



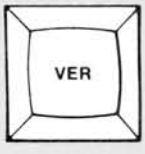

   Press CLEAR to initiate the transfer specified in steps 1 and 2 above. The display will rapidly show each Master PROM address and the data being loaded to the Buffer from those locations in sequence. At the completion of the operation, the display shows "F" (Finished).




4. Depress RESET before selecting another mode.

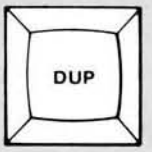



**COMPARE BUFFER DATA WITH MASTER PROM (Master-to-Buffer)**



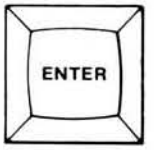

Press the VER mode key, then use steps 1, 2 and 3. The display will rapidly show Master addresses and data in sequence, then "F" (Finished) if all data compares. If the display halts, the data and address from the Master PROM are displayed. Use LIST to determine Buffer data, or press ENTER to proceed with the VER operation.

## PROGRAM COPY PROM FROM BUFFER (Buffer-to-Copy)

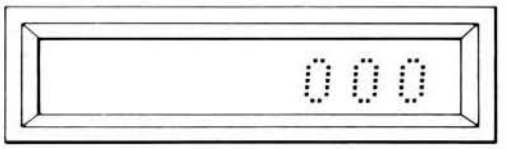



1. Select the first/last Copy PROM addresses to be programmed.

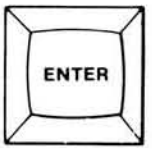
   Press ENTER to specify programming the entire Copy PROM; or Key in new first/last addresses (CLEAR corrects miskeyed addresses), then ENTER.



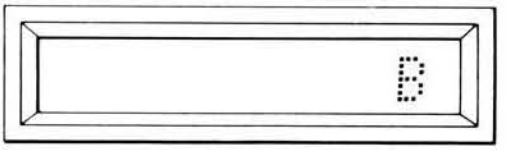

2. The M900B display now shows the first Buffer memory location, 000. This prompts the operator to select the Buffer start address from which the Copy is to be programmed.



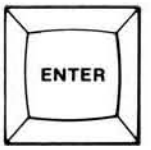

   Press ENTER to select Buffer address 000, causing Copy to be programmed from the beginning of the Buffer, or enter a new 3-digit Buffer start address (use CLEAR to correct mistakes) and then press ENTER.




3. The M900B display now shows "B" (Buffer function). The ENTER key now assumes its alternate function, Buffer-to-Copy programming.




   Press ENTER to start the programming process specified in steps 1 and 2. The display shows a scan of the Copy PROM addresses and the data being programmed into the Copy. At the completion, display shows "F" (Finished) unless "E" (Error).




If any of the bits at a Copy location will not successfully program, the M900B will stop at that location and display "E" (Error) preceding the data in the display. The Binary Data Display indicates the actual pattern in the Copy PROM. Operator should proceed as follows:

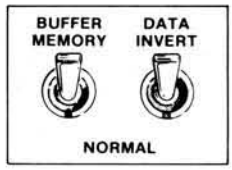
Fusible PROMs: As it attempts to program a bad location, the unit typically takes less than a second before indicating error, although delays of up to 12 seconds are possible. With many PROMs, the operator may retry the failed location by pressing ENTER (check manufacturer's specifications to ascertain whether retry is permissible). The display will indicate next sequential address if retry is successful; if not, "E" (Error) will reappear in the display. If it is desired to step over the failed location, the operator must redefine the address field, using the address after the failed location as start address.

UV PROMs: Following an unsuccessful attempt at programming, the Hex keyboard is locked out, preventing any new data entry. DO NOT TRY TO REPROGRAM A FAILED UV ERASABLE PROM WITHOUT COMPLETE ERASURE since this may result in a marginal data condition.

## COMPARE COPY PROM DATA WITH BUFFER (Buffer-to-Copy)


Press the VER mode key, then use steps 1, 2 and 3. The display will show a rapid scan of Copy addresses and Buffer data, Copy PROM data is displayed in the binary display next to the Copy socket on the Personality Module. If a mismatch occurs the M900B display will halt showing address of mismatch and data. Press ENTER to proceed with the verification, or select a new mode or RESET.

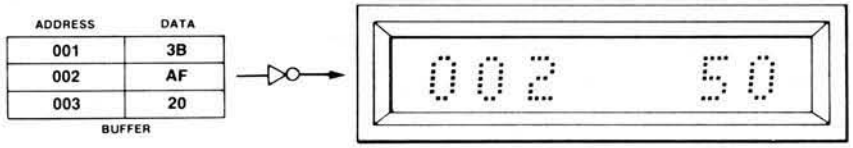
## DATA NORMAL/DATA INVERT



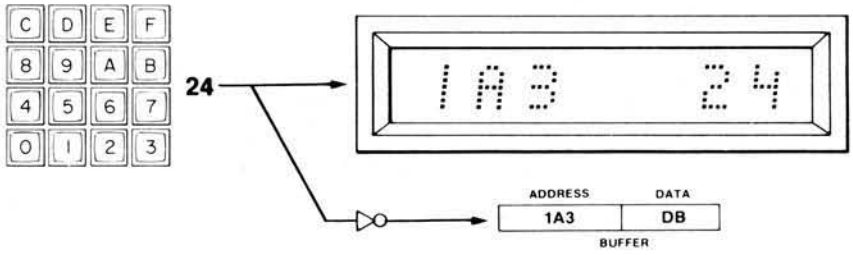

The DATA NORMAL/INVERT toggle switch is functional in all RAM Buffer modes. In the NORMAL position, data transfers to the buffer, the display, and the Copy PROM are unaltered. The INVERT position has the following effect on the modes:

1. **LIST Buffer Content**
   The data content at each buffer location is inverted prior to being displayed.

   Buffer Data: **Unaltered**

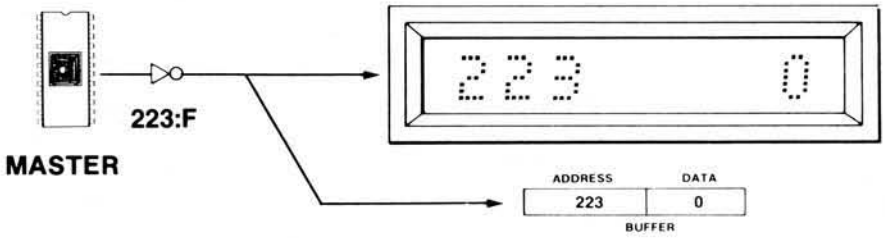



2. **PROGRAM Buffer**
   Keyboard data is displayed in true form but inverted before being stored in the Buffer.



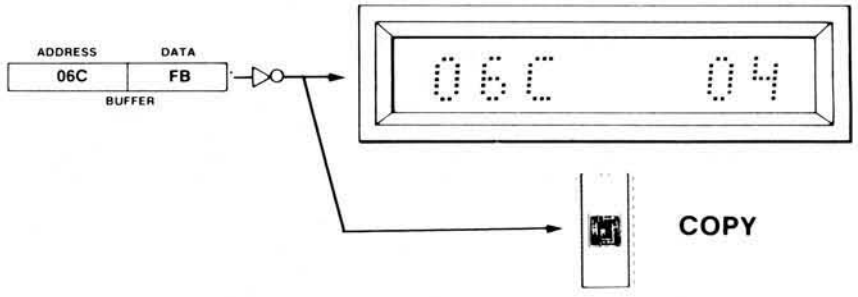

3. **DUP/VER Master-to-Buffer**
   Master PROM data is displayed; inverted data is stored in the Buffer.

   Buffer Data: **Altered**




4. **DUP/VER Buffer-to-Copy**
   Buffer data is inverted prior to display; in DUP, **Copy PROM is programmed with inverted data.**

   Buffer Data: **Unaltered**




## CLEARING THE BUFFER

It is often necessary to preload the Buffer with a field of all-ones or all-zeros according to the erased state of the PROM type used. This insures that unused locations in the Copy PROM will remain unprogrammed after the programming operation. The Buffer can be preset using the DUPLICATE Master-to-Buffer procedure by placing a blank PROM in the Master PROM socket. The DATA INVERT/NORMAL switch gives the option of loading all-ones or all-zeros. If the field size determined by the personality module is less than the buffer size, more than one DUP operation is required to clear the entire Buffer.

**BUFFER APPLICATION: Example 1 (The machine has a 2048x8 Buffer option)**

The code in a 256x8 PROM needs the following changes:

1. Locations 00 through 4F are correct;
2. 50 through 5F and 60 through 6F must be swapped;
3. Location 53 was incorrect and should contain EF;
4. 70 through F0 should be deleted;
5. F1 through FF should replace 70 through 7E;
6. New keyboard data should replace locations 7F through FF.

**Procedure:** Insert the PROM in the Master socket, insert a blank PROM in the Copy socket, and set the BUFFER/NORMAL switch to the Buffer position. Then,

| STEP | MODE | DISPLAY | OPERATOR RESPONSE | COMMENT |
|---|---|---|---|---|
| 1 | DUP | 00 FF<br>000<br>B | 00 4F ENTER<br>— ENTER<br>CLEAR | Move 00-4F From<br>Master to 000-04F in<br>Buffer |
| 2 | DUP | 00 FF<br>000<br>B | 60 6F ENTER<br>050 ENTER<br>CLEAR | Move 60-6F From Master<br>To 050-05F in Buffer |
| 3 | DUP | 00 FF<br>000<br>B | 50 5F ENTER<br>060 ENTER<br>CLEAR | Move 50-5F From Master<br>To 060 06F in Buffer |
| 4 | DUP | 00 FF<br>000<br>B | F1 FF ENTER<br>070 ENTER<br>CLEAR | Move F1-FF from Master<br>To 070-07E in Buffer |
| 5 | PROG | 000 3FF<br>063 | 063 063 ENTER<br>EF ENTER | Load EF in 063 (was 53<br>in Master) |
| 6 | PROG | 000 3FF<br>07F<br>080<br>•<br>•<br>•<br>0FF | 07F 0FF ENTER<br>xx ENTER<br>xx ENTER<br>•<br>•<br>•<br>xx ENTER | Load New Keyboard<br>Data (xx) in Buffer locations<br>07F-0FF |
| 7 | RESET | | | Required after Buffer loading operation |
| 8 | DUP | 00 FF<br>000<br>B | — ENTER<br>— ENTER<br>ENTER | Program a Blank Copy PROM's<br>Locations 00-FF with<br>Buffer Data in location 000-0FF |

**Example 2**
A 2708 PROM (1024x8) is to replace four 1702A PROMs (256x8 each). Move the 1702A data to the Buffer, then program a 2708 as follows: turn unit power OFF insert a PM9001A (1702A) Personality Module, and turn power back on. Then,

| STEP | MODE | DISPLAY | OPERATOR RESPONSE | COMMENT |
|---|---|---|---|---|
| 1. | Insert 1702A #1 in the Master socket | | | |
| | DUP | 00 FF | — ENTER | Move 1702A #1 Data to Buffer Page 0 |
| | | 000 | — ENTER | |
| | | B | CLEAR | |
| 2. | Insert 1702A #2 in the Master socket | | | |
| | DUP | 00 FF | — ENTER | Move 1702A #2 Data to Buffer Page 1 |
| | | 000 | 100 ENTER | |
| | | B | CLEAR | |
| 3. | Insert 1702A #3 in the Master socket | | | |
| | DUP | 00 FF | — ENTER | Move 1702A #3 Data to Buffer Page 2 |
| | | 000 | 200 ENTER | |
| | | B | CLEAR | |
| 4. | Insert 1702A #4 in the Master socket | | | |
| | DUP | 00 FF | — ENTER | Move 1702A #4 Data to Buffer Page 3 |
| | | 000 | 300 ENTER | |
| | | B | CLEAR | |

The 9107 Buffer now holds the content of four 1702A PROMs.

You have only 60 seconds to complete the following step, so have a PM9005A (2708) Personality Module close at hand:

5. Switch the M900B power OFF; remove the PM9001A Personality Module and insert the PM9005A Personality Module. Switch M900B power back ON.

Now insert a blank 2708 PROM in the Copy socket, then

| STEP | MODE | DISPLAY | OPERATOR RESPONSE | COMMENT |
|---|---|---|---|---|
| 6 | DUP | 000 3FF | — ENTER | Program a 2708 With the Buffer Content |
| | | 000 | — ENTER | |
| | | B | ENTER | |

SECTION 7

# 9103, UV ERASE LIGHT OPTION

Model 9103 is an ultraviolet erase lamp which is designed to accommodate a quantity of UV Erasable PROMs. The unit consists of a high intensity UV lamp 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 9103 is designed to fit in the 9202 attache case with the M900B PROM Programmer.

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

**FEATURES**

- UL Listed
- Automatic Shutoff 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 7-1 9103-1 U.V. 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. (8.3 cm) by 2.5 in. (6.4 cm) and accepts up to ten 24-pin Dual-inline packages or equivalent.

## CONTROLS

- TIMER SET is a rotary control at the top rear of the unit which adjusts UV lamp on-time from 0 to 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 (red push button) starts the UV lamp, only if the timer has first been set to the desired erase time (see table). LAMP OFF (black push button) can be used to remove lamp power.
- SAFETY INTERLOCK: An internal switch which removes lamp power when the chamber lid is raised. The lamp must be restarted using LAMP ON after reclosing the lid.

## 9103 OPERATING INSTRUCTIONS

1. Proper PROM erasure is the result of timed exposure to a UV light source of critical wavelength and intensity.
2. PROMs which are inadequately erased retain partial charges which will later affect the data pattern. 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 DIP PROMs or equivalent on the conductive foam pad. PROMs should sit flat on the pad only, with erase window up. Overcrowding PROMs or standing them at angles or off the pad may result in inadequate erasure.
5. Close the lid, set the timer, and hold 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 9103, 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 or equivalent.

| RECOMMENDED ERASE TIMES | | | | |
|---|---|---|---|---|
| **Minutes** | **15** | **30** | **60** | **60** |
| **Set Timer** | **90°** | **180°** | **360°** | **360°** |
| Device Type | 1702A | 1702 | TMS2508 | 2732 |
| | 3702 | 5202A | TMS2516 | IM6603 |
| | 4702A | 5203 | TMS2532 | IM6604 |
| | 8702A | 5204 | ALL 2708s | 8708 |
| | 9702 | 6834 | TMS27L08 | 8741 |
| | 58536S | | INTEL2716 | 8748 |
| | | | TMS2716 | 8755A |

## LAMP CHARACTERISTICS

- Unfiltered short wave ultraviolet light
- $\lambda$ = 254 nanometers (2540 Angstroms)
- Lamp type UVS-11, 5500 uW/CM$^2$

## POWER REQUIREMENTS

115 VAC, 60 Hz, 0.15 ampere

## CAUTION

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

SECTION 8

# 9108, RS-232-C COMMUNICATIONS INTERFACE OPTION

The 9108 option to the M900B PROM Programmer allows receiving and sending of information from or to the RAM buffer in a communications environment. The option uses the M303 RS-232-C communications adapter on a M900B PROM Programmer (Refer to schematic #102421 in docuemnt section).

The interconnection shown in Figure 1 allows the M900B PROM Programmer to operate on a communication link as a slave data receptor or sender. The PROM programmer in this case serves the function of a paper tape punch or reader.

Using the M303 adapter the following modes of operation are possible without changing cable connections.

- Normal Terminal to Remote Computer
- Normal M900B operations off-line
- Receive data into RAM buffer from Remote Computer
- Send RAM buffer contents to Remote Computer

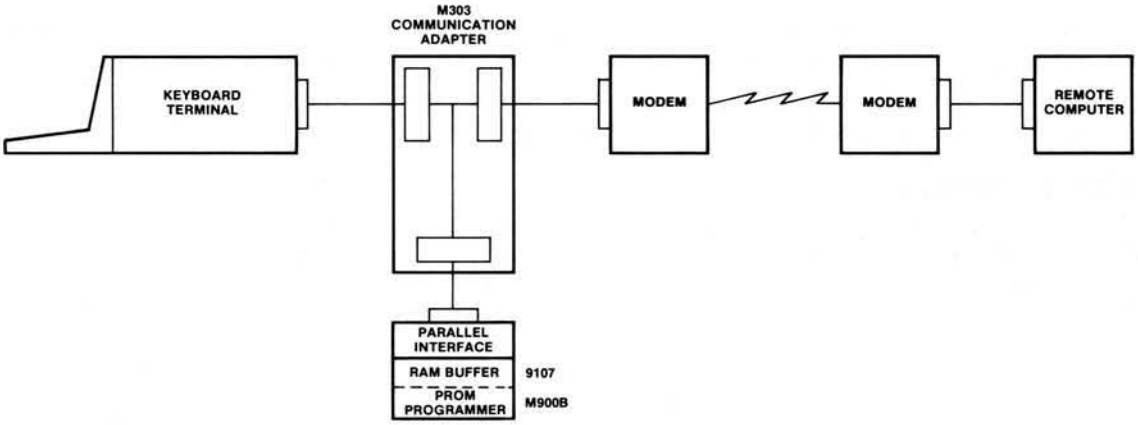



Figure 8-1 Interconnection for 9108 Communications to M900B Programmer

Figure 8-2 9108/M303 Typical Interconnect

### DATA FORMAT (ASCII HEX)

Data to or from the RAM buffer is coded as one ASCII character for each four data bits. The data stream is thus limited to the ASCII HEX characters 0 through 9 and A, B, C, D, E, F. For eight bit PROMs two ASCII HEX characters are handled for each RAM location. The most significant four bits are always handled first.

### SEND FORMAT

In the SEND mode the buffer inserts carriage returns, (CR) line feed (LF) and spaces to format the data for the terminal. Data is sent in blocks of 16 locations per line. Each block is terminated with a LF followed by CR. In standard time-sharing discipline the CR terminates the message; the buffer thus switches to receive an XON control character, which is the standard indicator to resume the message. The buffer sends blocks of 16 data locations until the complete buffer has been transmitted. During SEND mode, 0 appears in the display.

### RECEIVE FORMAT

In the RECEIVE mode the buffer decodes all characters and stores any ASCII HEX characters in the buffer. Non-hex characters are discarded. It is recommended that control characters such as CR, LF and space be inserted in the data stream to format the data for visual readout on the terminal. During RECEIVE mode, I appears in the display.

### BUFFER SIZE

Buffer operations start from location 00 and will proceed to the last buffer location and stop unless the operation is prematurely terminated. When the buffer operation terminates, 9108 appears in the display.

The XON control character is identical to DC1 (Device Control 1). H5 odd parity Hex code is 91 (binary 1001 0001). On terminals which have no XON or DC1 key use CTRL Q.

### BAUD RATE SELECTION

The 9108 option is available in three versions; 9108-1 (1200 Baud), 9108-2 (300 Baud), 9108-3 (110 Baud). These options work only with RAM buffered M900B's whether buffer is 2K or 4K must be specified when ordering. The Silent 700 terminal can be used with the 300 or 110 Baud versions.

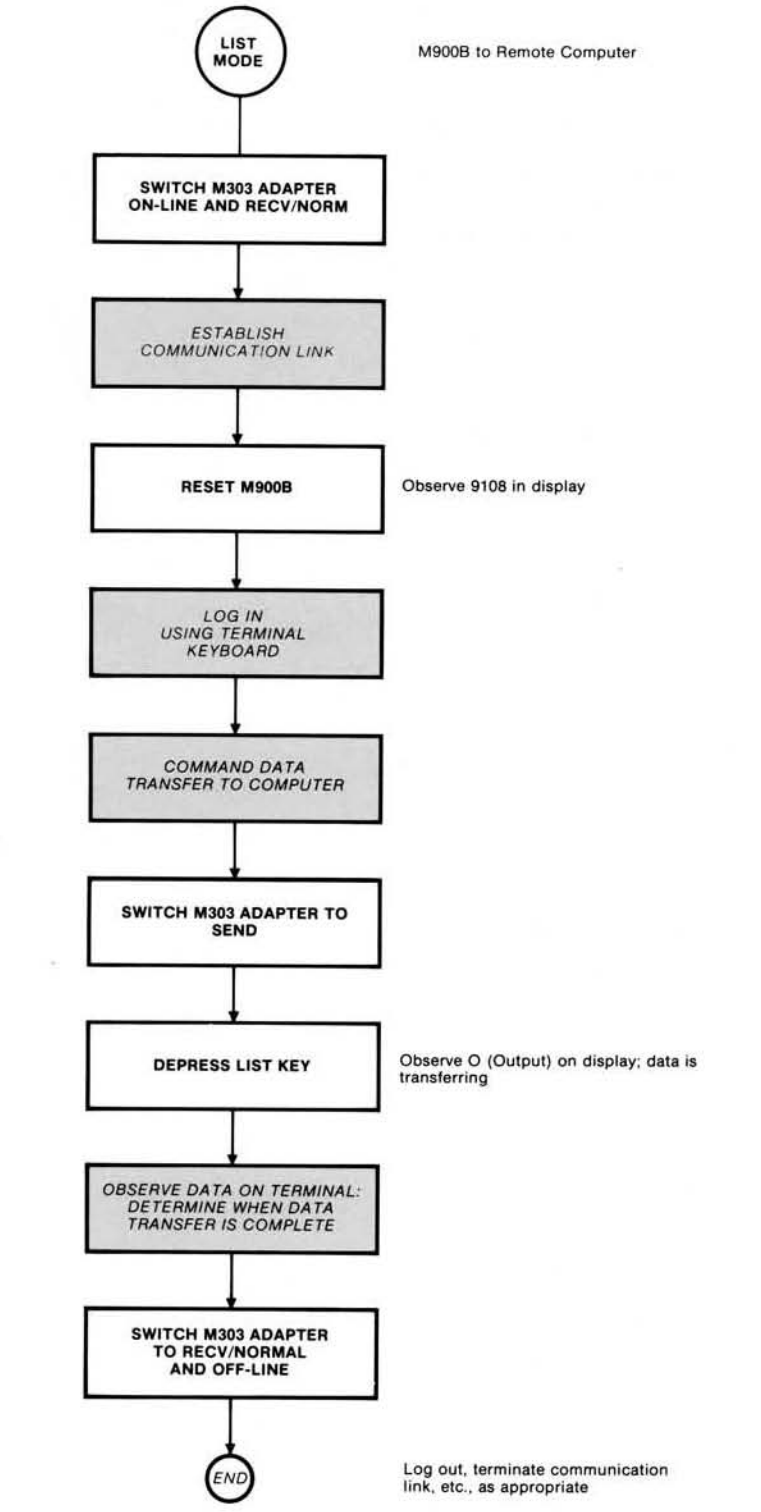



Figure 8-3 9108 "LIST" Flowchart

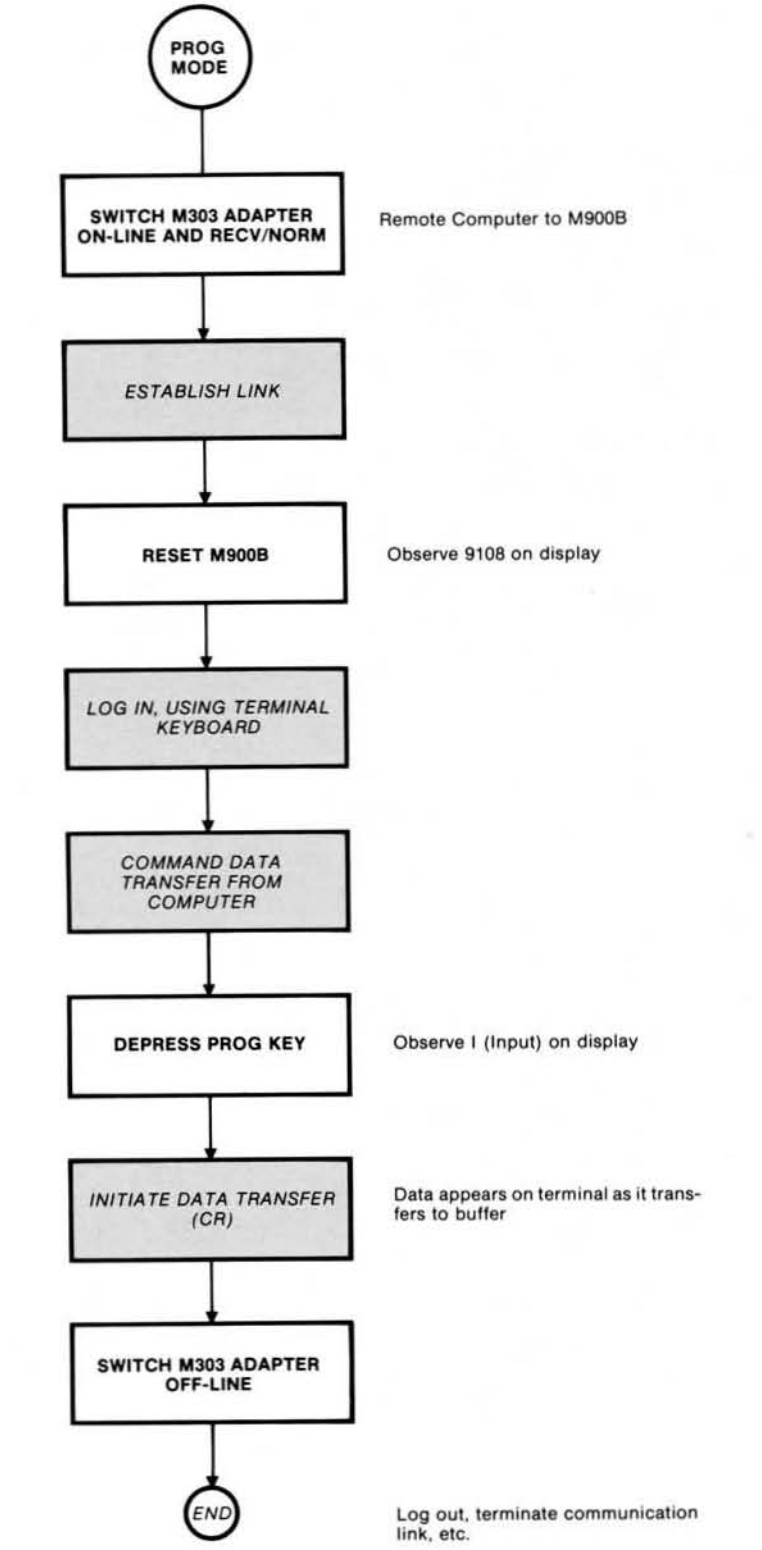



Figure 8-4 9108 "PROGRAM" Flowchart

SECTION 9

# 9111, PAPER TAPE READER OPTION

### 9111 PAPER TAPE READER OPTION

The 9111 reader option to the M900B Programmer provides an interface to the Pro-Log M301 paper tape reader.

With the reader option the M900B programmer can input data at a rate of greater than 100 characters per second for use in the DUPLICATE or VERIFY modes.

The reader option can exist on the M900B programmer with the teletype option. If the reader is connected and enabled, it will take priority over keyboard operation and teletype. To operate from the M900B programmer keyboard or with teletype the reader option must be disabled by turing the Reader Enable switch OFF.

For proper functioning, the M900B programmer must have a personality module installed.

Figure 9-1 9111, Paper Tape Reader

**PAPER TAPE CONNECTOR (Parallel Interface)**

The M301 paper tape reader connects to the M900B programmer via the 25 pin D type connector located in the center of the programmer control panel.

This connector provides four drive lines for reader stepping control, nine data lines from the reader, and logic power connections.

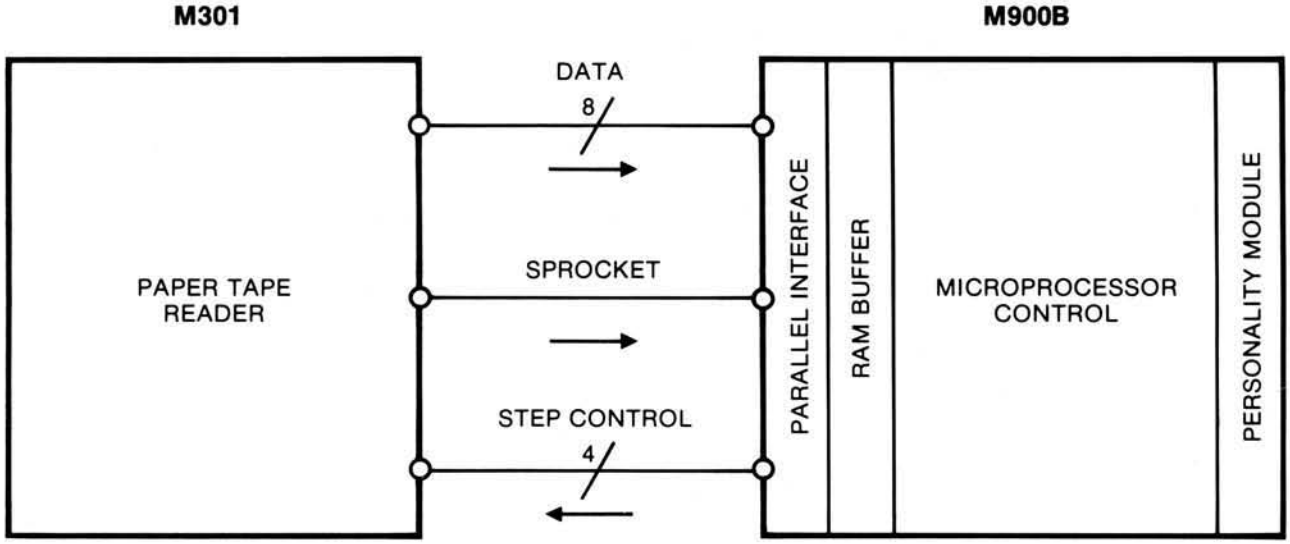



Figure 9-2 Paper Tape Reader Interface

**PAPER TAPE CONTROLS**

The M301 reader has two switches, Reader Power and Reader Enable. The programmer controls the reader through the DUP and VER keys on the M900B keyboard.

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

READER ENABLE Switch: A rocker switch located on the front of the reader mechanism. This switch enables the light source for the photo-reader in the ON position. To operate from the M900B keyboard or teletype, the reader enable switch must be OFF.

VER Key: A mode control key which puts the system in the VERIFY mode. When the reader option is connected and enabled, data from the paper tape is compared to the data in the RAM Buffer. When the reader is not connected or not enabled, the VER key functions as defined for the M900B keyboard operation.

DUP Key: A mode control key which puts the system in the DUPLICATE mode. When the reader option is connected and enabled, data from the paper tape is transferred into the RAM Buffer of the Programmer. Programming of the PROM then proceeds as described in the manual for Buffer-equipped Programmers. When the reader is not connected or not enabled, the DUP key functions as defined for the M900B keyboard operation.

SWITCHES: The "BUFFER MEMORY" and "DATA INVERT" switches are inoperative when using the 9111-4 Option.

OTHER Keys: All other keys on the programmer function exactly as defined for keyboard operation.

**PAPER TAPE INDICATORS AND DISPLAY**

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

Hexadecimal Display: Display digits located on the M900B programmer. "9111" is displayed when the M301 is connected. During operation, it displays the address field.

## PAPER TAPE FORMATS

The paper tape format is controlled by program coding. Three formats are currently available: ASCII Hex, Binary and MDS.

- **ASCII Hex Format (9111-1)** requires 8 level, ASCII data coding where only the hexadecimal characters represent data to be operated on.

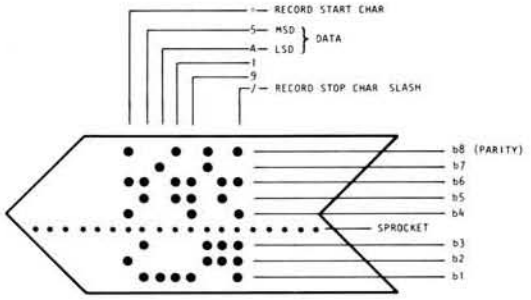



Figure 9-3 ASCII HEX Format

Address: Address information must not be on the tape. The M900B 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 characxters 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.

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

Ending Character: The tape read operation can be terminated by the ASCII character slash (/).

- **Binary Format (9111-3)** requires 8 level tape where each paper tape track represents one binary bit; all patterns are valid.

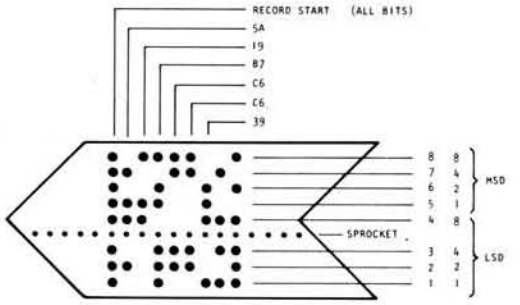



Figure 9-4 Binary Format

ADDRESS: There is no address information on tape. The M900B keeps sequential address count for each location operated on.

8 BIT DATA: Each 8 bit location to be operated on uses all eight tape tracks.

4 BIT DATA: Each 4 bit location to be operated on uses only the four low order tape tracks.

START CHARACTER: An all holes pattern (FF) must occur as the start character at the beginning of the data stream.

END: The tape will read until the operation is complete or until it runs out of tape.

- **MDS Format (9111-4)** provides an interface to the Pro-Log M-301 paper tape reader for reading MDS format paper tapes.

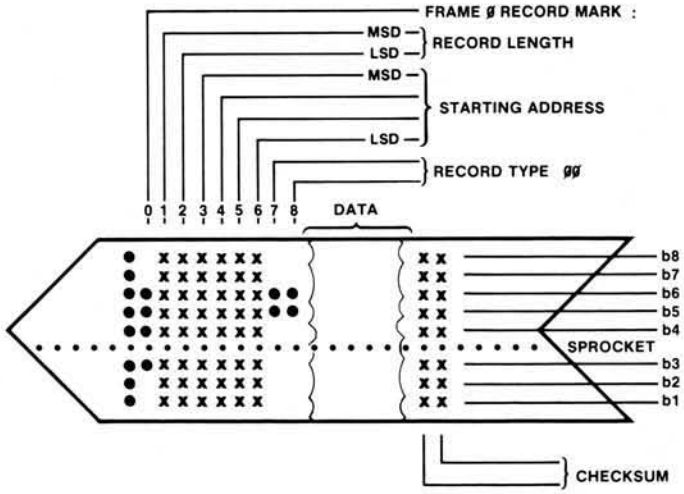



Figure 9-5 MDS Format

MDS - ASCII HEX FORMAT (9111-4) requires 8 level, ASCII data coding where only the hexadecimal characters represent data to be operated on.

ADDRESS: Starting at Zero, the M900B 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.

Start Character: The ASCII ":" character 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 or 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 through 8 = 2 (record length)**
These are for data digits. Each pair represents one 8-bit data byte in hexadecimal.

**Frames 9 = 2 (record length) to 10 = 2 (record length)**
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 (All Formats)**

DUPLICATE Operating Sequence: In the DUPLICATE mode, 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. Depress RESET; the display will now show "9111", indicating that it is ready for a function. Ensure that the Reader Power and Reader Enable switches are in the ON position.
2. Push the DUP key. The Hexadecimal Display shows the full Buffer address field as a question about the address field to be programmed. If the data to be transferred will fill the entire Buffer, proceed to step 3. To transfer over a limited field, enter the start and end addresses (Three Hex Digits each) of the field to be programmed via the hexadecimal keyboard and proceed to step 3.
3. Push the ENTER key. The paper tape will be read and transferred into the buffer. When all locations are transferred, the hexadecimal Display will indicate "9111" for finish. The data is now stored in the RAM Buffer of the M900B and can be used or altered by manual operations, as described in the Buffer Operation portion of the Addendum.

**CHECKSUM (9111-4 only)**

If, during the DUPLICATE mode, an error occurs which causes the checksum to mismatch with the tape checksum, the tape will stop and a "C" will be displayed on the M900B.

VERIFY Operating Sequence: In the VERIFY mode data from the paper tape is compared to the data in the RAM Buffer. The unit sequences through the defined field comparing data, stopping only if there is a mismatch. If there are no mismatches, the sequence proceeds to the end of the field and "9111" is displayed in the Hexadecimal Display.

1. Mount the paper tape, with the pattern to be verified, on the M301 reader: Ensure that the Reader Power and Reader Enable switches are in the ON position. Note that the tape is loaded with the Bit 1 (b1) row of holes closest to the unit, and feeds from left to right. Depress Reset; the display will now show "9111", indicating that it is ready for a function.
2. Push the VER key. The Hexadecimal Display shows the full Buffer address field as a question about the address field over which data is to be compared. To compare data in the entire Buffer, proceed immediately to step 3; otherwise enter the starting and ending addresses of the field to be compared via the Hexadecimal keyboard. Note that three characters for start and three for end must be entered (Ex: 000 03F).
3. Push the ENTER key. The paper tape will be read and verified with the data in the Buffer. If all positions in defined field compare, the hexadecimal Display indicates "9111" for finish. If there is a mismatch, the system stops at the address of the mismatch and displays the address of the mismatch in the Hexadecimal Display and the contents of the paper tape in the rightmost two positions of the Hexadecimal Display. The operator can make the system proceed to VERIFY from the next address by pushing the ENTER button again.

SECTION 10

# 9112-2, TTY INTERFACE OPTION

## 9112 AUTOBAUD TTY OPTION

The 9112-2 option to the M900B PROM 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 5.1K; open circuit voltage (pins 5&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.

## TTY HOOKUP

The 9112 option provides 20 mA send and receive current loops plus a -12V supply and current switch to drive a user-installed SPDT relay which is added to the ASR-33 console to control paper tape motion. These circuits are accessed at the SERIAL INTERFACE connector, a 9-pin D-type connector to the left of the M900B display.

Pin connections at the SERIAL INTERFACE connector are shown in Figure 10-1.

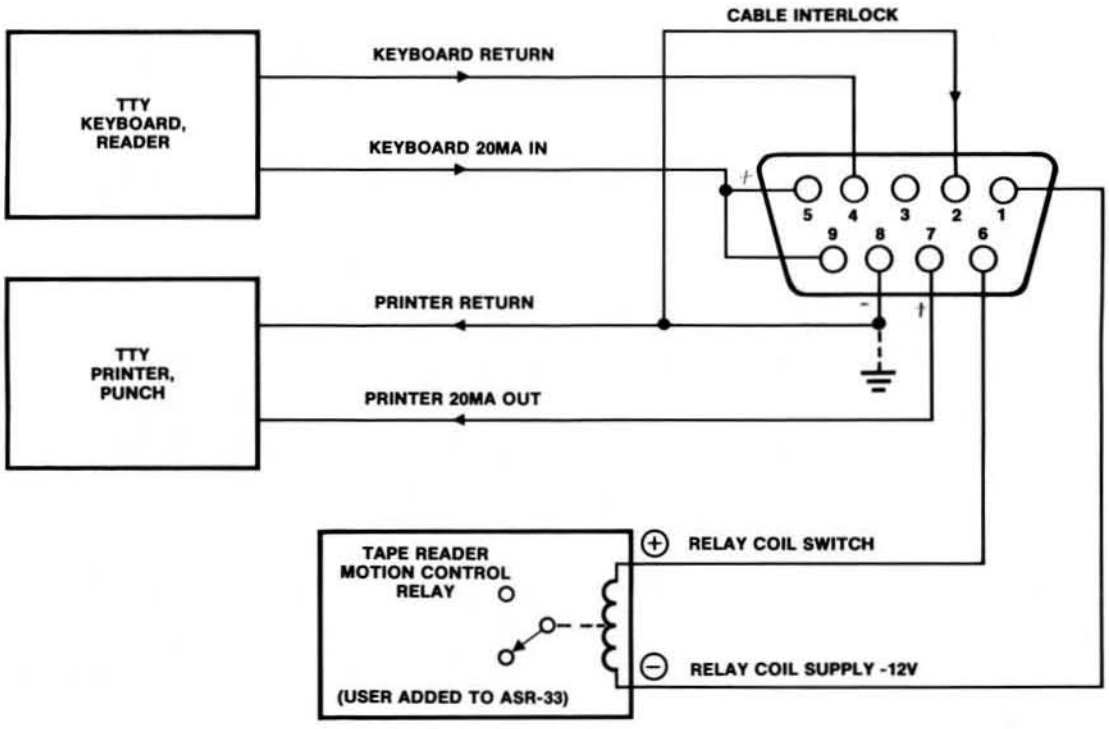



Figure 10-1 Serial Interface Connector Block Diagram

**STARTUP INSTRUCTIONS (After Power-On or RESET)**

1. Switch M900B power ON and switch TTY to ON LINE. Plug the TTY cable into the M900B's SERIAL INTERFACE connector and observe that TTY chatter stops. If chatter continues, check the TTY cable and connections.
2. Press M900B RESET. Observe A in M900B display; this indicates that the programmer has recognized the TTY cable and needs to know the BAUD rate of the TTY console.
3. Respond by pressing the RETURN (Carriage Return) key on the TTY keyboard. This sets the BAUD rate for the M900B. Carriage return-line feed and * (asterisk) will be printed on the TTY, signifying that the programmer has the correct rate and is ready to accept instructions.
4. Step 3 must be repeated anytime the RESET key is pressed on the M900B or after the power switch is switched on.
5. If an E (Error) appears in the M900B display, the start bit time for the RETURN character is excessive. This is generally indicative of a short in the interface cable. The M900B will accept only keyboard commands and will ignore the TTY.

The M900B prints * (asterisk) on the TTY to indicate that it is idle and ready to accept a command from either its own keyboard or the TTY keyboard. The 9112-2 option allows TTY communication only with the 9107 RAM Buffer, so PROM programming operations must be conducted at the M900B's own keyboard in the normal manner.

Commands from the M900B keyboard are ignored if a TTY operation is in progress and vice-versa. The M900B display shows 9112 during a TTY operation, or hexadecimal address/data information if a M900B keyboard operation is in progress. At the conclusion of either type of operation the M900B display shows F (Finished).

**TTY KEYBOARD COMMANDS**

Commands to the M900B from the TTY keyboard consist of a 3-digit hex start address, followed (without spaces) by a 3-digit hex stop address, followed by a single letter command which designates an operation.

The start and stop addresses define the portion of the 9107 Buffer to be operated on. This may be as small as one location, in which case the start and stop addresses are the same; or as large as the entire buffer. The full address ranges of the 9107 Buffer options are shown in Figure 10-2:

| OPTION | RAM SIZE | FIRST ADDRESS | LAST ADDRESS |
|---|---|---|---|
| 9107-2 | 2K RAM | 000 | 7FF |
| 9107-4 | 4K RAM | 000 | FFF |

Figure 10-2 Buffer Sizes

After the user types the desired start and stop addresses, the M900B types a space and waits for one of the following: single letter operation codes:

L - LIST (M900B ⟶ TTY)
P - PROGRAM (TTY ⟶ M900B)
D - DUPLICATE (Tape ⟶ M900B)
V - VERIFY (compare Tape to M900B)
T - TAPE PUNCH (M900B ⟶ Punch)

For a full explanation of the operating modes, see Figure 10-3.

The M900B cannot 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 9107 RAM Buffer.

If a 4-bit Personality Module is installed, the M900B regards one buffer location as a 4-bit word, which is the equivalent of one hex character. Thus the M900B displays, prints, and accepts one hex character per buffer location with 4-bit Personality Modules. The four most 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 M900B displays, prints, and accepts two hex characters per buffer location when an 8-bit Personality Module is installed.

| TTY KEY | MODE | OPERATION |
|---|---|---|
| L | LIST | Prints the content of the Buffer from the start address to the stop address.<br>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 stop address with hex data typed from the TTY keyboard.<br>The current Buffer address is printed by the M900B, followed by space. The user then types the hex data to be loaded into the Buffer, and the M900B 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.<br>The M900B recognizes all ASCII-HEX characters as data and stores them sequentially beginning at the start address and finishing when last address or a / (slash) is reached. Non hex characters are ignored. |
| V | VERIFY | Compares Buffer content to paper tape ASCII-HEX data.<br>The tape data is compared address by address to the data in the buffer beginning at the start address and finishing when last 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 10-3 Operating Modes

## TTY KEYBOARD ERRORS

If an error is made in the start-stop address definition phase, press SPACE, RETURN, or ESC (escape). The M900B will respond with the character ?, followed by * (asterisk), signaling a return to the idle condition.

To terminate the execution of an operation early, press the M900B RESET key. RESET is an overriding input to the M900B which does not affect the Master or Copy PROM or the data content of the 9107 RAM Buffer. Press RETURN on the TTY keyboard to re-establish the BAUD rate.

## SAMPLE 9112-2 DIALOGUE

Data = buffer line address is used as buffer content in the examples below:

Example 1: List the content of buffer locations 019 through 035. An 8-bit Personality Module is installed.

```
*019035 L
                              19 1A 1B 1C 1D 1E 1F
20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F
30 31 32 33 34 35 /
*
```

Example 2: Program buffer locations 456 through 45E with a 4-bit Personality Module installed.

```
*45645E P
456 6
457 7
458 8
459 9
45A A
45B B
45C C
45D D
45E E /
*
```

Example 3: Verify the entire buffer (2K) against a paper tape. Load the tape in the ASR-33 paper tape reader, then

```
*0007FF V
123 45 67
/
*
```

In this example, all locations up to address 123 matched the paper tape. At address 123, the paper tape had data = 45, while the buffer contained 67.

### TTY INTERFACE

The TTY connects to the M900B programmer via the 9 pin Serial Interface connector mounted to the center of the control panel. This interface within the M900B is a three circuit six wire connection. The three, two-wire circuits are:

- Data to TTY, 20 milliamp neutral loop receive.
- Data from TTY, 20 milliamp neutral loop send.
- Reader Control to TTY, 15 volt DC neutral loop reader control.

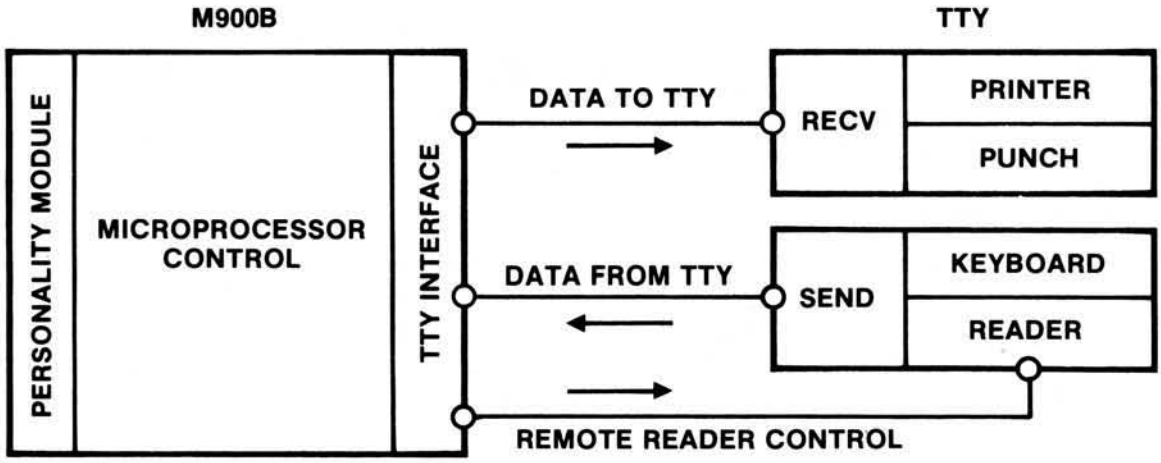



Figure 10-4 TTY Interface

This interface allows full-duplex send and receive, and remote reader control. The separate send and receive of full-duplex allows the M900B to edit the input data before printing and/or punching the output data. Remote reader control allows the M900B to operate the TTY reader at a rate compatible with the programming rate of the particular PROM being programmed.

### 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 opeings in the housing.

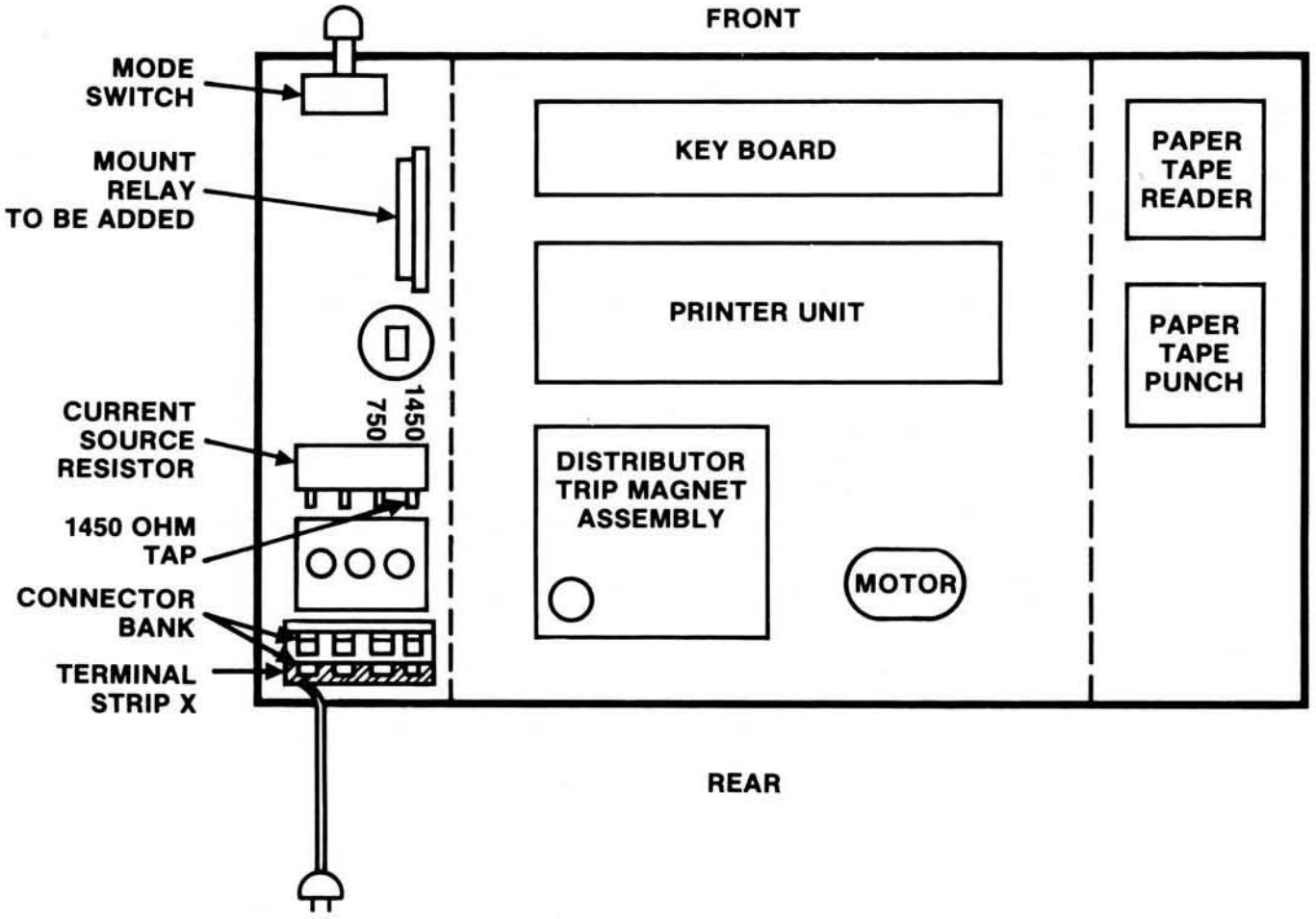



Figure 10-5 Top View-TTY with Housing Removed

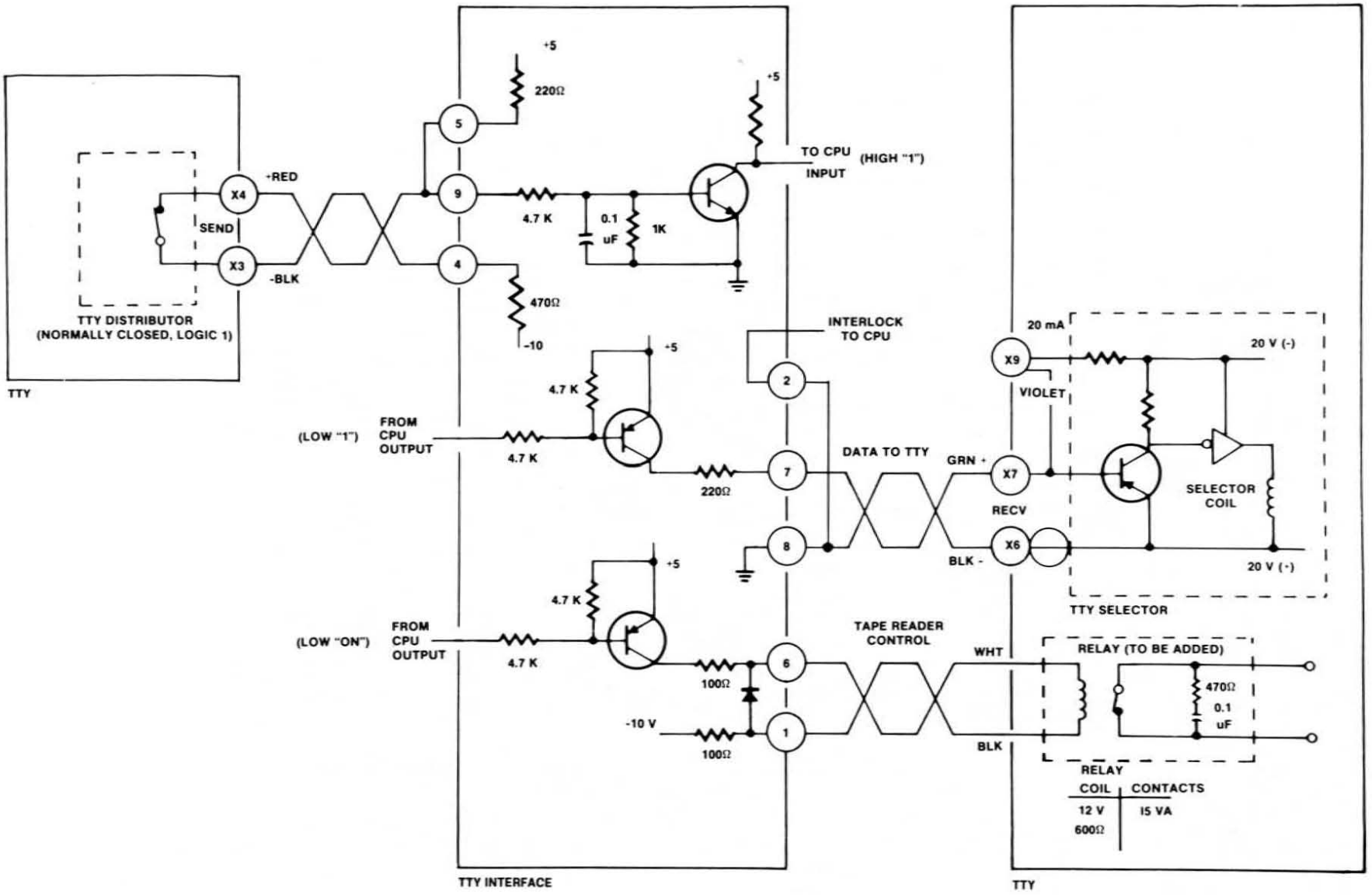



Figure 10-6 TTY Interface Circuit

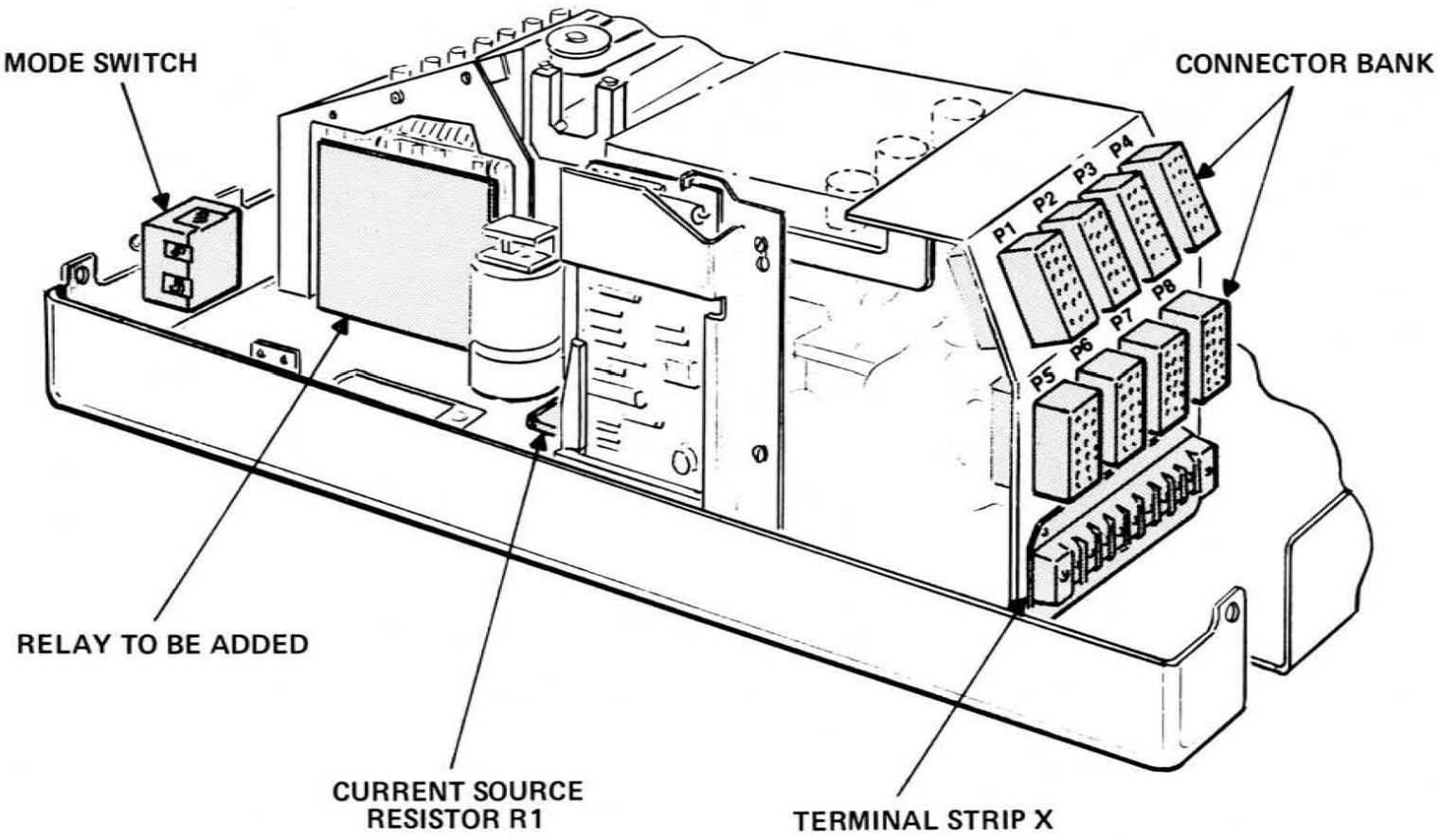



Figure 10-7 Side View-TTY with Housing Removed

**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 10-8, depending on whether the unit has an elapsed time meter.

**TTY Without Elapsed Time Meter**
A TTY without an elapsed time meter may be wired either as 1A or 1B of Figure 10-8. To modify for 20 milliamp:

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 terminal X9 with the yellow wire.

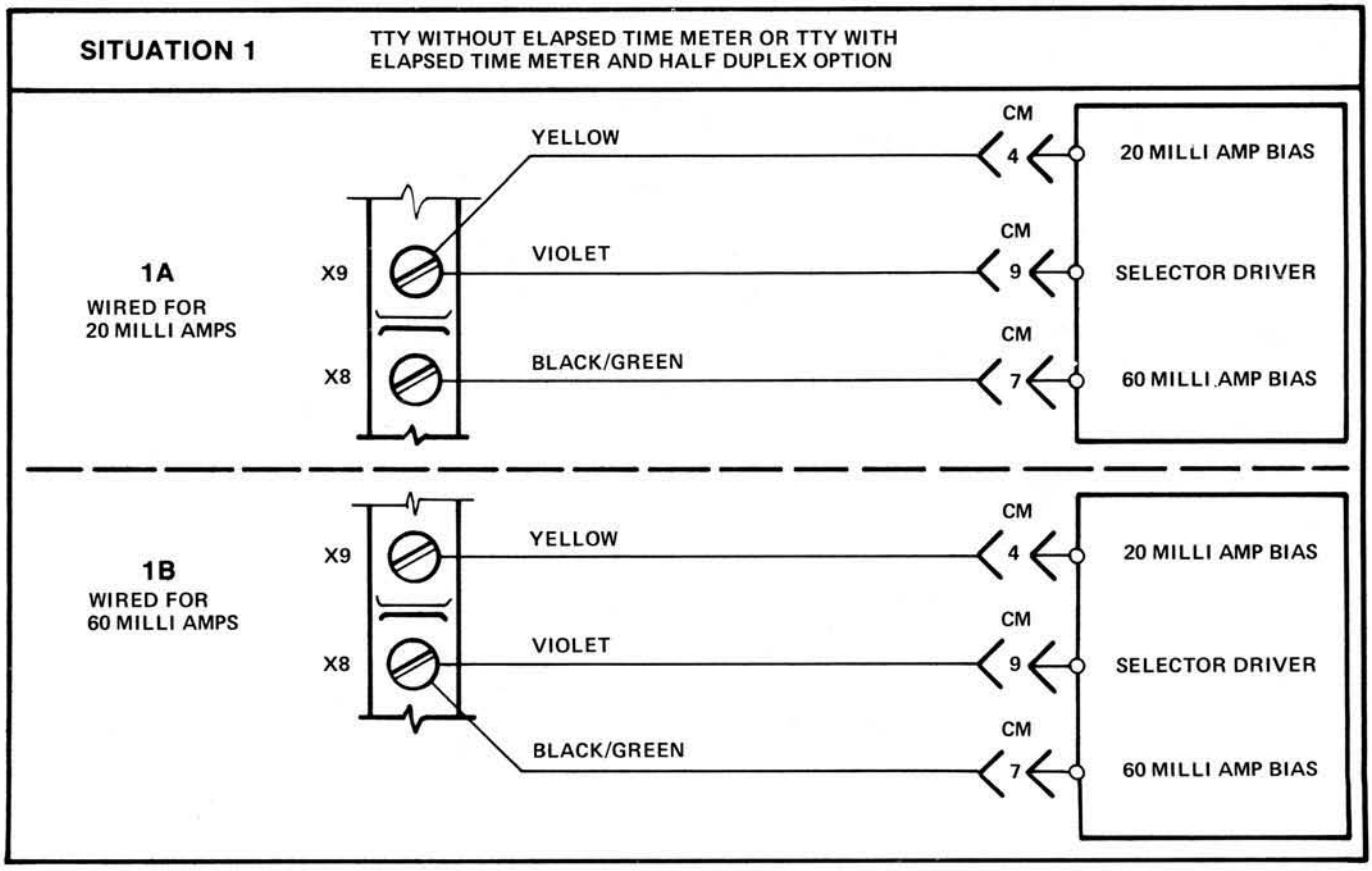



Figure 10-8 Current Loop Option

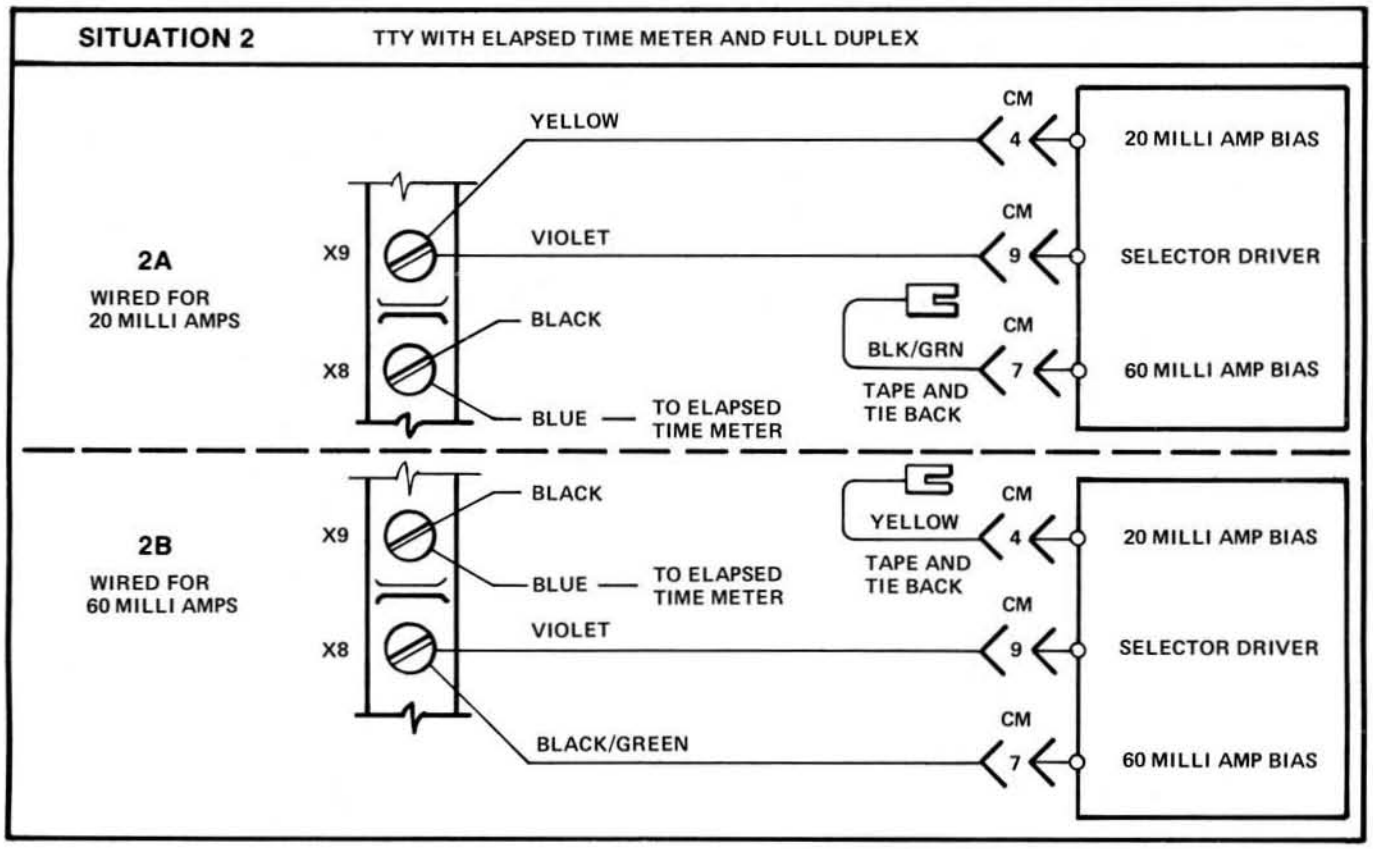



Figure 10-8 Current Loop Option

**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.

**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 10-9.

If the TTY is wired for full-duplex, terminal strip X should appear as in Figure 10-10.

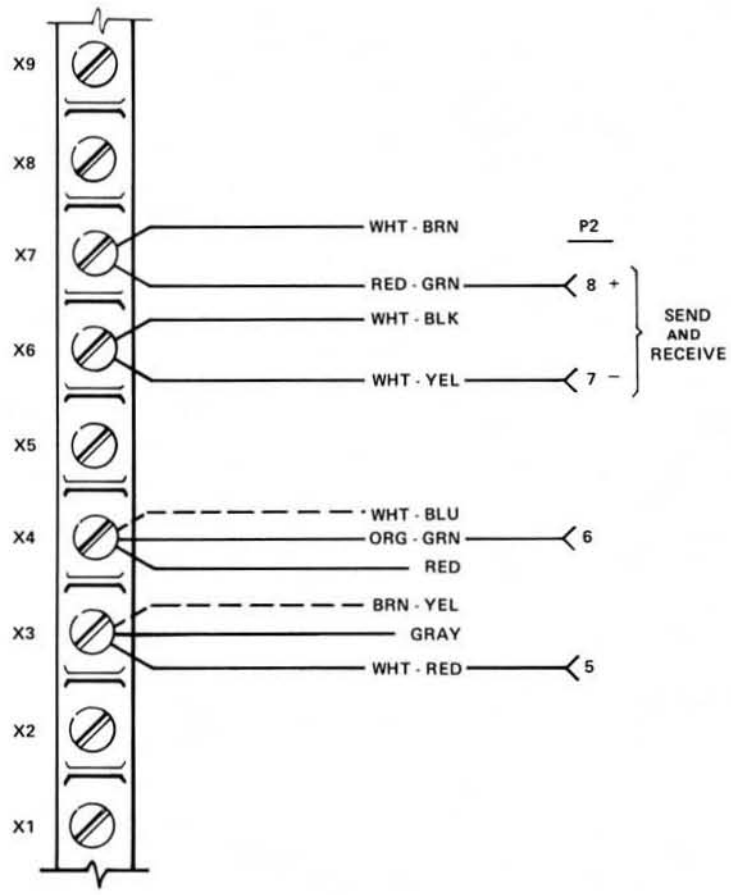



Figure 10-9 TTY Half-Duplex Option

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.

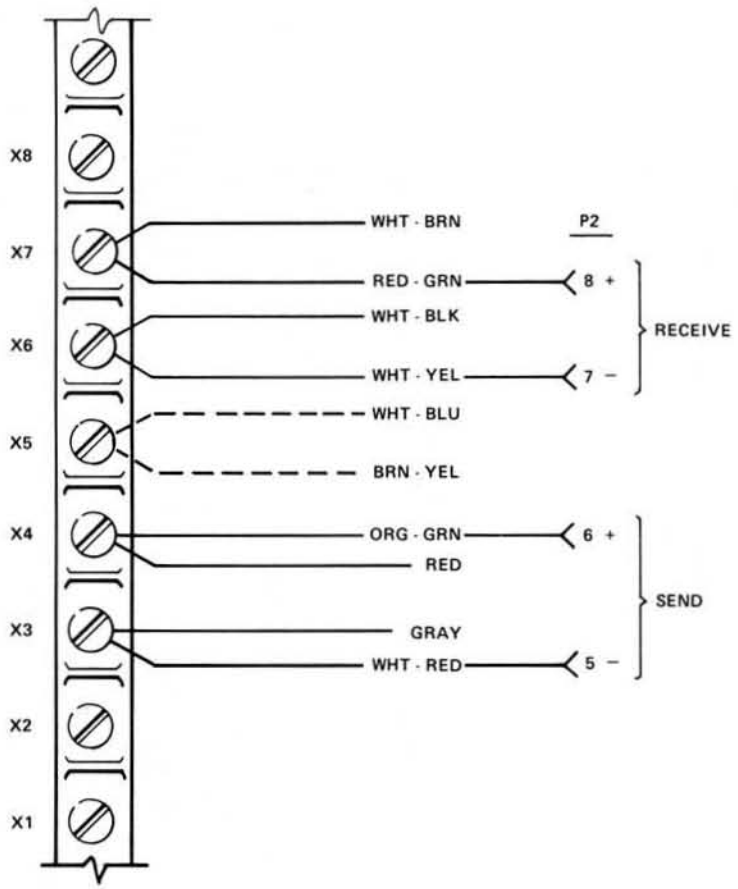



Figure 10-10 TTY Full-Duplex Option

**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 reader 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 10-11 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 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 10-11.
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.

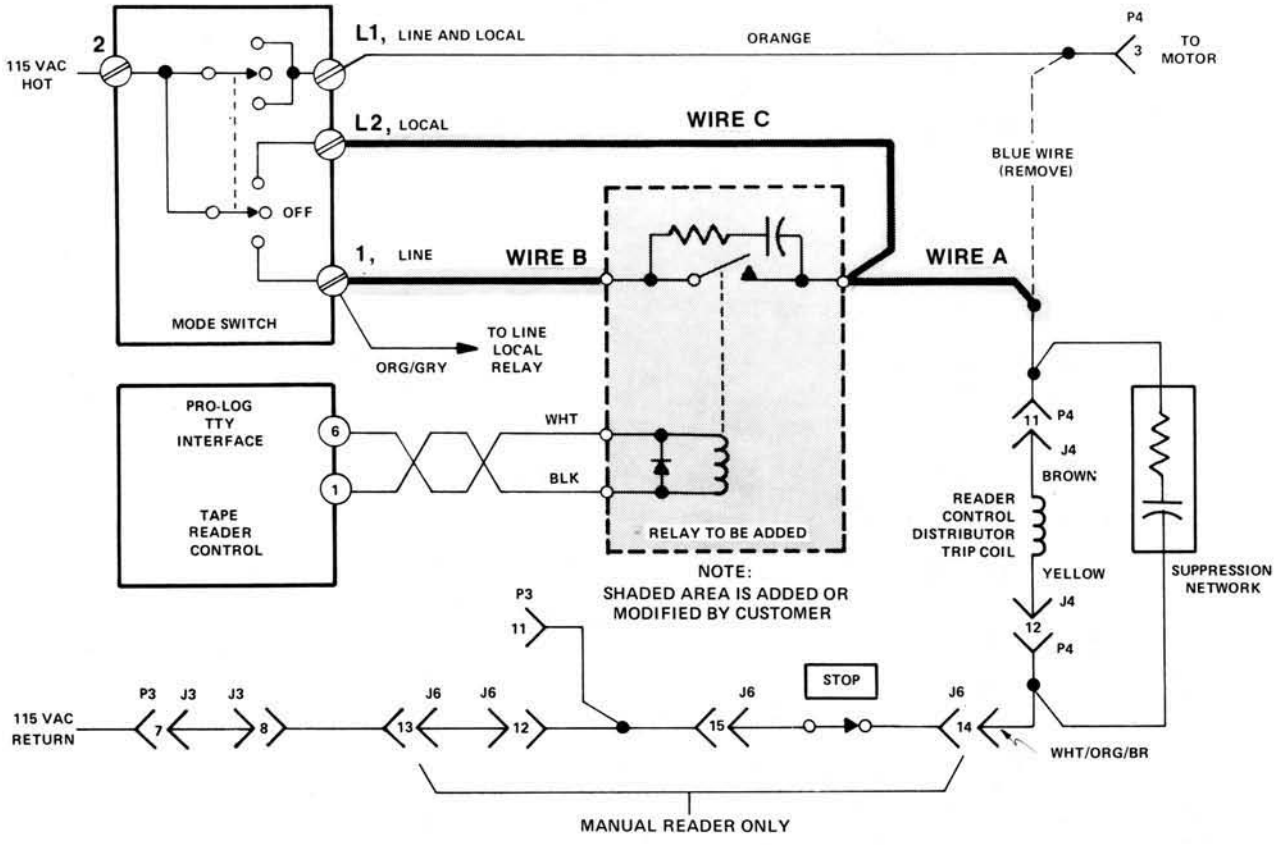



Figure 10-11 TTY Modification (Manual Reader)

**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 momentary 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 10-12.

**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 10-12.
2. Connect Wire A from the new relay to the blue wire at J6-14.
3. Connect Wire B from the new relay to the yellow/green wire at J6-13.

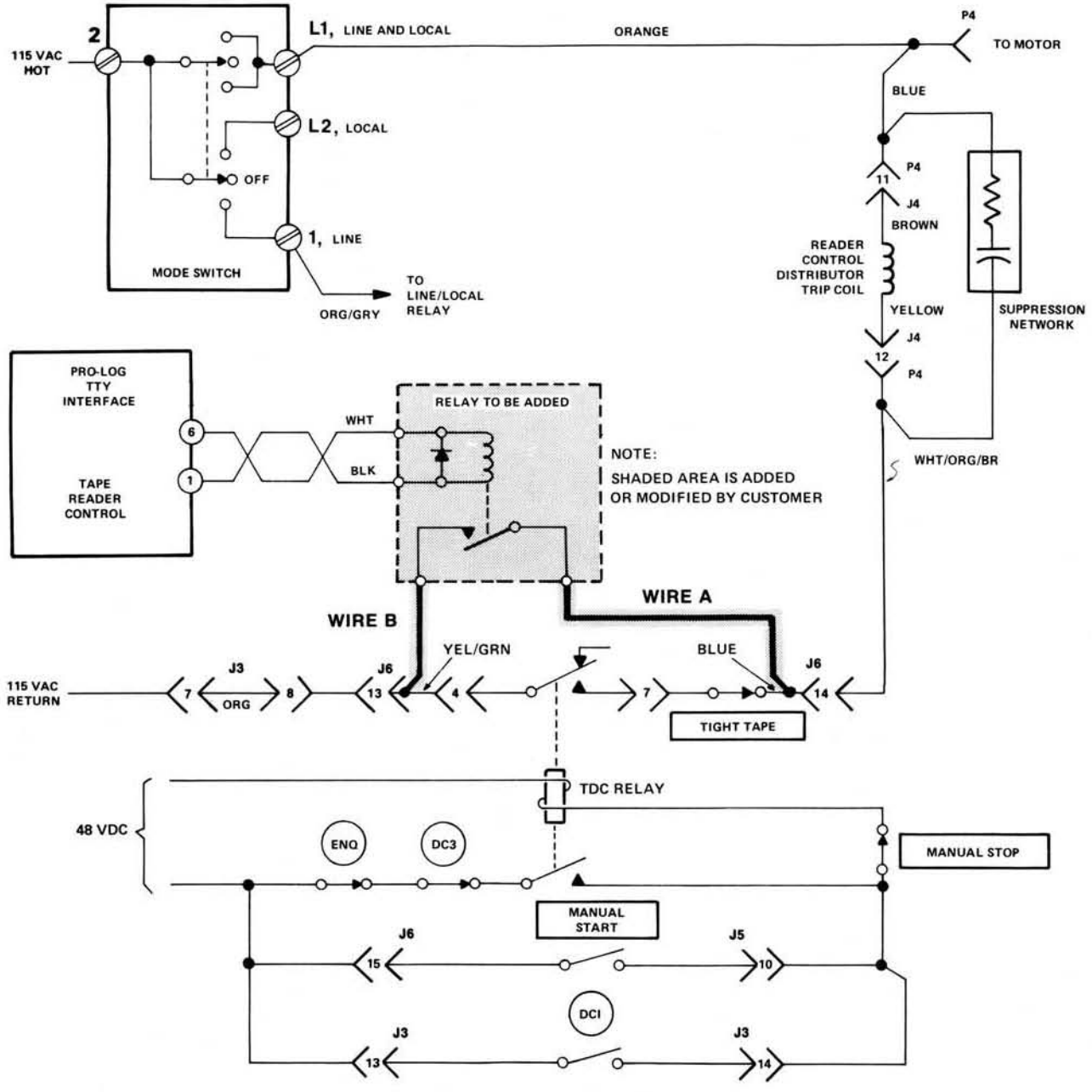



Figure 10-12 TTY Modification (Auto Reader)

SECTION 11

# 9114, COMPUTER INTERFACE OPTION

The 9114 Computer Interface is a factory-installed option that provides a handshake routine for transferring data bidirectionally between a computer and the RAM buffer in the M900B PROM Programmer.

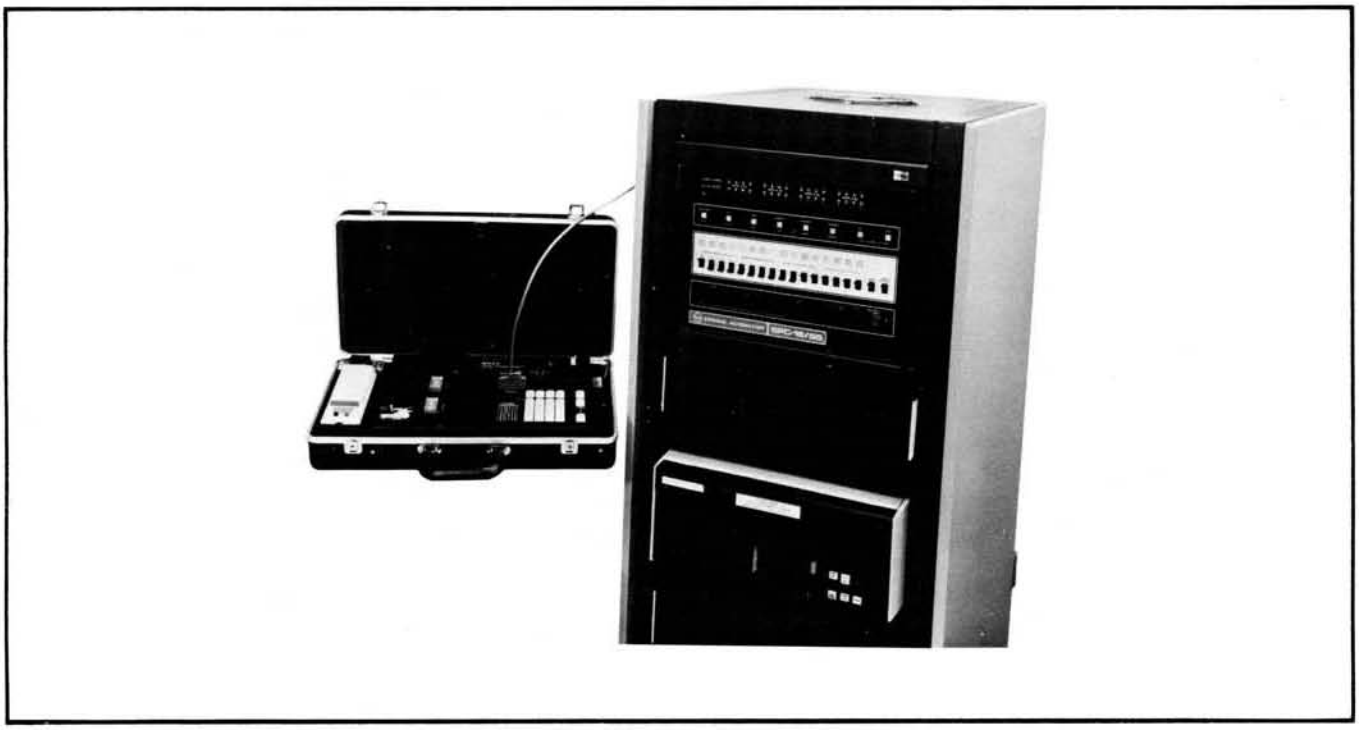


Figure 11-1 M900B with Computer

## OPERATING PROCEDURE

Connect the remote controller to the M900B via the parallel interface connector. The Personality Module to be used must be installed. Ensure that the remote controller is conditioned to hold the INTERLOCK signal low. Initialize the M900B with the RESET key on the keyboard. If the interface connection is recognized by the M900B the hex display will display 9114. Except for the RESET key, the M900B keyboard will be inoperative when the remote connection has been established.

If the interface connection is unsuccessful the display will stay blank following reset and the keyboard will still be operative. If the interface connection does not occur when the RESET key is pushed verify that the remote controller is holding INTERLOCK low.

The remote controller sends a 3-digit hex start address (MSD first) followed by a 3-digit hex stop address. This defines the buffer address range to be operated on.

The remote controller selects either the LIST mode to read data from the buffer or the PROGRAM mode to send data to the buffer. The display shows I (Input) in PROGRAM mode and O (Output) in LIST mode. When either operation is complete the M900B Hex display indicates F (Finished) in preparation for the next operating sequence. If INTERLOCK is still active, the display immediately shows 9114 again.

## INTERFACE

The Remote Controller is connected to the parallel interface of the M900B via a 25-pin, D-type connector. The interface provides eight parallel input data lines, eight parallel output data lines, seven handshake control lines, and an internal handshake program.

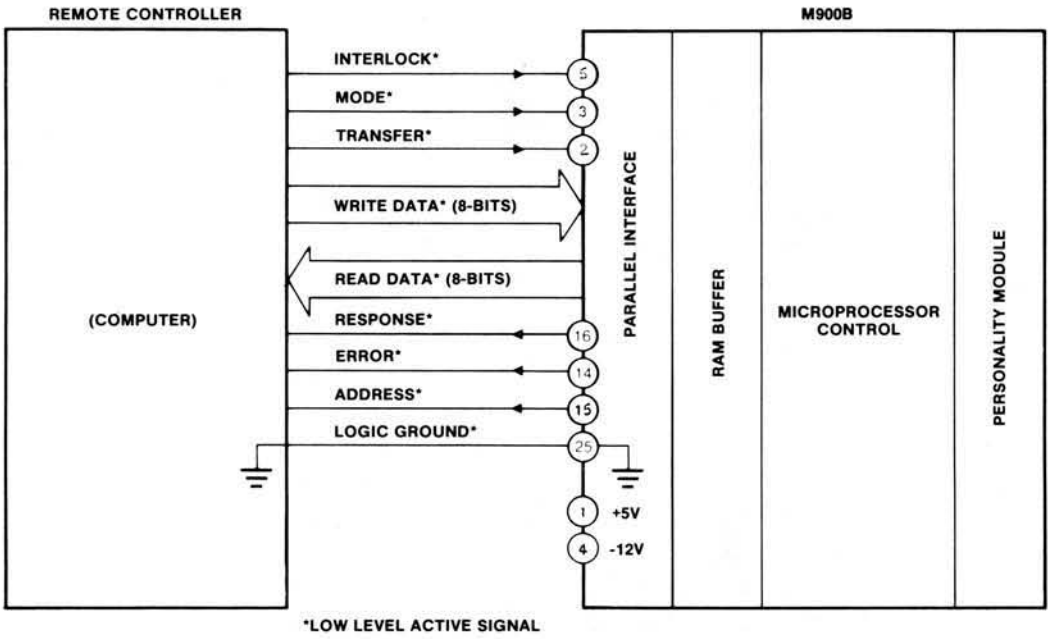



Figure 11-2 Parallel Interface

## SUMMARY OF OPERATION

When field definition is complete, the Remote Controller selects either the PROGRAM or LIST mode and initiates the data transfer either to or from the M900B. Data (up to 8 bits) is transferred for each address location.

When the complete field of data has been transferred, the M900B resets to address field definition for the next operation.

## ADDRESS FIELD DEFINITION

The field over which it is desired to operate (in either PROGRAM or LIST) must be defined with a start address and an end address. The address field is sent as 6 hexadecimal characters, where each hex character represents 4 bits of the binary address.

In the eight-bit character that is sent to the M900B for field definition, the low-order four bits contain the hex address character.

## SIGNAL DEFINITIONS

INTERLOCK causes the M900B to service or ignore the REMOTE interface. The Remote Controller acquires control of the M900B by holding the INTERLOCK low while the M900B is RESET. Once control of the M900B has been acquired, the Remote Controller can use INTERLOCK to reset the M900B to the field definition phase if any ERROR condition is detected.

MODE indicates to the M900B the direction of data transfer. The MODE line must be held low during field definition and in the PROGRAM mode. The MODE line must be held high in the LIST mode to indicate data transfer from the M900B.

TRANSFER indicates to the M900B that the Remote Controller is ready to effect a data transfer either to or from the M900B as indicated by the MODE line. The TRANSFER line must not change from high to low unless RESPONSE is high and should be held low until the Remote Controller detects a low RESPONSE signal. If the Remote Controller is sending data to the M900B, the WRITE DATA lines must be stable before TRANSFER occurs. If data is being requested by the Remote Controller, the READ DATA lines should be read after the RESPONSE signal goes low and before TRANSFER is removed (high signal).

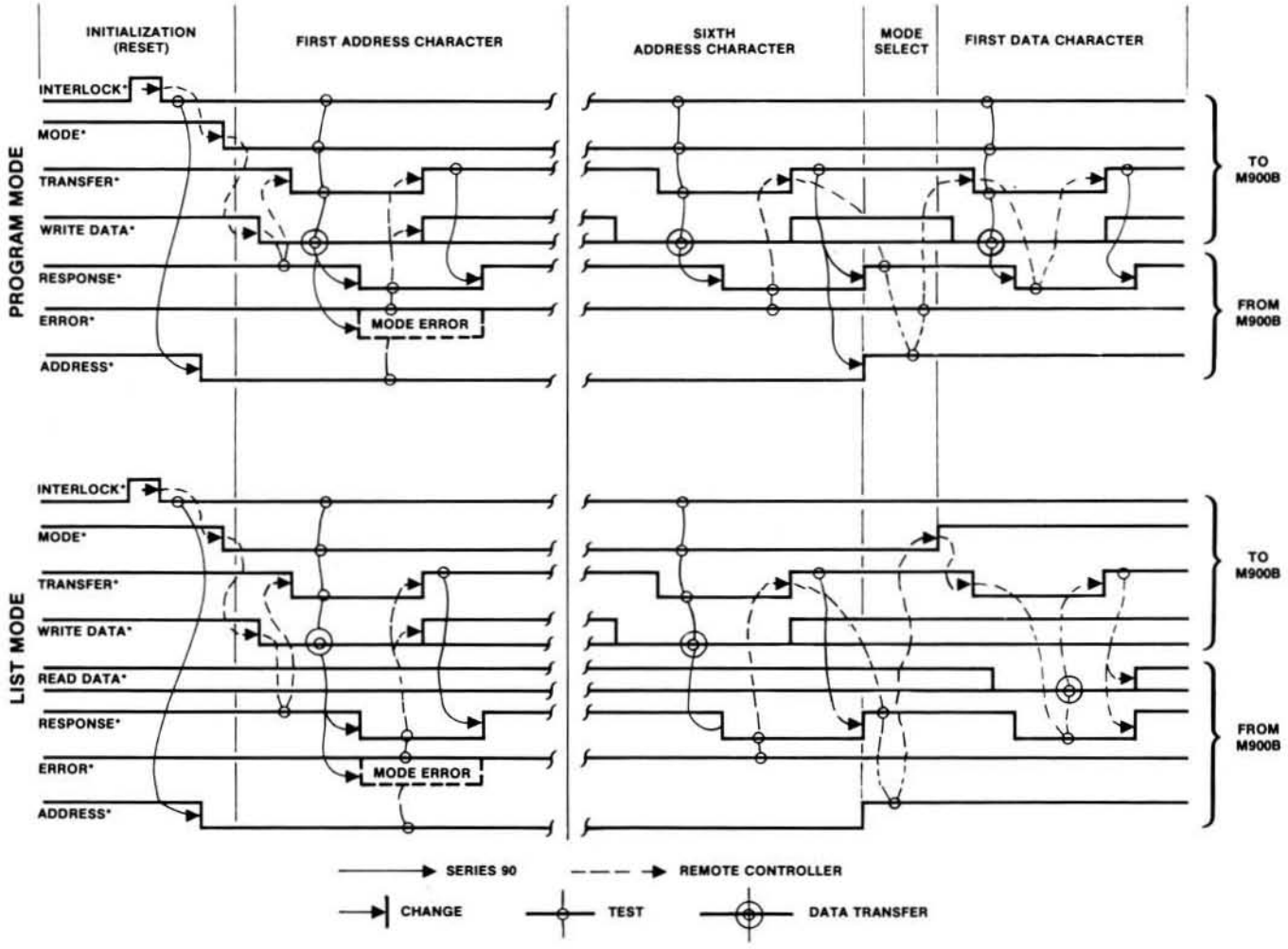
RESPONSE is a signal from the M900B which occurs in response to the TRANSFER line. During address field definition RESPONSE indicates that the address character has been accepted. RESPONSE remains low until the last address character. In the PROGRAM mode, RESPONSE indicates that the data being sent to the buffer has been accepted and stored by the M900B. In the LIST mode, RESPONSE indicates that data from the buffer is available on the READ DATA line.

ADDRESS is sent by the M900B to indicate that address field definition is required. The signal occurs in response to detection of the INTERLOCK signal whenever the M900B is reset. ADDRESS remains active until all field definition characters have been transferred to the M900B. ADDRESS will terminate prematurely if the MODE line to the M900B is in the incorrect state.

ERROR is a signal from the M900B which occurs in combination WITH RESPONSE and ADDRESS to indicate mode during field definition (ERROR, ADDRESS & RESPONSE).

WRITE DATA consists of eight data lines from the Remote controller used for transferring address information to be programmed to the M900B. Address information is sent as a series of hex characters. The low order data lines are used to send the hex address character. Data to be programmed is sent as binary data. The low order 4 bits are used for 4 bit words. All eight lines are used for 8 bit words. The most significant character is sent first.

READ DATA consists of eight data lines to the Remote Controller used for transferring data from the M900B. Data is sent as binary data. The low order 4 bits are used for 4 bit words. All eight lines are used for 8 bit words. The most significant character is sent first.




*low level active

Figure 11-3 Data Transfer Wave Forms

PARALLEL INTERFACE CONNECTIONS to the PARALLEL INTERFACE of the M900B Universal PROM Programmer are listed in the table below.

**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 | Usually no connection |
| 25 | LOGIC GROUND | Connect for reference |
| 4 | -12 volts | SPECIAL UNITS ONLY |

* low level active indicator

Figure 11-4 Connector Interface Pin List

**PARALLEL I/O**
**WRITE DATA SIGNALS**
**FOR ADDRESS FIELD DEFINITION**
**AND DATA TO BE PROGRAMMED**
**(000 START - 3FF END, E5, B6 DATA)**

| | SIGNAL | PIN | START ADDRESS MOST SIG. CHAR. | | | END ADDRESS MOST SIG. CHAR. | | | DATA | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 0 | 0 | 3 | F | F | E5 | B6 | | |
| HIGH ORDER | WRITE DATA 8* | 8 | ← NOT USED → | | | | | | L | L | MSB | 8-BIT PROM |
| | WRITE DATA 7* | 6 | ← NOT USED → | | | | | | L | H | | |
| | WRITE DATA 6* | | ← NOT USED → | | | | | | L | L | | |
| | WRITE DATA 5* | 10 | ← NOT USED → | | | | | | H | L | | |
| LOW ORDER | WRITE DATA 4* | 9 | H | H | H | H | L | L | H | H | | |
| | WRITE DATA 3* | 7 | H | H | H | H | L | L | L | L | | 4-BIT PROM |
| | WRITE DATA 3* | 12 | H | H | H | L | L | L | H | L | | |
| | WRITE DATA 1* | 11 | H | H | H | L | L | L | L | H | LSB | |

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

Figure 11-5 Parallel I/O Write Data Signals for Address Field Definition and Data to be Programmed

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 signal.

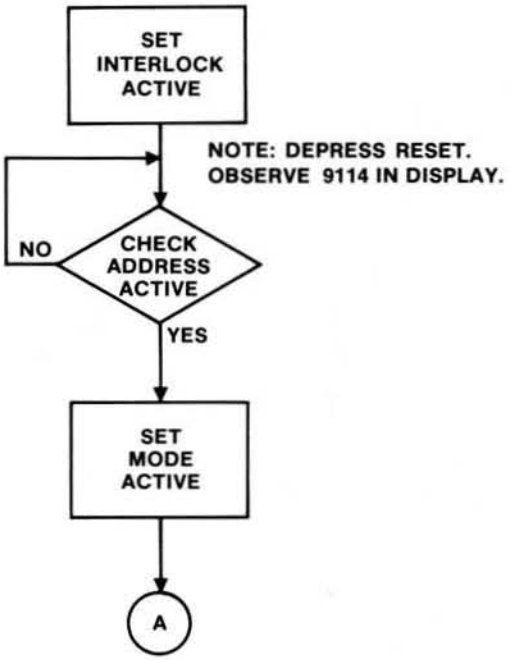



Figure 11-6 Initialization

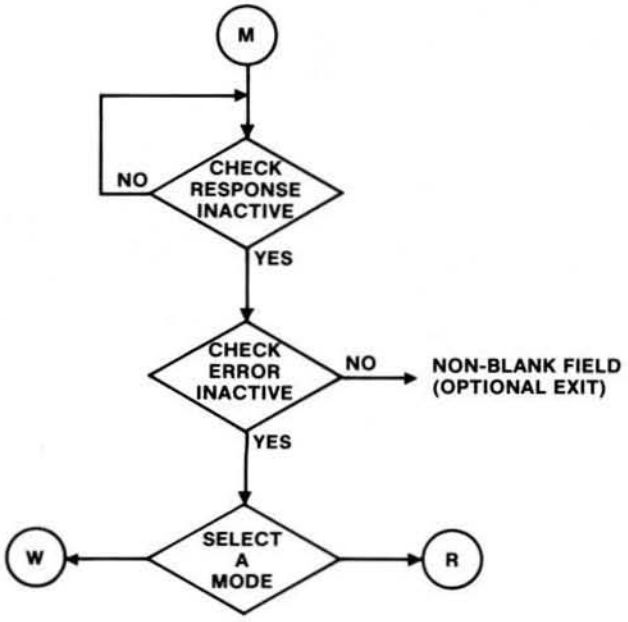



Figure 11-7 Mode Select

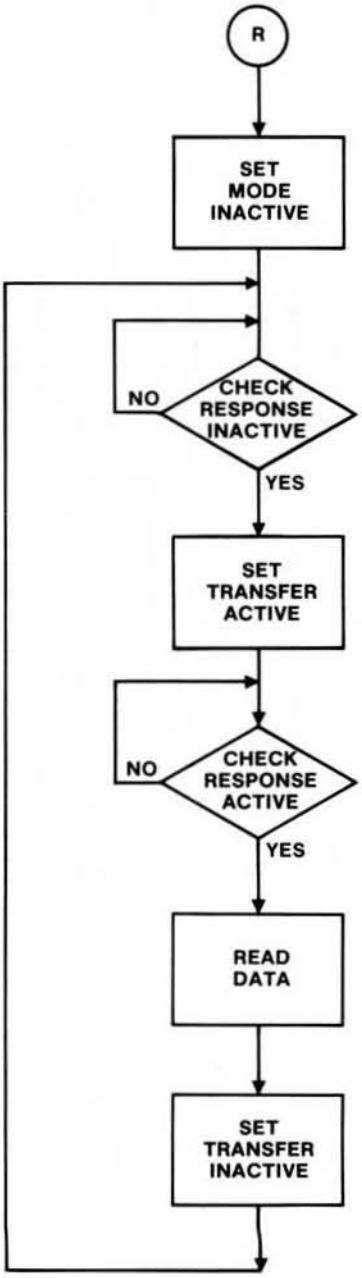



Figure 11-8 Basic Read

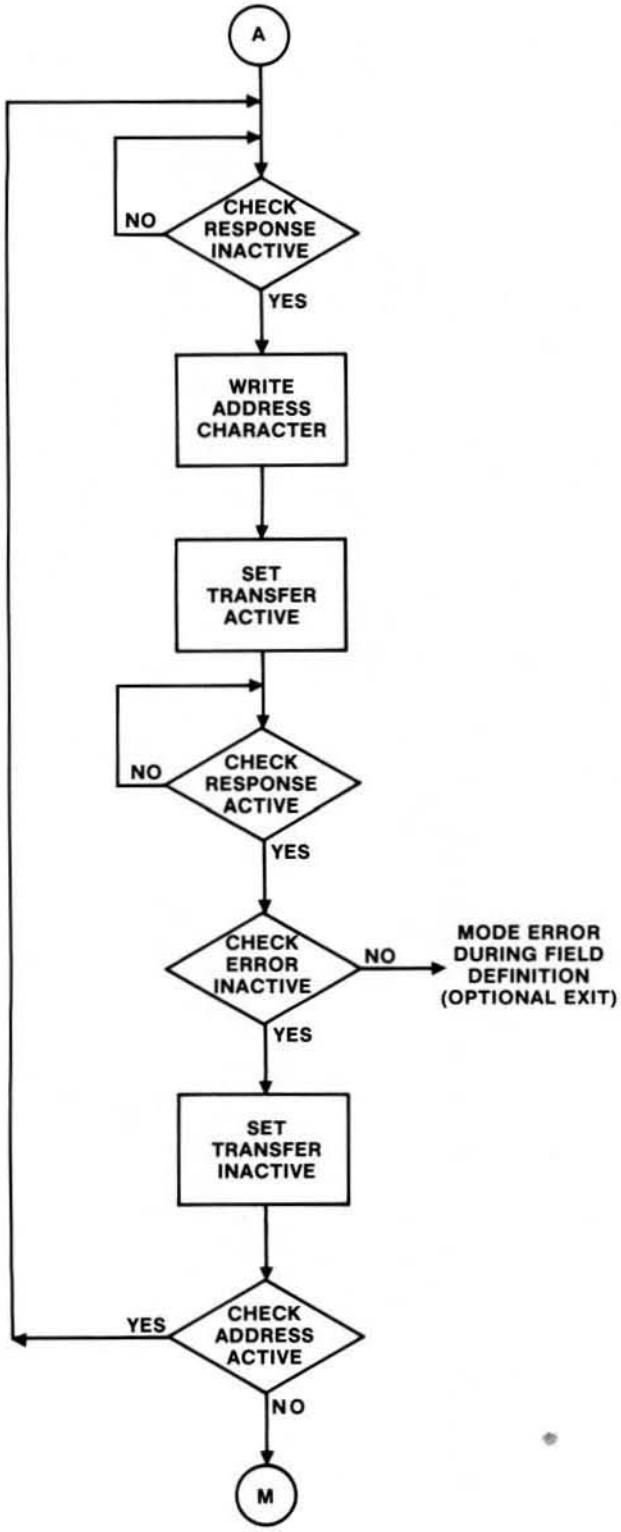



Figure 11-9 Address Definition

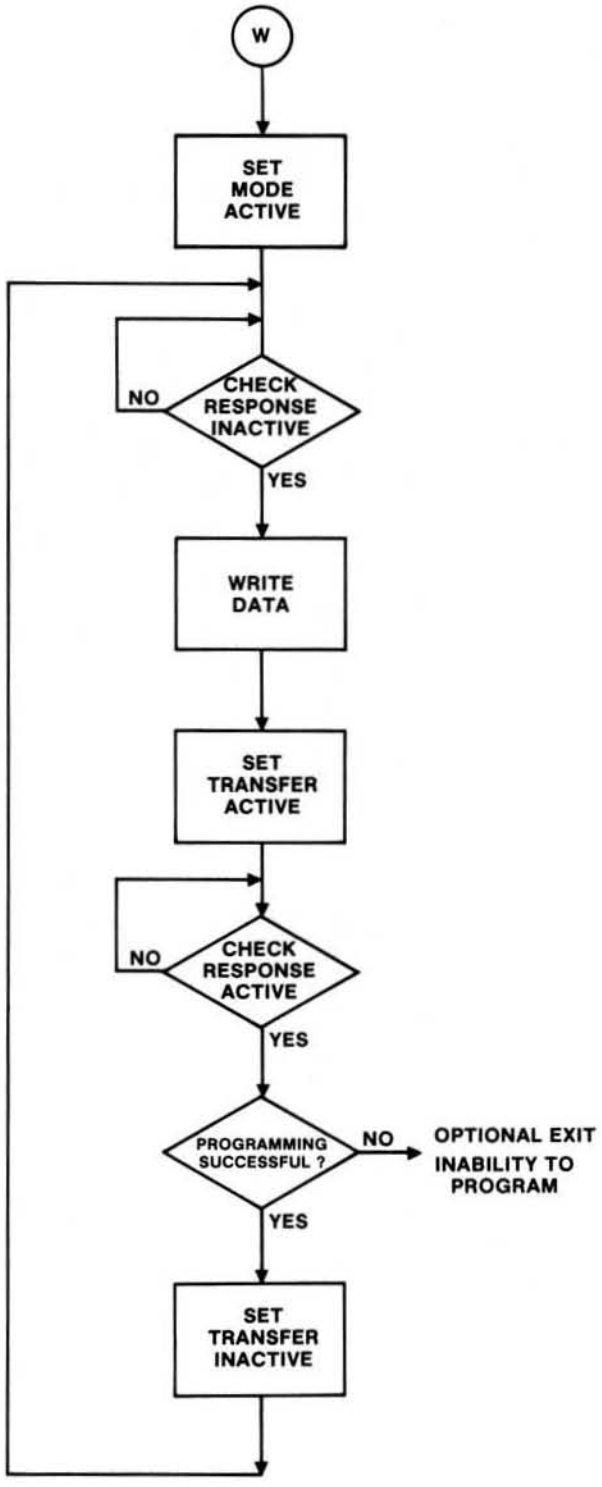



Figure 11-10 Write

SECTION 12

# 9115, RS-232-C INTERFACE OPTION

The 9115 option provides an RS-232-C interface to the M900B's 9107 RAM Buffer, allowing Buffer LIST and PROGRAM operations to be controlled at a remote terminal. This option places the M900B in the Data Set (modem) position in a standard RS-232-C communications link with a Data Terminal. 9115 operates at the true BAUD rate specified without delay between characters. This option includes a Pro-Log model M302 adapter for the interface terminal. Refer to back of manual for schematic and assembly drawing.

**FEATURES**

- RS-232-C Interface to M900B RAM Buffer
- Remote LIST and PROGRAM capability
- Designed for operation with Data Terminal
- Available in 110, 300 and 1200 BAUD Rates
- Includes M-302 EIA Standard RS-232-C Adapter
- Minimal data format and RS-232-C protocol considerations

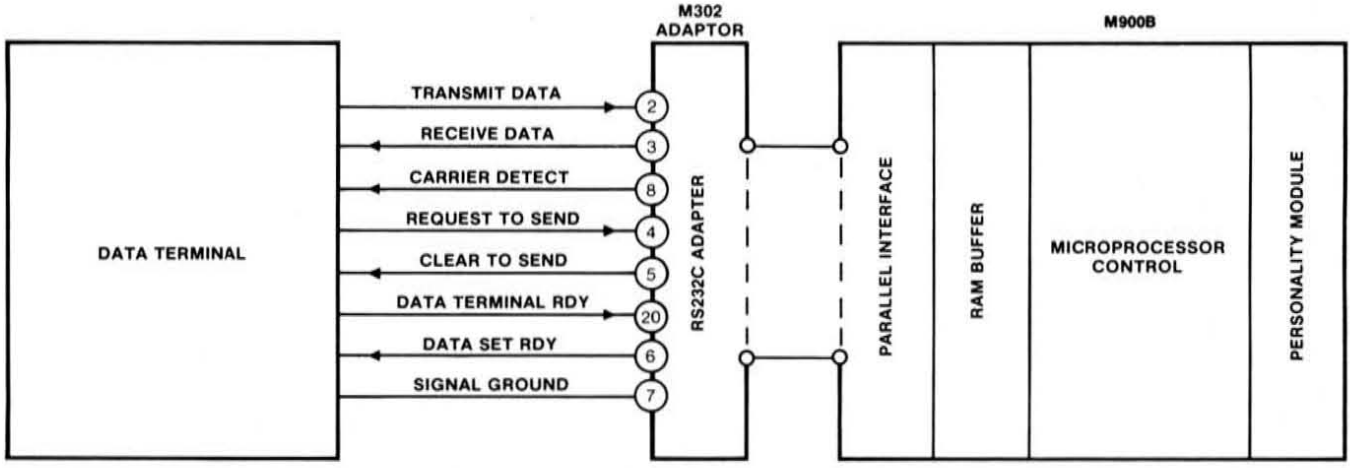



Figure 12-1 M302 Adapter

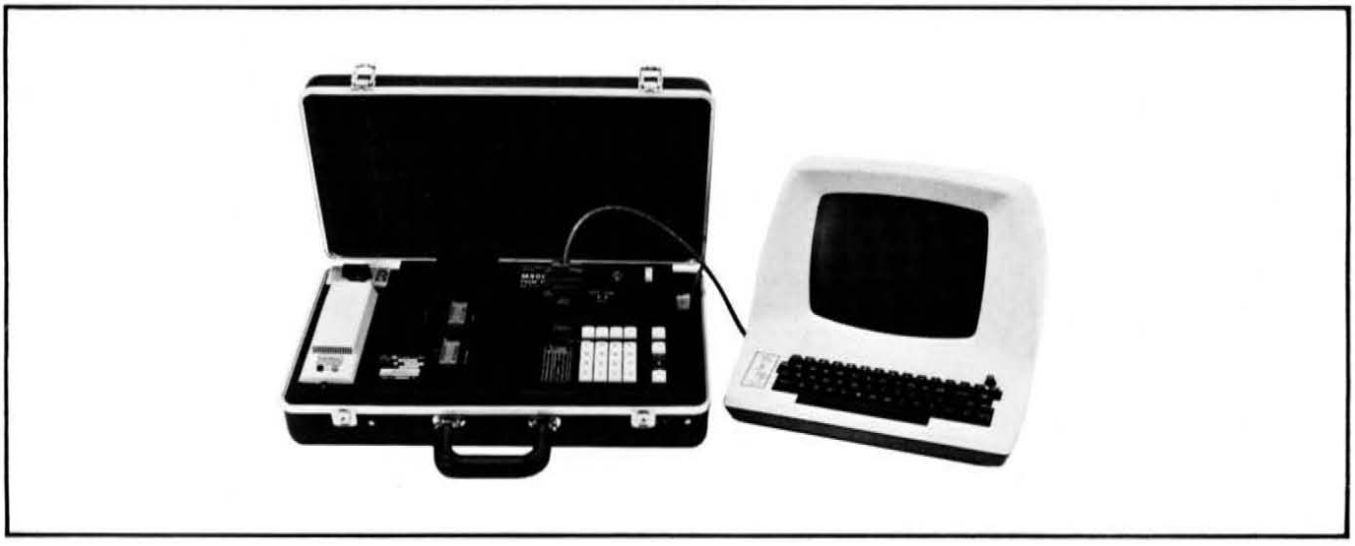


Figure 12-2 RS-232-C Interconnect

## HOOKUP

- Plug the M-302 adapter into the M900B's PARALLEL INTERFACE connector, then plug the DATA terminal cable into the M-302.

  CAUTION: Do not plug the Data Terminal cable directly into the M900B without the M-302 adapter.

- Set the data Terminal to the appropriate BAUD rate and select Parity = 1 or untested; select HALF DUPLEX operation.
- RESET the M900B; the display should show 9115
- Set the M900B BUFFER/NORMAL switch in the desired position (see below).

## OPERATION

The 9115 start sequence consists of transmitting a 3-digit HEXADECIMAL start address, followed by a 3-digit HEX stop address, followed by the character L (List mode) or the character P (Program mode) from the terminal to the M900B.

For example:
—000 0FF L instructs the M900B to output the first 256 storage locations in its buffer.
—123 456 P instructs the M900B to expect data for 820 locations and to store the data in HEX addresses 123 through 456.

In LIST mode, the M900B will format the data as sixteen buffer locations per line, separated by spaces. Each line is followed by carriage return-line feed.

In PROGRAM mode, the M900B will accept only HEX data. The user may format this data in any way he chooses (e.g. control characters, spaces, comments) so long as this formatting contains no additional HEX characters.

- Addresses and data are always transmitted most significant digit first
- The M900B cannot operate without a Personality Module installed
- If the Personality Module is for a 4-bit PROM, the M900B regards one Buffer location as one HEX digit; otherwise, one Buffer location is regarded as two HEX digits.
- The user may transmit any non-HEX characters in the data stream to maintain readability in PROGRAM mode.
- 9115 operates in HALF DUPLEX mode.

### RS-232-C Protocol

The 9115 option is activated by detection of the DATA TERMINAL READY signal (circuit CD, pin 20). The M900B will respond with DATA SET READY (circuit CC, pin 6) and CLEAR TO SEND (circuit CB, pin 5). These signals remain active during each operation. If DATA TERMINAL READY drops at any time, the operation is abruptly terminated and F is displayed by the M900B. DATA SET READY and CLEAR TO SEND are both dropped for approximately 10 ms if the BUFFER/NORMAL switch is in the BUFFER position (see below); in NORMAL, these signals are inactive until the user is finished with the M900B keyboard. CARRIER DETECT (circuit CF, pin 8) is active with DATA SET READY, and REQUEST TO SEND (circuit CA, pin 4) is not used.

### Buffer/Normal Toggle Switch

In the BUFFER position, this switch allows the 9115 option to restart immediately upon termination of a LIST or PROGRAM operation.

In the NORMAL position, the M900B terminates LIST and PROGRAM modes by dropping DATA SET READY and CLEAR TO SEND; the buffer address range just operated on appears in the display. At this point one NORMAL mode selection and operation can proceed. Upon termination the 9115 option will be reactivated.

### M900B Display

The display shows 9115 when idle; 1 when receiving data, 0 when transmitting data; F with DTR inactive; and most recent start/stop addresses when finished if the BUFFER/NORMAL switch is in the NORMAL position.

### Baud Rate Selection

The 9115 option is available in three versions; 9115-1 (1200 Baud), 9115-2 (300 Baud) or 9115-3 (110 Baud).

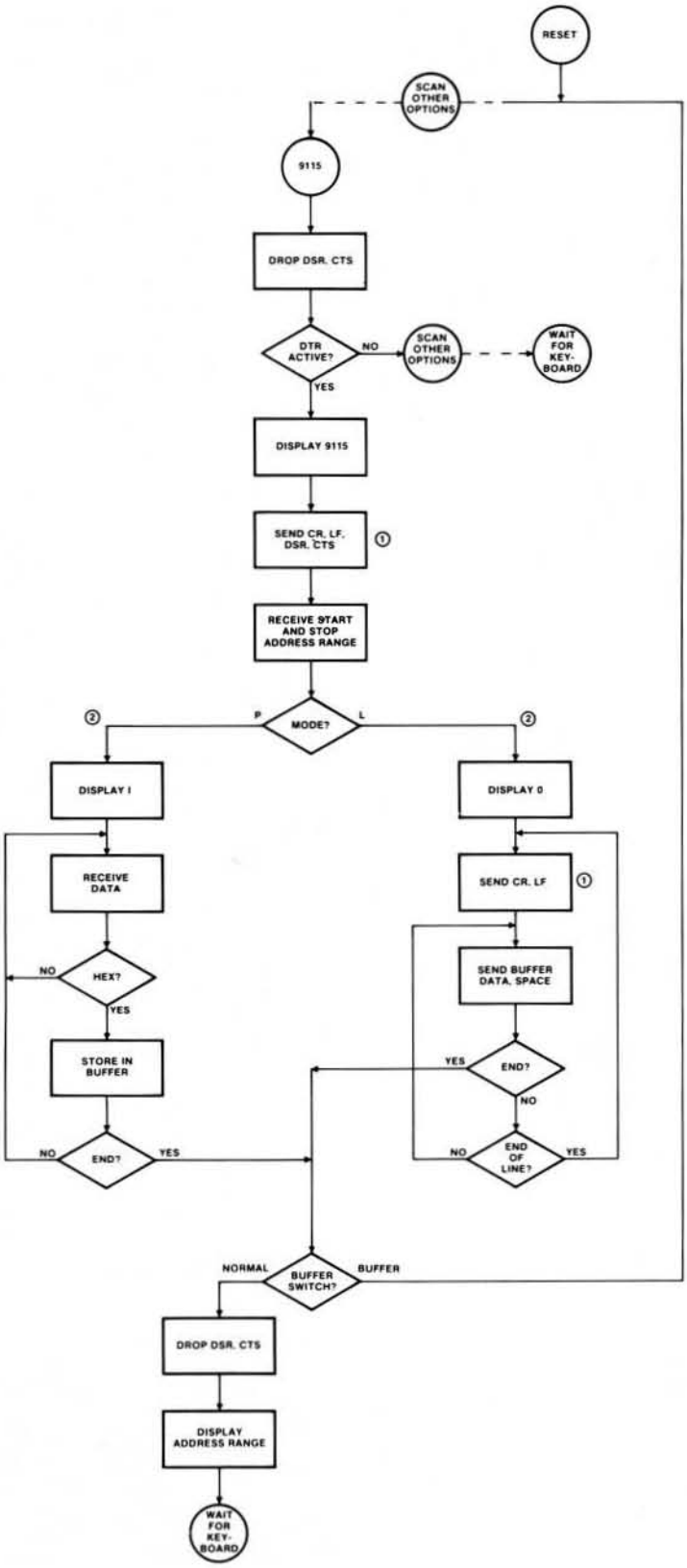



Figure 12-3 Flow Chart

SECTION 13

# 9118, RS-232-C SELECTABLE BAUD INTERFACE

## FUNCTIONAL DESCRIPTION

The 9118 option uses the M304 adapter as an RS-232-C interface between the M900B Programmer, a terminal and a modem. In the M304, a 25-pin "D" male connector for the terminal and a 25-pin "D" female connector for the modem are provided, permitting simultaneous communication between the M900B and both connectors.

Features provided by the M304/9118 are:
- Switch selectable BAUD rate from 50 to 9600 BAUD
- PROGRAM buffer from terminal and/or modem
- LIST buffer to terminal and/or modem

The 9118 option consists of two functional elements: the Control Program which is located in PROMs A, B and E of the M900B Control Unit; and the M304 Adapter, which plugs into the parallel interface socket on the M900B. The M304 Adapter interfaces the TTL level ports of the M900B to the RS-232-C 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 switching the modem and/or the M900B ON-LINE or OFF-LINE.

**NOTE:** The 9118 option does not permit direct programming of PROMs from an external source; the Buffer must be filled and then the data programmed from the Buffer to the PROM.

## 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 M900B inputs.

In the ON-LINE position, data is connected between the terminal and/or modem connectors to the input of the M900B. In the OFF-LINE position, the DTR line from the terminal connector and the CTS line from the modem connector is in the low state. Since the M900B will sample these lines at power-on or reset, a DTR or CTS low will isolate the M900B from the modem-terminal data path and cause the programmer to return to the main program.

### 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 M900B. 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, which is recessed behind the panel on the M304 Adapter and which requires a screwdriver to rotate. As the switch is rotated, a Hex-coded number appears in the window just above the screwdriver slot. Refer to the table below for BAUD rate versus position.

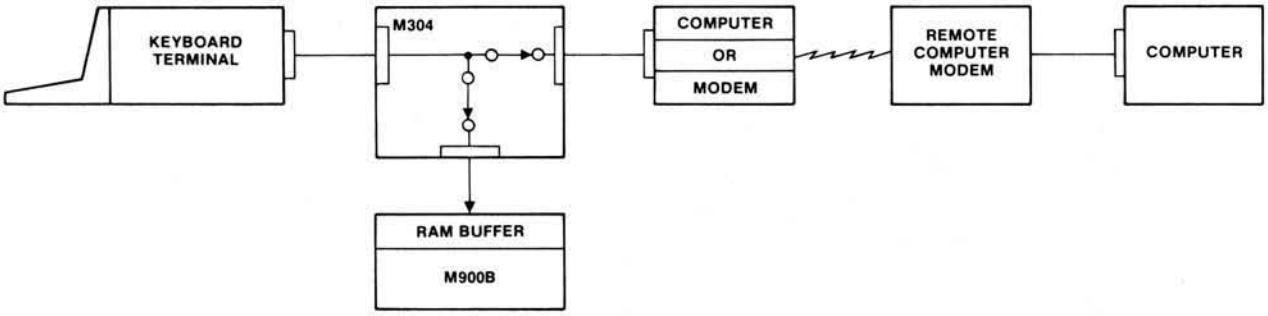
**BAUD Rate Selection**

| 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 |

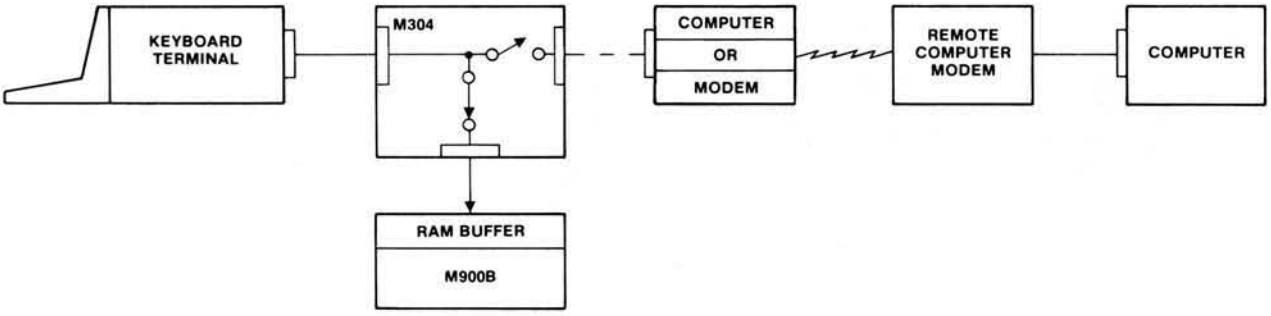
*These positions cause the software to insert a 200 ms delay (in LIST mode) after appropriate carriage returns and line feeds to accommodate mechanical terminals.

## TYPICAL APPLICATIONS

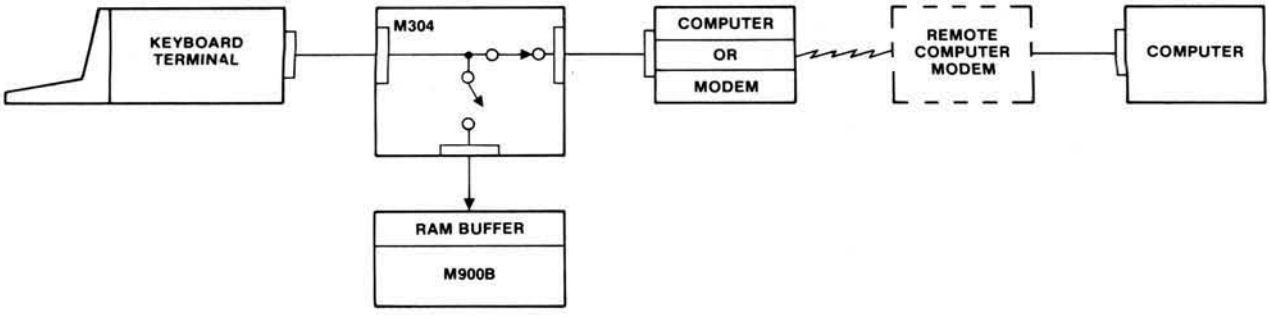
**Terminal to Computer and M900B**
**M900B to Terminal and Computer**
**Computer Terminal and M900B (M900 ON-LINE) (Similar to 9108 Option)**




**Terminal to M900B Ram Buffer (Similar to 9115 Option)**
**M900B Ram Buffer to Terminal**




**Terminal to Computer (M900B OFF-LINE)**



## OPERATING SEQUENCES

**NOTE: M304 ADAPTER MUST BE INSTALLED PRIOR TO M900B POWER-ON.**

**From Local Terminal (or Data Stream) or from M900B**

Prior to operation, the BAUD rate and format of the M304 and other devices in the data path must correspond. Both ON-LINE/OFF-LINE and modem ON/OFF (if a modem is in the data path) must be in the "ON" position.

1. Depress RESET key on the M900B keyboard. The programmer display should show "9118". In order for "9118" to appear, the DTR control line must be high (See Signal Discipline, at end of section).
2. Input desired address field from local terminal or M900B keyboard. The field is defined by 3-digit START and END addresses, which can range from the full buffer (000 3FF for 2K, 000 7FF for 4K) to a single location (eg. location 010 is defined as 010 010).

   Note: The M900B does not echo characters in this mode.
3. Following address field definition, the M900B requires a command character to define desired format.

The following command characters from the terminal or data stream define the format:

ASCII P : PROGRAM - Program Buffer
ASCII L : LIST - Data formatted 16 bytes per line
ASCII M : PRINT - Data formatted in 256 byte blocks, 16 bytes per line. Includes header and starting address of each line.
ASCII S : SCROLL - Like print but stops after each block and waits for "space" to send next block.
ASCII N : DUMP - Unformatted data only. Ends with carriage return/line feed.
ASCII X : XON LIST - Data formatted in 16 bytes per line. After each line, waits for XON character.

Alternately, the following command characters from the M900B keyboard define the format:

HEX 0 : PROGRAM
HEX 2 : LIST
HEX 3 : PRINT
HEX 1 : SCROLL
HEX 4 : DUMP
HEX 5 : XON LIST

**From Terminal or M900B Keyboard (if carriage return is required by computer)**

In some instances, a carriage return is required by the computer to initiate data transmission in the PROGRAM mode. The M900B is equipped to transmit a carriage return and line feed, which is useful when a local terminal is not in the data path.

Prior to operation, the BAUD rate and character structure of the M304 and other devices in the data path must correspond. Both ON-LINE/OFF-LINE and modem ON/OFF (if a modem is in the data path) must be in the "ON" position.

1. Depress RESET key on the M900B keyboard. The programmer display should show "9118". In order for "9118" to appear, the DTR control line must be high (See Signal Discipline, Appendix B at end of section).
2. Input desired address field from M900B keyboard (this may be done from terminal, if there is one in the data path). The field is defined by 3-digit START and END addresses, which can range from the full buffer (000 3FF for 2K, 000 7FF for 4K) to a single location (eg. location 010 is defined 010 010).

   Note: The M304 does not echo characters.
3. Following address field definition, the M900B requires a command character to define desired format.

The following command characters from the M900B keyboard define the format:

HEX 6 : PROGRAM (This causes the M900B to generate carriage return and line feed)
HEX 2 : LIST
HEX 3 : PRINT
HEX 1 : SCROLL
HEX 4 : DUMP
HEX 5 : XON LIST

If a terminal is part of the data path, the ASCII characters which correspond to the HEX command characters listed above will initiate identical operations if entered from the terminal keyboard.

## FORMAT DESCRIPTIONS

The 9118 option provides a PROGRAM format and 5 LIST formats for operations between modem and/or terminal and the M900B RAM buffer. The M900B will enter a mode in response to a command character (See Operating Sequence).

### PROGRAM Format

In this mode, the M900B accepts data as ASCII-coded HEX characters and sequentially stores it in the RAM buffer in the desired address field. Spaces, carriage returns, and non-Hex characters are ignored. This permits formatting (as data is programmed into the M900B buffer) for output to a printer or CRT display.

The M900B remains in the PROGRAM mode until the desired address field has been exhausted or the programmer is reset, at which time a new address field and command character may be entered.

Note: When operator wishes to program a PROM, the M304 must be switched OFF-LINE and the M900B reset. Refer to the M900B Operating Manual, Buffered Operation Section.

### LIST Formats

In all 5 LIST formats, the M900B will send (LIST) from the RAM buffer to the modem connector (if modem switch in ON) and to terminal connector.

Included in the following format descriptions are examples, which should best illustrate the operation of each mode, for the particular format under discussion. For purposes of illustration it is assumed that each M900B RAM buffer location has been arbitrarily loaded with the 2 least significant digits of its own address.

**LIST** - Starting with START address, data is output sequentially by address until END address is reached. Spaces separate each 2-digit data byte; carriage return and line feed occur every 16 bytes (32 digits). Except for the 200 ms delay (See BAUD rate table, Page 13-2) characters are sent serially adjacent.

```
INPUT     003065L

OUTPUT    03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12
          13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22
          23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F 30 31 32
          33 34 35 36 37 38 39 3A 3B 3C 3D 3E 3F 40 41 42
          43 44 45 46 47 48 49 4A 4B 4C 4D 4E 4F 50 51 52
          53 54 55 56 57 58 59 5A 5B 5C 5D 5E 5F 60 61 62
          63 64 65
```

**PRINT** - Data is output sequentially by address with spaces separating each 2-digit data byte and carriage return and line feed occurring every 16 bytes (32 digits). Each 256-byte block of data is preceded by a header and each line of output by the starting address of the line. In this mode, output will begin at that buffer location whose 2 most significant digits are the same as those of the defined start address but whose least significant digit is zero. The mode will terminate when END address is reached. This mode is primarily used for a printer interface.

```
INPUT     0E51F8M
OUTPUT          0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
          0E0 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
          0F0 F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF
                           •
                           •
                           •
                           •
          1D0 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
          1E0 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
          1F0 F1 F2 F3 F4 F5 F6 F7 F8
```

**XON LIST** - Data is formatted and output in 16-byte lines with spaces separating each data byte and carriage return and line feed following each line. In this mode, the M900B will output one line of data each time an XON character is received (XON is a control Q from an ASCII keyboard).

The XON LIST format is for use with time share systems that require XON protocol. The mode will terminate when the specified address field is exhausted or the programmer is reset.

```
INPUT     7E5815X
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 11012 13 14
INPUT     XON
OUTPUT    15
```

**DUMP** - Starting with the START address, data is output sequentially by address until END address is reached. Aside from a carriage return and line feed which follow the output data byte of the last defined address, there are no carriage returns, line feeds, or spaces in the data stream.

This mode affords the fastest possible data transfer rate, and can be utilized in data transfer between two M900B RAM buffers. However, due to the absence of formatting in DUMP, this mode is not useful for display or printing.

```
INPUT     7C3822N
OUTPUT    C3C4C5C6C7C8C9CACBCCCDCECFD1D2D3D4D5D6D7D8D9DADBDCDDDEDFE1E2E3E4
          E5E6E7E8E9EAEBECEDEEEFF1F2F3F4F5F6F7F8F9FAFBFCFDFEFF000102030405060708090
          0A0B0C0D0E0F10111212141516171819 1A1B1C1D1E1F202122
```

**SCROLL** - Data is formatted in a 256-byte block 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. When the entire block is displayed, the CRT cursor will remain to the right of the last line displayed. The M900B will output the next block of data when a "SPACE" is received.

The mode will terminate when the specified address field is exhausted, the programmer is reset, or any key except the space bar is depressed. The cursor will return to the left side of the CRT screen at mode termination.

```
INPUT     3E95F4S
OUTPUT          0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
          3E0 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
          3F0 F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 FA FB FC FD FE FF
          400 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
                                    •
                                    •
                                    •
                                    •
          4D0 D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF
INPUT     "SPACE"
OUTPUT          0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
          4E0 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
                                    •
                                    •
                                    •
                                    •
          5D0 D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF
INPUT     "SPACE"
OUTPUT          0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
          5E0 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF
          5F0 F0 F1 F2 F3 F4
```

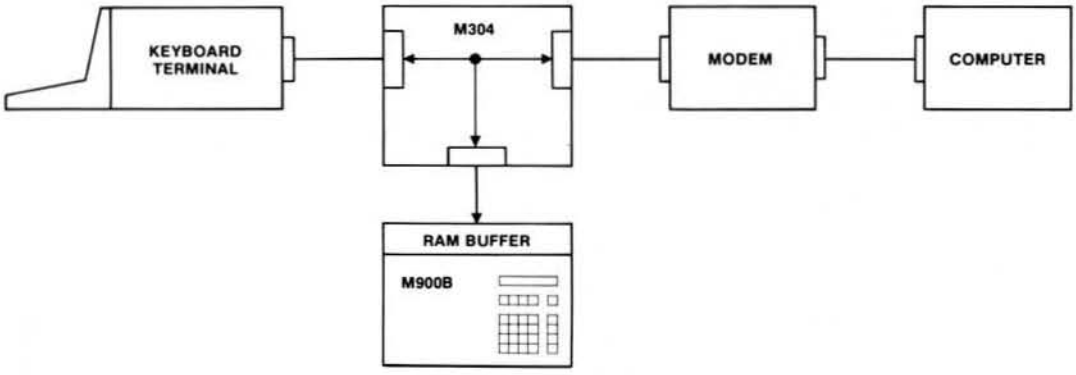
## ADDITIONAL 9118 APPLICATIONS

### Remote Buffer Programming

The 9118 option provides the means by which the M900B RAM Buffer may be programmed from a remote source. The following are possible communications links:

1. Local Terminal - M900B Buffer - Remote Computer (Via Modem)
2. M900B Buffer - Remote Computer (Via Modem)
3. Local Computer (With Terminal) - M900B Buffer
4. Local Computer (Without Terminal) - M900B Buffer

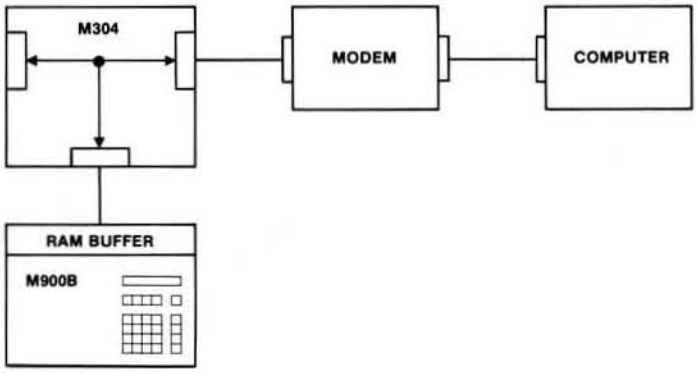
### Program Buffer from Remote Computer (via Modem) with Local Terminal




1. Install M304 Adapter in M900B parallel interface connector. Connect terminal and modem to the appropriate connectors.
2. Switch M304 OFF-LINE, modem switch ON. Establish communication between terminal and computer. Request desired data dump but DO NOT SEND CARRIAGE RETURN. Switch M304 ON-LINE.

   Note: If data dump contains address field and command character preceding desired data, RESET M900B. M900B generates a carriage return and data will transfer from computer to M900B RAM Buffer. Steps 3 and 4 may be omitted.
3. Switch modem switch OFF, RESET M900B. The M900B display should show "9118". From terminal or M900B keyboard, enter the desired 6-digit buffer address field.
4. Enter command character. Command character may be entered in one of the following ways:
   a. Enter "P" from terminal or Hex 0 from M900B. An "I" should appear in the M900B display. Switch modem Switch ON and enter Carriage Return from terminal, or
   b. Switch modem switch ON. Enter one HEX character (6 through F) from terminal or M900B keyboard. The M900B generates a carriage return. An "I" should appear and data will transfer from computer to M900B RAM Buffer.

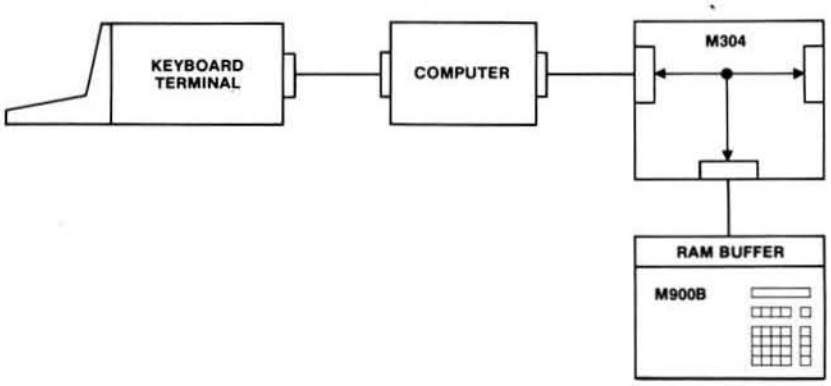
**Program Buffer from Remote Computer (via Modem) without Terminal**




1. Install M304 Adapter in M900B parallel interface connector. Connect modem to modem connector.
2. Desired data dump must be ready for transfer. Switch M304 ON-LINE, modem switch OFF. Reset M900B.

   Note: If data dump contains address field and command character preceding the desired data, switch modem switch ON, RESET M900B. The M900B generates a carriage return and data will transfer from computer to M900B RAM Buffer. Steps 3 and 4 may be omitted in this case.
3. Switch modem switch ON. Enter desired 6-digit buffer address field from M900B keyboard.
4. Enter one Hex character (6 through F) from M900B keyboard. This sends carriage return to computer. An "I" should appear in the display, and data will transfer from computer to M900B RAM Buffer.

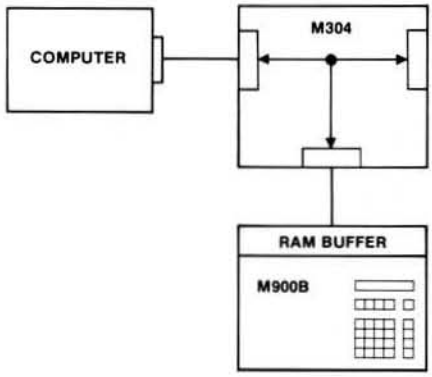
**Program Buffer from Local Computer with Terminal**




1. Install M304 Adapter in M900B parallel interface connector. Connect computer to terminal connector.
2. Switch M304 ON-LINE, RESET M900B. Select desired data dump from computer but DO NOT SEND CARRIAGE RETURN.

   Note: If data dump contains address field and command character, RESET M900B. This will generate a carriage return and data will transfer from computer to M900B RAM Buffer. Step 3 may be omitted.
3. The M900B display should show "9118". By terminal command or from M900B keyboard enter a 6-digit buffer address field and appropriate command character: "P" if from terminal, Hex "0" if from M900B keyboard. (If carriage return is required, enter "F" from either keyboard; the M900B will send a carriage return and accept data sequentailly over the defined address field.)

**Program Buffer from Local Computer without Terminal**




1. Install M304 Adapter in M900B parallel interface connector. Connect computer to terminal connector.
2. Desired data dump must be ready for transfer. Switch M304 ON-LINE.

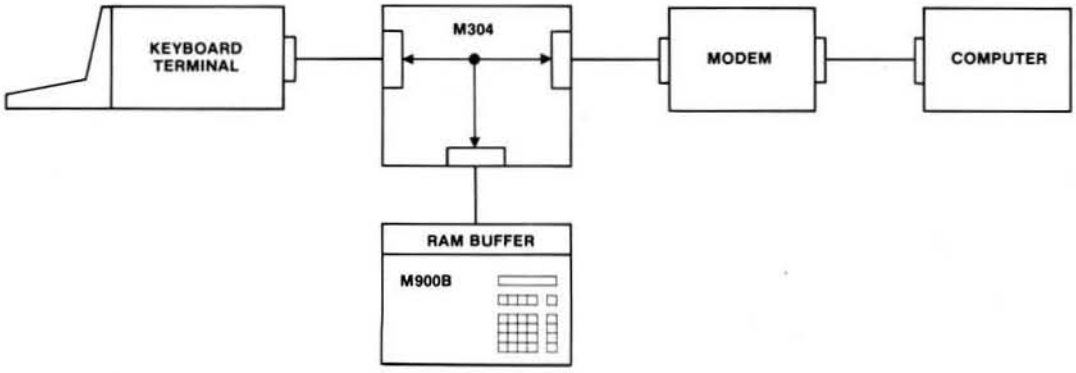
   Note: if data dump contains address field and command character preceding desired data, RESET M900B. This will generate carriage return and data will transfer from computer to M900B RAM Buffer. Steps 3 and 4 may be omitted.
3. RESET M900B. The M900B display should show "9118". Enter desired 6-digit buffer address field from M900B keyboard.
4. Enter one Hex character (6 through F) from M900B keyboard. This causes the M900B to transmit a carriage return. Data will transfer from computer to M900B RAM Buffer.

**BUFFER LISTING**

In addition to remote buffer programming, the 9118 option provides the means by which M900B RAM Buffer contents may be transferred to or listed on a remote device. Some of the list format applications are:

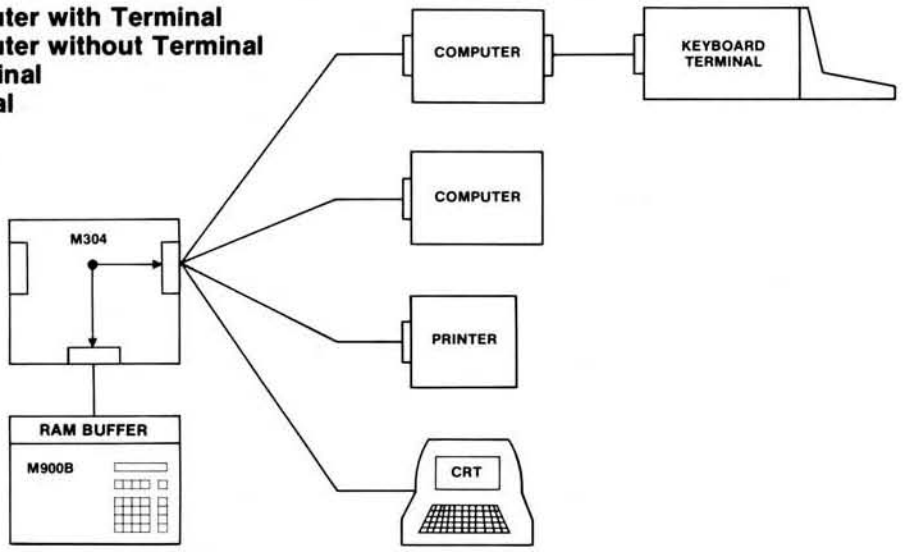
1. Listing to Remote Computer (Via Modem) using Local Terminal
2. Listing to Local Computer with Terminal
3. Listing to Local Computer without Terminal
4. Listing to Printer/Terminal
5. Listing to CRT/Terminal

**Listing to Remote Computer (via Modem) using Local Terminal**




1. Install M304 Adapter in M900B parallel interface connector. Connect terminal and modem to the appropriate connectors.
2. Switch M304 OFF-LINE. Modem switch ON. Establish communication with computer.
3. Switch M304 ON-LINE. Enter desired 6-digit address field from terminal or M900B keyboard and command character. Buffer contents will transfer to computer in format defined by command character. It should be noted that the address field and command characters will be received by the computer which must process them appropriately.

**Listing to: Local Computer with Terminal**
**Local Computer without Terminal**
**Printer/Terminal**
**CRT/Terminal**

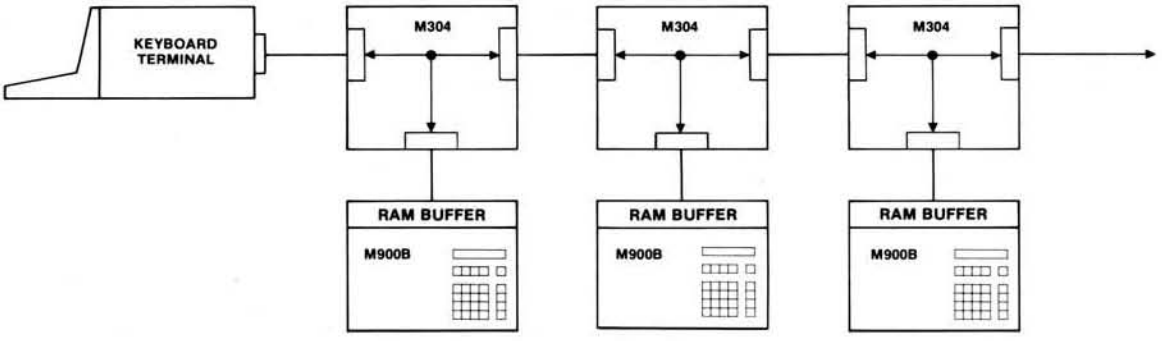



1. Install M304 Adapter in M900B parallel interface connector. Connect desired output device to terminal connector.
2. Establish communication with computer (if used). Switch M304 ON-LINE.
3. From M900B keyboard, enter desired 6-digit address field to be listed from buffer and the command character.

   Recommended command characters:
   To Computer with Terminal: "3", "2", "4", "5"
   To Computer without Terminal: "2", "4", "5"
   To Printer/Terminal: "3"
   To CRT/Terminal: "1"

   Data will be listed at output device according to format chosen.

**To Program M900B RAM Buffer(s) from a Terminal or 2nd M900B Buffer.**




1. Install M304 Adapter(s) in M900B parallel interface connector(s). Connect terminal to terminal connector of one M304 Adapter. To link remaining M900B units, connect modem connector of each M304 to the terminal connector of subsequent unit.
2. Switch M304 Adapters which are installed in M900B units not involved in the data transfer OFF-LINE. In the units involved, switch modem switch ON, M304 ON-LINE. RESET M900B(s) involved.
3. In unit(s) to be programmed, define desired address field from the keyboard of the unit itself. Enter "0" to initiate PROGRAM mode. If a terminal is used, data may be entered at this point, or
4. Define desired address field in the unit whose buffer contains desired data dump from the keyboard of the M900B unit itself.

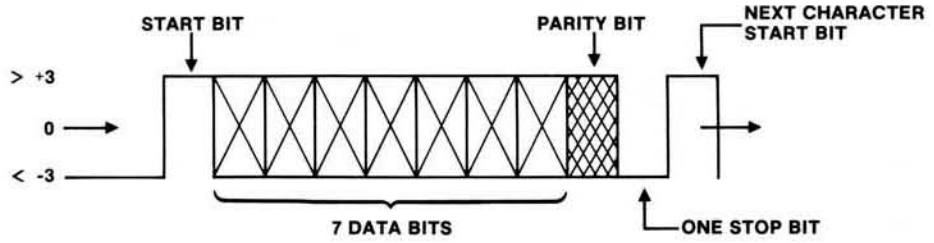
   Enter "4" from the keyboard of the M900B containing data dump. An "O" should appear in the display of the unit containing data, "I" in the display of units being programmed. Data will transfer to the designated buffers.

## 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 removed or clipped with side cutters. To install a new jumper, short pieces of insulated wire can be soldered 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.

**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 M900B when receiving. However, it must be sent either ODD, EVEN or fixed.

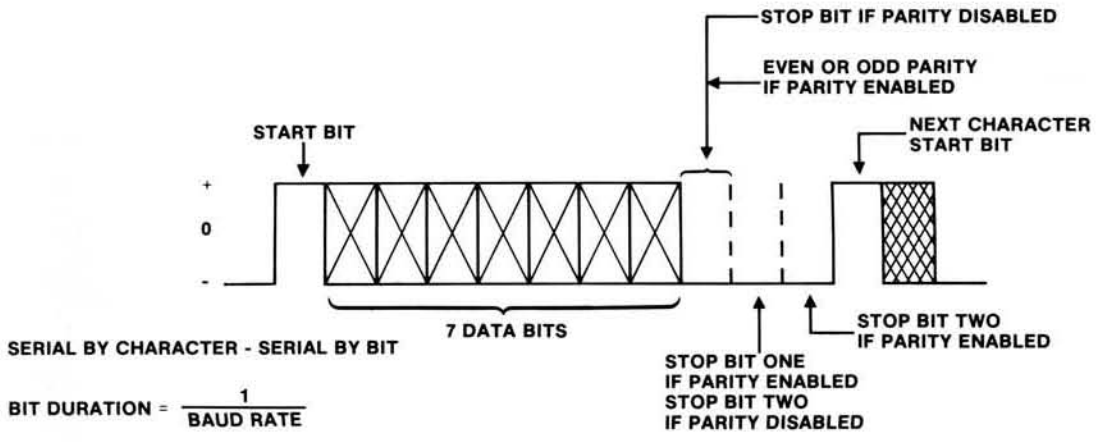
**Stop Bit Select (SBS)** - Selects whether there are one or two stop bits sent or required when receiving. The M304 is shipped in the one stop bit mode. To select two stop bits, remove jumper between E17, E16, and install between E17, E18. When transmitting to the M900B, the stop bit can be of any length, provided that it is a minimum length of one bit in the one's position and two bits in the two's 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)

**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 M900B. 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 M900B. 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 M900B. 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 9118 option as follows:

TRANSMIT DATA is used by the terminal to send address, control and data characters to the M900B and/or modem. TRANSMIT DATA is also used by the M900B to send data to the modem.

RECEIVE DATA is used by the M900B to send control and data characters to the terminal. RECEIVE DATA is also used by the modem to send data to the terminal and M900B.

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 M900B to indicate to the terminal it is ready to receive characters. This line is used to indicate the M900B is in the Receive Mode. CTS is also used by the modem.

DATA TERMINAL READY is used by the M900B to determine that the 9118 option is installed and ready to operate. This line should be held continuously high. Operation with the M900B 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 to 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**

## 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.

**Terminal/Modem I/O Specifications**

| 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<br>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<br>16 | feet<br>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

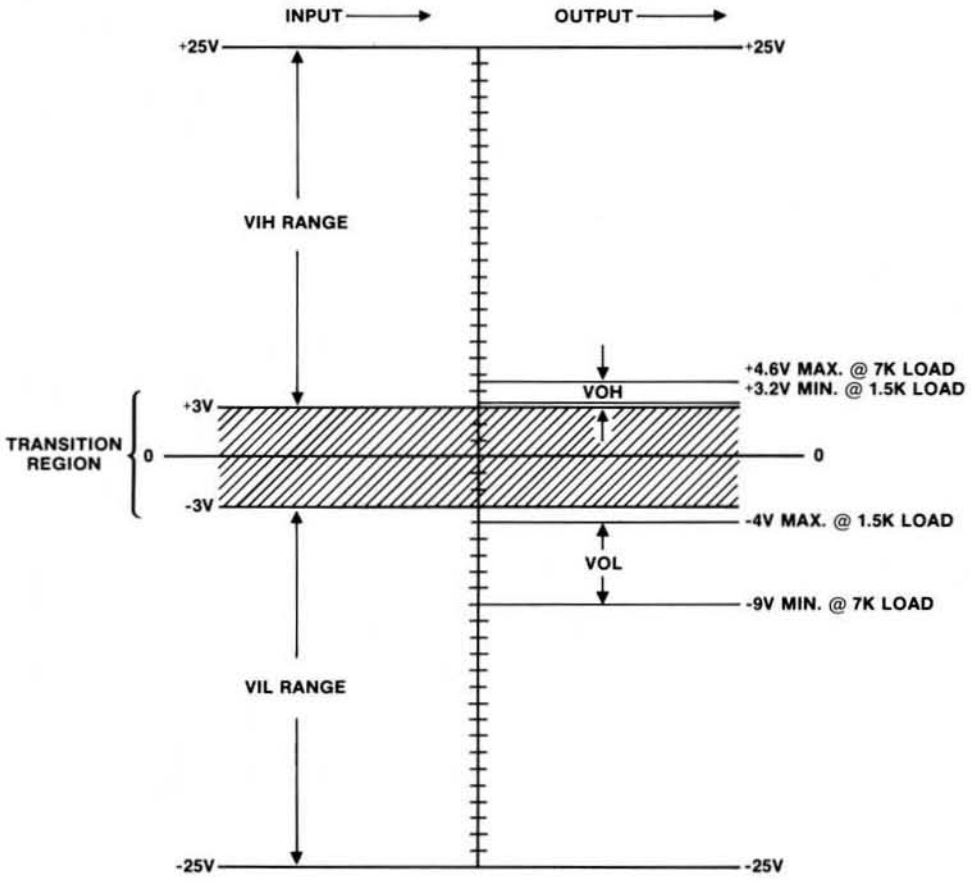
## MECHANICAL SPECIFICATIONS

Height App. 1 inch
Length 6 inches
Width 3.1 inches

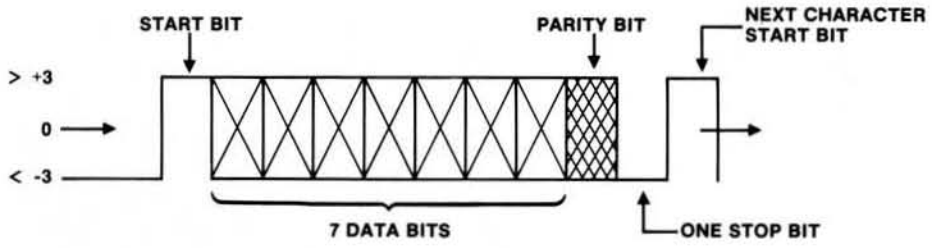
## ENVIRONMENTAL SPECIFICATIONS

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

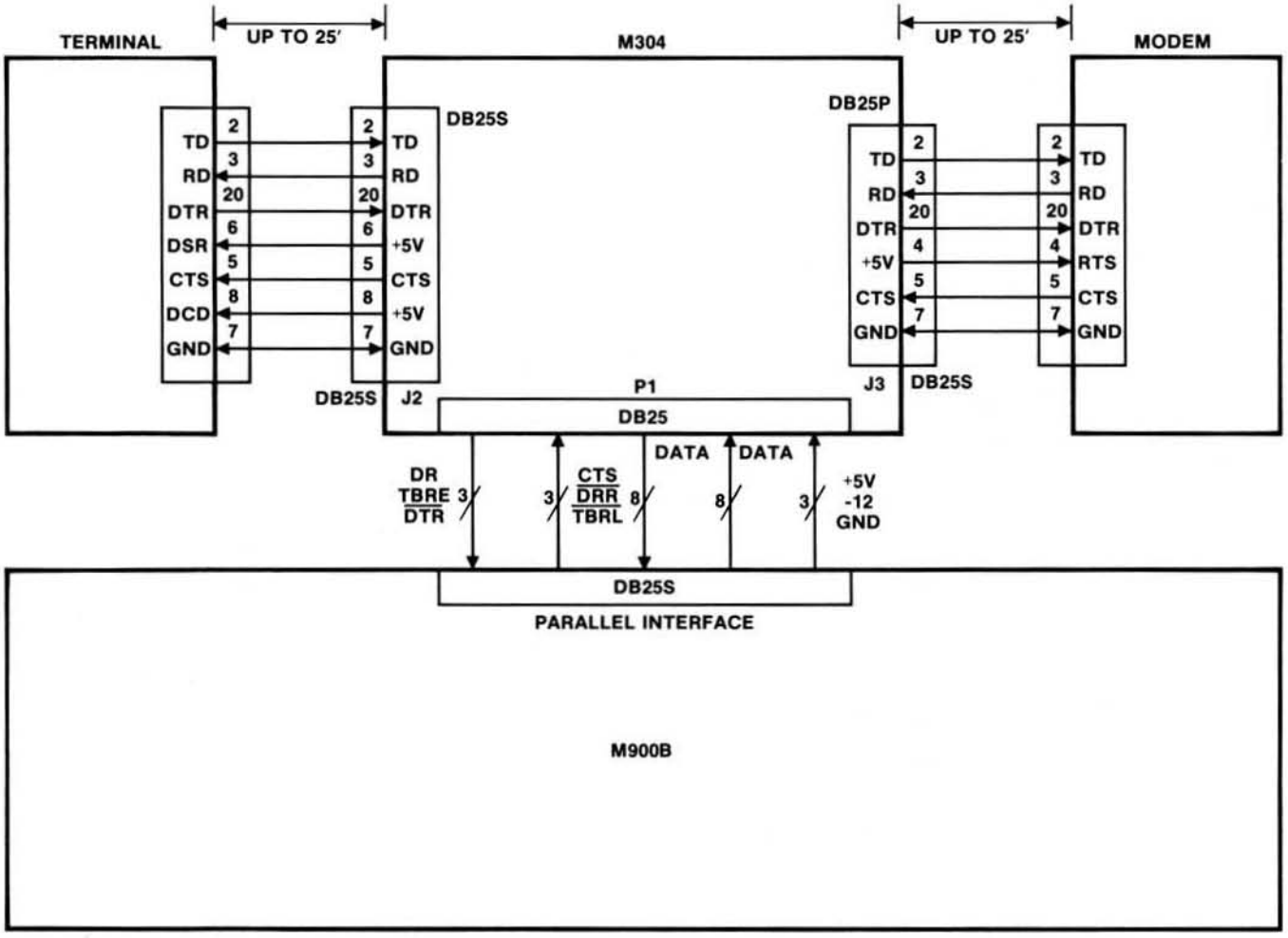
## M304 I/O Specification




## Character Format RS-232-C
## ASCII 7 Bit Parity One Stop Bit
## Serial by Bit/Serial by Character



## 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.

# SECTION 14

# 9119, CHECKSUM OPTION

CHECKSUM is a practical engineering, manufacturing, and field service tool which provides a high confidence verification of the data pattern stored in a PROM without requiring master PROMs, tapes, or listings close at hand for comparison.

The 9119 option uses the M900B display to show the hexadecimal sum of all data locations stored in a PROM or the M900B CMOS RAM Buffer. An extremely high probability exists that a change in the data pattern due to electrical loss, accidental alteration, or handling will result in a change in the checksum. The operator simply compares the M900B display against a previously recorded checksum for verification.

PROM data alteration can result from EPROMs which were inadequately erased prior to programming; bit regrowth in fusible PROMs; program modifications; human error in PROM duplication; damaged tapes containing PROM code; and faulty data transmission from remote sources. Unlabeled PROMs and ROMs which are mixed through handling can be conveniently sorted with CHECKSUM, and operators on the manufacturing floor can use CHECKSUM to verify that the latest revision of a microprocessor program is being installed in the product.

**CHECKS DATA PATTERN ALTERATION DUE TO:**

- Bit Dropout in Erasable PROMs
- Bit regrowth in Fusible PROMs
- Human error in PROM duplication
- Mixing of unlabeled PROMs, ROMs
- Use of obsolete program revisions
- Faulty data transmission
- Damaged data tapes
- Modifications or development patches
- RAM buffer content after excessive power-off time

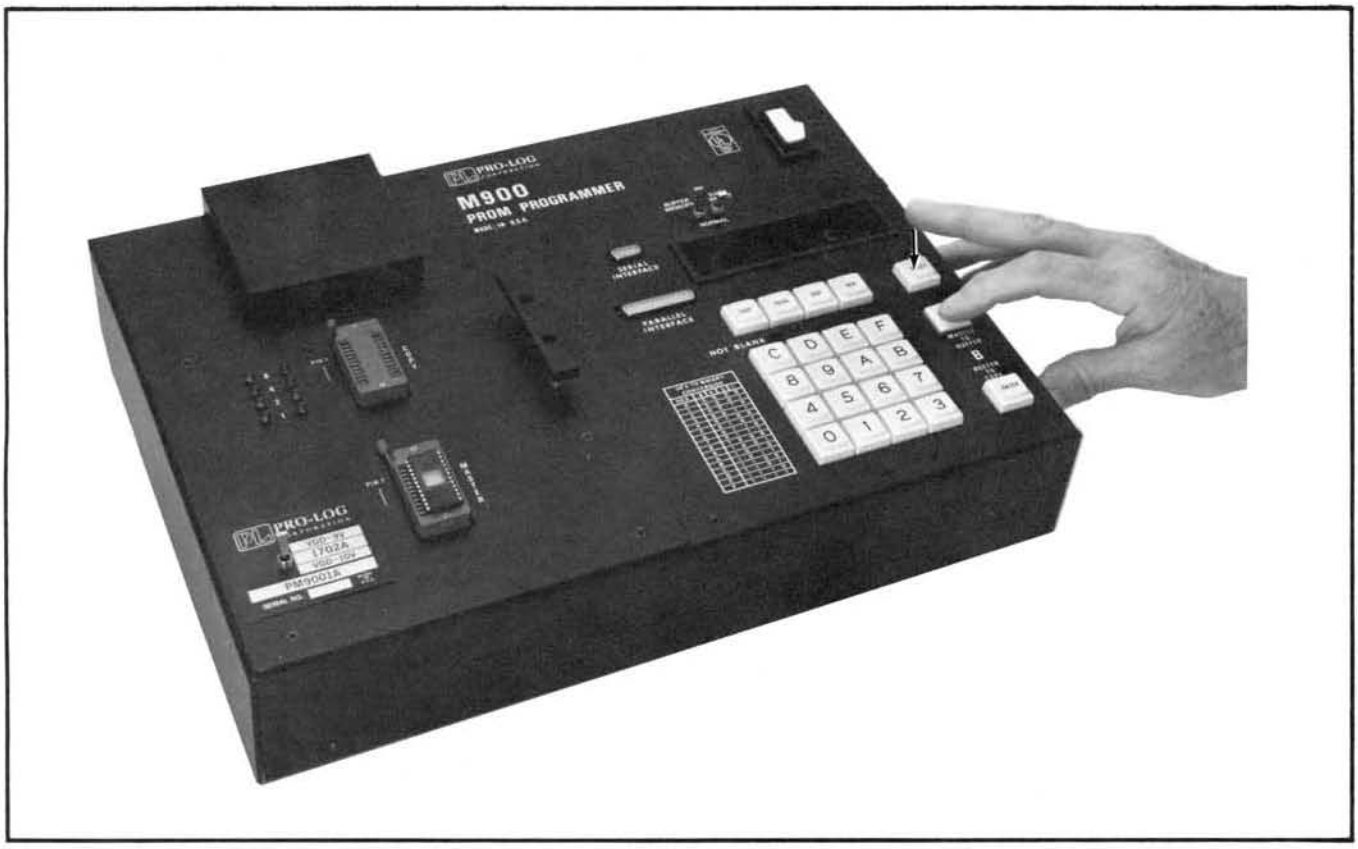



Figure 14-1 9119, Checksum Option

This option causes the M900B PROM Programmer to display the hexadecimal sum of code contained in the Master PROM. If the 9107 RAM buffer operation is present in the Programmer, the operator may select a RAM Buffer checksum by placing the BUFFER/NORMAL switch in the BUFFER position.

**PROCEDURE**

1. Select Master or buffer checksum by setting the BUFFER/NORMAL toggle switch in the desired position.
2. While holding the CLEAR key down, press and release the RESET key. CLEAR may then be released.
3. M900B display now shows C (checksum) to indicate activity. The length of time required for Checksum display depends on the size of the memory tested. This can be approximated by the following table:

| MEMORY SIZE | CHECKSUM TIME |
|---|---|
| 1024xN | 3.3 SEC |
| 4096xN | 10.1 SEC |

4. M900B display now shows a 6-digit hexadecimal checksum.

   For newly programmed PROMs, the checksum should be recorded on a label on the PROM and in a separate log for future reference.

   For previously programmed PROMs, the displayed checksum is compared against the recorded checksum.

5. Press ENTER or RESET to proceed with other M900B functions.

**NOTE**

Although the CHECKSUM technique is widely used with a high level of confidence, it is remotely possible that two complimentary bit errors will produce a correct checksum. This is very improbable due to the nature of PROM failure modes; however, the user should be aware that the CHECKSUM test, while fast and convenient, does not guarantee the certain pattern verification which the M900B VERIFY mode does guarantee by comparison with a Master PROM, tape, or remote data source.

# SECTION 15

# M900B MAINTENANCE

If for any reason the M900B becomes inoperative it is recommended the unit be returned to the factory for repairs. Contact the factory or your Pro-Log representative for instructions on returning equipment for any reason. Returned equipment should be properly packaged to avoid shipping damage.

## TROUBLESHOOTING HINTS

The M900B is centrally controlled by its microprocessor. If the microprocessor fails, the unit will be completely inoperative. If any operations are executable it is highly unlikely that the microprocessor is at fault. If the unit is completely dead the cause is usually due to loss of power or system clock.

NOTE: A possible cause of an inoperative system is a shorted key on the hexadecimal keyboard. If the system is inoperative and the power supply and clock checks normal, the program should be checked to determine if it is locked in the RD DBD subroutine. Program analysis requires the use of a M422A analyzer as indicated in the Microprocessor Check paragraph below.

**The M900B power supply consists of a dual plus and minus supply. The plus supply is set to 5.80 volts measured at the power supply. The minus supply is set to -12.60 volts measured at the power supply.**

## SYSTEM CLOCK CHECK

The system clock is a two phase crystal controlled clock. The clock signals as measured at the 01 and 02 test points on the CPU card are shown in Figure 1. If the CPU device is operating, the CM pulse will appear at pin 11 of the device. If the clock inputs are operating but the CM pulse is not present the CPU device is possibly defective.

## MICROPROCESSOR CHECK

The microprocessor operates on 32 bits of information every 11.2 microseconds. To analyze this volume of information requires the use of an M422A system analyzer. The M422A allows the user to capture data at selected program points to analyze system operation.

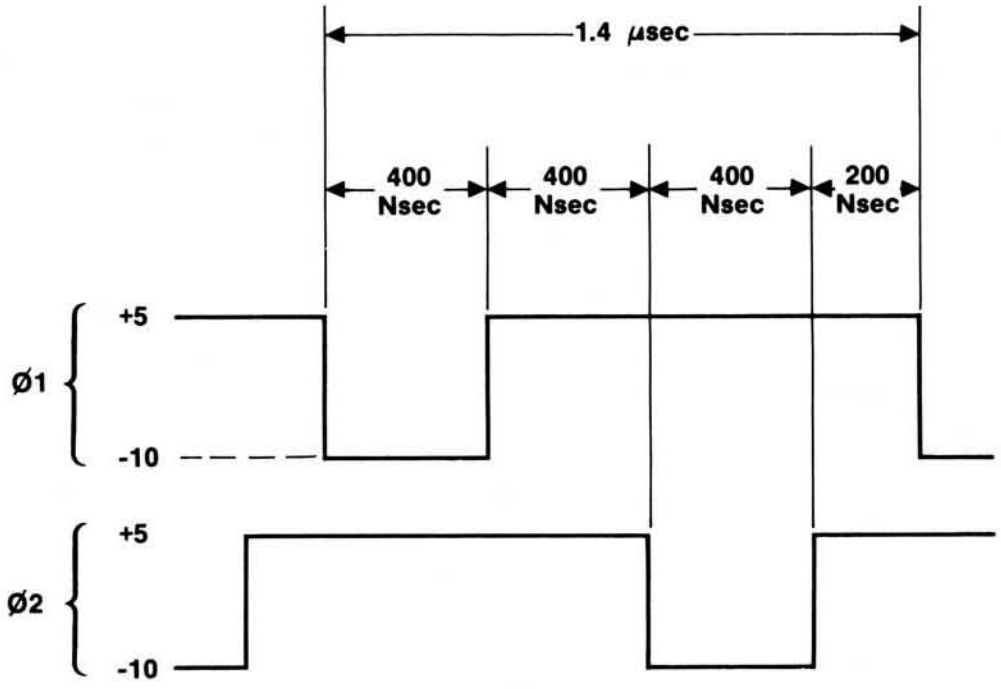



Figure 15-1 Clock Timing

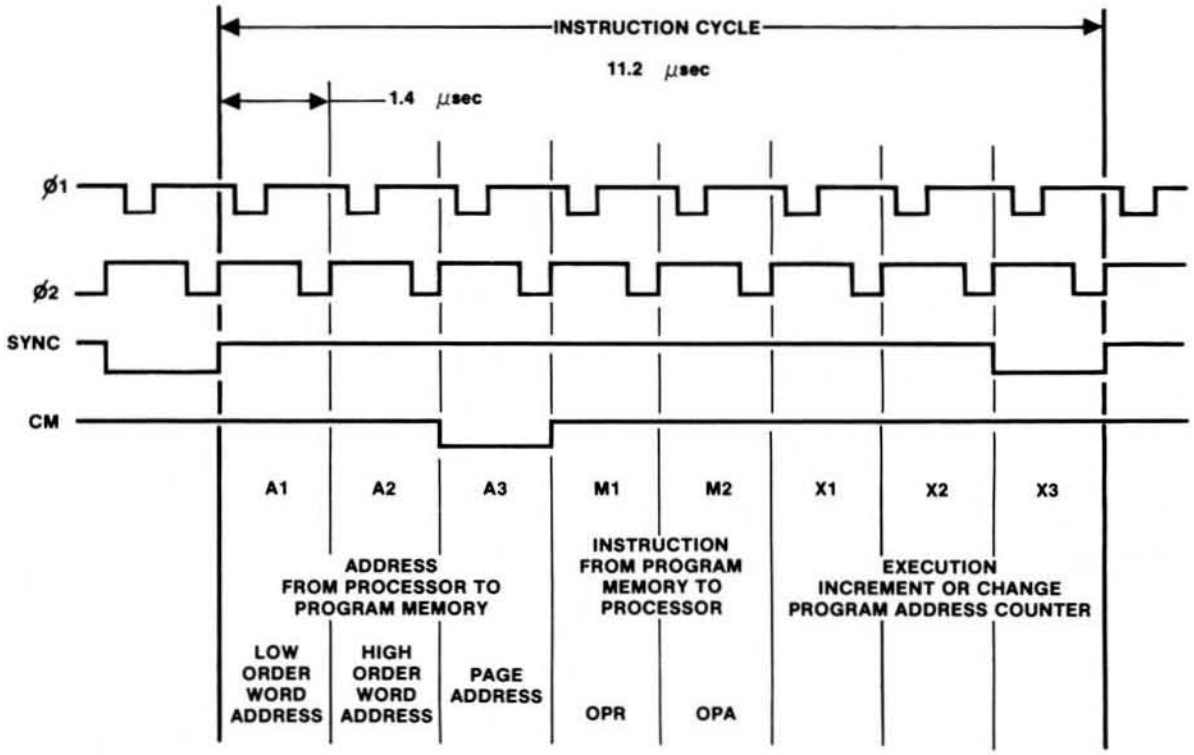



Figure 15-2 Control Timing

## THEORY OF OPERATION

The M900B is a microprocessor controlled instrument. The microprocessor treats the keyboard, switches, displays, interface connectors and personality module as Input-Output devices. Interaction of the I/O devices is controlled by programs stored in the microprocessor Read Only Memory (ROM). A portion of the ROM memory is included on the pluggable personality module. This portion is used to define the unique characteristic of each personality module.

Options to the M900B are implemented by adding programs to the basic control program in addition to any required hardware.

## BASIC CONTROL PROGRAM

The basic control program is stored in ROM page location 0, 1 and 2. Page 0 contains the main program (locations 000 to 09F) and subroutines for controlling the system operation of the keyboard and hex displays. Page 1 contains basic keyboard and display subroutines. Page 2 contains subroutines concerned with the MASTER and COPY sockets on the personality module.

The main program begins any time the system is reset or power is applied. If options are installed the program jumps out to test availability and priority. If no options are available or ready the keyboard is checked until one of the four mode keys is pushed or reset occurs. When a mode key is selected the program-flags and external indicators are initialized.

The PROM size information is moved from the personality program table to the working RAM registers as shown in Figure 15-3. The PROM size information is given at the FIRST address (all zero address bits) and the LAST address (all one address bits). The FIRST address and the LAST address are displayed in the hex display as a message to the operator. The program initializes the START address and END address RAM locations by moving the FIRST and LAST address into these locations. This is done as a default situation if the operator does not select a limited field to operate on. The program waits for the operator to define a START and END address or to proceed with the full field.

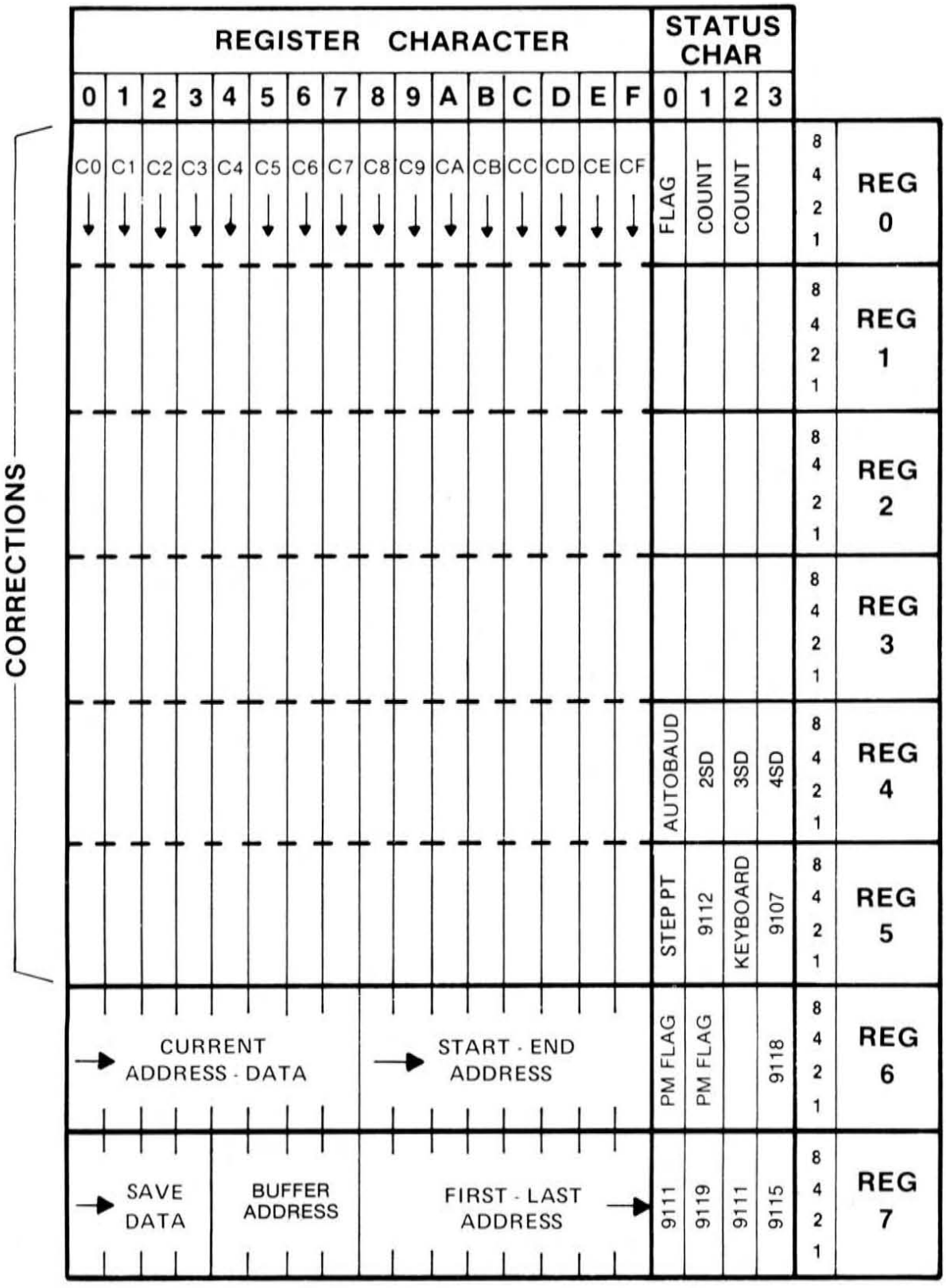



Figure 15-3 Ram Register Map

The program modes the START address to the CURRENT address location in RAM. This allows the ERASE CHECK to be performed over the defined field. The MODE flag stored in register F is checked for the DUP mode. In DUP mode the program diverts to accept change information entered through the keyboard.

If it is not the DUP mode or if all changes are entered the program moves the START address to the CURRENT address which was changed during ERASE CHECK.

The program reads data from the COPY socket using CURRENT address. The data is stored in the CURRENT data location of the RAM. The CURRENT address and data are loaded to the hex display. In the LIST mode the program waits for the ENTER key. When ENTER is selected the CURRENT address is incremented and checked to see if it agrees with the END address or the LAST address. If no ending comparison is made the COPY is read again and the sequence repeats. If an ending comparison occurs the program inserts an "F" in the display for finish and returns to the start of the control program.

When ENTER is selected the CURRENT address is incremented and checked to see if it agrees with the END address or the LAST address. If no ending comparison is made the COPY is read again and the sequence repeats. If an ending comparison occurs the program inserts an "F" in the display for finish and returns to the start of the control program.

In PROG mode the COPY data is blanked from the display and the program waits in the RD AD subroutine for the operator to enter the data to be programmed or to select the ENTER key. If data is entered the program exits to the personality module to perform the PROM programming. If the PROM Programming was successful or if the ENTER key was selected the program increments the CURRENT address and does the ending comparisons as in LIST mode.

In DUP mode data is read from the MASTER socket instead of the keyboard. The RD MASTER subroutine accomplishes insertion of any changes entered earlier in the sequence.

If PROM programming is unsuccessful in either PROG or DUP modes the CURRENT data is restored from the SAVE data location and the program waits for the ENTER key. When ENTER is selected, a skip or retry decision is made by checking the personality table. Based on the decision the same location is tried or the program skips to the next location.

In VER mode data is read from the MASTER socket to the CURRENT DATA RAM location. The CURRENT DATA is moved to a SAVE data RAM location. The RD COPY subroutine reads the COPY socket to the CURRENT data location and compares the CURRENT and SAVE data. If data compares, the address is incremented and the verify sequence repeats. If data does not compare, the program waits for the ENTER key before it repeats.

| | | | | |
|---|---|---|---|---|
| E | | P7 | MODE | F |
| C | RAM ADDRESS | | | D |
| A | DISPLAY POSITION | | | B |
| 8 | DISPLAY STROBE | | | 9 |
| 6 | KBD and TTY | | | 7 |
| 4 | MASK/RAM ADR | | | 5 |
| 2 | | P1 | # | 3 |
| 0 | | PO | | 1 |

Figure 15-4 Control Program Register Map

## PERSONALITY PROGRAM

The personality program is stored in ROM page location 8 which is located inside the personality module. ROM 8 contains a lookup table, subroutines to access the table, and a subroutine to control the unique programming characteristics of the PROM. The lookup table consists of variables that are loaded to the microprocessor registers by various subroutines. The actual values are constant for any given PROM but vary usually based on PROM size. The constants in the lookup table are given the mnemonic CST.

The subroutines for accessing the lookup table are located at the beginning of ROM 8 (800 to 81F). The main program establishes an indirect address in register R0 and R1. The FIN subroutines use registers R0 and R1 as an address for pulling two, three or five pairs of information from the table into the microprocessor working registers.

The remainder of ROM 8 (860 to 8FF) is used for the unique programming sequence required for each personality module. The subroutine PROGRAM controls the programming regulators located on the personality module. Pulse widths, time durations, and sequences greater than 20 microseconds are usually program controlled.

# DOCUMENTATION

| Page Number | Drawing Number | Title |
|---|---|---|
| 15-8 | 103198 | Program, M900B Control |
| 15-20 | | Program, Series 90 Personality |
| 15-22 | 100994 | Schematic, PROM Programmer Power and Interconnect |
| 15-23 | 100994 | Schematic, PROM Programmer Power and Interconnect |
| 15-24 | 100202 | Schematic, Power Supply (Dual Output) |
| 15-25 | 100202 | Assembly, Power Supply (Dual Output) |
| 15-26 | 100610 | Schematic, 4118 I/O Control Board (HP LED) |
| 15-27 | 100609 | Assembly, 4118 I/O Control Board (HP LED) |
| 15-28 | 101370 | Schematic, 4118 I/O Control Board (TI LED) |
| 15-29 | 101373 | Assembly, 4118 I/O Control Board (TI LED) |
| 15-30 | 102391 | Schematic, Series 90 CPU Board w/RAM |
| 15-31 | 102392 | Assembly, Series 90 CPU Board w/RAM |
| 15-32 | 102410 | Schematic, Series 90 4K RAM Expansion Board |
| 15-33 | 102408 | Assembly, Series 90 4K RAM Expansion Board |
| 15-34 | 101068 | Schematic, M302, RS232 Interface Adapter Board |
| 15-35 | 101071 | Assembly, M302, RS232 Interface Adapter Board |
| 15-36 | 102421 | Schematic, M303, RS232 Interface Adapter Board |
| 15-37 | 102422 | Assembly, M303, RS232 Interface Adapter Board |
| 15-38 | 104875 | Schematic, M304 Interface Adapter |
| 15-39 | 104876 | Assembly, M304 Interface Adapter |

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE M900B CONTROL (103198) COMMENTS |
|---|---|---|---|---|---|---|
| 0 | 00 | 00 | START | NOP | | |
| | 1 | 47 | | JUN | | *OR NOP IF NO OPTIONS OTHER THAN 9107 |
| | 2 | 90 | | | FIND OPTIONS | * NOP |
| | 03 | 51 | FIND MODE | JMS | | |
| | 4 | 04 | | | [NO KEY] | |
| | 5 | 40 | | JUN | | |
| | 6 | 03 | | | FIND MODE | |
| | 07 | 20 | NEW MODE | FIM | RO, R1 | CLEAR CHANGE FLAGS |
| | 8 | 00 | | | RAM 0 | |
| | 9 | 21 | | SRC | RO, R1 | |
| | A | D0 | | LDM | 0 | |
| | B | E4 | | WR0 | | |
| | C | E5 | | WR1 | | |
| | D | E6 | | WR2 | | |
| | E | 20 | | FIM | RO, R1 | |
| | F | 29 | | | 8 CLR-RAM | |
| 0 | 10 | 52 | | JMS | | |
| | 1 | 13 | | | [STORE RAM] | |
| | 2 | 20 | | FIM | RO, R1 | RESET NON-ERASED INDICATOR |
| | 3 | 30 | | | PORT 3 | |
| | 4 | 21 | | SRC | RO, R1 | |
| | 5 | D8 | | LDM | 8 | |
| | 6 | E2 | | WRR | | |
| | 7 | 43 | | JUN | | OR JMS = 58 IF NO 9107 OPTION |
| | 8 | 00 | | | BUFFER | (FIN 1ST - LAST) = 00 |
| | 19 | 20 | NEW MODE +18 | FIM | YO | DISPLAY 1ST AND LAST ADDRESS |
| | A | 46 | | | 8-1ST-LAST | |
| | B | 51 | | JMS | | |
| | C | F0 | | | {DISPLAY} | |
| | D | 20 | | FIM | RO, R1 | MOVE 1ST-LAST TO START-END |
| | E | 49 | | | 8 MV-1ST-LAST | |
| | F | 52 | | JMS | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE DATE COMMENTS |
|---|---|---|---|---|---|---|
| 0 | 20 | 75 | | | [MOV RAM] | |
| | 1 | 50 | | JMS | | KEY IN NEW START-END OR ENTER |
| | 2 | AA | | | {RD-AA} | |
| | 3 | 00 | | NOP | | |
| | 4 | 00 | | NOP | | |
| | 5 | 52 | | JMS | | MOVE START ADDRESS TO CURRENT |
| | 6 | 73 | | | [MV-ST→CUR] | |
| | 7 | 52 | | JMS | | CHECK IF PROM IS BLANK |
| | 8 | 00 | | | {ERASE CHK} | |
| | 9 | AF | | LD | RF | MAKE DUP MODE? |
| | A | F5 | | RAL | | |
| | B | F5 | | RAL | | |
| | C | 12 | | JCN | C1 | |
| | D | 70 | | | STR CHNG | |
| | 2E | 52 | RESTORE | JMS | | RESTORE CUR WITH START ADDRESS |
| | F | 73 | | | [MV-ST→CUR] | |
| 0 | 30 | 00 | | NOP | | * 47 JUN |
| | 1 | 00 | | NOP | | * 08 CHK PT |
| | 32 | 52 | REPEAT | JMS | | READ COPY, CHECK, INVERT & DISPLAY |
| | 3 | 1E | | | [RD COPY] | |
| | 4 | 00 | | NOP | | |
| | 5 | 00 | | NOP | | |
| | 6 | 51 | | JMS | | |
| | 7 | EC | | | {DISP-AD-INV} | |
| | 8 | AF | | LD | RF | LIST MODE? |
| | 9 | F6 | | RAR | | |
| | A | 12 | | JCN | C1 | |
| | B | 65 | | | LIST | |
| | C | F6 | | RAR | | DUP OR VER MODE? |
| | D | 1A | | JCN | C0 | |
| | E | 55 | | | DUP/VER | |
| | F | 50 | | JMS | | KEY IN N DATA CHARACTERS |

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|---|---|---|---|---|---|---|---|
| 0 | 40 | A0 | | | {RD-AD} | | |
| | 1 | 1C | | JCN | A1 | IF 1ST KEY IS ENTER GO TO NEXT ADDRESS | |
| | 2 | 67 | | | CHK ADR | | |
| | 43 | 52 | PROG INV | JMS | | CHECK INVERT | |
| | 4 | CO | | | [DATA INV] | | |
| | 45 | 58 | PROG | JMS | | PROGRAM THE PROM | |
| | 6 | 60 | | | {PROGRAM} | | |
| | 7 | 1C | | JCN | A1 | IF GOOD GO TO NEXT ADDRESS | |
| | 8 | 67 | | | CHK ADR | | |
| | 9 | 52 | | JMS | | RESTORE THE DATA | |
| | A | 80 | | | [RESTORE] | | |
| | B | 50 | | JMS | | FIND ENTER KEY | |
| | C | F0 | | | {FIND ENT} | | |
| | D | 58 | | JMS | | CHECK FOR ADDRESS SKIP OR RETRY | |
| | E | 55 | | | (SKP/RTRV) | | |
| | F | 14 | | JCN | A0 | | |
| 0 | 50 | 67 | | | CHK ADR | | |
| | 1 | 51 | | JMS | | RESET THE DISPLAY | |
| | 2 | EC | | | [DISP-AD-INV] | | |
| | 3 | 40 | | JUN | | GO PROGRAM | |
| | 4 | 43 | | | PROG INV | | |
| | 55 | 52 | DUP/VER | JMS | | READ MASTER, DISPLAY & INVERT | |
| | 6 | 86 | | | {RD MASTER} | | |
| | 7 | 51 | | JMS | | | |
| | 8 | EE | | | {DISP-AD} | | |
| | 9 | 52 | | JMS | | INVERT IF INVERT SWITCH | |
| | A | C0 | | | [DATA INV] | | |
| | B | AF | | LD | RF | DUP MODE? | |
| | C | F5 | | RAL | | | |
| | D | 1A | | JCN | CO | | |
| | E | 45 | | | PROG | | |
| | F | 52 | | JMS | | SAVE CUR DATA FOR VERIFY | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 0 | 60 | 6F | | | [SAV-CUR-DAT] | | |
| | 1 | 52 | | JMS | | READ & CHECK THE COPY | |
| | 2 | 1E | | | [RD COPY] | | |
| | 3 | 1C | | JCN | A1 | | |
| | 4 | 67 | | | CHK ADR | | |
| | 65 | 50 | LIST | JMS | | FIND ENTER KEY | |
| | 6 | F0 | | | {FIND ENT} | | |
| | 67 | 52 | CHK ADR | JMS | | CHECK CUR WITH LAST & END ADDRESSES | |
| | 8 | 3E | | | [ADR CHK] | INCREMENT THE CUR ADDRESS | |
| | 9 | 14 | | JCN | A0 | | |
| | A | 32 | | | REPEAT | | |
| | B | 51 | | JMS | | DISPLAY "F" FOR FINISH | |
| | C | 75 | | | [DISP F] | | |
| | D | 40 | | JUN | | | |
| | E | 00 | | | START | | |
| | F | 00 | | NOP | | | |
| 0 | 70 | DC | STR CHNG | LDM | C | DIXPLAY CX | |
| | 1 | 51 | | JMS | | | |
| | 2 | 76 | | | [DISP #7] | "C" | |
| | 3 | 2C | | FIM | RC, RD | | |
| | 4 | 00 | | | ZERO | | |
| | 5 | 2D | | SRC | RC, RD | | |
| | 6 | EE | | RD2 | | "X" | |
| | 7 | 28 | | FIM | R8, R9 | | |
| | 8 | CO | | | CO | | |
| | 9 | 51 | | JMS | | | |
| | A | 67 | | | (DISP) | | |
| | B | 20 | | FIM | RO, R1 | KEY IN THE CORRECTIONS | |
| | C | 40 | | | 8 RD CHNG | | |
| | D | 50 | | JMS | | | |
| | E | AC | | | {RD-N} | | |
| | F | 1E | | JCN | A1 CO | IS FIRST KEY ENTER | |

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|---|---|---|---|---|---|---|---|
| 0 | 80 | 2E | | | RESTORE | | |
| | 1 | 24 | | FIM | R4, R5 | UPDATE STORAGE ADDRESS | |
| | 2 | 00 | | | ZERO | | |
| | 3 | 25 | | SRC | R4, R5 | | |
| | 4 | EE | | RD2 | | | |
| | 5 | B5 | | XCH | R5 | | |
| | 6 | 20 | | FIM | RO, R1 | MOVE CORRECTION TO STORAGE AREA | |
| | 7 | 44 | | | 8 MV-CHNG | | |
| | 8 | 58 | | JMS | | | |
| | 9 | 11 | | | (FIN 2 PAIR) | | |
| | 8A | 2D | MV-N | SRC | RC, RD | | |
| | B | E9 | | RDM | | | |
| | C | 25 | | SRC | R4, R5 | | |
| | D | EO | | WRM | | | |
| | E | 6D | | INC | RD | | |
| | F | 64 | | INC | R4 | | |
| 0 | 90 | 73 | | ISZ | R3 | | |
| | 1 | 8A | | | MV-N | | |
| | 2 | 2C | | FIM | RC, RD | SET CHANGE FLAG | |
| | 3 | 00 | | | ZERO | | |
| | 4 | 2D | | SRC | RC, RD | | |
| | 5 | D1 | | LDM | 1 | | |
| | 6 | E4 | | WRO | | | |
| | 7 | EE | | RD2 | | STORE CHANGE COUNT | |
| | 8 | E5 | | WR1 | | | |
| | 9 | F2 | | IAC | | INCREASE COUNT FOR NEXT CHANGE | |
| | A | E6 | | WR2 | | | |
| | B | 1A | | JCN | CO | IS IT THE 16TH CHANGE | |
| | C | 70 | | | STR-CHNG | | |
| | D | 40 | | JUN | | | |
| | E | 2E | | | RESTORE | | |
| | F | 00 | | | | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 0 | A0 | 20 | {RD-AD} | FIM | RO, R1 | SETUP KEYBOARD & DISPLAY | |
| | 1 | 3B | | | 8RD-AD | TO ENTER DATA | |
| | 2 | 58 | | JMS | | | |
| | 3 | 0B | | | (FIN 5 PAIR) | | |
| | 4 | D0 | | LDM | 0 | | |
| | 5 | BE | | XCH | RE | | |
| | 6 | 51 | | JMS | | BLANK THE DISPLAY DATA | |
| | 7 | 67 | | | (DISP) | | |
| | 8 | 40 | | JUN | | | |
| | 9 | B4 | | | NEXT | | |
| | AA | 20 | {RD-AA} | FIM | RO, R1 | SETUP KEYBOARD & DISPLAY | |
| | B | 38 | | | 8RD-AA | | |
| | AC | 58 | {RD-N} | JMS | | | |
| | D | OF | | | (FIN 3 PAIR) | | |
| | E | 51 | | JMS | | | |
| | F | 7C | | | (STRT-STRB) | | |
| 0 | B0 | AA | MORE | LD | RA | IS THIS THE LAST KEY | |
| | 1 | F5 | | RAL | | | |
| | 2 | 12 | | JCN | C1 | | |
| | 3 | E2 | | | LAST | | |
| | B4 | 51 | NEXT | JMS | | READ THE KEYBOARD | |
| | 5 | 00 | | | [RD-KBD] | | |
| | 6 | 14 | | JCN | AO | DATA KEY | |
| | 7 | CD | | | DATA | | |
| | 8 | 1A | | JCN | CO | CLEAR KEY | |
| | 9 | D7 | | | CLR | | |
| | A | AE | | LD | RE | IS THIS THE FIRST KEY | |
| | B | F5 | | RAL | | | |
| | C | 12 | | JCN | C1 | | |
| | D | C7 | | | FIRST | | |
| | E | AB | | LD | RB | IS THIS THE MIDDLE KEY | |
| | F | F5 | | RAL | | | |

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|---|---|---|---|---|---|---|
| | | | | | | TITLE DATE |
| 0 | C0 | 1A | | JCN | CO | |
| | 1 | B4 | | | NEXT | |
| | 2 | A2 | | LD | R2 | CHECK MIDDLE KEY FLAG |
| | 3 | F5 | | RAL | | |
| | 4 | 1A | | JCN | CO | |
| | 5 | B4 | | | NEXT | |
| | 6 | C1 | | BBL | 1 | A1 C1 = MID KEY ENTER |
| | C7 | A2 | FIRST | LD | R2 | CHECK FIRST KEY FLAG |
| | 8 | F6 | | RAR | | |
| | 9 | 1A | | JCN | CO | |
| | A | B4 | | | NEXT | |
| | B | F1 | | CLC | | |
| | C | C1 | | BBL | 1 | A1 CO = FIRST KEY ENTER |
| | CD | 51 | DATA | JMS | | MOVE THE STROBE TO NEXT POSITION |
| | E | 83 | | | [ROT STRB] | |
| | F | 2D | | SRC | RC, RD | STORE THE DATA |
| 0 | D0 | A6 | | LD | R6 | |
| | 1 | E0 | | WRM | | |
| | 2 | 51 | | JMS | | DISPLAY THE DATA |
| | 3 | 67 | | | (DISP) | |
| | 4 | 6D | | INC | RD | SELECT NEXT LOCATION |
| | 5 | 40 | | JUN | | |
| | 6 | B0 | | | MORE | |
| | D7 | AE | CLR | LD | RE | IS CLEAR AT THE FIRST LOCATION |
| | 8 | F5 | | RAL | | |
| | 9 | 12 | | JCN | C1 | |
| | A | B4 | | | NEXT | |
| | B | 51 | | JMS | | |
| | C | A4 | | | (CLR STRB) | |
| | D | AD | | LD | RD | REMOVE THE DATA |
| | E | F8 | | DAC | | |
| | F | BD | | XCH | RD | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS |
|---|---|---|---|---|---|---|
| | | | | | | TITLE DATE |
| 0 | E0 | 40 | | JUN | | |
| | 1 | B0 | | | MORE | |
| | E2 | 51 | LAST | JMS | | READ THE LAST KEY |
| | 3 | 00 | | | [RD KBD] | |
| | 4 | 14 | | JCN | A0 | DATA KEY |
| | 5 | E2 | | | LAST | |
| | 6 | 1A | | JCN | CO | CLEAR KEY |
| | 7 | D7 | | | CLR | |
| | 8 | C0 | | BBL | 0 | A0 = LAST KEY ENTER |
| | 9 | | | | | |
| | A | | | | | |
| | B | | | | | |
| | C | | | | | |
| | D | | | | | |
| | E | | | | | |
| | F | | | | | |
| 0 | F0 | 51 | {FIND ENT} | JMS | | FIND THE ENTER KEY |
| | 1 | 00 | | | [RD KBD] | |
| | 2 | 1A | | JCN | CO | |
| | 3 | F0 | | | {FIND ENT} | |
| | F4 | C0 | 0 BBL 0 | BBL | 0 | |
| | F5 | F1 | (COMPARE) | CLC | | COMPARE 8 BITS |
| | 6 | A7 | | LD | R7 | |
| | 7 | 95 | | SUB | R5 | |
| | 8 | 1C | | JCN | A1 | |
| | 9 | F4 | | | 0 BBL 0 | |
| | A | F1 | | CLC | | |
| | B | A6 | | LD | R6 | |
| | C | 94 | | SUB | R4 | |
| | D | 1C | | JCN | A1 | |
| | E | F4 | | | 0 BBL 0 | A0 = NO COMPARE |
| | F | C1 | | BBL | 1 | A1 = COMPARE |

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|---|---|---|---|---|---|---|---|
| 1 | 00 | 51 | [RD KBD] | JMS | | IF KEY IS DOWN, WAIT | |
| | 1 | 2C | | | (SCAN) | | |
| | 2 | 1C | | JCN | A1 | | |
| | 3 | 00 | | | [RD KBD] | | |
| | 04 | 51 | [NO KEY] | JMS | | FIND KEY CLOSURE | |
| | 5 | 2C | | | (SCAN) | | |
| | 6 | 14 | | JCN | AO | | |
| | 7 | 04 | | | [NO KEY] | | |
| | 8 | 51 | | JMS | | DEBOUNCE | |
| | 9 | 50 | | | (4.5 MS) | | |
| | A | 51 | | JMS | | SEE IF KEY IS STILL CLOSED | |
| | B | 2C | | | (SCAN) | | |
| | C | 14 | | JCN | AO | | |
| | D | 04 | | | [NO KEY] | | |
| | E | A7 | | LD | R7 | CHECK FOR DOUBLE KEY | |
| | F | FC | | KBP | | | |
| 1 | 10 | F4 | | CMA | | | |
| | 1 | 14 | | JCN | AO | | |
| | 2 | 04 | | | [NO KEY] | | |
| | 3 | F4 | | CMA | | CONVERT ROW & COL TO HEX CHAR | |
| | 4 | F8 | | DAC | | CONVERT ROW TO MSB | |
| | 5 | F1 | | CLC | | | |
| | 6 | F5 | | RAL | | | |
| | 7 | F5 | | RAL | | | |
| | 8 | B0 | | XCH | RO | | |
| | 9 | A1 | | LD | R1 | CONVERT COL TO LSB | |
| | A | FC | | KBP | | | |
| | B | F8 | | DAC | | | |
| | C | F1 | | CLC | | COMBINE MSB & LSB | |
| | D | 80 | | ADD | RO | | |
| | E | B6 | | XCH | R6 | | |
| | F | 00 | | NOP | | CHECK FUNCTION KEY OR DATA KEY | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 1 | 20 | 14 | | JCN | AO | AO = DATA A1 = FUNC | |
| | 1 | 4E | | | 1 BBL 0 | REG 6 = HEX CHAR | |
| | 2 | A7 | | LD | R7 | CHECK FOR NEW MODE KEY | |
| | 3 | F6 | | RAR | | | |
| | 4 | A1 | | LD | R1 | | |
| | 5 | 12 | | JCN | C1 | | |
| | 6 | 2A | | | CL & ENT | | |
| | 7 | BF | | XCH | RF | SAVE NEW MODE & EXIT. REG F = MODE | |
| | 28 | 40 | | JUN | | OR JUN = 4C IF 9111 OPTION | |
| | 29 | 07 | | | NEW MODE | KBD RET = B5 | |
| | 2A | F6 | CL & ENT | RAR | | SET CARRY IF ENTER KEY | |
| | 2B | C1 | 1 BBL 1 | BBL | 1 | A1 = FUNC C1 = ENTER, C0 = CLEAR | |
| | 2C | 26 | (SCAN) | FIM | R6, R7 | KEYBOARD SCAN | |
| | D | FO | | | FO | SET FLAG LESS 1; 0= DATA, 1= FUNC | |
| | 2E | 66 | SCAN FUNC | INC | R6 | | |
| | F | 20 | | FIM | RO, R1 | | |
| 1 | 30 | 01 | | | 01 | | |
| | 31 | 21 | SCAN DATA | SRC | RO, R1 | SELECT & READ ROW | |
| | 2 | A1 | | LD | R1 | | |
| | 3 | E2 | | WRR | | | |
| | 4 | 27 | | SRC | P3 | | |
| | 5 | EA | | RDR | | | |
| | 6 | B7 | | XCH | R7 | SAVE ROW DATA | |
| | 7 | A6 | | LD | R6 | CHECK FUNC OR DATA | |
| | 8 | 14 | | JCN | AO | | |
| | 9 | 42 | | | DATA | | |
| | A | A7 | | LD | R7 | REMOVE TOGGLE SWITCH BITS | |
| | B | F5 | | RAL | | | |
| | C | F1 | | CLC | | | |
| | D | F5 | | RAL | | | |
| | E | F1 | | CLC | | | |
| | F | F6 | | RAR | | | |

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|---|---|---|---|---|---|---|---|
| 1 | 40 | F6 | | RAR | | | |
| | 1 | B7 | | XCH | R7 | | |
| | 42 | A7 | DATA | LD | R7 | CHECK FOR KEY CLOSED | |
| | 3 | 1C | | JCN | A1 | | |
| | 4 | 2B | | | 1 BBL 1 | | |
| | 45 | F1 | NEW COL | CLC | | ROTATE THE SCAN BIT | |
| | 6 | A1 | | LD | R1 | | |
| | 7 | F5 | | RAL | | | |
| | 8 | B1 | | XCH | R1 | | |
| | 9 | 1A | | JCN | C0 | CHECK FOR LAST COL | |
| | A | 31 | | | SCAN DATA | | |
| | B | A6 | | LD | R6 | CHECK FOR FUNC | |
| | C | 14 | | JCN | A0 | | |
| | D | 2E | | | SCAN FUNC | | |
| | 4E | C0 | 1 BBL 0 | BBL | 0 | A0 = NO KEY: A1 = KEY | |
| | F | 00 | | | | | |
| 1 | 50 | 20 | (4.5 MS) | FIM | R0, R1 | | |
| | 1 | 44 | | | 4.5 MILLISEC | | |
| | 52 | 70 | (SHORT Δ) | ISZ | R0 | VARIABLE DELAY | |
| | 3 | 52 | | | (SHORT Δ) | | |
| | 4 | 71 | | ISZ | R1 | | |
| | 5 | 52 | | | (SHORT Δ) | | |
| | 6 | C0 | | BBL | 0 | | |
| | 57 | 20 | (LONG Δ) | FIM | R0, R1 | LONG VARIABLE DELAY | |
| | 8 | 00 | | | ZERO | | |
| | 59 | 70 | (VAR Δ) | ISZ | R0 | | |
| | A | 59 | | | (VAR Δ) | | |
| | B | 71 | | ISZ | R1 | | |
| | C | 59 | | | (VAR Δ) | | |
| | D | 72 | | ISZ | R2 | | |
| | E | 59 | | | (VAR Δ) | | |
| | F | 73 | | ISZ | R3 | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 1 | 60 | 59 | | | (VAR Δ) | | |
| | 1 | C0 | | BBL | 0 | | |
| | 62 | 2A | (STRT CLR) | FIM | RA, RB | | |
| | 3 | 00 | | | ZERO | | |
| | 4 | FA | | STC | | | |
| | 65 | 28 | (CLR DISP) | FIM | R8, R9 | SET STROBE TO BLANK | |
| | 6 | 00 | | | ZERO | | |
| | 67 | 20 | (DISP) | FIM | R0, R1 | SEND DATA TO DISPLAY | |
| | 8 | 00 | | | PORT 0 | | |
| | 9 | 21 | | SRC | R0, R1 | | |
| | A | E2 | | WRR | | | |
| | 6B | 20 | (STROBE) | FIM | R0, R1 | STROBE MSD | |
| | C | 10 | | | PORT 1 | | |
| | D | 21 | | SRC | R0, R1 | | |
| | E | A9 | | LD | R9 | | |
| | F | E2 | | WRR | | | |
| 1 | 70 | 60 | | INC | R0 | STROBE LSD | |
| | 1 | 21 | | SRC | R0, R1 | | |
| | 2 | A8 | | LD | R8 | | |
| | 3 | E2 | | WRR | | | |
| | 4 | C0 | | BBL | 0 | | |
| | 75 | DF | [DISP-F] | LDM | F | PUT "F" IN DIGIT #7 | |
| | 76 | 51 | [DISP #7] | JMS | | LOAD DISPLAY DIGIT #7 | |
| | 7 | 65 | | | (CLR DISP) | | |
| | 8 | 28 | | FIM | R8, R9 | | |
| | 9 | 40 | | | LOC #7 | | |
| | A | 41 | | JUN | | | |
| | B | 6B | | | (STROBE) | | |
| | 7C | 2A | (STRT STRB) | FIM | RA, RB | | |
| | D | 00 | | | ZERO | | |
| | E | 28 | | FIM | R8, R9 | | |
| | F | 00 | | | ZERO | | |

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|---|---|---|---|---|---|---|---|
| 1 | 80 | D8 | | LDM | 8 | | |
| | 1 | BE | | XCH | RE | | |
| | 2 | C1 | | BBL | 1 | | |
| | 83 | DO | ROT STRB | LDM | O | CHECK FIRST POSITION | |
| | 4 | BE | | XCH | RE | | |
| | 5 | F5 | | RAL | | | |
| | 6 | 1A | | JCN | CO | | |
| | 7 | 8A | | | ROT | | |
| | 8 | 51 | | JMS | | | |
| | 9 | 67 | | | (DISP) | | |
| | 8A | AB | (ROT) | LD | RB | ROTATE POSITION | |
| | B | F5 | | RAL | | | |
| | C | BB | | XCH | RB | | |
| | D | AA | | LD | RA | | |
| | E | F5 | | RAL | | | |
| | F | BA | | XCH | RA | | |
| 1 | 90 | 12 | | JCN | C1 | | |
| | 1 | 2B | | | 1 BBL 1 | | |
| | 2 | A5 | | LD | R5 | ROTATE MASK | |
| | 3 | F6 | | RAR | | | |
| | 4 | A4 | | LD | R4 | | |
| | 5 | F6 | | RAR | | | |
| | 6 | B4 | | XCH | R4 | | |
| | 7 | A5 | | LD | R5 | | |
| | 8 | F6 | | RAR | | | |
| | 9 | B5 | | XCH | R5 | | |
| | A | 1A | | JCN | CO | | |
| | B | 8A | | | (ROT) | | |
| | C | F1 | | CLC | | INSERT POSITION, BIT INTO STROBE | |
| | D | A8 | | LD | R8 | | |
| | E | 8A | | ADD | RA | | |
| | F | B8 | | XCH | R8 | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 1 | A0 | A9 | | LD | R9 | | |
| | 1 | 8B | | ADD | RB | | |
| | 2 | B9 | | XCH | R9 | | |
| | 3 | CO | | BBL | O | | |
| | A4 | F1 | (CLR STRB) | CLC | | REMOVE STROBE BIT | |
| | 5 | A8 | | LD | R8 | | |
| | 6 | 9A | | SUB | RA | | |
| | 7 | B8 | | XCH | R8 | | |
| | 8 | F1 | | CLC | | | |
| | 9 | A9 | | LD | R9 | | |
| | A | 9B | | SUB | RB | | |
| | B | B9 | | XCH | R9 | | |
| | AC | A4 | ROT ← | LD | R4 | ROTATE MASK | |
| | D | F5 | | RAL | | | |
| | E | A5 | | LD | R5 | | |
| | F | F5 | | RAL | | | |
| 1 | B0 | B5 | | XCH | R5 | | |
| | 1 | A4 | | LD | R4 | | |
| | 2 | F5 | | RAL | | | |
| | 3 | B4 | | XCH | R4 | | |
| | 4 | F1 | | CLC | | ROTATE POSITION | |
| | 5 | AA | | LD | RA | | |
| | 6 | F6 | | RAR | | | |
| | 7 | BA | | XCH | RA | | |
| | 8 | AB | | LD | RB | | |
| | 9 | F6 | | RAR | | | |
| | A | BB | | XCH | RB | | |
| | B | 12 | | JCN | C1 | LEFTMOST POSITION | |
| | C | C3 | | | END | | |
| | D | A4 | | LD | R4 | IS THE NEXT POSITION BLANK? | |
| | E | F5 | | RAL | | | |
| | F | 1A | | JCN | CO | | |

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| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 1 | C 0 | AC | | | ROT ← | | |
| | 1 | 41 | | JUN | | | |
| | 2 | 67 | | | (DISP) | | |
| | C 3 | D8 | END | LDM | 8 | RESET FIRST POSITION BIT | |
| | 4 | BE | | XCH | RE | | |
| | 5 | 41 | | JUN | | | |
| | 6 | 67 | | | (DISP) | | |
| | C 7 | 20 | (RD DATA SW) | FIM | RO, R1 | READ THE DATA SWITCH | |
| | 8 | 50 | | | PORT 5 | | |
| | 9 | 21 | | SRC | RO, R1 | | |
| | A | EA | | RDR | | | |
| | B | F5 | | RAL | | | |
| | C | F5 | | RAL | | C1 = SWITCH CLOSED | |
| | D | CO | | BBL | O | | |
| | CE | 20 | (RD LEFT SW) | FIM | RO, R1 | READ THE OPTION SWITCH | |
| | F | 50 | | | PORT 5 | | |
| 1 | D 0 | 21 | | SRC | RO, R1 | | |
| | 1 | EA | | RDR | | | |
| | 2 | F6 | | RAR | | | |
| | 3 | F6 | | RAR | | C1 = SWITCH CLOSED | |
| | 4 | CO | | BBL | O | | |
| | D 5 | 20 | (CLR ADR) | FIM | RO, RI | REMOVE ADDRESS BITS | |
| | 6 | 9D | | | PORT 9, COURT 3 | FROM PORTS 9, A, B | |
| | 7 | DO | | LDM | Ø | | |
| | D 8 | 21 | CLR | SRC | RO, RI | | |
| | 9 | E2 | | WRR | | | |
| | A | 60 | | INC | RO | | |
| | B | 71 | | ISZ | RI | | |
| | C | D8 | | | CLR | | |
| | D | CØ | | BBL | Ø | | |
| | E | | | | | | |
| | F | | | | | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 1 | E 0 | | | | | | |
| 1 | E 0 | 2Ø | (CLR. PORTS) | FIM | RO,RI | CLEAR PORTS E & F | |
| | 1 | EØ | | | PORT E | | |
| | 2 | 21 | CLR | SRC | RO,RI | | |
| | 3 | FØ | | CLB | | | |
| | 4 | E2 | | WRR | | | |
| | 5 | 6Ø | | INC | RØ | | |
| | 6 | 21 | | SRC | RO,RI | | |
| | 7 | E2 | | WRR | | | |
| | 8 | CØ | | BBL | Ø | | |
| | 9 | | | | | | |
| | B | | | | | | |
| | EC | 52 | {DISP-AD-INV} | JMS | | DISPLAY ADDRESS & INVERTED DATA | |
| | D | CO | | | [DATA INV] | | |
| | EE | 20 | {DISP-AD} | FIM | RO, R1 | DISPLAY ADDRESS & DATA | |
| | F | 43 | | | 8 DISP-AD | | |
| 1 | F 0 | 58 | {DISPLAY} | JMS | | | |
| | 1 | 0F | | | (FIN 3 PAIR) | | |
| | 2 | 51 | | JMS | | | |
| | 3 | 7C | | | (STRT STRB) | | |
| | F 4 | 41 | NEXT | JMS | | ROTATE THE STROBE | |
| | 5 | 83 | | | [ROT STRB] | | |
| | 6 | 1C | | JCN | A1 | | |
| | 7 | FF | | | 1 BBL 0 | | |
| | 8 | 2D | | SRC | RC, RD | READ & DISPLAY | |
| | 9 | E9 | | RDM | | | |
| | A | 51 | | JMS | | | |
| | B | 67 | | | (DISP) | | |
| | C | 6D | | INC | RD | COUNT ADDRESS | |
| | D | 73 | | ISZ | R3 | | |
| | E | F4 | | | NEXT | | |
| | FF | CO | 1 BBL 0 | BBL | 0 | | |

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| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 2 | 00 | 52 | {ERASE CHK} | JMS | | | |
| | 1 | 11 | | | [SET ZERO] | | |
| | 02 | 52 | CHK-ALL | JMS | | READ & CHECK COPY | |
| | 3 | 1E | | | [RD COPY] | | |
| | 4 | 14 | | JCN | A0 | | |
| | 5 | 0B | | | NOT ZERO | | |
| | 6 | 52 | | JMS | | COUNT & CHECK ADDRESS | |
| | 7 | 3E | | | [ADR CHK] | | |
| | 8 | 14 | | JCN | A0 | | |
| | 9 | 02 | | | CHK ALL | | |
| | A | C1 | | BBL | 1 | | |
| | 0B | 20 | NOT ZERO | FIM | R0, R1 | SET NON-ERASED LIGHT | |
| | C | 30 | | | PORT 3 | | |
| | D | 21 | | SRC | R0, R1 | | |
| | E | DA | | LDM | A | | |
| | F | E2 | | WRR | | | |
| 2 | 10 | C0 | | BBL | 0 | | |
| | 11 | 20 | [SET ZERO] | FIM | R0, R1 | LOAD ZERO STATE | |
| | 2 | 2E | | | 8-ZERO | | |
| | 13 | 58 | [STORE RAM] | JMS | | STORE IN RAM | |
| | 4 | 11 | | | (FIN 2 PAIR) | | |
| | 15 | A2 | (STORE) | LD | R2 | | |
| | 16 | 2D | DO-N | SRC | RC, RD | | |
| | 7 | E0 | | WRM | | | |
| | 8 | 6D | | INC | RD | | |
| | 9 | 73 | | ISZ | R3 | | |
| | A | 16 | | | DO-N | | |
| | B | C0 | | BBL | 0 | | |
| | C | 00 | | | | | |
| | D | 00 | | | | | |
| | 1E | 58 | [RD COPY] | JMS | | ADDRESS ROM | |
| | F | 19 | | | (FIN ADR) | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 2 | 20 | 52 | | JMS | | | |
| | 1 | 62 | | | (ADR ROM) | | |
| | 22 | 20 | [READ] | FIM | R0, R1 | READ N CHARACTERS | |
| | 3 | 4E | | | 8 RD COPY | | |
| | 4 | 58 | | JMS | | | |
| | 5 | 11 | | | (FIN 2 PAIR) | | |
| | 26 | 23 | DO-X | SRC | R2, R3 | | |
| | 7 | EA | | RDR | | | |
| | 8 | 2D | | SRC | RC,RD | | |
| | 9 | E0 | | WRM | | | |
| | A | 62 | | INC | R2 | | |
| | B | 6D | | INC | RD | | |
| | C | 73 | | ISZ | R3 | | |
| | D | 26 | | | DO-X | | |
| | 2E | 20 | [CMP DATA] | FIM | R0, R1 | CHECK N CHARACTERS | |
| | F | 2B | | | 8 MOV-CMP | | |
| 2 | 30 | 58 | (CHECK-A) | JMS | | | |
| | 1 | 0F | | | (FIN 3 PAIR) | | |
| | 32 | 2D | (CHECK) | SRC | RC, RD | | |
| | 3 | E9 | | RDM | | | |
| | 4 | F1 | | CLC | | | |
| | 5 | 25 | | SRC | R4, R5 | | |
| | 6 | E8 | | SBM | | | |
| | 7 | 1C | | JCN | A1 | | |
| | 8 | BF | | | 2 BBL 0 | | |
| | 9 | 6D | | INC | RD | | |
| | A | 65 | | INC | R5 | | |
| | B | 73 | | ISZ | R3 | | |
| | C | 32 | | | (CHECK) | | |
| | 3D | C1 | 2 BBL 1 | BBL | 1 | | |
| | 3E | 20 | [ADR CHK] | FIM | R0, R1 | CHECK CUR AND END ADDRESS | |
| | F | 30 | | | 8 CUR END | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS |
|---|---|---|---|---|---|---|
| 2 | 40 | 58 | | JMS | | |
| | 1 | OF | | | (FIN 3 PAIR) | |
| | 2 | 52 | | JMS | | |
| | 3 | 32 | | | (CHECK) | |
| | 4 | 1C | | JCN | A1 | |
| | 5 | 3D | | | 2 BBL 1 | |
| | 46 | 20 | [CHK LAST] | FIM | R0, R1 | CHECK CUR AND LAST ADDRESS |
| | 7 | 33 | | | 8 CUR LAST | |
| | 8 | 58 | | JMS | | |
| | 9 | OF | | | (FIN 3 PAIR) | |
| | A | 52 | | JMS | | |
| | B | 32 | | | (CHECK) | |
| | C | 1C | | JCN | A1 | |
| | D | 3D | | | 2 BBL 1 | |
| | E | 20 | | FIM | R0, R1 | INCREMENT CUR ADDRESS |
| | F | 36 | | | 8 COUNT | |
| 2 | 50 | 58 | | JMS | | |
| | 1 | 11 | | | (FIN 2 PAIR) | |
| | 2 | D1 | | LDM | 1 | |
| | 53 | F1 | COUNT | CLC | | |
| | 4 | 2D | | SRC | RC, RD | |
| | 5 | EB | | ADM | | |
| | 6 | EO | | WRM | | |
| | 7 | F7 | | TCC | | |
| | 8 | BD | | XCH | RD | |
| | 9 | F8 | | DAC | | |
| | A | BD | | XCH | RD | |
| | B | 73 | | ISZ | R3 | |
| | C | 53 | | | COUNT | |
| | D | CC | | BBL | 0 | |
| | E | 00 | | | | |
| | F | 00 | | | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS |
|---|---|---|---|---|---|---|
| 2 | 60 | FA | (ADR COMPL) | STC | | ADDRESS COMPLEMENTED |
| | 1 | 10 | | SKP | | |
| | 62 | F1 | (ADR ROM) | CLC | | ADDRESS NORMAL |
| | 63 | 2D | DO-Y | SRC | RC, RD | |
| | 4 | E9 | | RDM | | |
| | 5 | 1A | | JCN | CO | |
| | 6 | 68 | | | NON-INV | |
| | 7 | F4 | | CMA | | |
| | 68 | 23 | NON-INV | SRC | R2, R3 | |
| | 9 | E2 | | WRR | | |
| | A | 62 | | INC | R2 | |
| | B | 6D | | INC | RD | |
| | C | 73 | | ISZ | R3 | |
| | D | 63 | | | DO-Y | |
| | E | CO | | BBL | 0 | |
| | 6F | 20 | [SAV-CUR-DAT] | FIM | R0, R1 | MOVE CUR DATA TO SAV DATA |
| 2 | 70 | 28 | | | 8 MOV-CMP | |
| | 1 | 42 | | JUN | | |
| | 2 | 75 | | | [MOV-RAM] | |
| | 73 | 20 | [MV-ST-CUR] | FIM | R0, R1 | MOVE START ADDRESS TO CUR ADDRESS |
| | 4 | 52 | | | 8 MV-ST-CUR | |
| | 75 | 58 | [MOV-RAM] | JMS | | MOVE RAM |
| | 6 | OF | | | (FIN 3 PAIR) | |
| | 77 | 2D | MOVE-N | SRC | RC, RD | |
| | 8 | E9 | | RDM | | |
| | 9 | 25 | | SRC | R4, R5 | |
| | A | EO | | WRM | | |
| | B | 6D | | INC | RD | |
| | C | 65 | | INC | R5 | |
| | D | 73 | | ISZ | R3 | |
| | E | 77 | | | MOVE-N | |
| | F | CO | | BBL | 0 | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 2 | 80 | 20 | [RESTORE] | FIM | R0, R1 | MOVE SAV DATA TO CUR DATA | |
| | 1 | 57 | | | 8-RESTORE | | |
| | 2 | 42 | | JUN | | | |
| | 3 | 75 | | | [MOV-RAM] | | |
| | 4 | 00 | | | | | |
| | 5 | 00 | | | | | |
| | 86 | 20 | {RD MASTER} | FIM | R0, R1 | READ MASTER SOCKET | |
| | 7 | 50 | | | 8 RD-MAST | | |
| | 8 | 58 | | JMS | | | |
| | 9 | 11 | | | (FIN 2 PAIR) | | |
| | 8A | 23 | N | SRC | R2, R3 | | |
| | B | EA | | RDR | | | |
| | C | F4 | | CMA | | | |
| | D | 2D | | SRC | RC, RD | | |
| | E | E0 | | WRM | | | |
| | F | 62 | | INC | R2 | | |
| 2 | 90 | 6D | | INC | RD | | |
| | 1 | 73 | | ISZ | R3 | | |
| | 2 | 8A | | | N | | |
| | 93 | 20 | {CHANGE} | FIM | R0, R1 | CHECK CHANGE FLAG | |
| | 4 | 00 | | | ZERO | | |
| | 5 | 21 | | SRC | R0, R1 | | |
| | 6 | EC | | RD0 | | | |
| | 7 | 14 | | JCN | A0 | | |
| | 8 | BF | | | 2 BBL 0 | | |
| | 9 | ED | | RD1 | | RETRIEVE CHANGE COUNT | |
| | A | F4 | | CMA | | | |
| | B | B9 | | XCH | R9 | | |
| | C | 24 | | FIM | R4, R5 | CHECK CHANGE ADDRESS | |
| | D | 00 | | | ZERO | | |
| | 9E | 20 | RD ADR | FIM | R0, R1 | | |
| | F | 34 | | | 8 CMP-ADR | | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 2 | A0 | 58 | | JMS | | | |
| | 1 | 11 | | | (FIN 2 PAIR) | | |
| | A2 | 2D | CHK-N | SRC | RC, RD | | |
| | 3 | E9 | | RDM | | | |
| | 4 | F1 | | CLC | | | |
| | 5 | 25 | | SRC | R4, R5 | | |
| | 6 | E8 | | SBM | | | |
| | 7 | 1C | | JCN | A1 | | |
| | 8 | BA | | | NO CHK | | |
| | 9 | 6D | | INC | RD | | |
| | A | 64 | | INC | R4 | | |
| | B | 73 | | ISZ | R3 | | |
| | C | A2 | | | CHK-N | | |
| | D | 20 | | FIM | R0, R1 | RETRIEVE CHANGE DATA | |
| | E | 2C | | | 8 MV-DATA | | |
| | F | 58 | | JMS | | | |
| 2 | B0 | 11 | | | (FIN 2 PAIR) | | |
| | B1 | 25 | MOVE DATA | SRC | R4, R5 | | |
| | 2 | E9 | | RDM | | | |
| | 3 | 2D | | SRC | RC, RD | | |
| | 4 | E0 | | WRM | | | |
| | 5 | 6D | | INC | RD | | |
| | 6 | 64 | | INC | R4 | | |
| | 7 | 73 | | ISZ | R3 | | |
| | 8 | B1 | | | MOVE DATA | | |
| | 9 | C0 | | BBL | 0 | | |
| | BA | 65 | NO-CHK | INC | R5 | SETUP NEXT CHANGE ADDRESS | |
| | B | D0 | | LDM | 0 | | |
| | C | B4 | | XCH | R4 | | |
| | D | 79 | | ISZ | R9 | CHECK N CHANGES | |
| | E | 9E | | | RD ADR | | |
| | BF | C0 | 2 BBL 0 | BBL | 0 | | |

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|---|---|---|---|---|---|---|
| | | | | | | TITLE DATE |
| 2 | C 0 | 51 | [DATA INV] | JMS | | READ DATA INVERT SWITCH |
| | 1 | C7 | | | (RD DATA SW) | |
| | 2 | 1A | | JCN | CO | |
| | 3 | BF | | | 2 BBL O | |
| | 4 | 20 | | FIM | RO, R1 | INVERT CUR DATA |
| | 5 | 2C | | | 8 CUR DAT | |
| | 6 | 58 | | JMS | | |
| | 7 | 11 | | | (FIN 2 PAIR) | |
| | C 8 | 2D | DO-Z | SRC | RD, RD | |
| | 9 | E9 | | RDM | | |
| | A | F4 | | CMA | | |
| | B | EO | | WRM | | |
| | C | 6D | | INC | RD | |
| | D | 73 | | ISZ | R3 | |
| | E | C8 | | | DO-Z | |
| | F | CO | | BBL | 0 | |
| 2 | D 0 | 00 | | | | |
| | 1 | 00 | | | | |
| | D 2 | A7 | (CIR P3→) | LD | R7 | CIRCULATE PAIR 3 RIGHT |
| | 3 | F6 | | RAR | | |
| | D 4 | A6 | (ROT P3→) | LD | R6 | ROTATE PAIR 3 RIGHT |
| | 5 | F6 | | RAR | | |
| | 6 | B6 | | XCH | R6 | |
| | 7 | A7 | | LD | R7 | |
| | 8 | F6 | | RAR | | |
| | 9 | B7 | | XCH | R7 | |
| | A | CO | | BBL | O | |
| | D B | 20 | (X→ASC11) | FIM | RO, R1 | CONVERT HEX TO ASC11 |
| | C | FO | | | F 0 | |
| | D | B1 | | XCH | R1 | HEX IN ACCUMULATOR |
| | E | 36 | | FIN | R6, R7 | ASC11 RESULT IN R6, R7 |
| | F | CO | | BBL | O | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS |
|---|---|---|---|---|---|---|
| | | | | | | TITLE DATE |
| 2 | E 0 | 20 | [HEX PRINT] | FIM | RO, R1 | PRINT ASC11 HEX (TTY) |
| | 1 | FO | | | FO | |
| | 2 | B1 | | XCH | R1 | |
| | 3 | 36 | | FIN | R6, R7 | |
| | 4 | 46 | | JUN | | |
| | 5 | 5A | | | [PRINT] | |
| | E 6 | 20 | [HEX CHEK] | FIM | RO, R1 | LOOK UP ASC11 HEX |
| | 7 | FO | | | FO | |
| | E 8 | 34 | HEX TRANS | FIN | R4, R5 | |
| | 9 | 50 | | JMS | | |
| | A | F5 | | | (COMPARE) | |
| | B | 1C | | JCN | A1 | A1 = HEX |
| | C | 3D | | | 2 BBL 1 | |
| | D | 71 | | ISZ | R1 | |
| | E | E8 | | | HEX TRANS | |
| | F | CO | | BBL | O | AO = NOT HEX |
| 2 | F 0 | BO | | CST | O = BO | HEX TO ASC11 TRANSLATION TABLE |
| | 1 | B1 | | CST | 1 = B1 | |
| | 2 | B2 | | CST | 2 = B2 | |
| | 3 | B3 | | CST | 3 = B3 | |
| | 4 | B4 | | CST | 4 = B4 | |
| | 5 | B5 | | CST | 5 = B5 | |
| | 6 | B6 | | CST | 6 = B6 | |
| | 7 | B7 | | CST | 7 = B7 | |
| | 8 | B8 | | CST | 8 = B8 | |
| | 9 | B9 | | CST | 9 = B9 | |
| | A | C1 | | CST | A = C1 | |
| | B | C2 | | CST | B = C2 | |
| | C | C3 | | CST | C = C3 | |
| | D | C4 | | CST | D = C4 | |
| | E | C5 | | CST | E = C5 | |
| | F | C6 | | CST | F = C6 | |

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE SERIES 90 PERSONALITY DATE / COMMENTS |
|---|---|---|---|---|---|---|
| 8 | 00 | 20 | (FIN-1ST-LAST) | FIM | R0, R1 | MOVE FIRST & LAST ADDRESSES TO RAM |
| | 1 | 20 | | | 8 AA-LOC | |
| | 2 | 38 | | FIN | R8, R9 | |
| | 03 | 61 | DO-1ST-LAST | INC | R1 | |
| | 4 | 32 | | FIN | R2, R3 | |
| | 5 | 29 | | SRC | R8, R9 | |
| | 6 | A3 | | LD | R3 | |
| | 7 | E0 | | WRM | | |
| | 8 | 79 | | ISZ | R9 | |
| | 9 | 03 | | | DO-1ST-LAST | |
| | A | C0 | | BBL | 0 | |
| | 0B | 38 | (FIN 5 PAIR) | FIN | R8, R9 | FETCH N REGISTER PAIRS |
| | C | 61 | | INC | R1 | FOR SUBROUTINES |
| | D | 3A | | FIN | RA, RB | |
| | E | 61 | | INC | R1 | |
| | 0F | 34 | (FIN 3 PAIR) | FIN | R4, R5 | |
| 8 | 10 | 61 | | INC | R1 | |
| | 11 | 3C | (FIN 2 PAIR) | FIN | RC, RD | |
| | 2 | 61 | | INC | R1 | |
| | 3 | 32 | | FIN | R2, R3 | |
| | 4 | C0 | | BBL | 0 | |
| | 15 | 3C | (FIN 2 TTY) | FIN | RC, RD | FETCH 2 REGISTER PAIRS |
| | 6 | 61 | | INC | R1 | FOR TTY AND PT OPTIONS |
| | 7 | 3A | | FIN | RA, RB | |
| | 8 | C0 | | BBL | 0 | |
| | 19 | 20 | (FIN ADR) | FIM | R0, R1 | FETCH 2 REGISTER PAIRS |
| | A | 4C | | | 8 ADR ROM | FOR PROM ADDRESSING |
| | B | 48 | | JUN | | |
| | C | 11 | | | (FIN 2 PAIR) | |
| | D | | | | | |
| | E | | | | | |
| | F | | | | | |

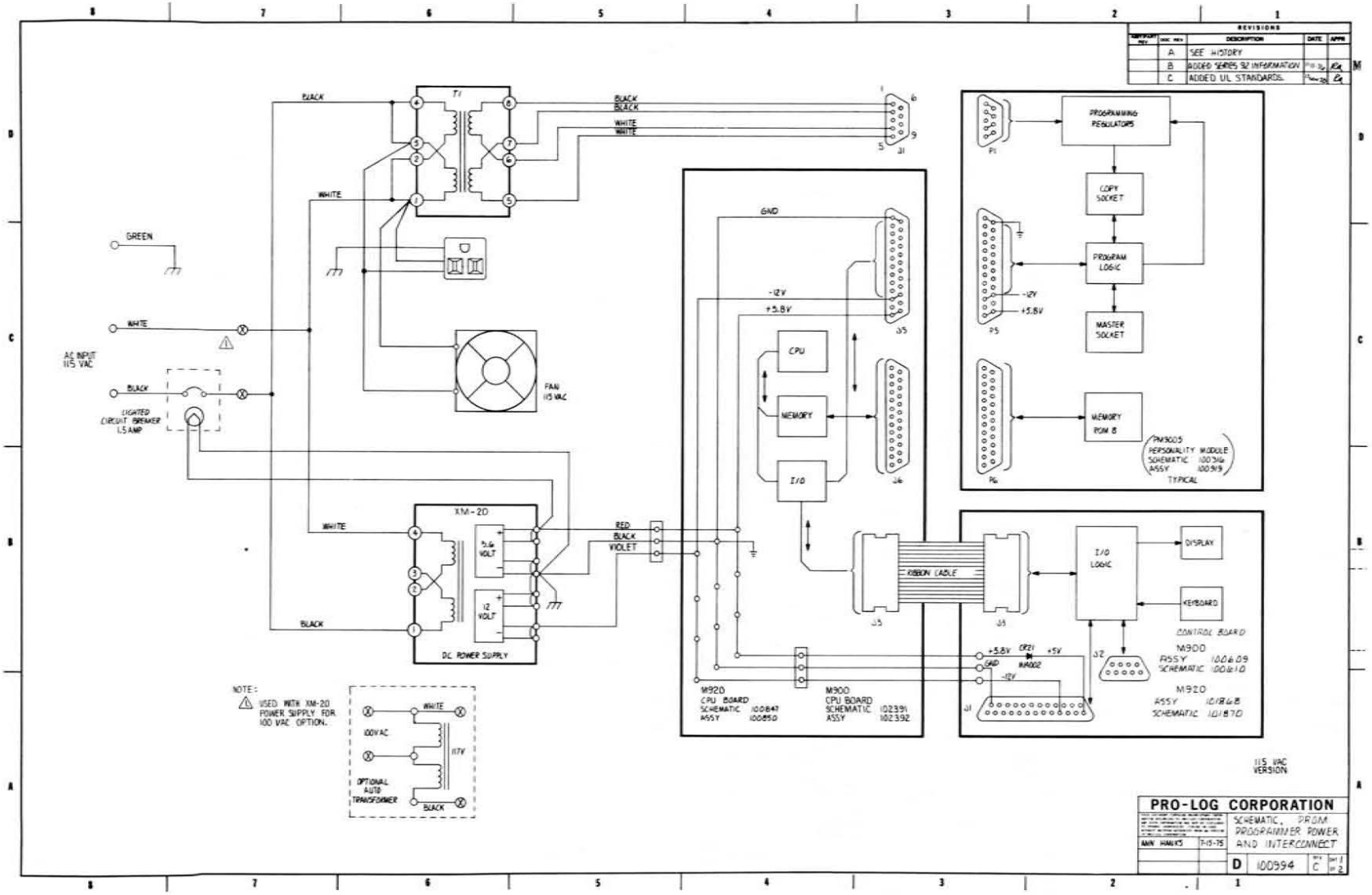
| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE DATE / COMMENTS |
|---|---|---|---|---|---|---|
| 8 | 20 | 7X | 8AA-LOC | CST | | R8=7; R9=X, RAM LOCATION 7X |
| | 1 | 0X | | CST | | FIRST & LAST ADDRESSES |
| | 2 | 0X | | CST | | R2=0, R3=ADDRESS CHARACTER X |
| | 3 | 0X | | CST | | |
| | 4 | 0X | | CST | | |
| | 5 | 0X | | CST | | |
| | 6 | 0X | | CST | | |
| | 7 | 0X | | CST | | |
| | 8 | 0X | | CST | | |
| | 29 | 74 | 8 CLR RAM | CST | | RC=7, RD=4; TO RAM LOCATION 74 |
| | A | 0X | | CST | | R2=0, R3=COUNT X |
| | 2B | 70 | 8 MOV-CMP | CST | | R4=7, R5=0; TO RAM LOCATION 70 |
| | C | XX | 8 CUR DAT | CST | | RC=X, RD=X; FROM RAM LOCATION XX |
| | D | -X | | CST | | R2=-, R3=COUNT X |
| | 2E | 70 | 8 ZERO | CST | | RC=7, RD=0; TO RAM LOCATION 70 |
| | F | XX | | CST | | R2=NON-PROG STATE, R3=COUNT X |
| 8 | 30 | XX | 8 CUR END | CST | | R4=6, R5=X; END ADDRESS LOCATION MSD |
| | 1 | 60 | | CST | | RC=6, RD=0; CUR ADDRESS LOCATION MSD |
| | 2 | -X | | CST | | R2=-, R3=COUNT X |
| | 33 | 7X | 8 CUR LAST | CST | | R4=7, R5=X; LAST ADDRESS LOCATION MSD |
| | 34 | 60 | 8 CUR ADR | CST | | RC=6, RD=0; CUR ADDRESS LOCATION MSD |
| | 5 | -X | | CST | | R2=-, R3=COUNT X |
| | 36 | XX | 8 COUNT | CST | | RC=X, RD=X; CUR ADDRESS LOCATION LSD |
| | 7 | -X | | CST | | R2=-, R3=COUNT X |
| | 38 | XX | 8 RD-AA | CST | | R4=X, R5=X; AA DISPLAY MASK |
| | 39 | 68 | 8 RD TTY-AA | CST | | RC=6, RD=8; START ADDRESS LOCATION MSD |
| | A | 1X | | CST | | R2=1, R3=COUNT FOR TTY |
| | 3B | XX | 8 RD-AD | CST | | R8=X, R9=X; ADR DISPLAY MASK |
| | C | 08 | | CST | 0001 0000 | RA=0, RB=8; POSITION 4 |
| | D | XX | | CST | | R4=X, R5=X; AD MASK (ROTATED) |
| | E | XX | | CST | | RC=X, RD=X; TO RAM LOCATION XX |
| | F | 80 | | CST | 0001 XXXX | R2=8, R3=0 |

PRO-LOG CORPORATION

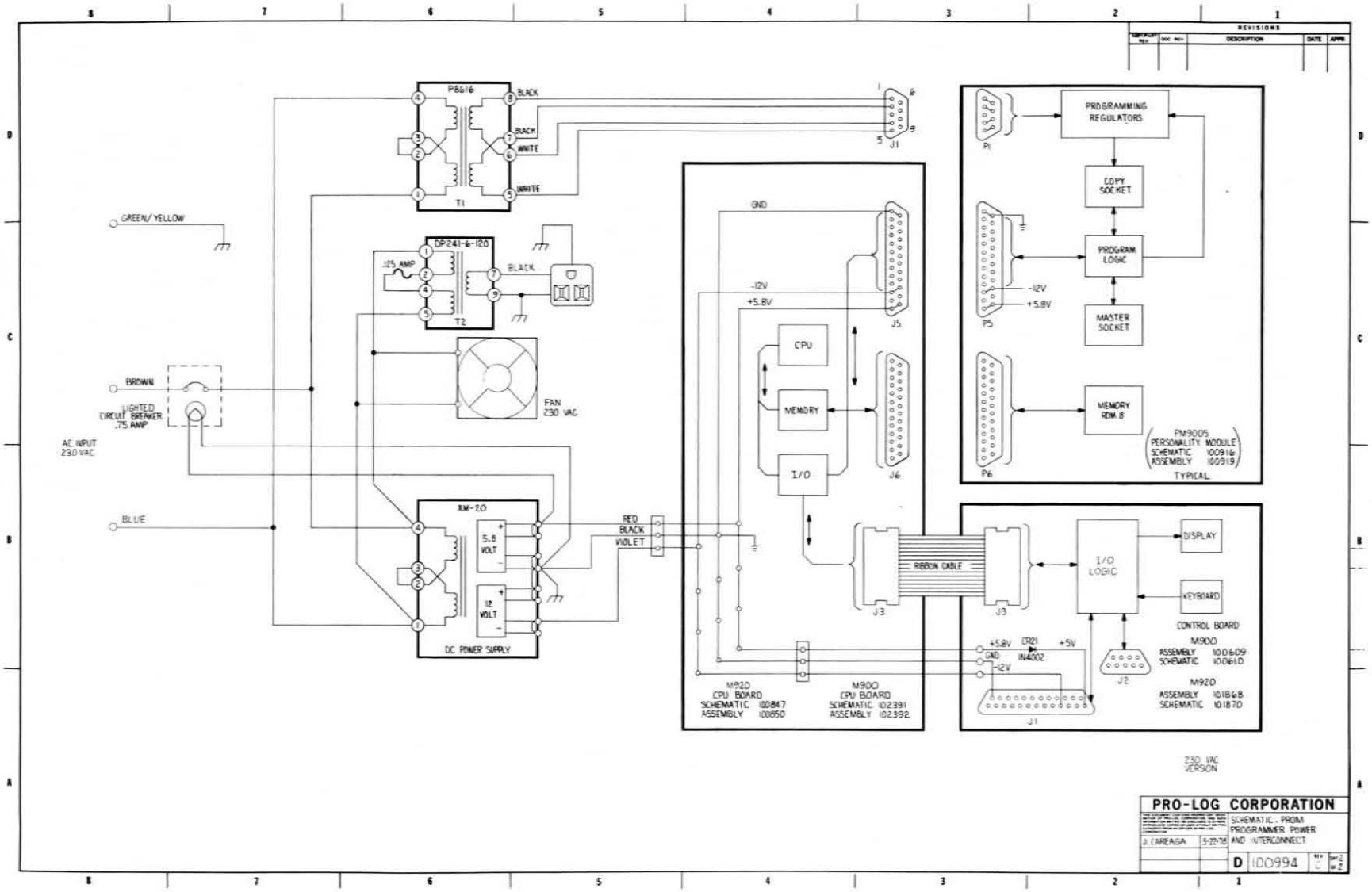
PROGRAM ASSEMBLY FORM

| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 8 | 40 | XX | 8 RD CHNG | CST | | R4=X, R5=X; AD MASK | |
| | 1 | 60 | | CST | | RC=6, RD=0; CUR ADDRESS LOCATION | |
| | 2 | 10 | | CST | | R2=1, R3=-; | |
| | 43 | XX | 8 DISP-AD | CST | | R4=X, R5=X; AD MASK | |
| | 44 | 60 | 8 TTY-AD/CHNG | CST | | RC=6, RD=0; CUR ADDRESS LOCATION | |
| | 5 | -X | | CST | | R2=-, R3=COUNT X | |
| | 46 | XX | 8 1ST-LAST | CST | | R4=X, R5=X; AA MASK | |
| | 7 | 7X | | CST | | RC=7, RD=X; TO RAM LOCATION 7X | |
| | 8 | 0X | | CST | | R2=-, R3=COUNT X | |
| | 49 | 68 | 8 MV 1ST-LAST | CST | | R4=6, R5=8; TO RAM LOCATION 68 | |
| | A | 7X | | CST | | RC=7, RD=X; FROM RAM LOCATION 7X | |
| | B | -X | | CST | | R2=-, R3=COUNT X | |
| | 4C | 60 | 8 ADR ROM | CST | | RC=6, RD=0; CUR ADDRESS LOCATION | |
| | D | XX | | CST | | R2=PORT X, R3=COUNT X: TO PORT | |
| | 4E | XX | 8 RD COPY | CST | | RC=X, RD=X; TO RAM LOCATION | |
| | F | XX | | CST | | R2=PORT X, R3=COUNT X; FROM PORT | |
| 8 | 50 | XX | 8 RD MAST | CST | | RC=X, RD=X; TO RAM LOCATION | |
| | 1 | XX | | CST | | R2=PORT X, R3=COUNT X: FROM PORT | |
| | 52 | 60 | 8 MV ST-CUR | CST | | R4=6, R5=0; TO RAM LOCATION 60 | |
| | 3 | 68 | | CST | | RC=6, RD=8; FROM RAM LOCATION 68 | |
| | 4 | 0X | | CST | | R2=-, R3=COUNT X | |
| | 55 | CX | (SKP/RTRY) | BBL | X | CO=SKIP, C1=RETRY | |
| | 6 | 00 | | | | | |
| | 57 | XX | 8 RESTORE | CST | | R4=X, R5=X | |
| | 8 | 70 | | CST | | RC=7, RD=0 | |
| | 9 | -X | | CST | | R2=-, R3=COUNT X | |
| | 5A | 6X | 8 BNPF | CST | | RC=6, RD=X | |
| | B | CX | | CST | | RA=C, BYTE COUNT: RB=X BIT COUNT | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| | F | | | | | | |

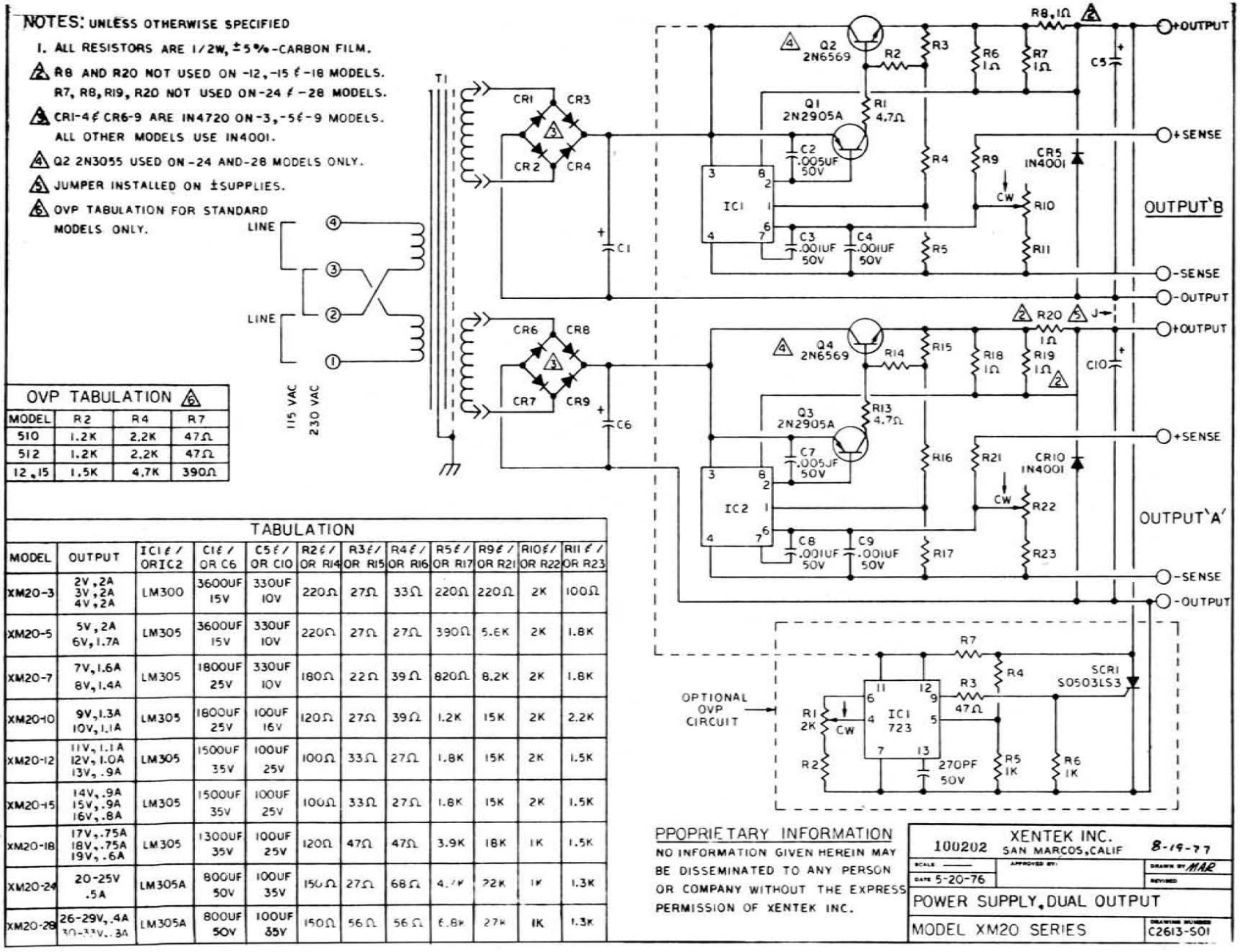
| HEXADECIMAL PAGE ADR | HEXADECIMAL LINE ADR | HEXADECIMAL INSTR | MNEMONIC LABEL | MNEMONIC INSTR | MNEMONIC MODIFIER | TITLE / COMMENTS | DATE |
|---|---|---|---|---|---|---|---|
| 8 | 60 | | {PROGRAM} | | | UNIQUE PROGRAMMING SEQUENCE | |
| | 1 | | | | | FOR EACH PERSONALITY MODULE | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |
| | 6 | | | | | | |
| | 7 | | | | | | |
| | 8 | | | | | | |
| | 9 | | | | | | |
| | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| | F | | | | | | |
| 8 | 70 | | | | | | |
| | 1 | | | | | | |
| | 2 | | | | | | |
| | 3 | | | | | | |
| | 4 | | | | | | |
| | 5 | | | | | | |
| | 6 | | | | | | |
| | 7 | | | | | | |
| | 8 | | | | | | |
| | 9 | | | | | | |
| | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| | F | | | | | | |




Schematic; PROM Programmer Power and Interconnect




Schematic; PROM Programmer Power and Interconnect




OVP TABULATION (6)

| MODEL | R2 | R4 | R7 |
|---|---|---|---|
| 510 | 1.2K | 2.2K | 47Ω |
| 512 | 1.2K | 2.2K | 47Ω |
| 12, 15 | 1.5K | 4.7K | 390Ω |

TABULATION

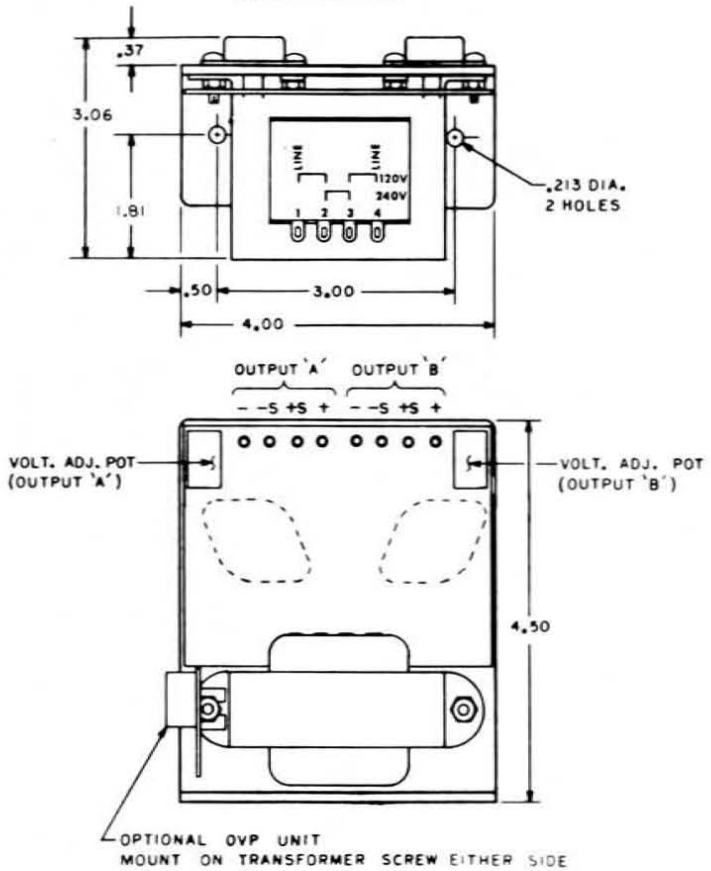
| MODEL | OUTPUT | IC1 & / OR IC2 | C1 & / OR C6 | C5 & / OR C10 | R2 & / OR R14 | R3 & / OR R15 | R4 & / OR R16 | R5 & / OR R17 | R9 & / OR R21 | R10 & / OR R22 | R11 & / OR R23 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| XM20-3 | 2V, 2A 3V, 2A 4V, 2A | LM300 | 3600UF 15V | 330UF 10V | 220Ω | 27Ω | 33Ω | 220Ω | 220Ω | 2K | 100Ω |
| XM20-5 | 5V, 2A 6V, 1.7A | LM305 | 3600UF 15V | 330UF 10V | 220Ω | 27Ω | 27Ω | 390Ω | 5.6K | 2K | 1.8K |
| XM20-7 | 7V, 1.6A 8V, 1.4A | LM305 | 1800UF 25V | 330UF 10V | 180Ω | 22Ω | 39Ω | 820Ω | 8.2K | 2K | 1.8K |
| XM20-10 | 9V, 1.3A 10V, 1.1A | LM305 | 1800UF 25V | 100UF 16V | 120Ω | 27Ω | 39Ω | 1.2K | 15K | 2K | 2.2K |
| XM20-12 | 11V, 1.1A 12V, 1.0A 13V, .9A | LM305 | 1500UF 35V | 100UF 25V | 100Ω | 33Ω | 27Ω | 1.8K | 15K | 2K | 1.5K |
| XM20-15 | 14V, .9A 15V, .9A 16V, .8A | LM305 | 1500UF 35V | 100UF 25V | 100Ω | 33Ω | 27Ω | 1.8K | 15K | 2K | 1.5K |
| XM20-18 | 17V, .75A 18V, .75A 19V, .6A | LM305 | 1300UF 35V | 100UF 25V | 120Ω | 47Ω | 47Ω | 3.9K | 18K | 1K | 1.5K |
| XM20-24 | 20-25V .5A | LM305A | 800UF 50V | 100UF 35V | 150Ω | 27Ω | 68Ω | 4.7K | 22K | 1K | 1.3K |
| XM20-28 | 26-29V, .4A 30-33V, .3A | LM305A | 800UF 50V | 100UF 35V | 150Ω | 56Ω | 56Ω | 6.8K | 27K | 1K | 1.3K |



100202 XENTEK INC. SAN MARCOS, CALIF 8-19-77
SCALE —— APPROVED BY: DRAWN BY MAR
DATE 5-20-76 REVISED
POWER SUPPLY, DUAL OUTPUT
MODEL XM20 SERIES DRAWING NUMBER C2613-S01

Schematic, Power Supply (Dual Output)

## OUTLINE AND MOUNTING DIMENSIONS




## SPECIFICATIONS

LOAD REGULATION : .1% (0 TO FULL LOAD)

LINE REGULATION : .1% FOR 120/240VAC, ± 10%, 60-420 HZ (SEE ①)

NOISE AND RIPPLE : .1%

ISOLATED OUTPUTS

REMOTE SENSING (SEE ②)

FOLDBACK CURRENT LIMITING

RESPONSE TIME : ≤ 25 μSEC

OPERATING TEMP. : 0-40°C (SEE ③)

ELECTROSTATICALLY SHIELDED TRANSFORMER

REVERSE VOLTAGE PROTECTION

OVERVOLTAGE PROTECTION (OVP) AVAILABLE

DUAL TRACKING OUTPUTS AVAILABLE

1. TRACKS TO WITHIN 1% OVER A ± 10% ADJUSTMENT RANGE
2. IF EITHER OUTPUT IS SHORTED THE OTHER OUTPUT COLLAPSES FOR EQUIPMENT PROTECTION
3. DIFFERENTIAL OVP AVAILABLE

⑤ TO SET OPTIONAL OVP : TURN OVP ADJ. POT FULL COUNTER-CLOCKWISE. SET OUTPUT VOLTAGE TO DESIRED OVERVOLTAGE LIMIT (20% ABOVE OUTPUT VOLTAGE RECOMMENDED). TURN OVP ADJ. POT SLOWLY CLOCKWISE UNTIL SCR FIRES, (VOLTAGE DROPS TO APPROX. 1 VOLT). TURN POWER OFF. TURN VOLTAGE ADJ. POT FULL CLOCKWISE. RE-APPLY POWER AND SET SUPPLY VOLTAGE TO NORMAL OUTPUT.

④ RECOMMENDED EXTERNAL FUSING : .75AMP FOR 120V OPERATION ; .38 AMP FOR 240V OPERATION.

③ POWER SUPPLY IS DESIGNED FOR CONTINUOUS OPERATION UNDER FULL LOAD AND HIGH LINE CONDITIONS AT 40°C AMBIENT IN FREE AIR ENVIRONMENT. IF AIR FLOW IS RESTRICTED, THE CASE TEMP. OF 2N3055 TRANSISTORS SHOULD BE MONITORED UNDER PARTICULAR WORST CASE. MAX. CASE TEMP. IS 150°C.

② IF REMOTE SENSING IS NOT DESIRED INSTALL JUMPER BETWEEN + AND + SENSE & - AND - SENSE TERMINALS. IF REMOTE SENSING IS DESIRED DO NOT INSTALL JUMPERS, BUT CONNECT + SENSE TO + OUTPUT AT LOAD END OF LINE AND - SENSE TO - OUTPUT AT LOAD END OF LINE.

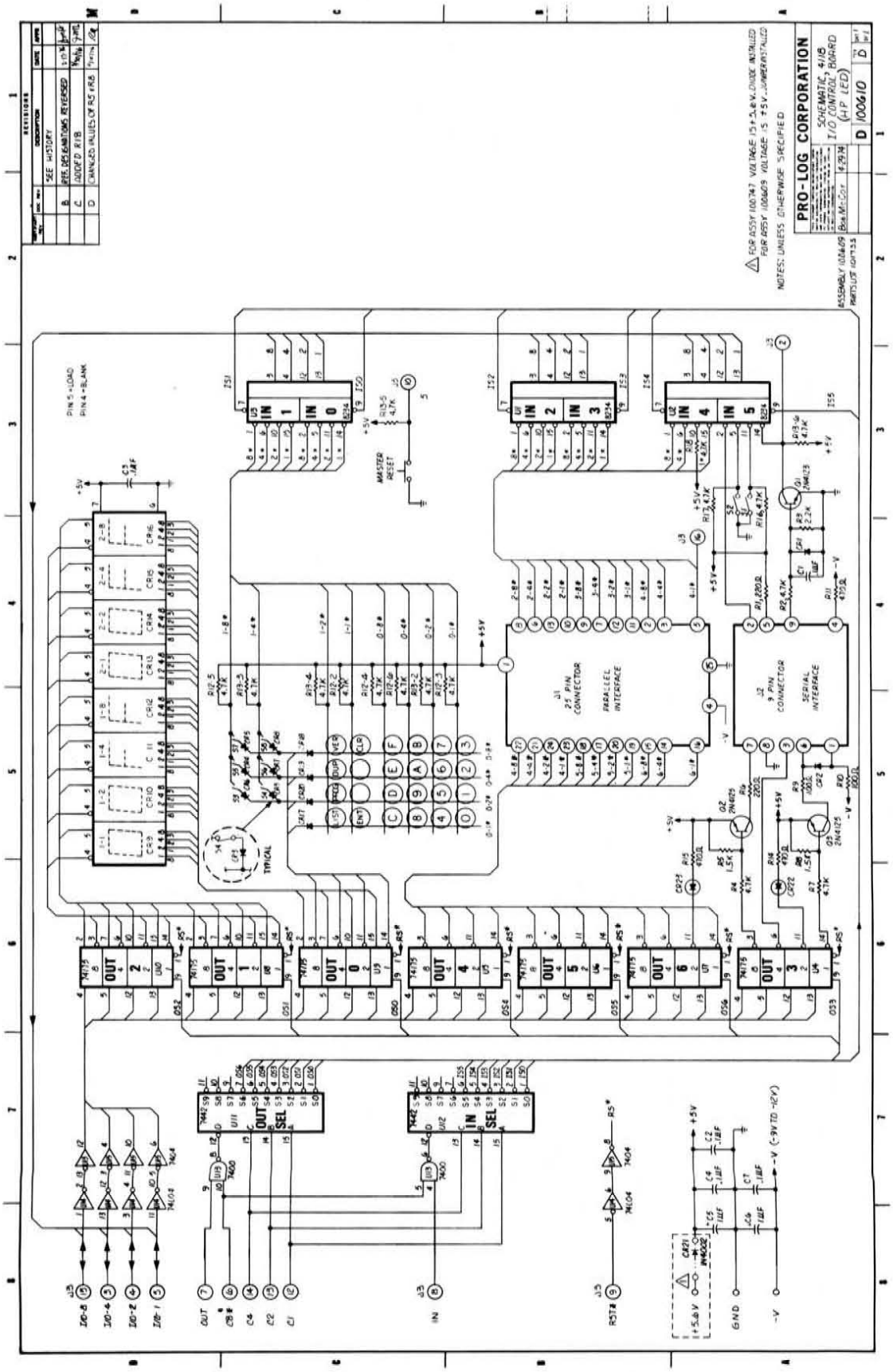
① FOR 120VAC INPUT JUMPER 1 TO 2 & 3 TO 4 ON T1 ; FOR 240VAC JUMPER 2 TO 3. APPLY LINE POWER TO 1 AND 4.

CAUTION : READ INSTRUCTIONS ABOVE BEFORE OPERATING POWER SUPPLY

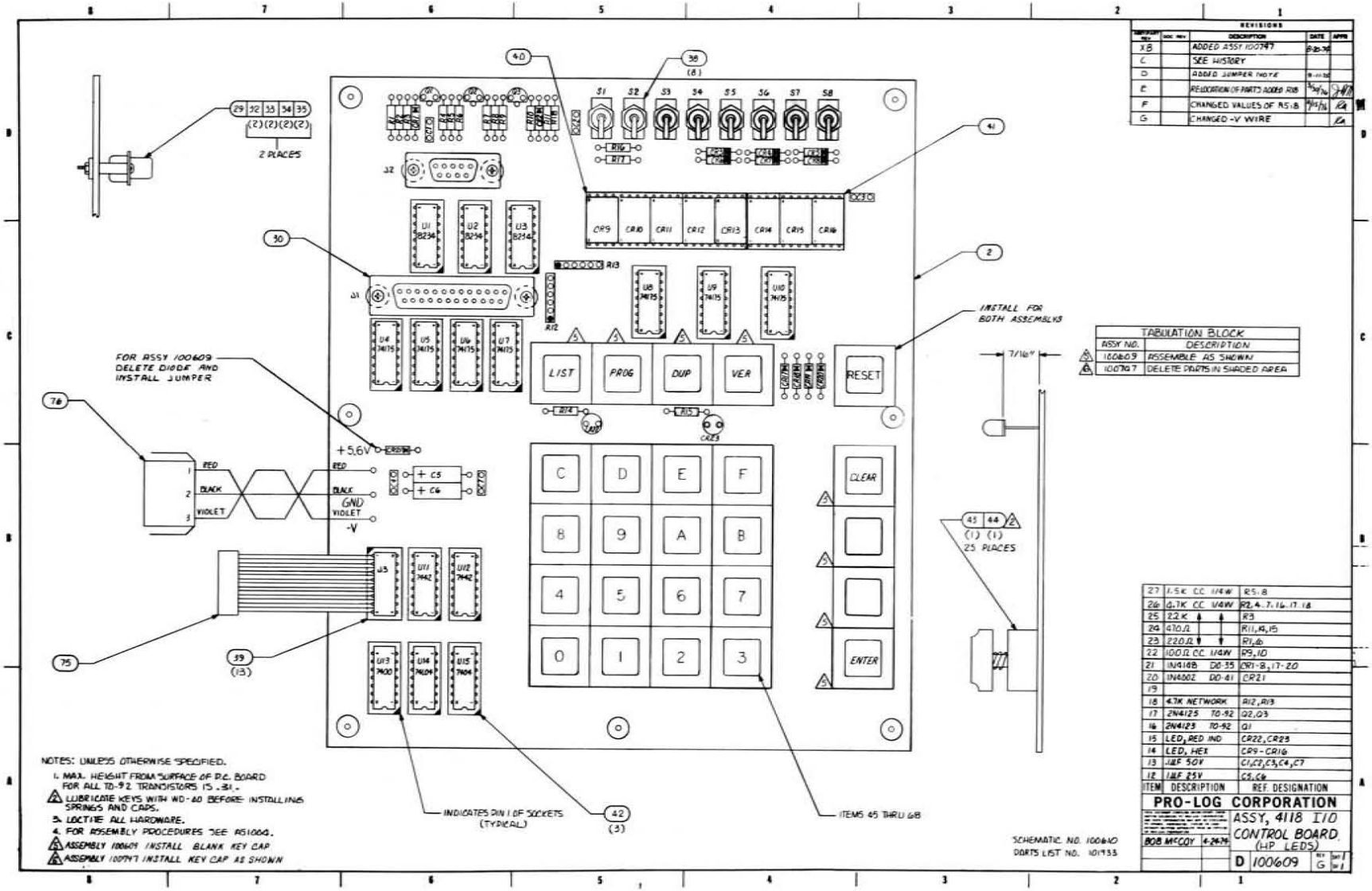
**100202**

| XENTEK INC. SANTA FE SPRINGS, CALIF. | | |
|---|---|---|
| SCALE — | APPROVED BY | DRAWN BY L.K. |
| DATE 3-28-73 | | REVISED |
| POWER SUPPLY, DUAL OUTPUT | | |
| MODEL XM20-5-10A | | DRAWING NUMBER C2606-501 |

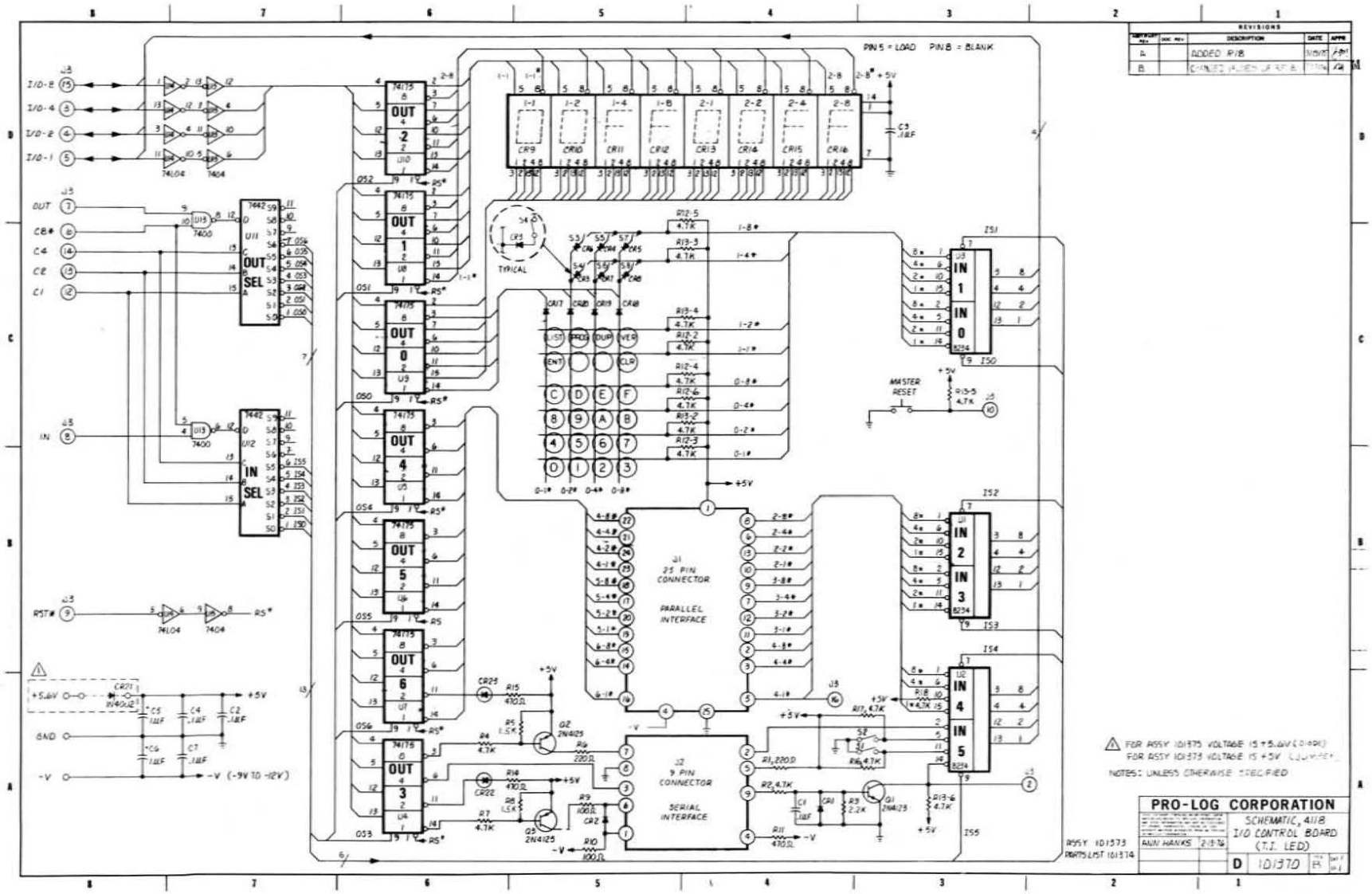
Assembly, Power Supply (Dual Output)



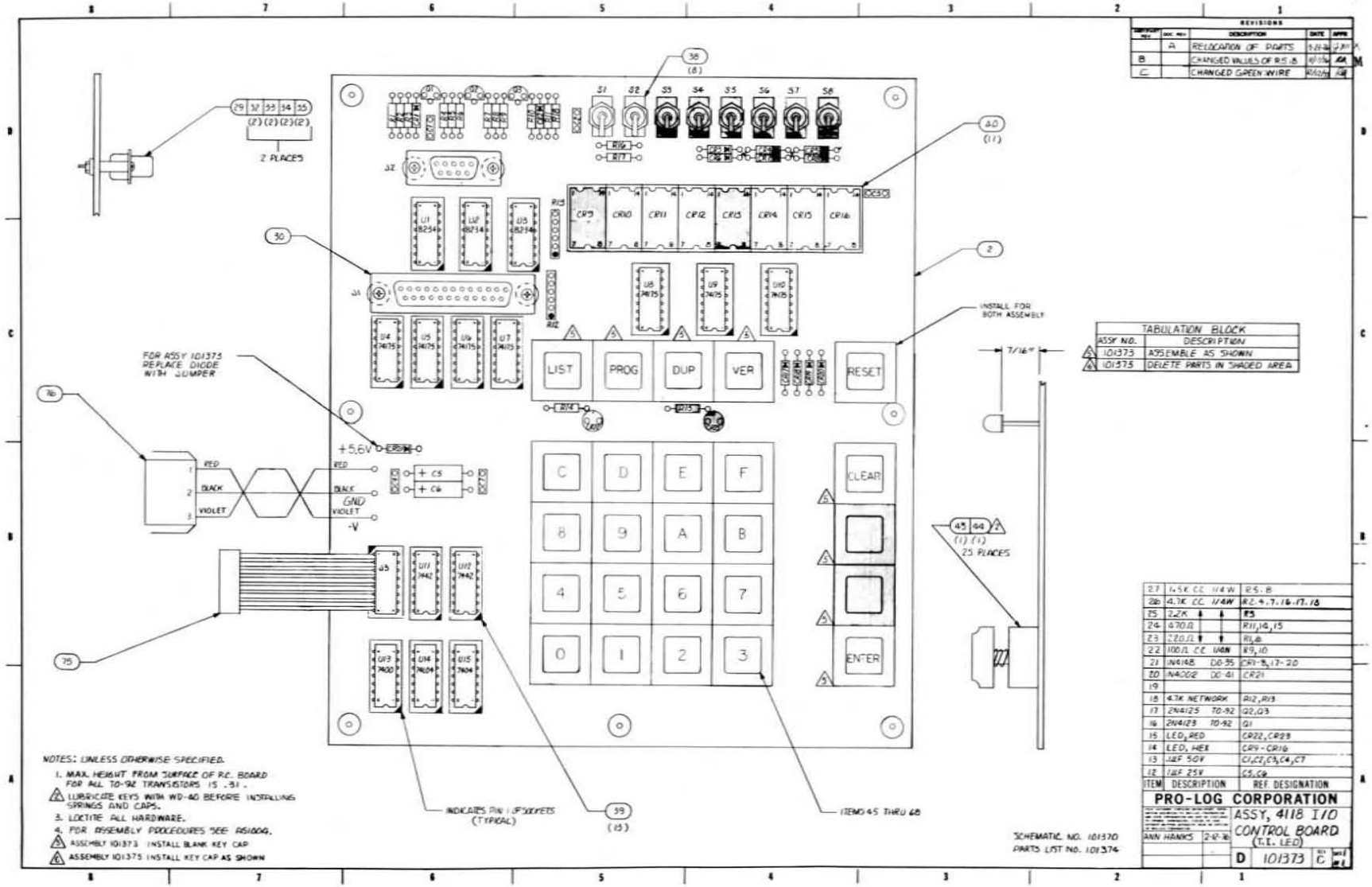

Schematic; 4118 I/O Control Board (HP LED)



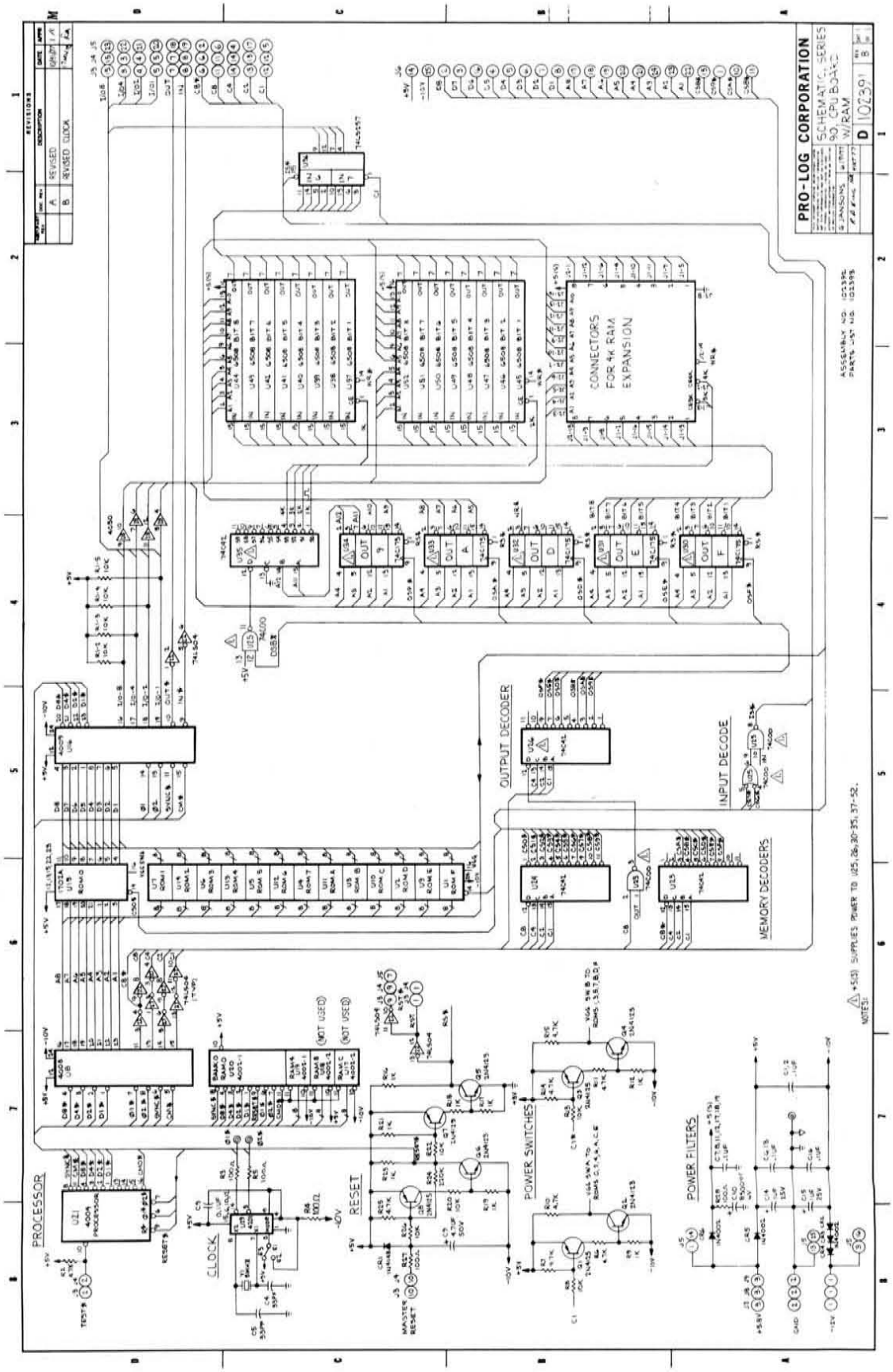

Assembly; 4118 I/O Control Board (HP LEDS)



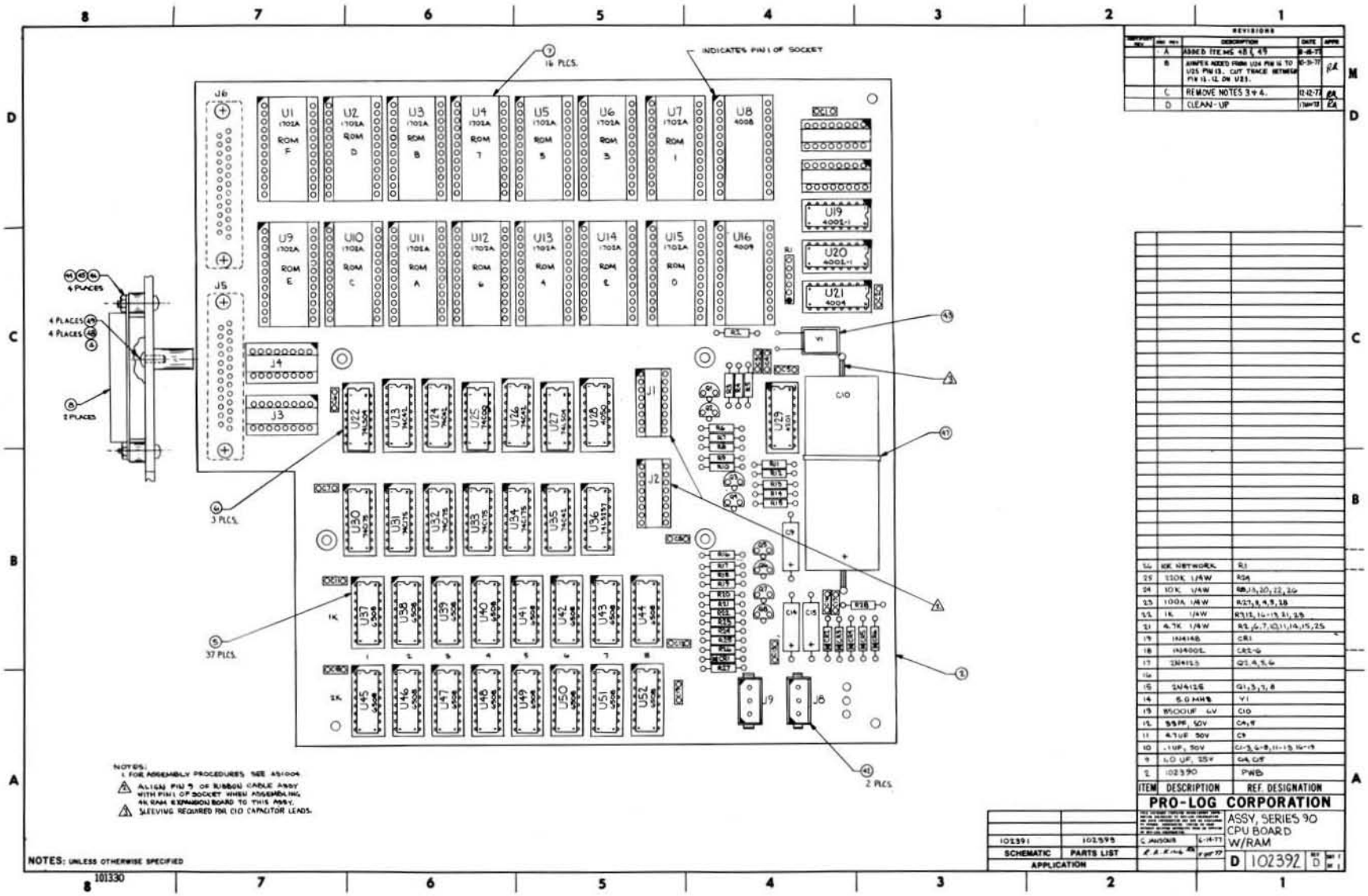

Schematic; 4118 I/O Control Board (T.I. LED)




Assembly; 4118 I/O Control Board (T.I. LED)



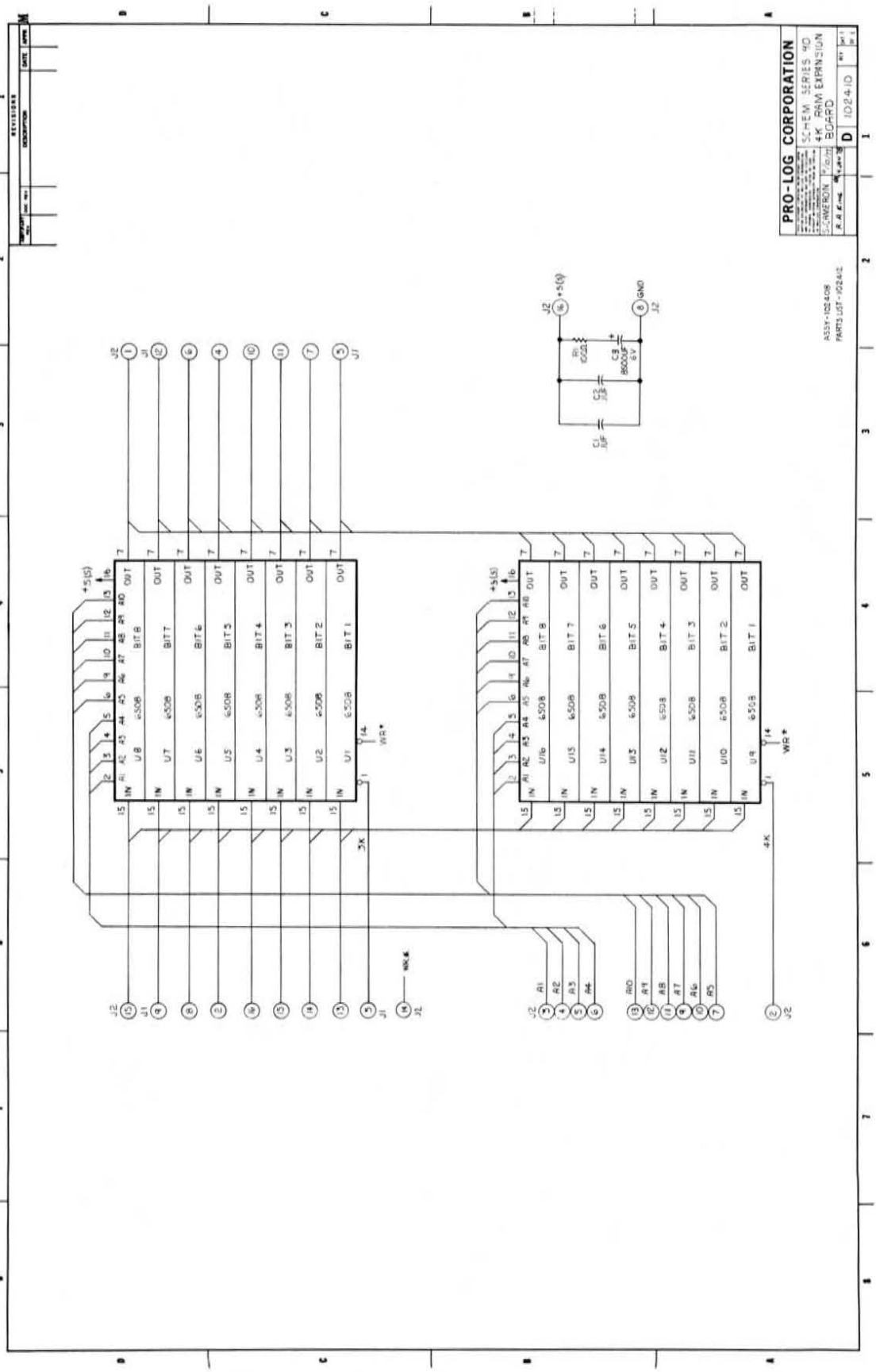

Schematic; Series 90, CPU Board w/RAM



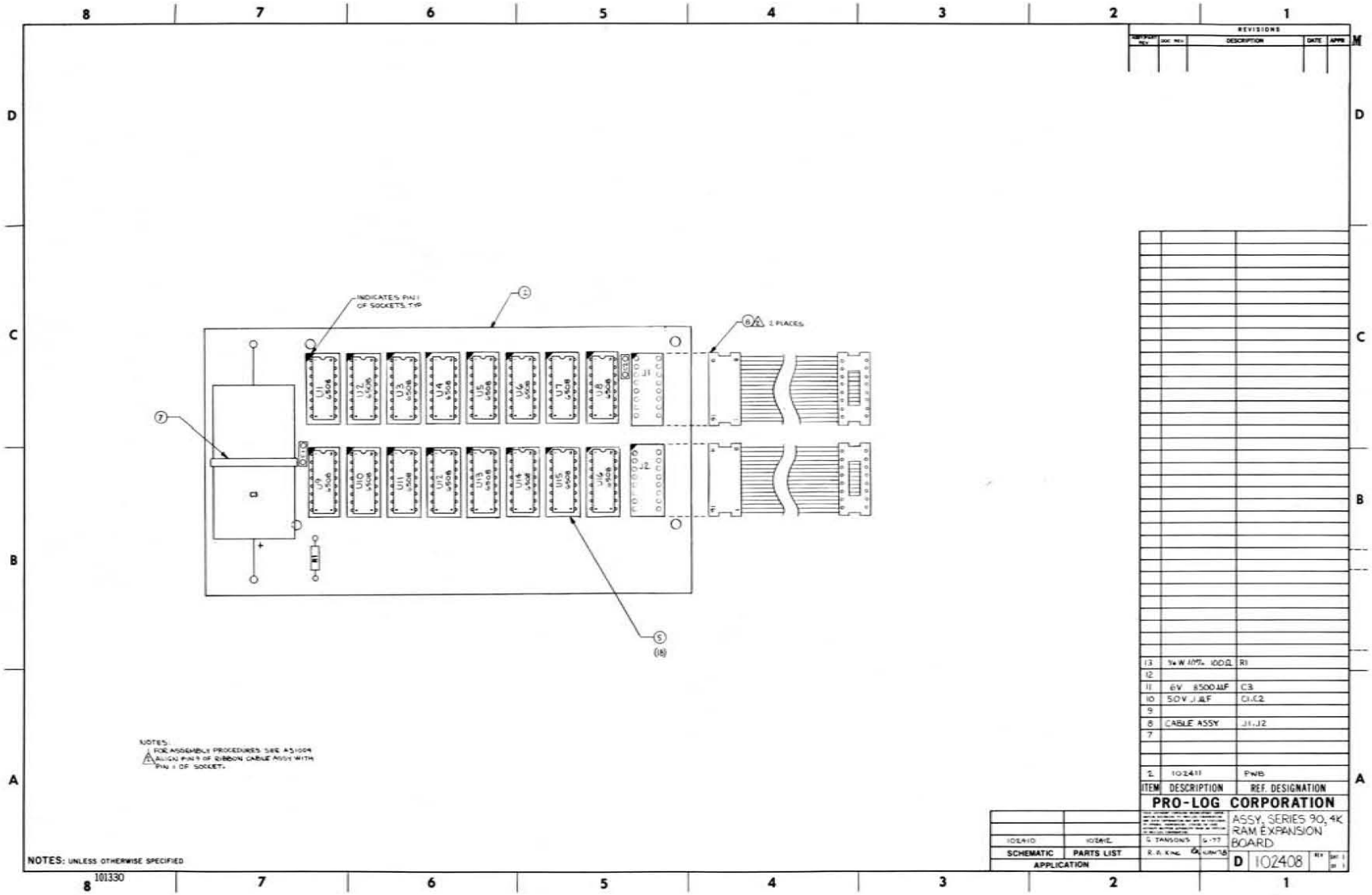

| ITEM | DESCRIPTION | REF. DESIGNATION |
|---|---|---|
| 50 | 10K NETWORK | R1 |
| 29 | 330K 1/4W | R24 |
| 24 | 10K 1/4W | R8,15,20,22,26 |
| 23 | 100A 1/4W | R23,8,4,9,28 |
| 22 | 1K 1/4W | R3,13,16-19,21,29 |
| 21 | 4.7K 1/4W | R5,6,7,10,11,14,15,25 |
| 19 | IN4148 | CR1 |
| 18 | IN4001L | CR2-6 |
| 17 | 2N4125 | Q2,4,5,6 |
| 16 | | |
| 15 | 2N4126 | Q1,3,7,8 |
| 14 | 5.0 MHZ | Y1 |
| 13 | 8500UF 6V | C10 |
| 12 | 33PF, 50V | C4,9 |
| 11 | 4.7uF 50V | C3 |
| 10 | .1UF, 50V | C1-3,6-8,11-13,16-19 |
| 9 | 1.0 UF, 25V | C4, C5 |
| 2 | 102390 | PWB |



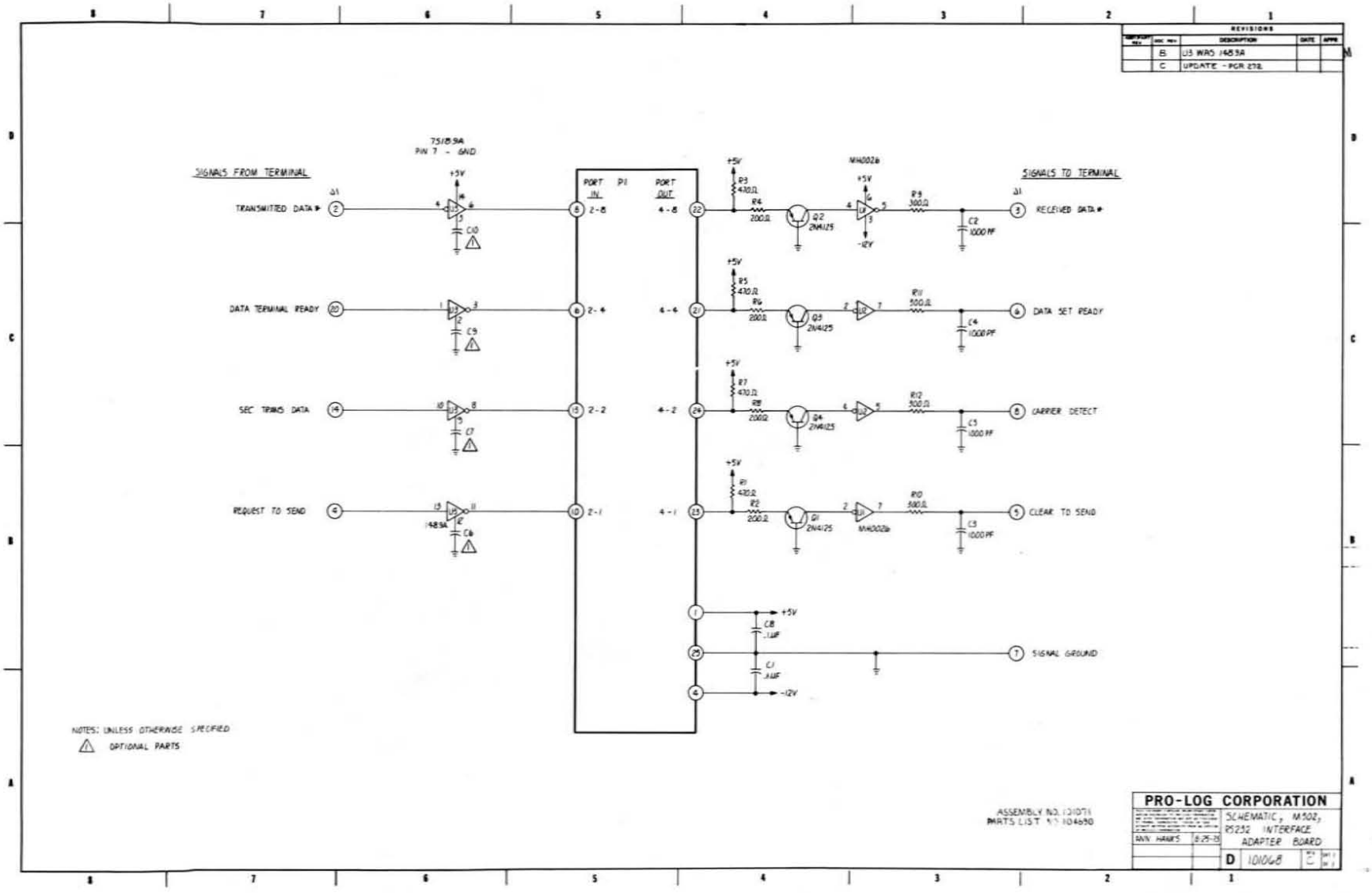
Assembly; Series 90 CPU Board w/RAM



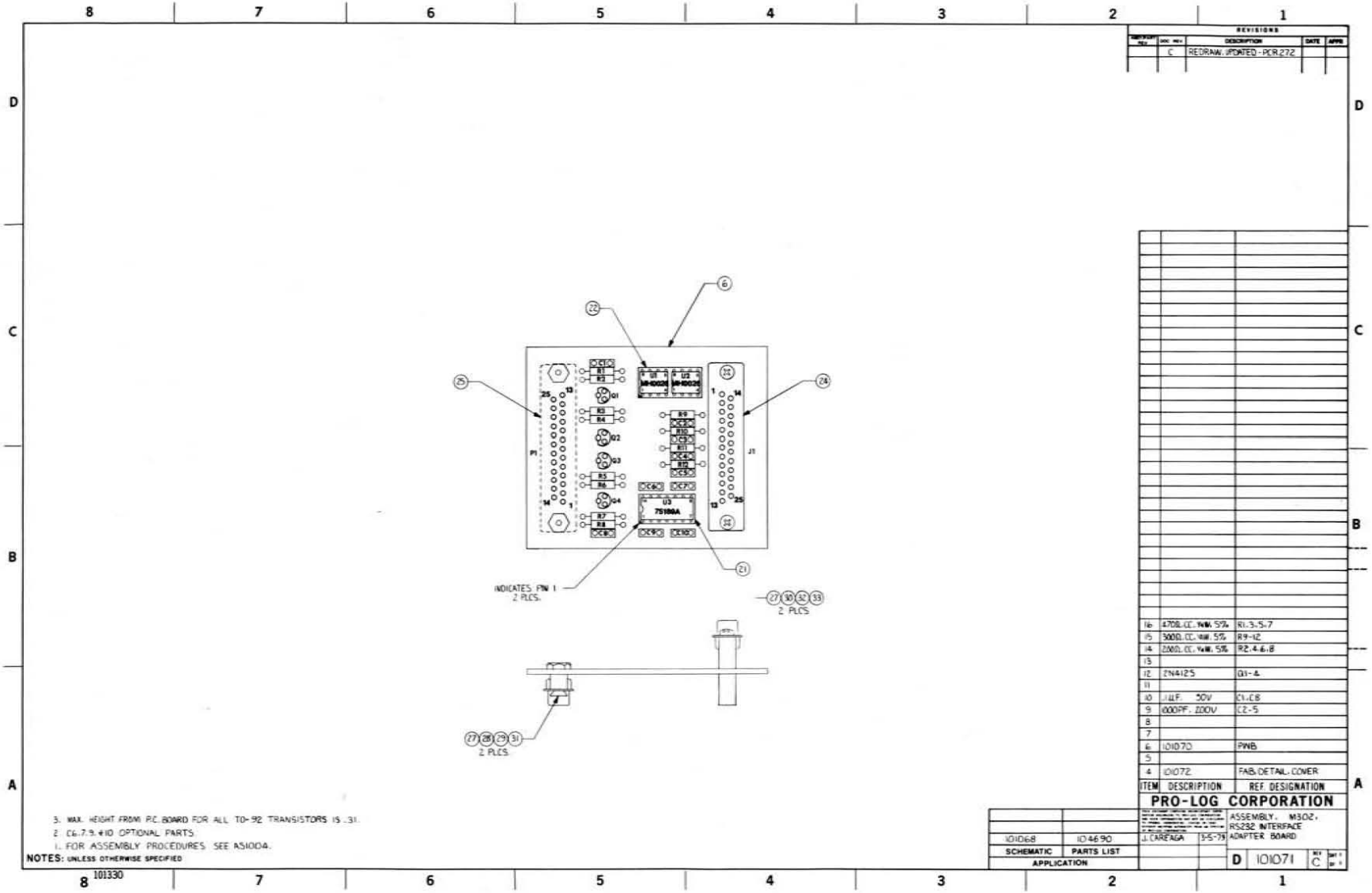

Schematic; Series 90 4K RAM Expansion Board



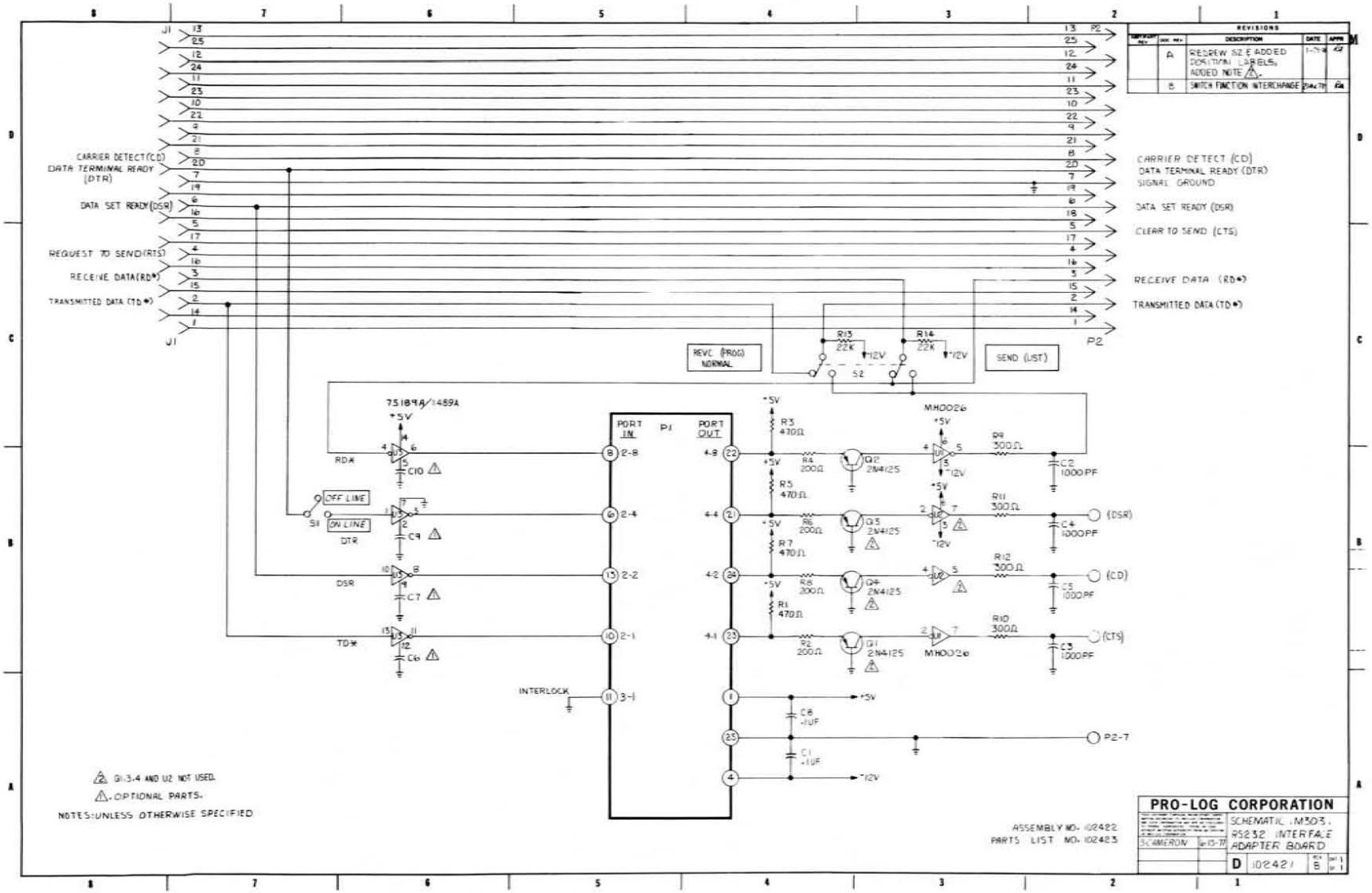

Assembly; Series 90 4K RAM Expansion Board



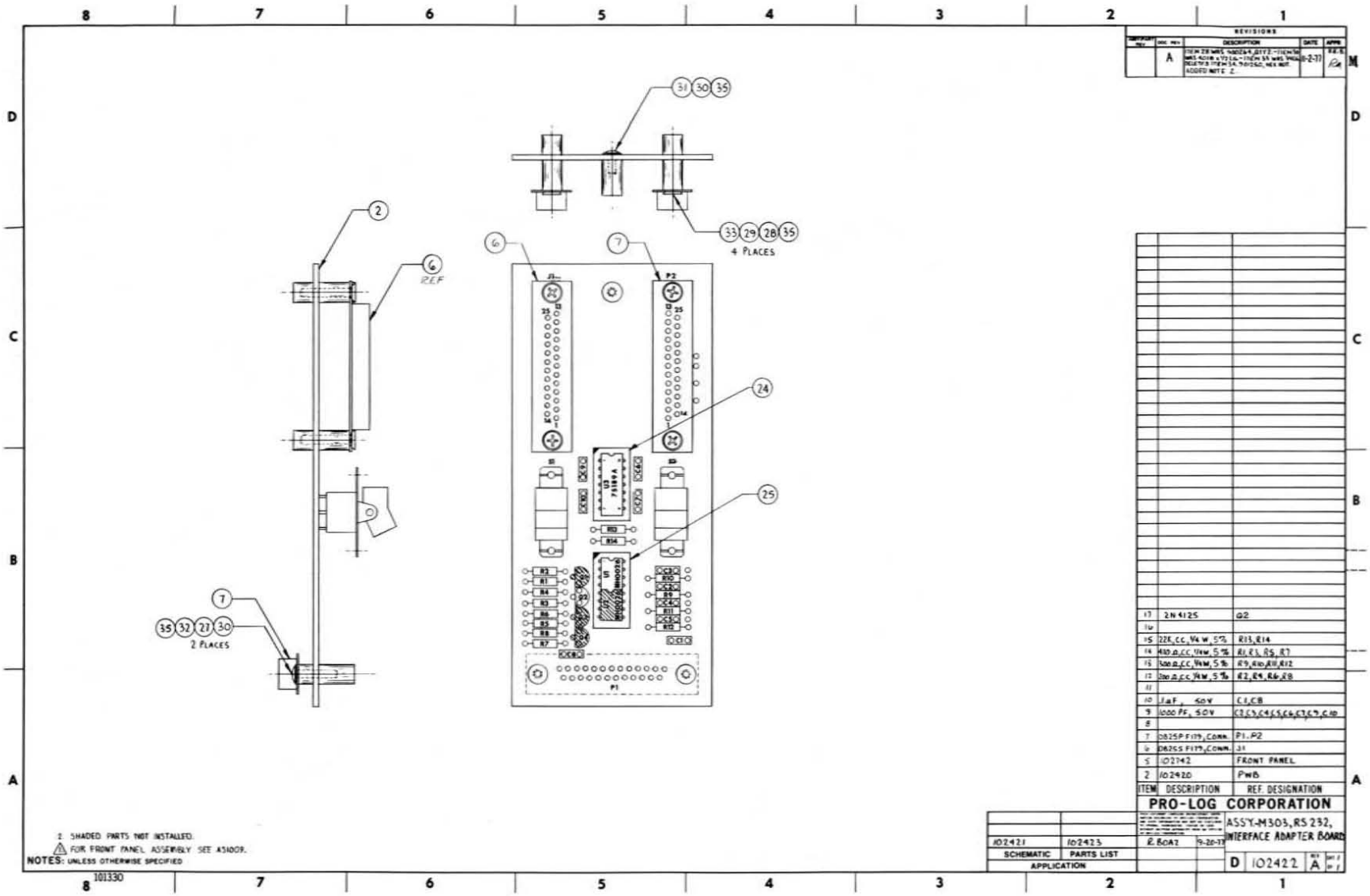

Schematic; M302, RS232 Interface Adapter Board



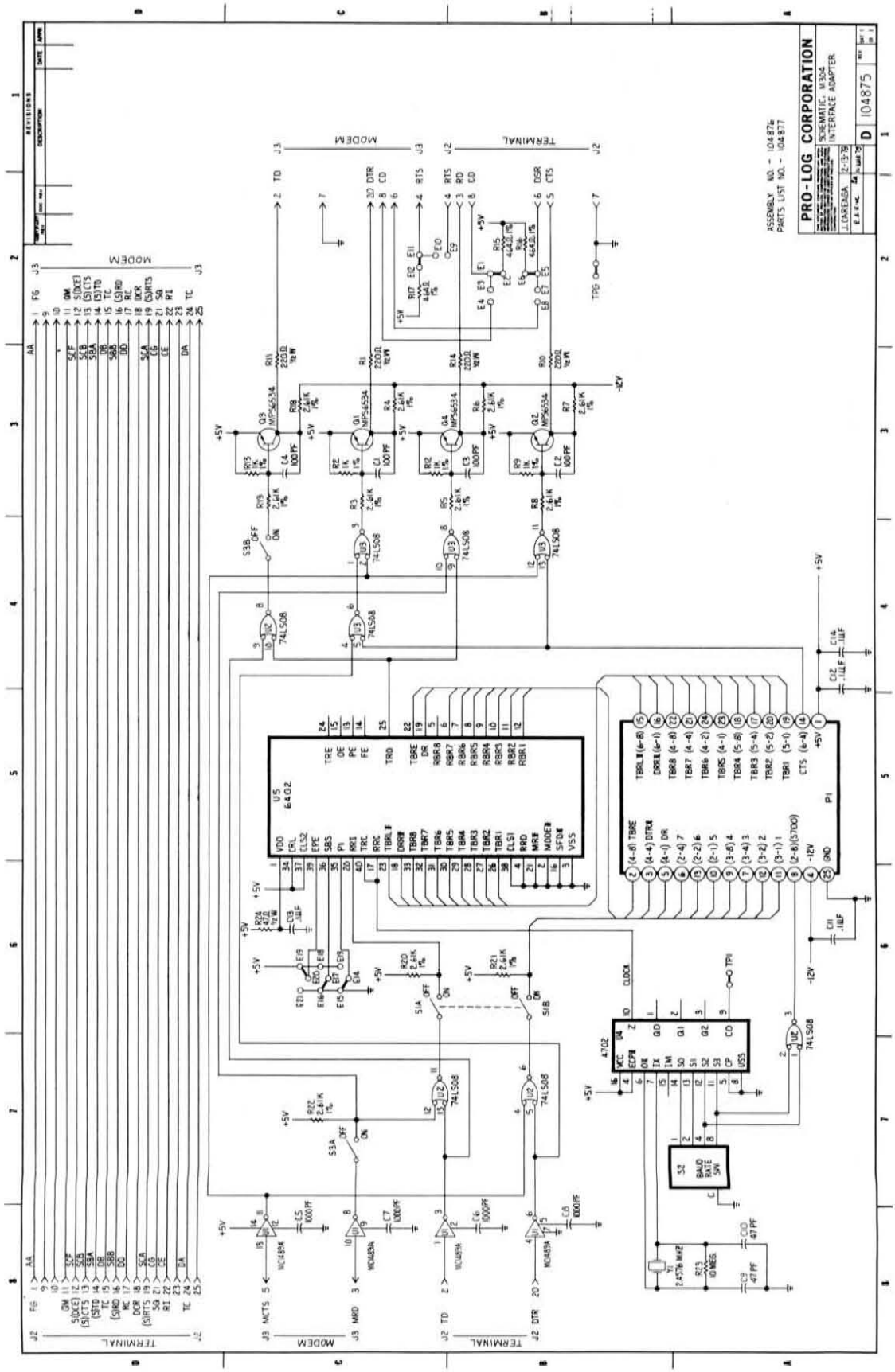

Assembly; M302, RS232 Interface Adapter Board



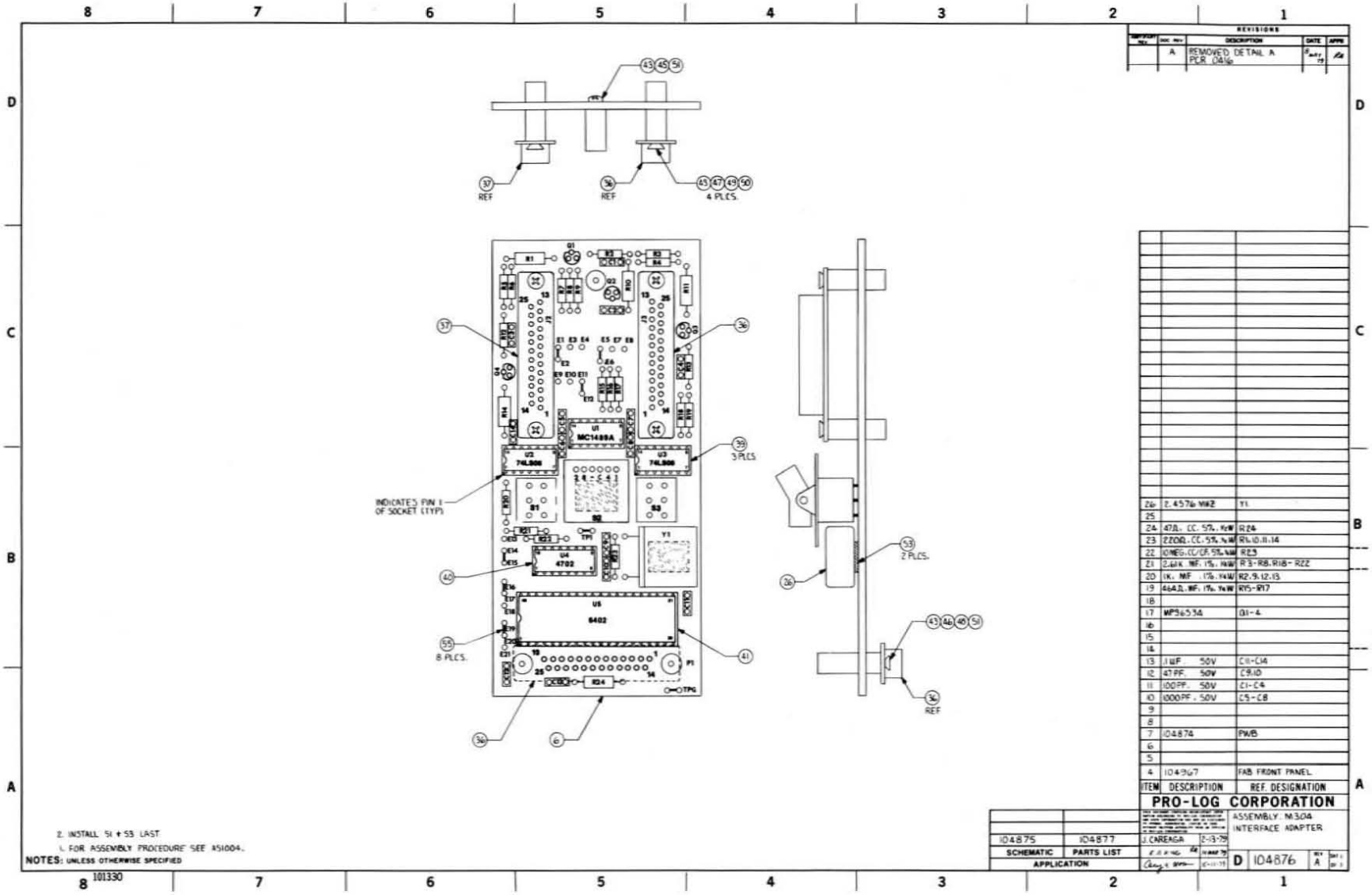

Schematic; M303, RS232 Interface Adapter Board




Assembly; M303, RS232 Interface Adapter Board




Schematic; M304 Interface Adapter




Assembly; M304 Interface Adapter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