PROM PROGRAMMER
SERIES 90

The Series 90 PROM Programmer is a low cost, portable and highly versatile solution to programming requirements for MOS and fusible link PROMs. The Master Control Unit may have plugged into it one of a series of Personality Modules to program any PROM now being manufactured and any that could be introduced in the foreseeable future.

Its conversational interaction with the operator makes it simple to use in engineering, manufacturing, quality assurance or in the field.

The unit may be used to program PROMs or PROM arrays having up to 4,096 words with up to 8 bits in each word.

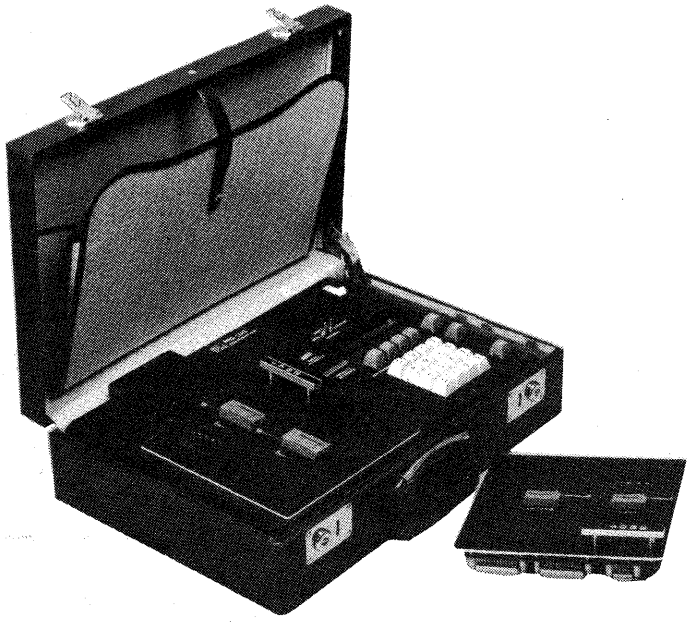
The Master Control Unit contains a microprocessor system which gives it the capability to handle the wide variety of PROMs and to interface with TTY, Paper Tape readers or punches, minicomputers and a host of other equipment. Most of these interfaces are available as standard options to the system.

The Personality Modules are readily pluggable modules which contain the specialized interfacing, power supplies and programming instructions required to program specific PROMs or families of PROMs. In many cases a single module enables the user to program several different types of PROMs.

The unit comes in an Attache Case and weighs less than 18 pounds — with a personality card plugged in.

FEATURES

- Simple to operate conversational system.
- Microprocessor controller gives computer power and flexibility.
- PROGRAM, LIST, DUPLICATE, and VERIFY, modes of Operation.
- Unique Program-Verify sequence adapts to needs of each bit.
- A DUPLICATE with advance substitution capability that allows up to sixteen changes to be made in the copy.
- Automatic Zero Check of defined address field.
- Hexadecimal Keyboard (0-9, A-F).
- Six Character Hexadecimal Display of Addresses and Data.
- Auxiliary Binary Data Display.
- Quick Load, Zero Insertion Force, PROM Sockets.
- Forced Air Cooling of PROMs and System.
- Fully portable for field or in-plant use.



SERIES 90

FUNCTIONS

List: Data stored in a PROM is read out a word at a time. The address is displayed in Hexadecimal and the data is displayed both in Hexadecimal and Binary.

Program: Keyboard Data is Programmed into the copy PROM. A Hexadecimal character defines each 4 bits at each address location in the PROM. Both address and Data are displayed for verification prior to actual programming. The unit automatically reads the PROM to verify correct programming.

Duplicate: Data in a MASTER PROM is automatically programmed into the COPY PROM. Prior to actual programming the operator can enter data corrections for up to 16 words.

Verify: Data in a MASTER PROM is automatically compared to data in the COPY PROM. The Programmer halts on a mismatch and displays the address and data in the Master PROM (in Hexadecimal) and the data in the COPY PROM (in binary). The operator can continue comparing beyond the mismatch. Verification of two matching PROMs takes about two seconds.

Zero Check: Once the operator defines the address field over which he will work, the unit automatically checks that field in the PROM and indicates whether or not it is all zeros.

INCLUDES

M900 Master Control Unit

- Microprocessor Controller with crystal clock and program expansion capability.
- Power On/Off Control — Lighted Circuit Breaker.
- Sixteen Key Data Entry Keyboard (0-9, A, B, C, D, E, F).
- Seven Control Keys: PROGRAM; DUPLICATE; LIST; VERIFY; RESET; CORRECT and ENTER.
- Address Invert and Data Invert Control Switches.
- Six Digit Hexadecimal Display.
- Zero Field Status Light.
- Cooling Fan.
- Attache Case.
- Receptacle and Connectors for Personality Modules.

PM9000 Personality Module

- Zero Insertion Force PROM Sockets for Master and Copy PROMs.
- Binary Data Display for Copy PROM (4 or 8 bits).
- Specialized Interface Circuits, Regulators and Program Instructions for specific PROM.
- Control Switches as required to enable special functions.

PHYSICAL CHARACTERISTICS

- Housed in an 18" x 12" x 4.5" Attache Case.
- Maximum weight: 18 pounds

POWER REQUIREMENTS

- Factory wired for either 117 V 60Hz, or 220 V (50-60 Hz).
- Maximum Power: 50 watts.

PERSONALITY MODULES

PM9001 — For 1702A MOS PROMs (256x8)
PM9002 — For 5202A MOS PROMs (256x8)
PM9003 — For 3601 Fusible Link PROMs (256x4)
PM9004 — For 3604 (Intel) Fusible Link PROMs (512x8)
PM9005 — For 5704 (Intel) MOS PROMs (512x8)
PM9006 — For 5204 (National) MOS PROMs (512x8)
PM9007 — For 5603A (Intersil) Fusible Link PROMs (256x4)
PM9008 — For 82S126 (Signetics) Fusible Link PROMs (256x4)
PM90XX — FOR OTHER PROMs

OPTIONS (All options are factory installed.)

9101 — Paper Tape Reader — Plug in attachment including photoelectric paper tape reader, interface circuits and control program. Expands system capability to program or verify a chip with data on paper tape. ASCII Hexadecimal Tape Coding is standard, but custom code formats may be specified for a small one-time fee.

9102 — Teletype Interface — Programming and interface connector providing hook-up to an ASR-33 (full duplex with remote reader control). Operator may list PROM to punch paper tape or record on Teletype Printer, program PROM from Teletype Keyboard or punched paper tape, or verify PROM with data on paper tape. Normal code is ASCII, Hexadecimal characters.

PRO-LOG CORPORATION
852 Airport Road
Monterey, California
(408) 372-4593

SERIES 90 SUMMARY

Series 90 programmers are portable intelligent programmers provided with a movable personality module and controlled by a micro-computer. The personality modules can be changed to accommodate different types of PROMs. The micro-computer interacts with the operator to guide him through each operation and is interactive with the PROM assuring him rapid and accurate device programming.

FEATURES

M900 Master Control Unit

- Portable attache packaging, less than 13 pounds
- Hexadecimal Keyboard and Displays (0-9, A-F)
- Data Invert Switch
- PROGRAM, LIST, DUPLICATE, and VERIFY modes of Operation
- Automatic Erase check in all modes
- A unique DUPLICATE with advance substitution capability that allows up to sixteen changes to be made in the copy
- Cooling Fan

PM9000 Personality Module

- Zero Insertion Force PROM Sockets for Master and Copy PROMs
- Binary Data Display for Copy PROM (4 or 8 bits)
- Specialized Interface Circuits, Regulators and Program Instructions for specific PROM
- Control Switches as required to enable special functions

Series 90 programmers are available for programming either ultra-violet erasible MOS PROMs or fusible link bipolar PROMs. The following table indicates the Series 90 Personality Module for PROM types currently supported.

PERSONALITY MODULES

PM 9001 - For 1702A, 8702 MOS PROMs (256x8)
PM 9002 - For 5202A, 5202 MOS PROMs (256x8)
PM 9003 - For 3601 Fusible Link PROMs (256x4)
PM 9004 - For 3604 (Intel) Fusible Link PROMs (512x8)
PM 9005 - For 5704 (Intel) MOS PROMs (512x8)
PM 9006 - For 5204 (National) MOS PROMs (512x8)
PM 9007 - For 5603A (Intersil) Fusible Link PROMs (256x4)
PM 9008 - For 82S126 (Signetics) Fusible Link PROMs (256x4)
PM 90XX - FOR OTHER PROMs

OPTIONS AVAILABLE

- 9101 Paper tape reader
- 9102 Teletype control
- 9104 Parallel input interface

It is recommended the reader review the section on Hexadecimal notation, P-24, before proceeding.

OPERATING PANEL DESCRIPTION

The operating panel shown in figure 1 has all the controls and indicators necessary for manual operation plus the connectors for operating with the teletype and paper tape reader options.

SOCKETS

COPY ROM Socket A zero insertion pressure socket which holds the PROM to be listed (read), verified, or programmed (from the keyboard or from the master ROM). Pin 1 is located by the locking lever in the upper left corner.

MASTER ROM Socket: A zero insertion pressure socket used in the VERIFY or DUPLICATE modes. The ROM in this socket contains the data to be programmed into the COPY PROM or to be verified against data in the COPY ROM. Pin 1 is located by the locking lever in the upper left corner.

DISPLAYS AND INDICATORS

NON ERASED light: An individual light located above the keyboard which lights if the address field in the COPY ROM is not completely erased. If the defined field is completely erased, the light remains out. Pushing the ENTER button during definition of the address field operates this light in all modes.

BINARY DATA Display: Four, eight, or twelve individual lights located to the right of the COPY socket. These lights display the data in the COPY ROM at the address shown by the Hexadecimal display. Each four lights represent one hexadecimal data character. The most significant bits are the top most bits and for 8 & 12 bit data the most significant Hex character is to the left. A light "off" represents a low level out of the COPY ROM for that bit. A light "on" represents a high level out of the COPY ROM for that bit.

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

The leftmost characters always represent address information whereas the rightmost characters can be either address information or data. The rightmost characters represent address information during the field definition phase at the beginning of all operating sequences. At all other times the rightmost characters represent data.

In List the data is the Hexadecimal equivalent of the Binary Data Display. In Program this data is the data to be programmed into the COPY ROM. In Verify or Duplicate this data is the data stored in the MASTER ROM (whereas the Binary Data Display simultaneously shows the data in the COPY ROM).

KEYBOARD

HEXADECIMAL Keys: Sixteen keys labelled 0-F and arranged in four rows of four keys. These keys are used to enter data into the system. This data may define the address field or may define data to be programmed into the COPY ROM. Each key represents one of the sixteen possible patterns of 1's and 0's for four bits. (See Hexadecimal notation)

LIST Key: A mode control key which puts the system in the List mode. In this mode the COPY ROM may be read one address at a time both on the Binary Data Display and on the Hexadecimal Display.

PROGRAM Key: A mode control key which puts the system in the program mode. In this mode the COPY ROM may be programmed an address at a time from data entered through the keyboard.

VER Key: A mode control key which puts the system in the Verify mode. In this mode the data in the MASTER ROM is compared to the data in the COPY ROM. The system displays the address and data in the two ROMs at each location where there is a mismatch.

DUP Key: A mode control key which puts the system in the Duplicate mode. In this mode the data in the MASTER ROM is copied into the COPY ROM. Up to sixteen corrections can be entered into system memory prior to the actual programming of the COPY ROM. These corrections (identified by address and data) will be programmed in the COPY ROM rather than the original data in the MASTER ROM.

RESET Key: A control key which resets the operation regardless of what is going on in the system. The Hexadecimal Display is cleared but the Binary Data Display shows the data in address 00 of the COPY ROM. A mode control key (List, Prog, Ver or Dup) must be pushed before the system will operate.

CLEAR Key: A control key which erases the rightmost character displayed in the Hexadecimal Display. Its primary use is to

allow correction of erroneous keyboard data entries. It may also be used to redefine address data.

ENTER Key: A control key which causes the system to execute one cycle of operation as defined by the mode the system is in. In the LIST Mode the system proceeds to the next sequential address in the field being Listed. In the PROGRAM Mode the system performs the data programming defined by the data in the Hexadecimal Display and proceeds automatically to the next address in the field being programmed. In the VERIFY or DUPLICATE Modes the system proceeds automatically from one operation to the next. The enter key function is described in more detail in the operating instructions for each operating sequence.

DATA INVERT SWITCH: In the normal position all 1's in the data to be programmed provide a high level at the programming input of the chip in the copy socket. With the switch in the inverted position 1's in the input data word cause a low level programming input to the chip.

MANUAL OPERATING SEQUENCES

"LIST" Operating Sequence

In the LIST Mode the data in the COPY ROM is read and displayed by both the Binary Data Display and the Hexadecimal Display.

1. Insert the ROM to be listed (read) in the COPY ROM socket. (It does not matter if there is or isn't a ROM in the Master Socket).

2. Push the "LIST" Key. The Hexadecimal Display shows 00 this is a question about the address field to be listed. If you wish to start reading the ROM at address 00 and to proceed sequentially through all addresses then proceed immediately to step 3. If you wish to start at another address (say 99) and proceed over a limited field (say to AB) then enter the data 99AB through the Hexadecimal Keyboard. Proceed to step 3.

3. Push the ENTER Key. The "NON ERASED" light turns on if there is data stored anywhere in the selected address field of the ROM. The address being read is shown in the first two (leftmost two) characters of the Hexadecimal display. The data stored in the COPY ROM at that address is shown in the rightmost character of the Hexadecimal Display and in the Binary Data Display.

4. To proceed to the next address, push the ENTER Key. The address shown in the Hexadecimal display increments and the

data will change to reflect the data in the COPY ROM at the new address. If the previous address was the last one in the defined address field (per step 2), the leftmost character of the Data Display will be F and the other three characters will be blank.

"PROGRAM" Operating Sequences

1. Insert the ROM to be programmed into the COPY ROM socket. (It does not matter if there is or isn't a ROM in the MASTER socket).

2. Push the PROG Key. The Hexadecimal Display shows 00 FF (1), this is a question about the address field to be programmed. If you wish to start programming the ROM at address 00 and to proceed sequentially through all addresses, then proceed immediately to step 3. If you wish to program over a limited field, key in the starting and ending address of that field through the Hexadecimal keyboard. That data will replace the 00 FF in the Hexadecimal Display. Proceed to step 3.

3. Push the ENTER Key. The NON ERASED light turns on if there is data stored anywhere in the field defined in step 2. The leftmost two characters of the Hexadecimal Display show the first address to be programmed. The rightmost two characters are not lit. The Binary Data Display shows the data stored in that address. If any of the Binary Data Display lights indicate programmed bits, it is possible that address location can not be properly programmed.

4. Enter the data to be programmed by keying in the appropriate Hexadecimal data (two characters for 8 bit PROMs and one character for 4 bit PROMs). This data will appear in the rightmost position(s) of the Hexadecimal Display. The ROM itself will not be programmed until the ENTER key is pushed. If an incorrect character is entered, push the clear key and the last character entered will be erased. Key in the correct character.

5. Push the ENTER Key. The unit will program the ROM according to the information shown in the Hexadecimal Display. When the programming is successfully completed the next sequential address to be programmed is automatically displayed in the Hexadecimal Display. Steps 4 and 5 are repeated until the entire field has been programmed.

6. If any of the bits at a location will not successfully program, the unit will stop at that location with the following indications.

Fusible PROMs: The unit may take from 3 to 12 seconds as it tries to program the bad location. When the unit completes an unsuccessful effort to program a location, it stops with an "E" for error in the sedond digit from the right in the Hex display. The rightmost digit displays the pattern that was being programmed and the binary display indicates the actual pattern in the PROM. The operator may retry the failed location by pushing the ENTER key. If the retry is successful, the address will step to the next sequential address. If the retry is unsuccessful, the operator may retry as often as he desires by pressing the ENTER key when the "E" appears in the display.

If it is desired to step aroung the failed location, the operator must start from step 2 defining the next address as the starting field address.

UV PROMs: When the unit completes an successful effort to program a location, it stops with a blank data field in the Hex display and the failed address shown in the address field. The binary data display indicates the actual pattern in the PROM. The keyboard is locked out preventing any new data entry. The operator may proceed from the next address in sequence by pushing the ENTER key.

The operator can use a failed PROM in the DUPLICATE mode to generate a good PROM. DO NOT TRY TO PROGRAM A FAILED LOCATION AGAIN ON A UV ERASIBLE PROM. The programming routine is designed to insure adequate margins over the life of the PROM, attempting to reprogram an address without first erasing the entire PROM will result in a marginal data condition (see UV application, P-25).

7. When the specified field has been successfully programmed, the Hexadecimal display shows an F in the leftmost position with all other positions blank.

"DUPLICATE" Operating Sequence

In the Duplicate mode the data stored in the MASTER ROM is programmed into the COPY ROM. During the programming of each location the data is verified and the system stops if it cannot correctly program a given location. The operator may enter up to sixteen corrections into the system prior to the actual programming of the COPY ROM. These corrections are entered via the Hexadecinal Keyboard into a memory in the system controller. The operator specifies the address to be changed and the data to be stored in the COPY ROM in lieu of the data in the MASTER ROM. Each character is automatically verified after programming.

1. Insert the ROM containing the source data in the MASTER socket. Put the ROM to be programmed into the COPY socket.

2. Push the DUP key. The Hexadecimal Display shows 00 FF (1), this is a question about the address field to be programmed. if you wish to program the entire COPY ROM proceed to step 3. If you wish to program over a limited field then enter the first and last address of the field to be programmed via the Hexadecimal keyboard and proceed to step 3.

3. Push the ENTER key. Check the NON ERASED light. If it is on, the COPY ROM is not erased over the field to be programmed and the operator must decide whether to proceed or not.

4. The Hexadecimal Display contains CO in the positions. This is a question asking "what is the first correction you wish to make in the COPY ROM?" If you simply wish to duplicate the MASTER ROM, proceed to step 5. It you wish to make a correction, then enter the address of that correction and the data to be substituted for the data in the MASTER ROM through the Hexadecimal kayboard. This address and data information is displayed on the Hexadecimal Display. Then push the ENTER key again; the display changes to C1.... this is a question about the next correction to be entered. Enter the required information and repeat the operation up to sixteen times (to CF on the display) if you wish. When you have entered the last correction, proceed to step 5.

5. Hit the ENTER key. The programming of the COPY ROM proceeds automatically. When all locations are properly programmed, the Hexadecimal Display has an F in the leftmost position and the other three positions are blank. If a location in the COPY ROM cannot be properly programmed, the system stops at that address. The retry procedure is identical to step 6 as defined in the PROGRAM mode.

"VERIFY" Operating Sequence

In the VERIFY mode data in the MASTER ROM is compared to the data in the COPY ROM. The unit automatically sequences through the defined field comparing data and stops only if there is a mismatch. If there are no mismatches, it proceeds to the end of the field and an F is displayed in the leftmost position of the Hexadecimal Display; all other positions are off. The VERIFY mode takes less than two seconds for two matching ROMs.

1. Insert the two ROMs to be compared in the system, one in the MASTER socket and the other in the COPY socket. Make sure both are properly locked in place.

2. Push the VER key. The Hexadecimal Display shows 00 FF (1). This is a question about the address field over which data is to be compared. If you wish to compare data in the entire ROM, proceed immediately to step 3, otherwise enter the starting and ending addresses of the field to be compared through the Hexadecimal keyboard.

3. Push the ENTER key. The Verify is executed automatically. If all positions in the defined field compare, the Hexadecimal Display ends up with an F in the leftmost position and the other three positions blank. 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, the contents of the MASTER ROM in the rightmost position(s) of the Hexadecimal Display and the contents of the COPY ROM in the Binary Data Display. The operator can make the system proceed to VERIFY from the next address by pushing the ENTER button again.

(1) 00 FF describes the address limits for 256xN PROM. Other examples would be:

000 2 FF for a 512xN PROM

TELETYPE OPTION

The 9102 TTY option is a factory installed feature which provides an interface to a modified ASR-33 teletype.

With the TTY connected the Series 90 can be operated from either the TTY or its own Hex keyboard. The unit initiating the mode takes control of the operation. The RESET key can be used to terminate control.

The TTY can be used to LIST, PROGRAM, DUPLICATE, or VERIFY.

In LIST the TTY prints the address and data of the COPY PROM. If the punch is ON, a paper tape can be created.

In PROGRAM the TTY prints the address and the operator enters data to the COPY PROM from the TTY keyboard. The TTY punch can be used to create a paper tape.

In DUPLICATE the TTY paper tape reader is used as an input to program the COPY PROM.

In VERIFY the contents of the COPY PROM are checked against the paper tape.

TTY INTERFACE

The TTY connects to the Series 90 programmer via a 9 pin D type connector mounted to the left center on the control panel. The interface within the Series 90 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.

This interface allows full-duplex send and receive, and remote reader control. The separate send and receive of full-duplex allows the Series 90 to edit the input data before printing and/or punching the output data. Remote reader control allows the Series 90 to operate the TTY

reader at a rate compatible with the programming rate of the particular PROM being programmed.

The 20 milliamp send and receive loops are options available on the ASR-33 TTY obtained by wiring the TTY for full-duplex operation. The remote reader control requires the addition of a 12 to 15 volt DC relay capable of switching the 115 volt AC reader circuit inside the TTY.

A number of mini-computers specify a similar interface, thus many teletypes already have this connection.

A schematic of the connection is shown in figure 2. Detailed instructions for modifying a standard ASR 33 to this interface are given in the Intel MCS-4 Users Manual. Appendix D. Also refer to the application note section for additional TTY interface information.

TTY CONTROLS AND INDICATORS

There are no special controls or indicators on the Series 81 for the TTY option. The RESET key is the only key used in conjunction with the TTY operation. If the TTY is properly connected in the LINE mode, the RESET key will cause the TTY to print NUL characters for as long as the key is held down.

TTY operation is controlled by the TTY keyboard and switches.

Mode Switch: A three position rotary switch located to the lower right of the TTY keyboard.

- LOCAL position allows local TTY control.
- OFF position disables the TTY.
- LINE position allows remote control of the TTY and is the setting for operating with the Series 81.

Reader Control Switch: A four position lever switch located on the TTY paper tape reader.

- MANUAL START is a momentary contact to start the reader in LOCAL.
- AUTO is the normal position for remote operation.
- MANUAL STOP is a momentary contact to stop the reader in LOCAL.
- FREE is the position for loading and unloading paper tape.

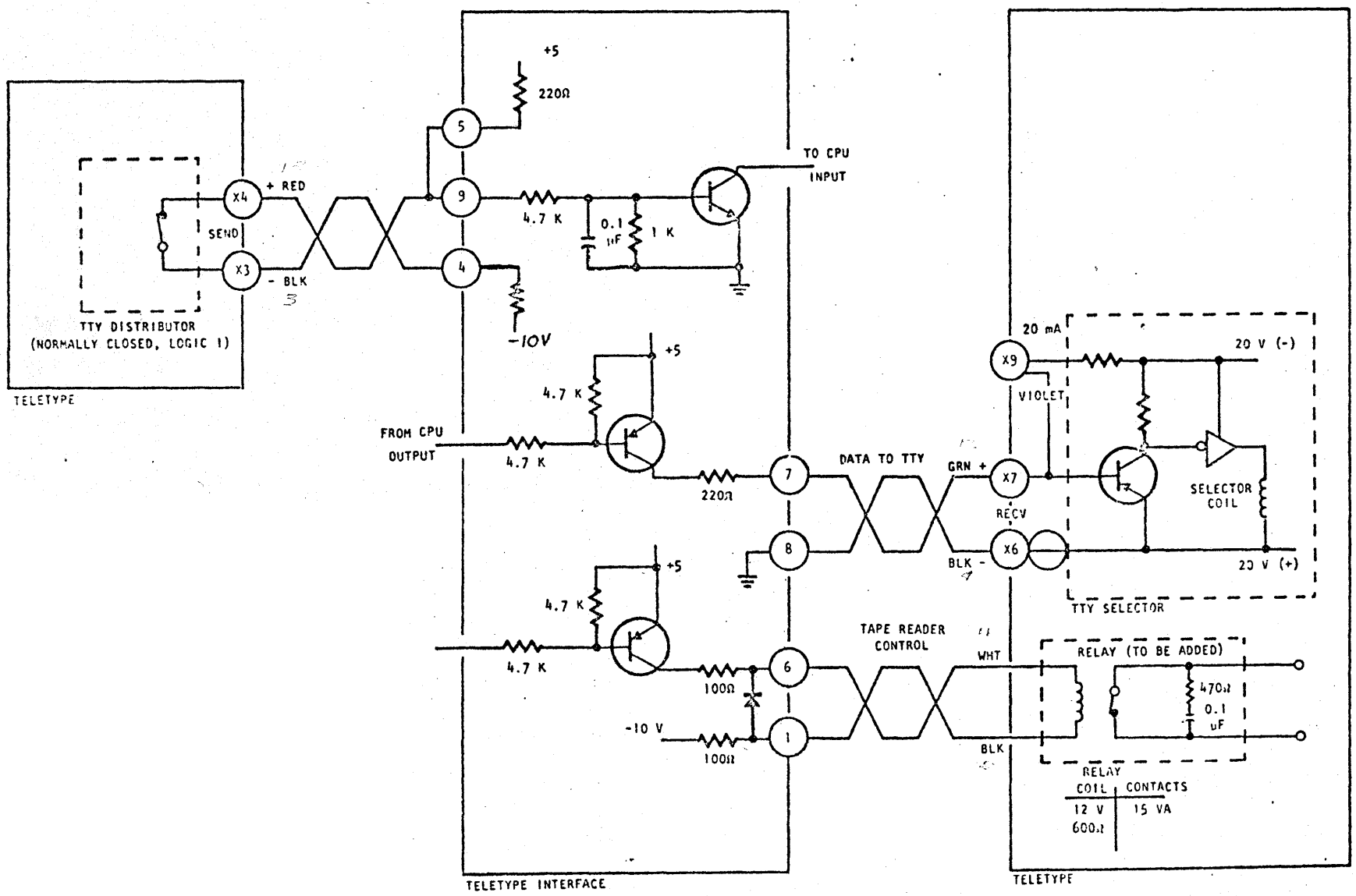


FIGURE 2
Teletype Interface

Punch Controls: Four push-buttons located on the punch.

- ON, enables the punch.
- OFF, disables the punch.
- RELEASE, disengages the punch drive for tape loading.
- BACK SPACE, moves tape backward one character.

Keyboard: Keys for entering data and control characters from the TTY.

TTY PAPER TAPE FORMAT

The paper tape format for the standard Series 81 TTY option requires 8 level ASCII Hex characters. The character sequence on tape is address, data, and carriage return.

Non-Hex characters are allowed between the address and data, and following the carriage return. When a tape is generated in the LIST mode the actual format for each line becomes: address, space, data, carriage return, and line feed. Since address information is included on the tape, random addresses may be programmed.

256 x 8 PROMs: Two Hex address characters followed by two Hex data characters followed by a carriage return.

256 x 4 PROM: Two Hex address characters followed by one Hex data character followed by a carriage return.

512 x 8 PROM: Three Hex address characters followed by two Hex data charaters followed by a carriage return.

Ending Character: The paper tape reader stop command character is the ASCII character slash (/). The stop command should follow the last location to be programmed.

TTY OPERATING SEQUENCES

The TTY takes control fo the programmer whenever the programmer is reset and any key is operated on the TTY keyboard with the TTY in the LINE mode. The TTY can be used to LIST, PROGRAM, DUPLICATE or VERIFY. The operating mode is selected by the asterisk (*) followed by L, P, D, or V. In LIST and PROGRAM the address field must be defined following mode selection.

LIST Operating Sequence: In the LIST mode data in the COPY ROM is read and displayed on the Binary Data Display and printed with is address on the TTY.

1. Insert the ROM to be listed in the COPY socket.

2. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).

3. Type the letter L on the TTY keyboard. The TTY will do a CR and LF.

4. Type in the four Hex characters that define the starting address and the ending address of the field to be listed. The TTY will do a CR, LF, LF and begin automatically listing the content of the COPY ROM over the defined address field.

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

5. When the TTY reaches the end of the field it does a LF, prints a slash (/) and does another CR and LF.

Sample listing of a 256 x 8 ROM:

```
*          Type *, TTY does CR LF
L          Type L, TTY does CR LF
0B16       Type field, TTY does CR LF
           TTY does LF
0B 7A      TTY lists Adr Adr space Data Data CR LF
0C 5C
0D 5D
0E 24
0F E3
10 68
11 F2
12 CD
13 EE
14 4F
15 18
16 69
           TTY does LF
/          TTY does /, CR and LF
           TTY stops
```

To make a paper tape to use in the DUPLICATE mode of operation it is necessary to leave the punch OFF until just prior to entering the last character in the field definition step. This

is necessary because in DUPLICATE the field definition would be interpreted as an address and data.

PROGRAM Operating Sequence: In the PROGRAM mode data from the TTY keyboard is programmed to the COPY PROM.

1. Insert the PROM to be programmed in the COPY socket.

2. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).

3. Type the letter P on the TTY keyboard. The TTY will do a CR and LF.

4. Type in the four Hex characters that define the field to be programmed. The TTY will do a CR, LF, LF and print the first address.

5. Type the Hex data to be programmed into the COPY PROM. The TTY begins programming when valid Hex data is entered and does a CR, LF and prints the next sequential address when the programming operation is complete.

6. If invalid data is entered the TTY does a CR, LF, LF and reprints the current address. The operator can enter the correct data.

7. If the location cannot program for any reason, the TTY does a CR, LF, LF and reprints the current address. The operator may retry the same address but should observe the precautions defined in step 6 of the Manual Program operating sequence. If the operator desires to proceed past a failed location, it is necessary to start from step 2 and define the starting address as the next sequential address.

8. When the TTY reaches the end of the field, it does a LF, prints a slash (/) and does another CR and LF.

Sample Program of a 256 x 8 PROM from TTY:

```
*          Type *, TTY does CR and LF
P          Type P, TTY does CR and LF
0009       Type address field, TTY does CR and LF
           TTY does LF
00 28      TTY prints address, operator types data
01 DA
02 59
03 DW           Operator error, non-hex data, TTY does CR LF
                TTY does LF
03 DA           TTY reprints address 03
04 5C
05 C2
06 22
07 R            Operator error, non-hex data, TTY does CR LF
                TTY does LF
07 5C           TTY reprints address 07
08 88
09 FC
           TTY prints LF
/          TTY prints /, CR and LF
           TTY stops
```

DUPLICATE Operating Sequence: In the DUPLICATE mode of operation a paper tape is read by the TTY reader. Data on the tape is interpreted as address and data. This is the reason for caution when making a paper tape in the PROGRAM and LIST modes of operation. In the DUPLICATE mode of operation the only data that is printed is exception data. If an address cannot be programmed to the data on tape, both address and the data read from the ROM at that address will be printed out.

1. Insert the PROM to be programmed in the COPY socket.

2. Load the paper tape to be duplicated on the TTY paper tape reader.

3. Place the paper tape reader control switch in the AUTO position.

4. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).

5. Type the letter D on the TTY keyboard. The TTY will do a CR and LF, and the reader will begin to read the address and data information. As each location is

programmed the address and data will appear in the Hex display.

6. If a location cannot be programmed, the address and the data of the COPY ROM at that address will be printed on the TTY. The operation does not stop on errors.

7. The DUPLICATE mode ends when a slash (/) is read from the paper tape.

VERIFY Operating Sequence: The VERIFY mode compares the data from the paper tape against the data in the COPY ROM. The data from the tape appears with the address in the Hex display.

1. Insert the ROM to be verified in the COPY socket.

2. Load the paper tape containing the master information on the TTY paper tape reader.

3. Place the paper tape reader control switch in the AUTO position.

4. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).

5. Type the letter V on the TTY keyboard. The TTY will do a CR and LF and the reader will begin to read. As each location is verified, address and data will appear in the Hex display.

6. If a location does not verify, the address and data of the COPY ROM at that address will be printed on the TTY. The operation does not stop on errors.

7. The VERIFY mode ends when a slash (/) is read from the paper tape.

PAPER TAPE READER OPTION

The 9101 reader option is a factory installed feature which provides an interface to a PRO-LOG M301 paper tape reader.

With the reader option the programmer can input data at a rate of 100 characters per second for use in the DUPLICATE or VERIFY modes. The actual operation rate is a function of the mode and type of ROM being operated upon.

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

PAPER TAPE (OR PARALLEL I/O) CONNECTOR

The M301 paper tape reader connects to the programmer via a 25 pin D type connector. This connector is mounted in the upper center of the programmer control panel.

This connector provides four drive lines for reader stepping control, nine data lines from the reader, and power connections. (used in the parallel I/O mode it provides 8 data input, 8 data output and 7 control lines for handshake and communications).

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 manual 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 manual 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 COPY ROM. When the reader is not connected or not enabled, the VER key functions as defined for the Series 90 in manual 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 programmed into the COPY ROM. Up to sixteen corrections can be entered into Series 90 memory prior to the actual programming of the COPY ROM. These corrections will be programmed in the COPY ROM rather than the original data from the paper tape. When the reader is not connected or not enabled, the DUP key functions as defined for the Series 90 in manual operation.

Other Keys: All other keys on the programmer function exactly as defined for manual 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 Series 90 programmer. Indicates address and data information during reader operations.

PAPER TAPE FORMAT

The paper tape format for the standard reader option requires 8 level, ASCII, HEX sequential data.

Address: Address information must <u>not</u> be on the tape. The programmer keeps sequential address count for each location operated on.

Data, 8 bit PROMs: Each 8 bit location to be programmed 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.

Data, 4 bit PROMs: Each 4 bit location to be programmed 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 preceeds the asterisk start character.

Ending Character: The data stream can be terminated by the ASCII character slash (/) if less than a full ROM is to be duplicated.

PAPER TAPE OPERATING SEQUENCES

DUPLICATE Operating Sequence: In the DUPLICATE mode data from the paper tape is programmed into the COPY ROM. During the programming of each location the data is verified and the system stops if it cannot correctly program a given location. The operator may enter up to sixteen corrections into the system prior to the actual programming of the COPY ROM. These corrections are entered via the Hexadecimal Keyboard into a memory in the system controller. The operator specifies the address to be changed and the data to be stored in the COPY ROM in lieu of the data on the paper tape. Each bit is automatically verified after programming.

1. Mount the paper tape, with the pattern to be programmed, on the M301 reader. Ensure that the Reader Power and Reader Enable switches are in the ON position. Insert the ROM to be programmed in the COPY socket of the Series 90 programmer.

2. Push the DUP key. The Hexadecimal Display shows 00 FF as a question about the address field to be programmed. If you wish to program the entire COPY ROM, proceed to step 3. If you wish to program over a limited field, then enter the first and last addresses of the field to be programmed via the Hexadecimal keyboard and proceed to step 3.

3. Push the ENTER key. Check the NON ERASED light. If it is on, the COPY ROM is not erased over the field to be programmed and the operator must decide whether to proceed.

4. The Hexadecimal Display contains C0 in the leftmost two positions. This is a question asking "what is the first correction you wish to make in the COPY ROM?" If you simply wish to duplicate the paper tape, proceed to step 5. If you wish to make a correction, enter the

address of that correction and the data to be substituted for the data on the paper tape through the Hexadecimal keyboard. This address and data information is displayed on the Hexadecimal Display. Push the ENTER key again, the display changes to C1....this is a question about the next correction to be entered. Enter the required information and repeat the operation up to sixteen times (to CF on the display) if you wish. When you have entered the last correction, proceed to step 5.

5. Push the ENTER key. The paper tape will be read and programmed into ROM in the COPY socket. When all locations are properly programmed, the Hexadecimal Display has an F in the leftmost position. If a location in the COPY ROM cannot be properly programmed, the system stops at that address. The operator may proceed from the next location by pushing the ENTER key.

6. The operator should observe the precautions given in step 6 of the Manual Program operating sequence before trying to reprogram a failed location.

VERIFY Operating Sequence: In the VERIFY mode data from the paper tape is compared to the data in the COPY ROM. 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 an F is displayed in the leftmost position of the Hexadecimal Display. The VERIFY mode takes less than five seconds for matching data.

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. Insert the ROM to be verified in the COPY socket of the Series 90 programmer.

2. Push the VER key. The Hexadecimal Display shows 00 FF as a question about the address field over which data is to be compared. If you wish to compare data in the entire ROM, proceed immediately to step 3, otherwise enter the starting and ending addresses of the field to be compared through the Hexadecimal keyboard.

3. Push the ENTER key. The paper tape will be read and verified with the data in the COPY socket. If all

positions in the defined field compare, the Hexadecimal Display ends with an F in the leftmost position. If there is a mismatch, the system stops at the address of the mismatch and displays the the address of the mismatch in the Hexadecimal Display, the contents of the paper tape in the rightmost two positions of the Hexadecimal Display and the contents of the COPY ROM in the Binary Data Display. The operator can make the system proceed to VERIFY from the next address by pushing the ENTER button again.

Hexadecimal Notation is a convenient way of representing all sixteen combinations of four bits of information with a single character. The most popular character set for displaying Hexadecimal data are the characters 0 thru 9 to represent the binary combinations 0 thru 9 and A B C D E and F to represent the binary combinations 10 thru 15.

Hexadecimal Character	Binary Equivalent				Decimal Equivalent
	8	4	2	1	
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

As an extension of this technique, all 256 combinations of 8 bits can be represented by two hexadecimal characters.
Example Hexadecimal representation of 8 bits:

Hexadecimal Characters	Binary Bits	Decimal Character
000	0000 0000 0000	0
001	0000 0000 0001	1
03E	0000 0011 1110	52
042	0000 0100 1101	66
0E1	0000 1110 0001	241
0FF	0000 1111 1111	255
200	0010 0000 0000	512

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

UV PROMs: PROGRAMMING TECHNIQUES

Ultra-violet erasible PROMs are programmed by inducing charges in buried MOS gates within the device. These charges are induced by gating sufficient voltage to the bit to cause avalanche injection of electrons into the floating gate. The trapped charge on the gate biases the MOS FET associated with the gate.

It is the nature of this charge that within a short time (48 hours) after programming a certain degradation is observed. This is due to recombination of loosely trapped charge on the gate and those charges that were left within the insulating oxide.

Floating gate UV PROMs are not purely digital in nature in that insufficiently programmed or improperly erased bits may give a partial output that is between the specified one or zero level.

The keys to successful programming of UV PROMs is to begin with a properly erased PROM and to provide sufficient overcharge so that unwanted charge or ion migration does not cause a bit to become marginal.

The Series 90 programmer evaluates where the threshold is of each bit and insures a minimum overcharge of 40% while avoiding unnecessary overcharging.

The Series 90 provides an overcharge based on how many programming pulses it took to reach the threshold. This technique requires two precautions:

1. Always start with a fully erased PROM.
2. Never try to reprogram a location that did not program on the initial try.

UV PROMs: ERASING TIME

The correct erasure time for UV PROMs is a function of the lamp intensity and distance from the lamp to the PROM. It is possible to under-erase causing data retention problems, and it is possible to over-erase causing permanent damage to the PROMs. The following table gives the recommended erasure time using the PRO-LOG 8103 UV erase light.

Device Type	Erase Time	Timer Set
1702A	15 minutes	180° (start)
1702	30 minutes	360°
5202, 5203	30 minutes	360°

UV PROMs· EVALUATION TECHNIQUE

The Series 90 programmer can be used as a tool for evaluating the quality of UV PROMs such as for incoming inspection. This is accomplished by fully erasing the PROM and then using the DUPLICATE mode, programming all bits into the device. The programmer has built in programming limits. Any PROM which fails to program on the Series 90 should be rejected.

TTY Modification for Model 3320 SJA Teletype

Inside the cover of the TTY, locate a bank of 15 pin Molex connectors on the upper left as you face the rear of the TTY. The sedond plug from the left on the top row is called P2. Most TTYs from the factory have a jumper between pin 1 and pin 2 of P2. This jumper must be included in the P2 plug. The interface cable supplied with the Series 90 TTY option should be wired into P2 as follows:

Series 90 Circuit	Series 90 Connector		TTY P2 Connector	TTY Circuit
Data to TTY	Pin 7	green	Pin 7	receive +
Ground	Pin 8	black	Pin 8	receive -
Data from TTY	Pin 9	red	Pin 6	send +
-10 VR	Pin 4	black	Pin 4	send -

For the TTY reader control, the third plug on the left in the top row is P3. Pins 7 and 8 of this plug are connected together. Break this jumper and connect pins 7 and 8 to the normally open contacts of the relay to be added to the TTY.

Series 90 Circuit	Series 90 Connector		TTY
+5 switched	Pin 6	white	relay coil +
-10 VR	Pin 1	black	relay coil -

Interface to a TTY Modified for PDP Series Minicomputer

PDP Series minicomputers use a TTY interface compatible with Series 90 programmers. The TTY modification is referred to as: SCA #013: M33 DCT Interface to a DEC PDP Series Minicomputer - TYPE I.

This modification provides an 8 pin connector on a 6 to 12 foot cable. The connector is a special DEC port. The Series 90 TTY option can be interfaced directly by mating to the special connector.

Series 90 Circuit	Series 90 Connector		TTY Connector		TTY Circuit
Data to TTY	Pin 7	green	Pin 5	black	receive +
Ground	Pin 8	black	Pin 2	white	receive -
Date from TTY	Pin 9	red	Pin 7	red	send +
-10 VR	Pin 4	black	Pin 3	green	send -
+5 Switched	Pin 6	white	Pin 6	orange	relay + (XTR Control)
-10 VR	Pin 1	black	Pin 4	blue	relay - (-15 VDC)

INDEX TO DRAWINGS

100634	Block Diagram, 1702 Manual PROG
100677	Block Diagram, 3601 Manual PROG
100724	Schematic, PLS 402
100610	Assy, PLS 402
100202	Schematic, Power Supply
100232	Assy, Cable TTY Interface

ADDENDUM TO M900 MANUAL:

A switch has been added to PM9001 and PM9002 to accommodate a wider range of devices.

This switch is labled VDD -10/-9 on PM 9001 and -12/-9 on PM 9002. On the PM 9001 for 1702A devices, the switch should be in the -9V position for programming 1702A devices with VDD specified at -9V on the device data sheet. The -10V position should be used when programming a device where VDD = -10V. This setting is used for 1702A-S314 devices presently.

Likewise, on PM 9002, the -12V position should be used for devices where VDD = -12V and the -9V position for devices where VDD = -9V.

REV	DESCRIPTION	DATE	APPR
A	CORRECT DISPLAY ON INVERTED RETRY	11-6-74	MZB
B	ADDED PARALLEL INTERFACE	1-31-75	MZB

M. Brown 11-4-74

PRO-LOG CORPORATION

PROGRAM SERIES 90 CONTROL

A	100789	REV B	SHT 1 OF

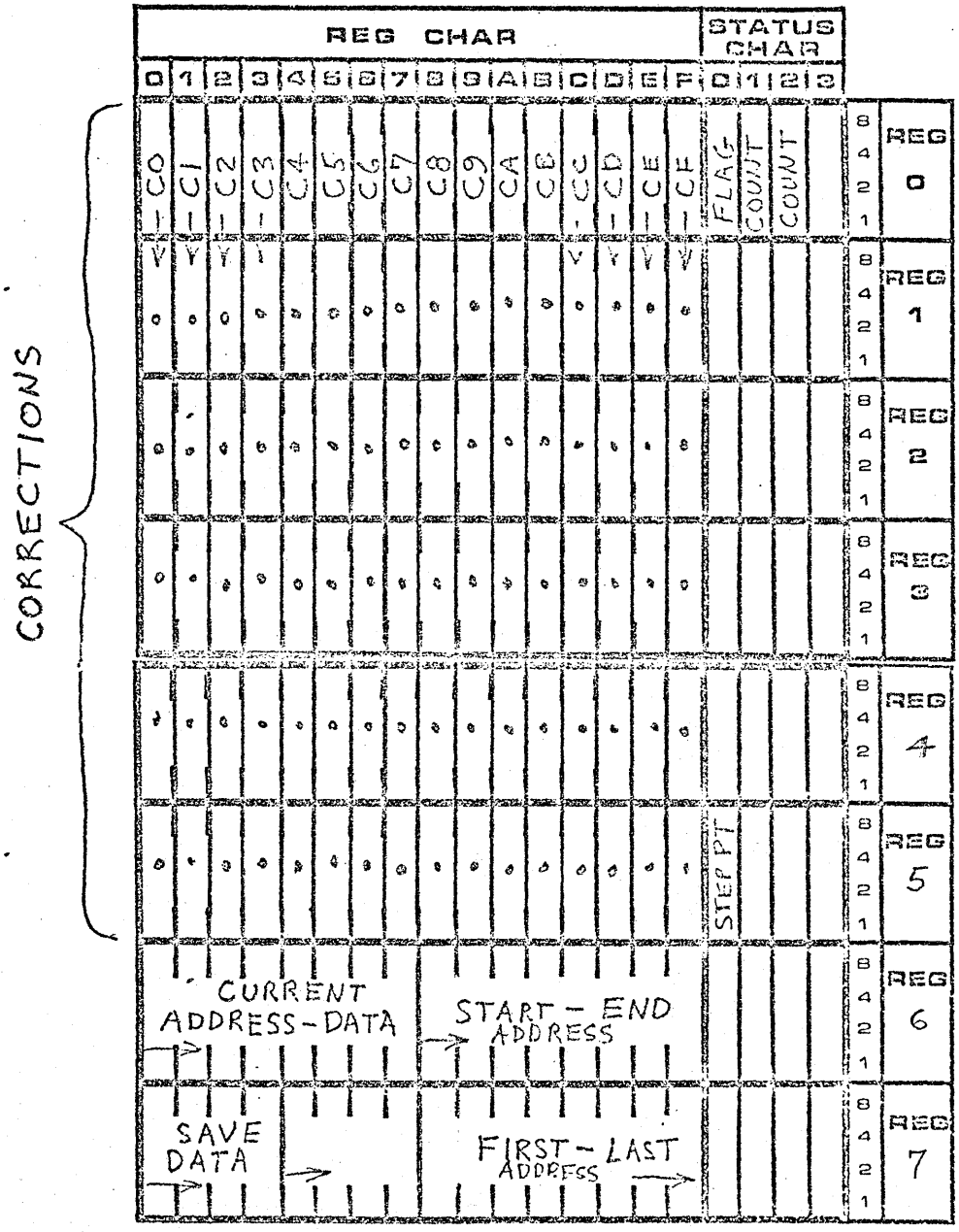
This program is the control program for the Series 90 programmers.

OPTIONS

Options are installed with program changes as defined in the following table:

PROGRAM	OPTIONS						
	NONE	9101 TTY	9102 PT	9104 PI	9101 9102	9102 9104	9101 9102 9104
Control 100789-0	001-00 002-00 030-00 031-00	001-45 002-00	030-47 031-08	001-44 002-00	001-45 002-00 030-47 031-08	001-44 002-00 030-47 031-08	001-45 002-00 030-47 031-08
TTY 100790-5		505-00 506-00			505-47 506-00		505-47 506-00
PT (Hex) 100791-7 (BNPF) 100855-7			704-40 705-03		704-45 705-07		704-44 705-00
PI 100889-4				404-40 405-03			404-45 405-07

RAM REGISTER MAP



PLS 400 REGISTER MAPS

100789

P7	E		P7	MODE	F
P6	C	RAM ADDRESS			D
P5	A	DISPLAY POSITION			B
P4	8	DISPLAY STROBE			9
P3	6	KBD & TTY			7
P2	4	MASK /.RAM ADR			5
P1	2		P1	#	3
P0	0		P0		1

ROM 0 | PRO-LOG CORPORATION | PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / COMMENTS
						TITLE DATE 11-1-7
0	00	09	START	NOP		
	1	00		NOP		* JUN Find options
	2	09		NOP	.	* (see table pg 2)
	03	51	FIND MODE	JMS		
	4	04			[NOKEY]	
	5	10		JUN		
	6	03			FIND MODE	
	07	20	NEW MODE	FIM	P0	Clear CHNG flags
	8	00			RAM 0	
	9	21		SRC	P0	
	A	D0		LDM	0	
	B	E4		WR0		
	C	E5		WR1		
	D	E6		WR2		
	E	20		FIM	P0	
	F	29			8CLR-RAM	
	10	52		JMS		
	1	13			[STORE RAM]	
	2	20		FIM	P0	Reset NON-ERASED limit
	3	30			PORT 3	
	4	21		SRC	P0	
	5	D8		LDM	8	
	6	E2		WRR		
	7	58		JMS		Move 1st and last address to RAM
	8	00			(FIN 1ST-LAST)	
	9	20		FIM	P0	Display 1st and last address
	A	46			8-1ST-LAST	
	B	51		JMS		
	C	F0			[DISPLAY]	
	D	20		FIM	P0	Move 1st-last to start-End
	E	49			RAM-1ST-LAST	
	F	52		JMS		

100001 8/74

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

	HEXADECIMAL			MNEMONIC			TITLE / DATE / COMMENTS
	PAGE ADR	LINE ADR	INSTR	LABEL	INSTRUCTION OPERATION	INSTRUCTION OPERAND	
	0	20	75			[MOVRAM]	
		1	50		JMS		Key in new START-END on FILTER
		2	AA			{RD AA}	
		3	00		NOP		
		4	00		NOP		
		5	52		JMS		Move START addrs to CUR
		6	73			[MV-ST→CUR]	
		7	52		JMS		
		8	00			{ERASE CHRS}	
		9	AF		LD	F	DUP
		A	F5		RAL		
		B	F5		RAL		
		C	12		JCN	C1	
		D	70			STR CHNG	
		2E	52	RESTORE	JMS		Restore CUR with START addrs
		F	73			[MV ST→CUR]	
*		30	00		NOP		* 47 JUN
BX		1	00		NOP		* 08 CHK PT
		32	52	REPEAT	JMS		Read, check invert, & display
		3	1E			[RD COPY]	
A		4	00		NOP		
A		5	00		NOP		
		6	51		JMS		
A		7	EC			{DISP ADDR}	
		8	AF		LD	F	LIST
	1	9	F6		RAR		
	0	A	12		JCN	C1	
	0	B	65			LIST	
	7	C	F6		RAR		DUP/VER
	8	D	1A		JCN	C0	
	6	E	55			DUP/VER	
	8	F	50		JMS		Key in N data characters

100001 8/74

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
0	40	A0			{RD AD}	
	1	1C		JCN	A1	If 1st key in ENTER go to next address
	2	67			CHK ADR	
	43	52	PROG INV	JMS		Check Invert
	4	C0			[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
	C	F0			{FIND ENT}	
	D	58		JMS		Check for address skip or retry
	E	55			(SKP/RTRY)	
	F	14		JCN	A0	
	50	67			CHK ADR	
	1	51		JMS		Reset the display
A	2	EC			{DISP AD INV}	
	3	40		JUN		GO PROG
A	4	43			PROG INV	
	55	52	DUP/VER	JMS		Read & display the MASTER
	6	86			{RD MASTER}	
	7	51		JMS		
	8	EE			{DISP AD}	
	9	52		JMS		
	A	C0			[DATA INV]	
	B	AF		LD	F	DUP
	C	F5		RAL		
	D	1A		JCN	C0	
	E	15			PROG	
	F	52		JMS		Save CUR data for VERIFY

100789A

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
	60	6F			[SAVCUR DATA]	
	1	52		JMS		Read & check the COPY
	2	1F			[RD COPY]	
	3	1C		JCN	A1	
	4	67			CHK ADR	
	65	50	LIST	JMS		
	6	F0			{FIND EOT}	
	67	52	CHK ADR	JMS		Check CUR with last and end address
	8	3E			[ADR CHK]	
	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					
	70	DC	STRCHNG	LDM	C	Display CX
	1	51		JMS		
	2	76			[DISP #7]	"C"
	3	2C		FIM	P6	
	4	00			ZERO	
	5	2D		SRC	P6	
	6	EE		RD2		"X"
	7	28		FIM	P4	
	8	C0			C0	
	9	51		JMS	1	
	A	67			(DISP)	
	B	20		FIM	P0	Key in the corrections
	C	40			8RDCHNG	
	D	50		JMS		
	E	AC			{RD-N}	
	F	1E		JCN	A1C0	Is last key ENTER

191,001

PRO-LOG CORPORATION . PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / COMMENTS
						TITLE DATE
0	80	2E			RESTORE	COMMENTS
	1	24		FIM	P2	Update storage address
	2	00			ZERO	
	3	25		SRC	P2	
	4	EE		RD2		
	5	B5		XCH	5	
	6	20		FIM	P0	Move correction to storage area
	7	47			8MV-CHNG	
	8	58		JMS		
	9	11			(FIN2PAIR)	
	8A	2D	MV-N	SRC	P6	
	B	E9		RDM		
	C	25		SRC	P2	
	D	E0		WRM		
	E	6D		INC	D	
	F	64		INC	4	
	90	73		ISZ	3	
	1	8A			MV-N	
	2	2C		FIM	P6	Set CHNG flag
	3	00			ZERO	
	4	2D		SRC	P6	
	5	D1		LDM	1	
	6	E4		WR0		
	7	EE		RD2		Store CHNG count
	8	E5		WR1		
	9	F2		IAC		Increase count for next CHNG
	A	E6		WR2		
	B	1A		JCN	C0	Do it the 16 th change
	C	70			STRCHNG	
	D	10		JUN		
	E	2E			RESTORE	
	F	00				

100001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
0	A 0	20	{RD-AD}	FIM	P0	Setup keyboard & display
	1	3B			RD-AD	to enter data
	2	58		JMS		
	3	0B			(FIN5PAIR)	
	4	D0		LDM	0	
	5	BE		XCH	E	
	6	51		JMS		Blank the data locations
	7	67			(DISP)	
	8	40		JUN		
	9	84			NEXT	
	AA	20	{RD-AA}	FIM	P0	Setup keyboard & display
	B	38			RD-AA	
	AC	58	{RD-N}	JMS		
	D	0F			(FIN3PAIR)	
	E	51		JMS		
	F	7C			(STRT STRB)	
	B 0	AA	MORE	LD	A	Is this the last key
	1	F5		RAL		
	2	12		JCN	C1	
	3	E2			LAST	
	B4	51	NEXT	JMS		Read the keyboard
	5	00			[RDKBD]	
	6	14		JCN	A0	Data key
	7	CD			DATA	
	8	1A		JCN	C0	Clear key
	9	D7			CLR	
	A	AE		LD	E	Is this the first key
	B	F5		RAL		
	C	12		JCN	C1	
	D	C7			FIRST	
	E	AB		LD	B	Is this the MID key
	F	F5		RAL		

100001 8/74

b81001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
0	C0	1A		JCN	C0	
	1	B4			NEXT	
	2	A2		LD	2	Check Mid key flag
	3	F5		RAL		
	4	1A		JCN	C0	
	5	B4			NEXT	
	6	C1		BBL	1	A1.C1 = MID key ENTER
	C7	A2	FIRST	LD	2	Check 1ST key flag
	8	F6		RAR		
	9	1A		JCN	C0	
	A	B4			NEXT	
	B	F1		CLC		
	C	C1		BBL	1	A1.C0 = 1ST key ENTER
	CD	51	DATA	JMS		Move the stack to next position
	E	83			(ROT STKR)	
	F	2D		SRC	P6	Store the data
	D0	A6		LD	6	
	1	E0		WRM		
	2	51		JMS		Display the data
	3	67			(DISP)	
	4	6D		INC	D	Select next location
	5	40		JUN		
	6	B0			MORE	
	P7	AE	CLR	LD	E	to clear at first location
	8	F5		RAL		
	9	12		JCN	C1	
	A	B4			NEXT	
	B	51		JMS		
	C	A7			(CLR STK3)	
	D	AD		LD	D	Remove the data
	E	F8		DAC		
	F	BD		XCH	D	

100787

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
0	0	40		JUN		
	1	B0			MORE	
	E2	51	LAST	JMS		Read the last key
	3	00			[RDKBD]	
	4	14		JCN	A0	Data
	5	E2			LAST	
	6	1A		JCN	C0	Clear
	7	D7			CLR	
	8	C0		BBL	0	A0 = LAST KEY entered
	9					
	A					
	B					
	C					
	D					
	E					
	F					
	F0	51	{FINDENT}	JMS		Find the ENTER key
	1	00			[RDKBD]	
	2	1A		JCN	C0	
	3	F0			{FINDENT}	
	F4	C0	OBBLO	BBL	0	
	F5	F1	(COMPARE)	CLC		Compare 8 bits
	6	A7		LD	7	
	7	75		SUB	5	
	8	1C		JCN	A1	
	9	F4			OBBLO	1
	A	F1		CLC		
	B	A6		LD	6	
	C	74		SUB	4	
	D	1C		JCN	A1	
	E	F1			OBBLO	A0 = NO COMPARE
	F	C1		BBL	1	A1 = COMPARE

100001

ROM 1 | PRO-LOG CORPORATION | PROGRAM ASSEMBLY FORM

TITLE | DATE 11-1-

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
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	A0	
	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	A0	
	D	07			NO KEY	
	E	A7		LD	7	Check for double key
	F	FC		KBP		
	10	F4		CMA		
	1	14		JCN	A0	
	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	0	
	9	A1		LD	1	Convert COL to LSB
	A	FC		KBP		
	B	F8		DAC		
	C	F1		CLC		Combine MSB & LSB
	D	20		ADD	0	
	E	B6		XCH	6	
	F	00		NOP		Check FUNC or DATA

100789

PRO-LOG CORPORATION · PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
1	20	14		JCN	A0	A0 = DATA A1 = FUNC
	1	4E			1 BBLO	REG 6 = HEX CHAR
	2	A7		LD	R7	Check for new mode key
	3	F6		RAR		
	4	A1		LD	1	
	5	12		JCN	C1	
	6	2A			CL + ENT	
	7	BF		XCH	F	Save new mode & exit REG F = MODE
	8	40		JUN		
	9	07			NEW MODE	
	2A	F6	CL + ENT	RAR		Set carry if ENTER
	2B	C1	1 BBL 1	BBL	1	A1 = FUNC and C1 = ENT, C0 = CLEAR
	2C	26	(SCAN)	FIM	P3	KEY BOARD SCAN
	D	F0		F	0	Set flag minus 1 ; 0 = DATA , 1 = FUNC
	2E	66	SCAN FUNC	INC	6	
	F	20		FIM	P0	
	30	01		0	1	
	31	21	SCAN DATA	SRC	P0	Select & read row
	2	A1		LD	1	
	3	E2		WRR		
	4	27		SRC	P3	
	5	EA		RDR		
	6	37		XCH	7	Save ROW data
	7	A6		LD	6	Check FUNC or DATA
	8	14		JCN	A0	
	9	42			DATA	
	A	A7		LD	7	Remove toggle switch bit
	B	F5		RAL		
	C	F1		CLC		
	D	F5		RAL		
	E	F1		CLC		
	F	F5		RAR		

100769

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
1	40	F6		RAR		
	1	B7		XCH	R7	
	42	A7	DATA	LD	R7	Check for key closed
	3	1C		JCN	A1	
	4	2B			1BBL1	
	45	F1	NEW COL	CLC		Rotate the scan bit
	6	A1		LD	1	
	7	F5		RAL		
	8	B1		XCH	1	
	9	1A		JCN	C0	Check for last col
	A	31			SCAN DATA	
	B	A6		LD	6	Check for FUNC
	C	14		JCN	A0	
	D	2E			SCAN FUNC	
	4E	C0	1BBL0	BBL	0	A0 = NO KEY ; A1 = KEY
	F	00				
	50	20	(4.5MS)	FIM	P0	
	1	44			4.5 Millisec	
	52	70	(SHORT Δ)	ISZ	0	Variable delay
	3	52			(SHORT Δ)	
	4	71		ISZ	1	
	5	52			(SHORT Δ)	
	6	C0		BBL	0	
	57	20	(LONG Δ)	FIM	P0	Long variable delay
	8	00			ZERO	
	59	70	(VAR Δ)	ISZ	0	
	A	59			(VAR Δ)	
	B	71		ISZ	1	
	C	59			(VAR Δ)	
	D	72		ISZ	2	
	E	59			(VAR Δ)	
	F	73		ISZ	3	

100001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
1	60	59			(VAR 0)	
	1	C0		BBL	0	
	62	2A	(STRT CLR)	FIM	P5	
	3	00			ZERO	
	4	FA		STC		
	65	28	(CLR DISP)	FIM	P4	Set strobe to blank
	6	00			ZERO	
	67	20	(DISP)	FIM	P0	Load data to display
	8	00			PORT 0	
	9	21		SRC	P0	
	A	E2		WRR		
	6B	20	(STROBE)	FIM	P0	Strobe MSD
	C	10			PORT 1	
	D	21		SRC	P0	
	E	A9		LD	9	
	F	E2		WRR		
	70	C0		INC	0	Strobe LSD
	1	21		SRC	P0	
	2	A8		LD	8	
	3	E2		WRR		
	4	C0		BBL	0	
	75	DF	[DISP F]	LDM	F	
	6	51	[DISP #7]	JMS		Read display digit #7
	7	65			(CLR DISP)	
	8	28		FIM	P4	
	9	40			LOC #7	
	A	41		JUN		
	B	68			(STROBE)	
	7C	2A	(STRT STRB)	FIM	P5	
	D	00			ZERO	
	E	28		FIM	P4	
	F	00			ZERO	

100001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
1	80	D8		LDM	8	
	1	BE		XCH	E	
	2	C1		BBL	1	
	83	D0	[ROT STRB]	LDM	0	Check first position
	4	BE		XCH	E	
	5	F5		RAL		
	6	1A		JCN	C0	
	7	8A			ROT	
	8	51		JMS		
	9	67			(DISP)	
	8A	AB	(ROT)	LD	B	Rotate position
	B	F5		RAL		
	C	BB		XCH	B	
	D	AA		LD	A	
	E	F5		RAL		
	F	BA		XCH	A	
	90	12		JCN	C1	
	1	2B			[BBL]	
	2	A5		LD	5	Rotate mask
	3	F6		RAR		
	4	A4		LD	4	
	5	F6		RAR		
	6	B4		XCH	4	
	7	A5		LD	5	
	8	F6		RAR		
	9	B5		XCH	5	
	A	1A		JCN	C0	
	B	8A			(ROT)	
	C	F1		CLC		Insert position bit into strobe
	D	A8		LD	8	
	E	8A		ADD	A	
	F	B8		XCH	8	

100001 8/74

1982001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL			MNEMONIC			TITLE / DATE / COMMENTS
PAGE ADR	LINE ADR	INSTR	LABEL	INSTRUCTION OPERATION	INSTRUCTION OPERAND	
1	A0	A9		LD	9	
	1	9B		ADD	B	
	2	B9		XCH	9	
	3	C0		BBL	0	
	A4	F1	(CLR STAB)	CLC		Remove strobe bit
	5	A8		LD	8	
	6	9A		SUB	A	
	7	B8		XCH	8	
	8	F1		CLC		
	9	A9		LD	9	
	A	9B		SUB	B	
	B	B9		XCH	9	
	AC	A4	ROT ←	LD	4	Rotate mask
	D	F5		RAL		
	E	A5		LD	5	
	F	F5		RAL		
	B0	B5		XCH	5	
	1	A4		LD	4	
	2	F5		RAL		
	3	B4		XCH	4	
	B4	F1		CLC		Rotate position
	5	AA		LD	A	
	6	F6		RAR		
	7	BA		XCH	A	
	8	AB		LD	B	
	9	F6		RAR		
	A	BB		XCH	B	
	B	12		JCN	C1	Left/Right position
	C	C3			END	
	D	A4		LD	4	Is the next position blank
	E	F5		RAL		
	F	1A		JCN	C0	

100791

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
1	C0	AC			ROT ←	
	1	41		JUN		
	2	67			(DISP)	
	C3	D8	END	LDM	8	Reset first position bit
	4	BE		XCH	E	
	5	41		JUN		
	6	67			(DISP)	
	C7	20	(RD DATA SW)	FIM	P0	Read the DATA switch
	8	50			PORT 5	
	9	21		SRC	P0	
	A	EA		RDR		
	B	F5		RAL		
	C	F5		RAL		
	D	C0		BBL	0	
	CE	20	(RD LEFT SW)	FIM	P0	
	F	50			PORT 5	
	D0	21		SRC	P0	
	1	EA		RDR		
	2	F6		RAR		
	3	F6		RAR		
	4	C0		BBL	0	
	5					
	6					
	7					
	8					
	9					
	A					
	B					
	C					
	D					
	E					
	F					

100789

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
1	E0					
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	A					
	B					
	EC	52	{ DISPAD INV }	JMS		
	D	C0			[DATA INV]	
	EE	20	{ DISPAD }	FIM	P0	
	F	43			8 DISP-AD	
	F0	58	{ DISPLAY }	JMS		
	1	0F			(FIN 8 PAIR)	
	2	51		JMS		
	3	7C			(START STRB)	
	F4	51	NEXT	JMS		Rotate the strobe
	5	83			[ROT STRB]	
	6	1C		JCN	A1	
	7	FF			1 BBLO	
	8	2D		SRC	P6	Read & display
	9	E9		RDM		
	A	51		JMS		
	B	67			(DISP)	
	C	6D		INC	D	Count address
	D	73		ISZ	3	
	E	F4			NEXT	
	FF	C0	1 BBLO	BBL	0	

[ROM 2] PRO-LOG CORPORATION PROGRAM ASSEMBLY FORM

TITLE DATE 11-1

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
2	00	52	& ERASE CHKS	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	P0	Set NON-ERASED light
	C	30			P0P1 3	
	D	21		SRC	P0	
	E	DA		LDM	A	
	F	E2		WMP		
	0	C0		BBL	0	
	11	20	[SET ZERO]	FIM	P0	Load proto plate
	2	2E			8 ZERO	
	13	58	[STORE RAM]	JMS		
	4	11			(FIN 2PAIR)	
	5	A2		LD	2	
	16	2D	DO-N	SRC	P6	
	7	E0		WRM		
	8	6D		INC	D	
	9	73		ISZ	3	
	A	16			DO-N	
	B	C0		BBL	0	
	C	00				
	D	00				
	1E	58	[RD COPY]	JMS		CK Proto ROM
	F	19			(FIN ADR)	

100001 8/7

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
2	20	52		JMS		
	1	62			(ADR ROM)	V
	2	20		FIM	P0	T Read N characters
	3	4E			8 RD COPY	
	4	58		JMS		
	5	11			(FIN 2 PAIR)	
	26	23	DO-X	SRC	P1	
	7	EA		RDR		
	8	2D		SRC	P6	
	9	E0		WRM		
	A	62		INC	2	
	B	6D		INC	D	
	C	73		ISZ	3	
	D	26			DO-X	V
	2E	20	[CMP DATA]	FIM	P0	T Check N characters
	F	2B			8 MOV CMP	V
	0	58		JMS		
	1	0F			(FIN 3 PAIR)	
	32	2D	(CHECK)	SRC	P6	
	3	E9		RDM		
	4	F1		CLC		
	5	25		SRC	P2	
	6	E8		SBM		
	7	1C		JCN	A1	
	8	BF			2BBL0	
	9	6D		INC	D	
	A	65		INC	5	
	B	73		ISZ	3	
	C	32			(CHECK)	V
	3D	C1	2BBL1	BBL	1	
	3E	20	[ADR CHK]	FIM	P0	T Check CUR and END address
	F	30			8 CUR-END	T

100001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
2	40	58		JMS		
	1	OF			(FIN 3 PAIR)	
	2	52		JMS		
	3	32			(CHECK)	
	4	1C		JCN	A1	
	5	3D			2BBL1	↓
	6	20		FIM	P0	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			2BBL1	↓
	E	20		FIM	P0	Increment CUR address
	F	36			8-COUNT	
	50	58		JMS		
	1	11			(FIN 2 PAIR)	
	2	D1		LDM	1	
	53	F1	COUNT	CLC		
	4	2D		SRC	P6	
	5	EB		ADM		
	6	E0		WRM		
	7	F7		TCC		
	8	BD		XCH	D	
	9	F8		DAC		
	A	BD		XCH	D	
	B	73		ISZ	3	
	C	53			COUNT	↓
	D	C0		BBL	0	
	E	00				
	F	00				

BBL001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL			MNEMONIC			TITLE / DATE / COMMENTS
PAGE ADR	LINE ADR	INSTR	LABEL	INSTRUCTION: OPERATION	INSTRUCTION: OPERAND	
2	60	FA	(ADR COMP)	STC		Address Complemented
	1	10		SKP		
	62	F1	(ADR ROM)	CLC		Address normal
	63	2D	DO-Y	SRC	P6	
	4	E9		RDM		
	5	1A		JCN	C0	
	6	68			NON INV	
	7	F4		CMA		
	68	23	NON INV	SRC	P1	
	9	E2		WRR		
	A	62		INC	2	
	B	6D		INC	D	
	C	73		ISZ	3	
	D	63			DO-Y	
	E	C0		BBL	0	
	6F	20	[SAV-CUR-DAT]	FIM	P0	Move CUR data to SAV data
	0	2B			8 MV/CMP	
	1	42		JUN		
	2	75			[MOV RAM]	
	73	20	[MV-ST-CUR]	FIM	P0	Move START address to CUR address
	4	52			8 MV ST CUR	
	75	58	[MOV RAM]	JMS		Move RAM
	6	0F			(FIN 3 PAIR)	
	77	2D	MOVE N	SRC	P6	
	8	E9		RDM		
	9	25		SRC	P2	
	A	E0		WRM		
	B	6D		INC	D	
	C	65		INC	5	
	D	73		ISZ	3	
	E	77			MOVE N	
	F	C0		BBL	0	

1682667

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
2	80	20	[RESTORE]	FIM	P0	Move SAV data to CUR data
	1	57			& RESTORE	
	2	42		JUN		
	3	75			[MOVRAM]	
	4					
	5					
	86	20	{RD MASTER}	FIM	P0	Read MASTER
	7	50			& RD MAST	
	8	58		JMS		
	9	11		..	(FIN ZPAR)	
	8A	23	N	SRC	P1	
	B	EA		RDR		
	C	F4		CMA		
	D	2D		SRC	P6	
	E	E0		WRM		
	F	62		INC	2	
	90	6D		INC	D	
	1	73		ISZ	3	
	2	8A			N	
	93	20	{CHANGE}	FIM	P0	Check CHNG flag
	4	00			ZERO	
	5	21		SRC	P0	
	6	EC		RD0		
	7	14		JCN	A0	
	8	BF			2 BELO	
	9	ED		RD1		Retrieve CHNG count
	A	F4		CMA		
	B	B9		XCH	9	
	C	24		FIM	P2	Check for CHNG address
	D	00			ZERO	
	9E	20	RD ADR	FIM	P0	
	F	34			& CMP ADR	

100001 8/74

100781-001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
2	A 0	58		JMS		
	1	11			(FIN 2 PAIR)	
	A 2	2D	CHK N	SRC	P6	
	3	E9		RDM		
	4	F1		CLC		
	5	25		SRC	P2	
	6	E8		SBM		
	7	1C		JCN	A1	
	8	BA			NO CHK	
	9	6D		INC	D	
	A	64		INC	4	
	B	73		ISZ	3	
	C	A2			CHK N	
	D	20		FIM	P0	Retrieve CHNG data
	E	2C			8 HIV DATA	
	F	58		JMS		
	B 0	11			(FIN 2 PAIR)	
	B 1	25	MOVE DATA	SRC	P2	
	2	E9		RDM		
	3	2D		SRC	P6	
	4	E0		WRM		
	5	6D		INC	D	
	6	64		INC	4	
	7	73		ISZ	3	
	8	B1			MOVE DATA	
	9	C0		BBL	0	
	BA	65	NO CHK	INC	5	Retrieve past CHNG address
	B	D0		LDM	0	
	C	B4		XCH	4	
	D	99		ISZ	9	Check N change
	E	9E			RD ADR	
	BF	C0	2 BBLO	BBL	0	

181001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
2	C0	51	[DATA INV]	JMS		
	1	C7			(RD DATASW)	
	2	1A		JCN	CO	
	3	BF			2BBLO	
	4	20		FIM	P0	Invert CUR data
	5	2C			CUR DAT	
	6	58		JMS		
	7	11			(FIN 2PAIR)	
	C8	2D	DO-Z	SRC	P6	
	9	E9		RDM		
	A	F4		CMA		
	B	E0		WRM		
	C	6D		INC	D	
	D	73		ISZ	3	
	E	C8			DO-Z	
	F	C0		BBL	0	
	D0					
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	A					
	B					
	C					
	D					
	E					
	F					

100001

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
2	E0	20	[HEX PRINT]	FIM	P0	Print ASCII HEX
	1	F0		F	0	
	2	B1		XCH	1	
	3	36		FIN	P3	
	4	46		JUN		
	5	5A			[PRINT]	
	F6	20	[HEXCHEK]	FIM	P0	Look-up ASCII HEX
	7	F0		F	0	
	E8	34	HEX TRANS	FIN	P2	
	9	50		JNS		
	A	F5			(COMPARE)	
	B	1C		JCN	A1	
	C	3D			2 BBL 1	A1 = HEX
	D	71		ISZ	1	
	E	E8			HEX TRANS	
	F	C0		BBL	0	A0 = NOT HEX
	F0	B0		CST		
	1	B1				
	2	B2				
	3	B3				
	4	B4				
	5	B5				
	6	B6				
	7	B7				
	8	B8				
	9	B9				
	A	C1				
	B	C2				
	C	C3				
	D	C4				
	E	C5				
	F	C6		CST		

100789

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
6	20	F6		RAR		
	1	B6		XCH	6	
	2	C0		BBL	0	
	23	56	[RD TTY PT]	JMS		
	4	39			(TTY RDR)	
	25	11	[RD TTY]	JCN	T0	
	6	25			[RD TTY]	
	7	51		JMS		
	8	50			(4.5 MS)	
	9	24		FIM	P2	
	A	08			EIGHT	
	2B	56	NEXT BIT	JMS		
	C	43			(9 MS)	
	D	F0		CLB		Read TTY bit
	E	19		JCN	T1	
	F	31			NO BIT	
	30	FA		STC		
	31	56	NO BIT	JMS		
	2	6E			(ROT P3→)	
	3	75		ISZ	5	
	4	2B			NEXT BIT	
	5	56		JMS		
	6	43			(9 MS)	
	7	46		JUN		
	8	1D			RD END	
	39	20	(TTY RDR)	FIM	P0	Start TTY reader
	A	30			PORT 3	
	B	21		SRC	P0	
	C	D9		LDM	1	
	D	E2		WRR		
	E	D8		LDM	0	
	3F	11	FIND STRT	JCN	T0	

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
6	40	3F			FINDSTRT	
	1	E2		WAR		Stop TTY reader
	2	C0		BBL	0	
	43	20	(9 MS)	FIM	P0	
*	4	09		0	9	09 for XTAL, 37 for Non XTAL
	5	22		FIM	P1	
	6	FF		E	F	
	7	41		JUN		
	8	59			(VARA)	
	9					
	A					
	B					
	C					
	D					
	E					
	F					
	50	26	[SPACE]	FIM	P3	
	1	A0			SP	
	2	46		JUN		
	3	5A			[PRINT]	
	54	26	{CR LF}	FIM	P3	
	5	8D			CR	
	6	56		JMS		
	7	5A			[PRINT]	
	58	26	[LF]	FIM	P3	
	9	8A			LF	
	5A	24	[PRINT]	FIM	P2	Set start bit 0111
	B	74		7	4	
	C	20		FIM	P0	
	D	30			PORT 3	
	E	21		SRC	P0	
	F	FA		STC		

100001 8/74

100790

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
6	60	56	12 BITS	JMS		Get one bit at a time
	1	6E			(ROT P3→)	↓
	2	A4		LD	4	Output the bit in position 8
	3	F6		RAR		
	4	B4		XCH	4	
	5	A4		LD	4	
	6	F6		RAR		
	7	D0		LDM	0	
	8	F6		RAR		
	9	E2		WRR		↓ Note: Insert RAL between steps 6097 6GA if data is to be retained after 12 bits are sent out.
	A	56		JMS		
	B	43			(9MS)	
	C	75		ISZ	5	
	D	60			12 BITS	
	6E	A6	(ROT P3→)	LD	6	Rotate Pair 3 right
	F	F6		RAR		
	70	B6		XCH	6	
	1	A7		LD	7	
	2	F6		RAR		
	3	B7		XCH	7	↓
	74	C1	6BBL1	BBL	1	
	5					
	6					
	7					
	8					
	9					
	A					
	B					
	C					
	D					
	E					
	F					

REV	DESCRIPTION	DATE	APPR
A		1-31-75	MZB
B	PM9005 (2708)	6-27-75	Matt

M. Brewis 11-4-74

PROGRAM SERIES 90
9102 TTY HEX

PRO-LOG CORPORATION

A	100790	REV B	SHT 1 OF

This program provides Teletype option for the Series 90 control program 100789,

To install this option add ROMs 5 & 6, 100790.
Make changes to 100789 as defined in 100789.

OPTIONS

To use with 9101 Paper Tape Reader option make changes defined in the 9101 option program. Also:

```
Change ROM 5.
Program 100790
     505 to 47    JUN
     506 to 00              FIND PT
```

To use with 9104 Parallel Interface option make changes defined in 100889. Also:

```
Change ROM 5.
Program 100790
     505 to 44    JUN
     506 to 00              FIND P1
```

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

TITLE

DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
5	00	20	FIND TTY	FIM	P0	Silence TTY
	1	30			PORT 3	
	2	21		SRC	P0	
	3	D8		LDM	8	
	4	E2		WRR		
	5	00		NOP		JUN – Find other options
	6	00		NOP		(see INSTRUCTIONS)
	07	20	OPT RET TTY	FIM	P0	Set all Keyboard strobes
	8	00			PORT0	
	9	21		SRC	P0	
	A	DF		LDM	F	
	B	E2		WRR		
	C	20		FIM	P0	Setup Keyboard read
	D	10			PORT 1	
	E	21		SRC	P0	
	0F	19	KB + TTY	JCN	T1	Is TTY there?
	10	18			TTY	
	1	EA		RDR		Is Keyboard there?
	2	F6		RAR		
	3	F6		RAR		
	4	1A		JCN	C0	
	5	0F			KBD + TTY	
	16	40	READER	JUN		
	7	03			FIND MODE	
	18	56	TTY	JMS		Find *
1	9	02			[RD & PRNT]	
001	A	24		FIM	P2	
0	B	AA			*	
7	C	50		JMS		
69	D	F5			(COMPARE)	
0	E	14		JCN	A0	
8	F	18			TTY	

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
5	20	56		JMS		
	1	54			{CR-LF}	
	2	58		JMS		
	3	00			(FIN 1ST-LAST)	
	24	56	LPDV	JMS		"L"
	5	02			[RD & PRINT]	
	6	D1		LDM	1	
	7	BF		XCH	F	
	8	24		FIM	P2	
	9	CC			"L"	
	A	50		JMS		
	B	F5			(COMPARE)	
	C	1C		JCN	A1	
	D	90			LIST/PROG	
	E	D2		LDM	2	"P"
	F	BF		XCH	F	
	30	24		FIM	P2	
	1	D0			"P"	
	2	50		JMS		
	3	F5			(COMPARE)	
	4	1C		JCN	A1	
	5	90			LIST/PROG	
	6	D4		LDM	4	"D"
	7	BF		XCH	F	
	8	24		FIM	P2	
1	9	C4			"D"	
0	A	50		JMS		
0	B	F5			(COMPARE)	
7	C	1C		JCN	A1	
9	D	46			DUP/VER	
0	E	D8		LDM	8	"V"
B	F	BF		XCH	F	

PRO-LOG CORPORATION — PROGRAM ASSEMBLY FORM

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	TITLE / DATE / COMMENTS
5	40	24		FIM	P2	
	1	D6			"V"	
	2	50		JMS		
	3	F5			(COMPARE)	
	4	14		JCN	A0	
	5	24			LPDV	
	46	56	DUP/VER	JMS		
	7	54			{CR LP}	
	48	20	D/V MOR	FIM	P0	Read address & data
	9	44			RD TTY BD	
	A	58		JMS		
	B	15			(FIN 2 TTY)	
	4C	56	RD PT	JMS		
	D	23			[RD TTY PT]	
	E	52		JMS		Is it a hex char?
	F	E6			[HEX CHEK]	
	50	14		JCN	A0	
	1	5D			NOT HEX	
	2	AB		LD	B	Too many hex?
	3	14		JCN	A0	
	4	48			D/V MOR	
	5	2D		SRC	P6	
	6	A1		LD	1	
	7	E0		WRM		
	8	6D		INC	D	
1	9	7B		ISZ	B	
0	A	4C			RD PT	
0	B	45		JUN		
4	C	4C			RD PT	
6	5D	24	NOT HEX	FIM	P2	"/"
0	E	AF			SLASH	
	F	50		JMS		

PRO-LOG CORPORATION — PROGRAM ASSEMBLY FORM

HEXADECIM PAGE ADR	LINE ADR	INSTR	MNEMONIC LABEL	INSTRUCTION OPERATION	OPERAND	TITLE / COMMENTS / DATE
5	60	F5			(COMPARE)	
	1	1C		JCN	A1	
	2	CA			END	↓
	3	24		FIM	P2	Is it Carriage return
	4	8D			CR	
	5	50		JMS		
	6	F5			(COMPARE)	
	7	14		JCN	A0	
	8	4C			RD PT	↓
	9	AB		LD	B	Not enough hex ?
	A	1C		JCN	A1	
	B	48			P/V MOR	↓
	C	51		JMS		
	D	EE			{DISP AD}	
	E	52		JMS		
	F	C0			[DATA INV]	
	70	AF		LD	F	
	1	F5		RAL		
	2	12		JCN	C1	
	3	8A			VER	↓
	4	2C		FIM	P6	MOVE Current Adr to start adr
	5	60			CUR ADR	
	6	24		FIM	P2	(for 2708 PM 9005)
	7	68			START ADR	
	8	20		FIM	P0	
1	9	54			8 ADR COUNT	
0	A	58		JMS		
0	B	13			(FIN IPAIR)	
7	C	52		JMS		
9	D	77			(MOVE N)	↓
0	E	58		JMS		
8	F	60			{PROGRAM}	

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
5	80	1C	ERR END	JCN	A1	
	1	48			D/V MOR	
	2	55		JMS		┐ PRINT address & data
	3	E6			{PR ADR}	
	4	52		JMS		
	5	C0			[DATA INV]	
	6	55		JMS		
	7	F3			{PR DATA}	↓
	8	45		JUN		
	9	48			D/V MOR	
	8A	52	VER	JMS		
	B	6F			[SAVCORDAT]	
	C	52		JMS		
	D	1E			[RD COPY]	
	E	45		JUN		
	F	80			ERR END	
	90	56	LIST/PROG	JMS		
	1	54			{CR LF}	
	2	20		FIM	P0	┐ Read START - END address
	3	39			RD TTY-AA	
	4	58		JMS		
	5	15			(FIN 2TTY)	
	96	56	RD N HEX	JMS		
	7	02			[RD & PRINT]	
	8	52		JMS		
1	9	E6			[HEX CHEK]	
0	A	14		JCN	A0	
0	B	90			NEW TRY	
V	C	2D		SRC	P6	
9	D	A1		LD	1	
0	E	E0		WRM		
8	F	6D		INC	D	

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
5	A 0	7B		ISZ	B	
	1	96			RD NHEX	
	2	52		JMS		
	3	73			[MVST→CUR]	
	A 4	51	RETRY	JMS		
	5	65			(CLR DISP)	
	6	56		JMS		
	7	58			[LF]	
	8	56		JMS		
	9	54			{CR LF}	
	A A	55	NEXT	JMS		
	B	E6			{PR-ADR}	
	C	AF		LD	F	LIST
	D	F6		RAR		
	E	12		JCN	C1	
	F	D6			LIST	
	B 0	20		FIM	P0	Read N data characters
	1	2C			CUR DATA	
	2	58		JMS		
	3	15			(FIN 2 TTY)	
	B 4	56	N CHAR	JMS		
	5	02			[RD & PRINT]	
	6	52		JMS		
	7	E6			[HEX CHEK]	
	8	14		JCN	A0	
1	9	A4			RETRY	
0	A	A1		LD	1	
0	B	2D		SRC	P6	
V	C	E0		WRM		
6	D	6D		INC	D	
0	E	7B		ISZ	B	
8	F	B4			N CHAR	

PRO-LOG CORPORATION

PROGRAM ASSEMBLY FORM

HEXADECIM PAGE ADR	LINE ADR	INSTR	MNEMONIC LABEL	INSTRUCTION OPERATION	OPERAND	TITLE / DATE / COMMENTS
5	C0	52		JMS		
	1	C0			[DATA INV]	
	2	58		JMS		
	3	60			{PROGRAM}	
	4	14		JCN	A0	
	5	A4			RETRY	
	6	56		JMS		
	7	54			{CR LF}	
	C8	52	CHK END	JMS		Check & count address
	9	3E			[ADR CHK]	
	A	14		JCN	A0	
	B	AA			NEXT	
	C	56	END	JMS		
	D	54			{CR-LF}	
	E	26		FIM	P3	Print slash for end
	F	AF			SLASH	
	D0	56		JMS		
	1	5A			[PRINT]	
	2	56		JMS		
	3	54			{CR LF}	
	4	40		JUN		
	5	00			START	
	D6	52	LIST	JMS		Read and list copy
	7	1E			[RD COPY]	
	8	52		JMS		
	9	C0			[DATA INV]	
	A	55		JMS		
	B	F3			{PR DATA}	
	C	45		JUN		
	D	C8			CHK END	
	E					
	F					

PRO-LOG CORPORATION — PROGRAM ASSEMBLY FORM

TITLE — DATE

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
5	E0					
	1					
	2					
	3					
	4					
	5					
	E6	20	{PR ADR}	FIM	P0	Print N data characters
	7	34			CUR ADR	
	8	58		JMS		
	9	15			(FIN 2 TTY)	
	EA	2D	PRNT N	SRC	P6	
	B	E9		RDM		
	C	52		JMS		
	D	E0			[HEX PRINT]	
	E	6D		INC	D	
	F	7B		ISZ	B	
	0	EA			PRNT N	
	1	46		JUN		
	2	50			[SPACE]	
	F3	20	{PR DATA}	FIM	P0	Print X data characters
	4	2C			CUR DATA	
	5	58		JMS		
	6	15			(FIN 2 TTY)	
	E7	2D	PRNT X	SRC	P6	
	8	E9		RDM		
1	9	52		JMS		
0	A	E0			[HEX PRINT]	
0	B	6D		INC	D	
J	C	7B		ISZ	B	
9	D	F7			PRNT X	
0	E	46		JUN		
	F	54			{CR LF}	

ROM 6 | PRO-LOG CORPORATION | TTY | PROGRAM ASSEMBLY FORM

TITLE | DATE 11-1-74

HEXADECIMAL PAGE ADR	HEXADECIMAL LINE ADR	HEXADECIMAL INSTR	MNEMONIC LABEL	MNEMONIC INSTRUCTION OPERATION	MNEMONIC INSTRUCTION OPERAND	COMMENTS
6	00	56	[PT RD & PRNT]	JMS		
	1	39			(TTY RDR)	
	02	11	[RD & PRNT]	JCN	TO	
	3	02			[RD & PRNT]	
	4	51		JMS		
	5	50			(4.5 MS)	
	6	20		FIM	P0	Echo start bit
	7	30			PORT 3	
	8	21		SRC	P0	
	9	D0		LDM	0	
	A	E2		WRR		
	B	24		FIM	P2	Set 8 count
	C	08			EIGHT	
	0D	56	BIT	JMS		
	E	43			(9 MS)	
	F	F0		CLB		Read the TTY bit
	10	19		JCN	T1	
	1	14			ZERO	
	2	D8		LDM	8	
	3	FA		STC		
	14	E2	ZERO	WRR		Echo the TTY bit
	5	56		JMS		Save the bit
	6	6E			(ROT P3→)	
	7	75		ISZ	5	
	8	0D			BIT	
	9	56		JMS		
	A	43			(9 MS)	
	B	D8		LDM	8	Set STOP bit
	C	E2		WRR		
	1D	A6	RD END	LD	6	Set carry bit = 1
	E	F5		RAL		
	F	FA		STC		

SERIES 90 PROM PROGRAMMER OPERATING MANUAL

ADDENDUM TO SECTION 6

TELETYPE FORMATS

TTY PAPER TAPE FORMATS

The paper tape format is controlled by program coding. Two formats are currently available; ASCII Hex (address data) and ASCII Hex (data only).

ASCII Hex (Address Data) Format 9102-1

Requires 8 level ASCII Hex characters. The character sequence on tape is address, data, and carriage return.

When a tape is generated in the LIST mode the actual format for each line becomes: address, space, data, carriage return, and line feed. Since address information is included on the tape, random addresses may be programmed.

ADDRESS AND DATA: Address information must be on tape preceeding the data. Non-Hex characters are allowed to separate the address and data and following the carriage return.

Examples:

256 x 8 PROMs: Two Hex address characters followed by two Hex data characters followed by a carriage return.

256 x 4 PROMs: Two Hex address characters followed by one Hex data character followed by a carriage return.

512 x 8 PROM: Three Hex address characters followed by two Hex data characters followed by a carriage return.

PROGRAM CHARACTER: In the duplicate mode the carriage return character is used as the program control character and must be on tape to initiate programming.

ENDING CHARACTER: The paper tape reader stop command character is the ASCII character slash (/). The stop command should follow the last location to be programmed.

ASCII Hex (Data Only) Format 9102-2

Requires 8 level, ASCII data coding where the hexadecimal characters represent data to be operated on. When a tape is generated in the LIST mode the actual format becomes: data, space, data, space...with sixteen locations followed by a carriage return and line feed.

ADDRESS: Address information must not be on the tape. The Series 90 keeps sequential address count for each location operated on.

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

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

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

TTY OPERATING SEQUENCES (DATA ONLY FORMAT) 9102-2

The TTY takes control of the programmer whenever the programmer is reset and any key is operated on the TTY keyboard with the TTY in the LINE mode. The TTY can be used to LIST, PROGRAM, DUPLICATE or VERIFY. The operating mode is selected by typing the asterisk (*) followed by typing the starting and ending address followed by L, P, D, or V.

List Operating Sequence: In the LIST mode data in the COPY ROM is read and displayed on the Binary Data Display and printed sixteen locations per line on the TTY.

1. Insert the ROM to be listed in the COPY socket.
2. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).
3. Type in the Hex characters that define the starting address and the ending address of the field to be listed. The TTY will do a CR, LF, LF.
4. Type the letter L on the TTY keyboard. The TTY will do a CR, LF and begin automatically listing the content of the COPY ROM over the defined address field.

   If it is desired to punch a tape, the punch should not be turned on prior to the entry of the letter L on the TTY keyboard. This ensures that the field information will not be on the tape where it would be interpreted as a valid location.

5. When the TTY reaches the end of the field it does a CRLF, prints a slash (/) and does another CR and LF.

SAMPLE LISTING OF A PORTION OF A 256 x 8 ROM:

*	*Type *, TTY does CR LF*
0027	*Type address field, TTY does CR LF* *TTY does LF*
L	*Type L, TTY does CR LF, TTY lists data*

20 30 21 D8 E2 47 00 20 00 21 DF E2 20 10 21 19

18 EA F6 F6 1A 0F 40 03 56 02 24 AA 50 F5 14 18

56 54 58 00 56 02 D1 BF

/	*TTY prints /* *TTY does CR and LF* *TTY stops*

Program Operating Sequence: In the PROGRAM mode data from the TTY keyboard is programmed to the COPY PROM.

1. Insert the PROM to be programmed in the COPY socket.
2. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).
3. Type in the Hex characters that define the field to be programmed. The TTY will do a CR, LF, LF.
4. Type the letter P on the TTY keyboard. The TTY will do a CR, LF and print the first address.
5. Type the Hex data to be programmed into the COPY PROM. The TTY begins programming when valid Hex data is entered and does a CR, LF and prints the next sequential address when the programming operation is complete.
6. If invalid data is entered the TTY does a CR, LF, LF and reprints the current address. The operator can enter the correct data.
7. If the location cannot program for any reason, the TTY does a CR, LF, LF and reprints the current address. The operator may retry the same address but should observe the precautions defined in the Manual Program operating sequence. If the operator desires to proceed past a failed location, it is necessary to start from step 2 and define the starting address as the next sequential address.
8. When the TTY reaches the end of the field, it does a LF, prints a slash (/) and does another CR and LF.

SAMPLE PROGRAM OF A PORTION OF 256 x 8 PROM FROM TTY

```
*          Type *, TTY does CR and LF
0009       Type address field, TTY does CR and LF
           TTY does LF
P          Type P, TTY does CR and LF
00 28      TTY prints address, operator types data
01 DA
02 59
03 DW                Operator error, non-hex, TTY does CR LF
                     TTY does LF
03 DA                TTY reprints address 03
04 5C
05 C2
06 22
07 R                 Operator error, non-hex data, TTY does CR LF
                     TTY does LF
07 5C                TTY reprints address 07
08 88
09 FC
 /         TTY prints /
           TTY does CR and LF
           TTY stops
```

Duplicate Operating Sequence: In the DUPLICATE mode of operation a paper tape is read by the TTY reader. Information on the tape is interpreted as data. This is the reason for caution when making a paper tape in the LIST mode of operation. In the DUPLICATE mode of operation the only information that is printed is exception data. If an address cannot be programmed to the data on tape, both address and the data read from the ROM at that address will be printed out.

1. Insert the PROM to be programmed in the COPY socket.
2. Load the paper tape to be duplicated on the TTY paper tape reader.
3. Place the paper tape reader control switch in the AUTO position.
4. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).
5. Type in the Hex characters that define the field to be duplicated. The TTY will do a CR, LF, LF.
6. Type the letter D on the TTY keyboard. The TTY will do a CR and LF, and the reader will begin to read the data information. As each location is programmed the address and data will appear in the Hex display.
7. If a location cannot be programmed, the address and the data of the COPY ROM at that address will printed on the TTY. The operation does not stop on errors.
8. The DUPLICATE mode ends when the end of the address field is reached or if a slash (/) is read from the paper tape.

Verify Operating Sequence: The VERIFY mode compares the data from the paper tape against the data in the COPY ROM. The data from the tape appears with the address in the Hex display.

1. Insert the ROM to be verified in the COPY socket.
2. Load the paper tape containing the master information on the TTY paper tape reader.
3. Place the paper tape reader control switch in the AUTO position.
4. Type asterisk (*) on the TTY keyboard. The TTY will do a carriage return (CR) and a line feed (LF).
5. Type in the Hex characters that define the field to be verified. The TTY will do a CR, LF, LF.
6. Type the letter V on the TTY keyboard. The TTY will do a CR and LF and the reader will begin to read. As each location is verified, address and data will appear in the Hex display.
7. If a location does not verify, the address and data of the COPY ROM at that address will be printed on the TTY. The operation does not stop on errors.
8. The VERIFY mode ends when the end of the address field is reach or if a slash (/) is read from the paper tape.

REV	DESCRIPTION	DATE	APPR

PRO-LOG CORPORATION

Bob McCoy 11-19-74

ASSY, CPU BD
SERIES 90 PROG

A	100850	REV XA	SHT 1 OF 3

PARTS LIST

ITEM NO.	PRO-LOG NUMBER	VENDOR PART NO. OR SPEC. NO.	DESCRIPTION	QUANTITY REQ'D ASSY NO. 100850	ASSY NO.	ASSY NO.	ASSY NO.
1	100850		ASSY, CPU BD - SERIES 90 PROG	REF			
2	100847		SCHEMATIC, CPU BD - SERIES 90 PROG	REF			
3	100849		PWB, CPU BD - SERIES 90 PROG	1			
4		TI	SOCKET, 16 PIN DIP	13			
5		TI	SOCKET, 24 PIN DIP	9			
6		MC-18	CRYSTAL, 5 MHZ	1			
7		8316	IC, C MOS 2K ROM -	1			
8		14001	IC, Mc Mos QUAD 2-INPUT NOR GATE	1			
9		14049	IC, Mc Mos HEX BUFFERS	1			
10		14526	IC, Mc Mos 4 BIT COUNTER	1			
11		4002-1	IC, Mos-P Mcs4 RAM	1			
12		4004	IC, Mos-P MCS4 CPU 4BIT	1			
13		4008	IC, Mos-P MCS4 MEM INTERFACE	1			
14		4009	IC, Mos-P MCS4 MEM & I/O INTERFACE	1			
15		7404	IC, TTL, GATE HEX BUFFERS	2			
16		7442	IC, TTL, DECODER BCD TO DECIMAL ACT/LO	1			
17			CAPACITOR, ALUM 20V 4.7μF	1			
18			, ALUM 25V 1μF	2			
19			, CER 50V .1μF	7			
20			, CER 200V 33PF	1			
21			CAPACITOR, CER 200V 100PF	2			

PRO-LOG CORPORATION	ASSY, CPU BD SERIES 90 PROG	PL 100850	XA	SHT 2 OF 3

Form 100088

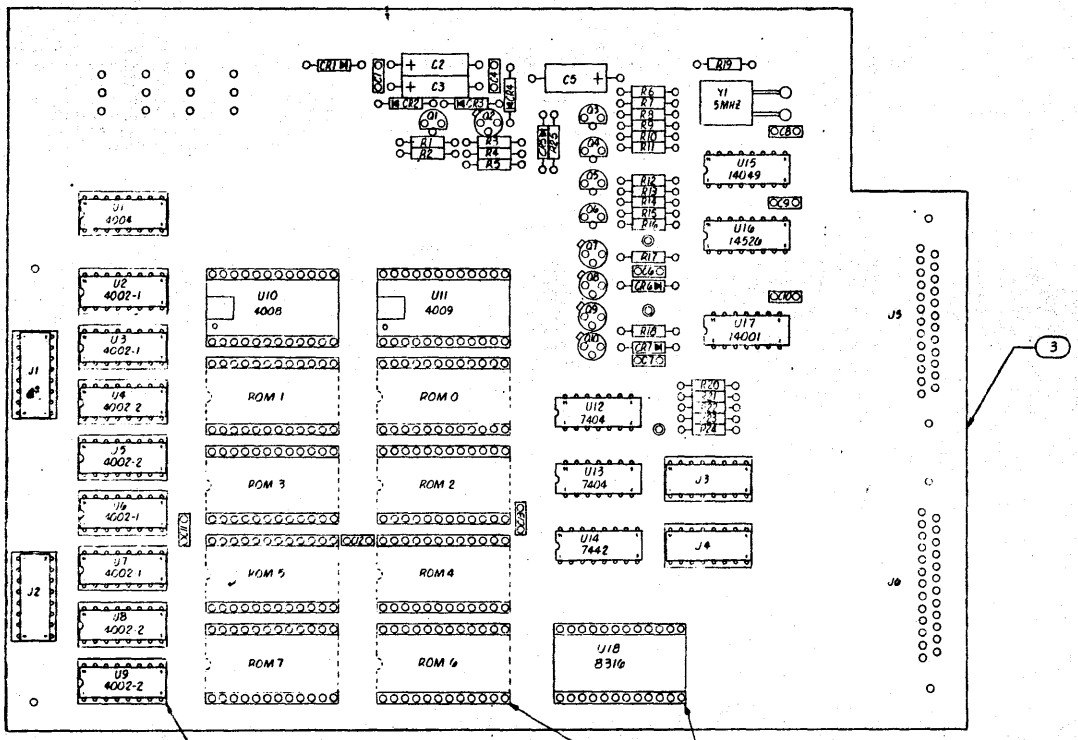
PARTS LIST

ITEM NO.	PRO-LOG NUMBER	VENDOR PART NO. OR SPEC. NO.	DESCRIPTION	QUANTITY REQ'D ASSY NO. 100950	ASSY NO.	ASSY NO.	ASSY NO.
22		2N2369A	TRANSISTOR, NPN 100MA 15V HS SW TO-18	5			
23		2N4125	TRANSISTOR, PNP 200MA 30V GP TO-92	3			
24		2N4123	TRANSISTOR, NPN 200MA 30V GP TO-92	2			
25							
26		IN4148	DIODE, 10MA 75V SIG DO-35	3			
27		IN4002	DIODE, RECT 1A 100V DO-41	4			
28							
29			RESISTOR, CARBON COMP 1/4W 100Ω	1			
30			1K	9			
31			4.7K	3			
32			10K	5			
33			22K	5			
34			47K	1			
35			RESISTOR, CARBON COMP 1/4W 220K	1			
36							
37							
38							
39							
40							
41							
42							

PRO-LOG CORPORATION	ASSY, CPU BD SERIES 90 PROG	PL 100850	XA	SHT 3 OF 3

Form 100088

REVISIONS				
REPORT REV	DOC REV	DESCRIPTION	DATE	APPR



ITEM	DESCRIPTION	REF DESIGNATION
35	220K CC ¼W	R16
34	47K	R15
33	22K	R2, R20–R23
32	10K	R1, R5, R8, R9, R13
31	4.7K	R3, R7, R24
30	1K	R4, R12, R17, R18, R25–R28
29	100Ω CC ¼W	R25
28		
27	IN4002 DO-41	CR1–CR6
26	IN4148 DO 35	CR7, CR8, CR9
25		
24	2N4123 TO-92	Q4, Q6
23	2N4125 TO-92	Q1, Q3, Q5
22	2N3640-A TO-18	Q2, Q7–Q10
21	100 PF 200V	C9, C10
20	33 PF 200V	C8
19	.1 MF 50V	C1, C4, C6, C7, C11, C12, C13
18	1 MF 25V	C2, C3
17	4.7 MF 10V	C5

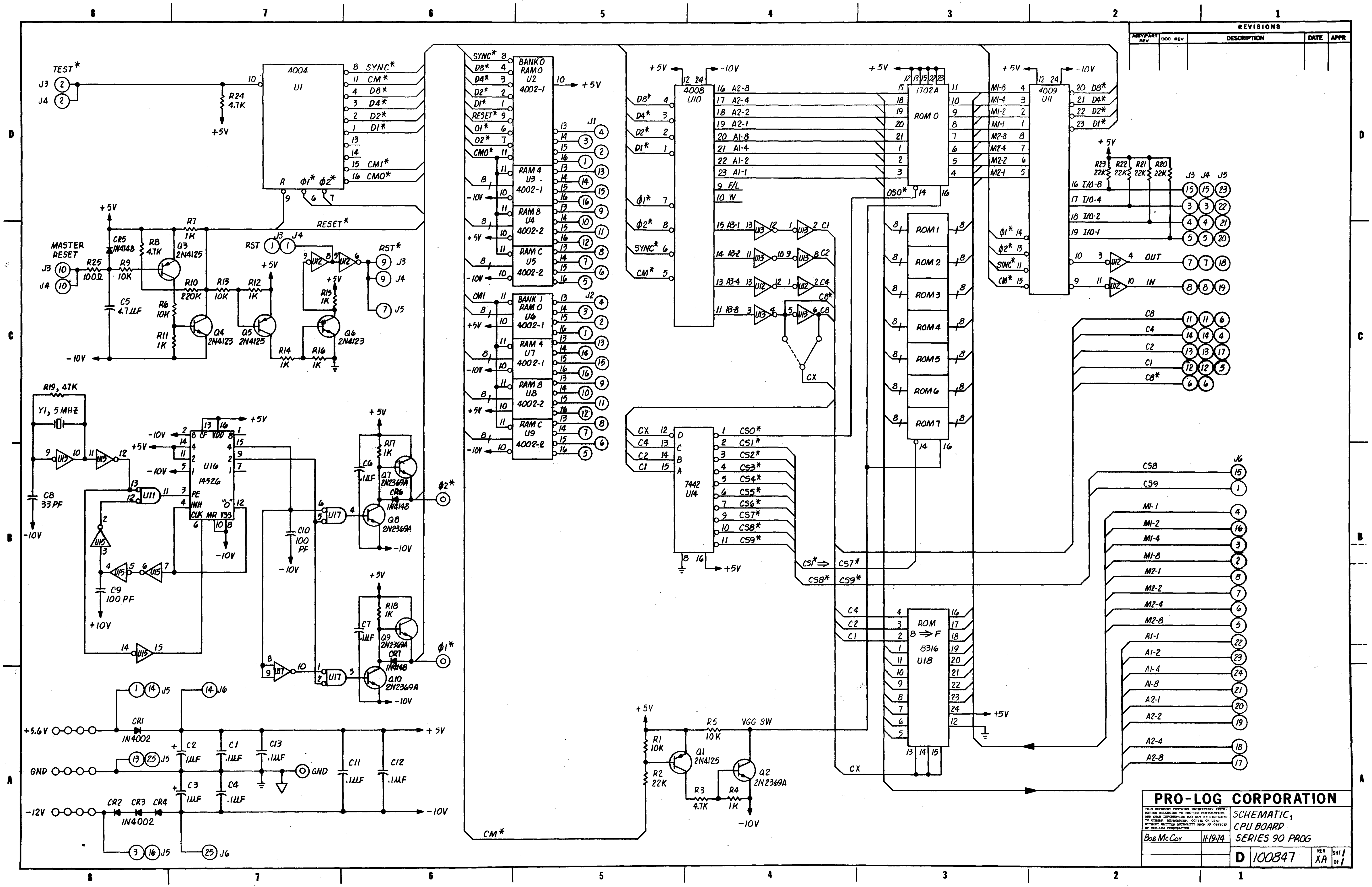
PRO-LOG CORPORATION

ASSY. CPU BD
SERIES 90 PROG

BOB McCOY 11.19.76

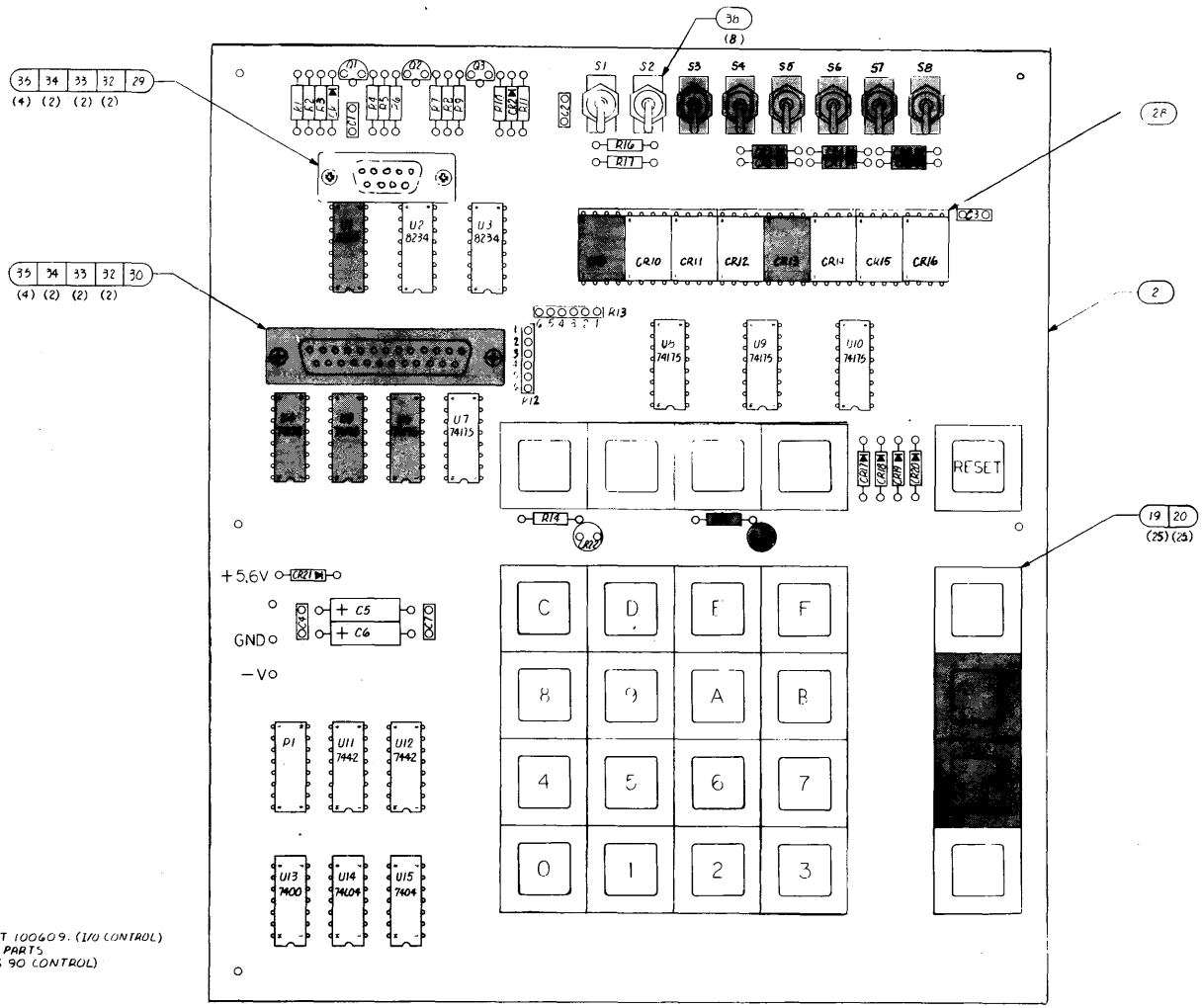
D 100850 XA

SHEET 1 OF 1



REVISIONS
ASSY/PART REV
DOC REV
DESCRIPTION
DATE
APPR
TEST*
MASTER RESET
4004 U1
SYNC*
CM*
D8*
D4*
D2*
D1*
CM1*
CM0*
RESET*
RST
RST*
BANK 0 RAM 0 U2 4002-1
RAM 4 U3 4002-1
RAM 8 U4 4002-2
RAM C U5 4002-2
BANK 1 RAM 0 U6 4002-1
RAM 4 U7 4002-1
RAM 8 U8 4002-2
RAM C U9 4002-2
4008 U10
1702A
ROM 0
ROM 1
ROM 2
ROM 3
ROM 4
ROM 5
ROM 6
ROM 7
4009 U11
OUT
IN
7442 U14
ROM 8 ⇒ F 8316 U18
14526 U16
Y1, 5 MHZ
R19, 47K
VGG SW
+5.6V
GND
-12V
+5V
-10V
1N4002
1N4148
2N4125
2N4123
2N2369A
PRO-LOG CORPORATION
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION BELONGING TO PRO-LOG CORPORATION AND SUCH INFORMATION MAY NOT BE DISCLOSED TO OTHERS, REPRODUCED, COPIED OR USED WITHOUT WRITTEN AUTHORITY FROM AN OFFICER OF PRO-LOG CORPORATION.
SCHEMATIC, CPU BOARD SERIES 90 PROG
Bob McCoy
11-19-74
D 100847
REV XA
SHT 1 OF 1

REVISIONS				
ASSY/PART REV	DOC REV	DESCRIPTION	DATE	APPR
XB		ADDED ASSY 100747	9-20-74	



NOTES:
ASSEMBLE PER PARTS LIST 100609. (I/O CONTROL)
FOR ASSY 100730 DELETE PARTS
IN SHADED AREA. (SERIES 90 CONTROL)

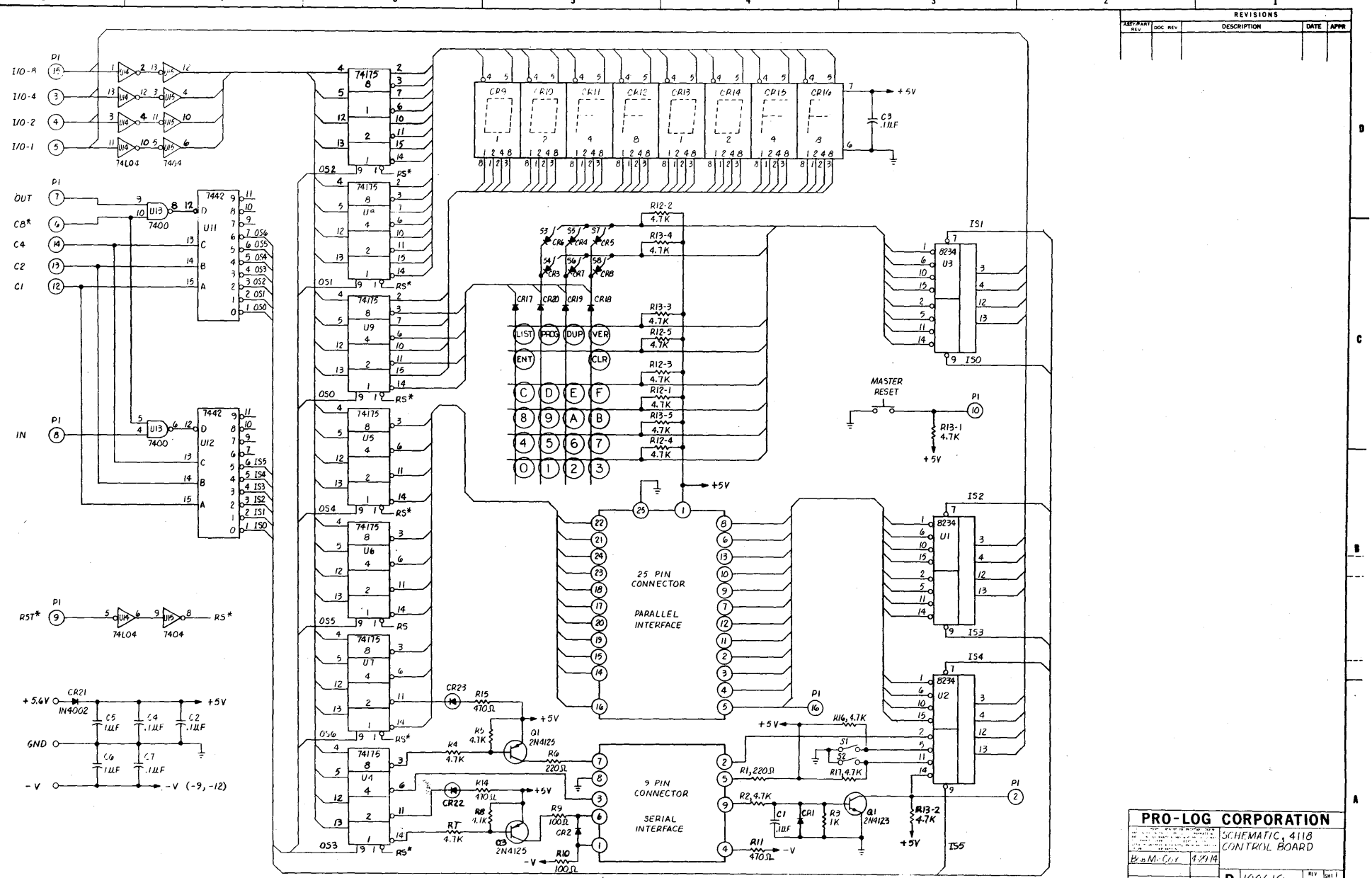
ITEM	DESCRIPTION	REF. DESIGNATION
27	IN4002 DO-41	CR21
26	4.7K ¼W	R2,R4,R5,R7,R8,R16,R17
25	1K	R3
24	470Ω	R11,R14,R15
23	220Ω	R1,R6
22	100Ω ¼W	R9,R10
21	IN4148 DO-35	CR1-CR8,CR17-CR20
18	4.7K NETWORK	R12,R13
17	2N4125 TO-92	Q2,Q3
16	2N4123 TO-92	Q1
15	LED, RED IND	CR22,CR23
14	LED, HEX	CR9-CR16
13	.1μF 50V	C1,C2,C3,C4,C7
12	1μF 25V	C5,C6

PRO-LOG CORPORATION

ASSY, 4118
CONTROL BOARD

BOB MCCOY 4-24-74

D 100609 XB SHT 1 OF 1


REVISIONS
DESCRIPTION
DATE
APPR
I/O-8
I/O-4
I/O-2
I/O-1
74L04
74/14
OUT
CB*
C4
C2
C1
7400
7442
U11
IN
U12
RST*
74L04
7404
RS*
+5.6V
IN4002
CR21
+5V
GND
-V
-V (-9, -12)
C5 1UF
C4 .1UF
C2 .1UF
C6 1UF
C7 .1UF
74175
U13
U8
U9
U5
U6
U7
U4
OS2
OS1
OS0
OS4
OS5
OS6
OS3
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
C3 .1UF
S3
S4
S5
S6
S7
S8
CR6
CR4
CR5
CR3
CR7
CR8
CR17
CR20
CR19
CR18
LIST
PROG
DUP
VER
ENT
CLR
C
D
E
F
8
9
A
B
4
5
6
7
0
1
2
3
R12-2 4.7K
R13-4 4.7K
R13-3 4.7K
R12-5 4.7K
R12-3 4.7K
R12-1 4.7K
R13-5 4.7K
R12-4 4.7K
IS1
IS0
IS2
IS3
IS4
IS5
8234
U3
U1
U2
MASTER RESET
R13-1 4.7K
25 PIN CONNECTOR
PARALLEL INTERFACE
9 PIN CONNECTOR
SERIAL INTERFACE
R15 470Ω
R5 4.7K
R4 4.7K
Q1 2N4125
R6 220Ω
R14 470Ω
R8 4.7K
R7 4.7K
Q3 2N4125
R9 100Ω
CR2
R10 100Ω
R16, 4.7K
R17 4.7K
R1, 220Ω
R2, 4.7K
C1 1UF
CR1
R3 1K
Q1 2N4123
R13-2 4.7K
R11 470Ω
PRO-LOG CORPORATION
SCHEMATIC, 4118
CONTROL BOARD
B.M.C.
4.29.14
D 100610
REV
SHT 1 OF 1

HEWLETT hp PACKARD

COMPONENTS

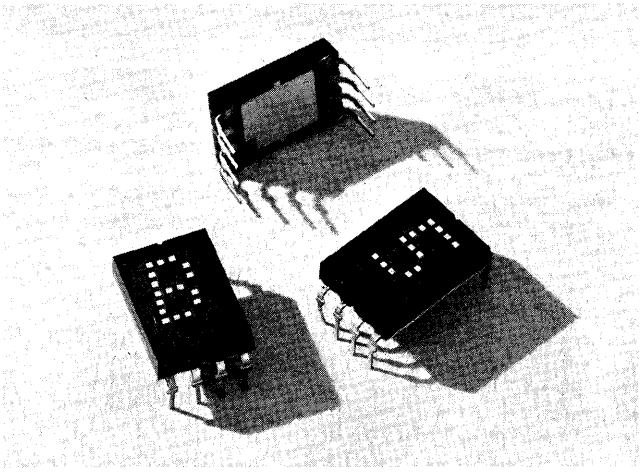
NUMERIC and HEXADECIMAL INDICATORS

5082-7300 SERIES

TENTATIVE DATA MAY 1972

FEATURES

- Numeric 5082-7300/-7302
  - 0-9, Test State, Minus Sign, Blank States
  - Decimal Point
    - 7300 Right Hand D.P.
    - 7302 Left Hand D.P.
- Hexadecimal 5082-7340
  - 0-9, A-F, Base 16 Operation
  - Blanking Control, Conserves Power
  - No Decimal Point
- DTL – TTL Compatible
- Includes Decoder/Driver with Memory
  - 8421 Positive Logic Input
- 4 X 7 Dot Matrix Array
  - Shaped Character, Excellent Readibility
- Standard .600 inch X .400 inch Dual-in-Line Package including Contrast Filter
- Categorized for Luminous Intensity
  - Assures Uniformity of Light Output from Unit to Unit within a Single Category



DESCRIPTION

The HP 5082-7300 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory provide a reliable, low-cost method for displaying digital information.

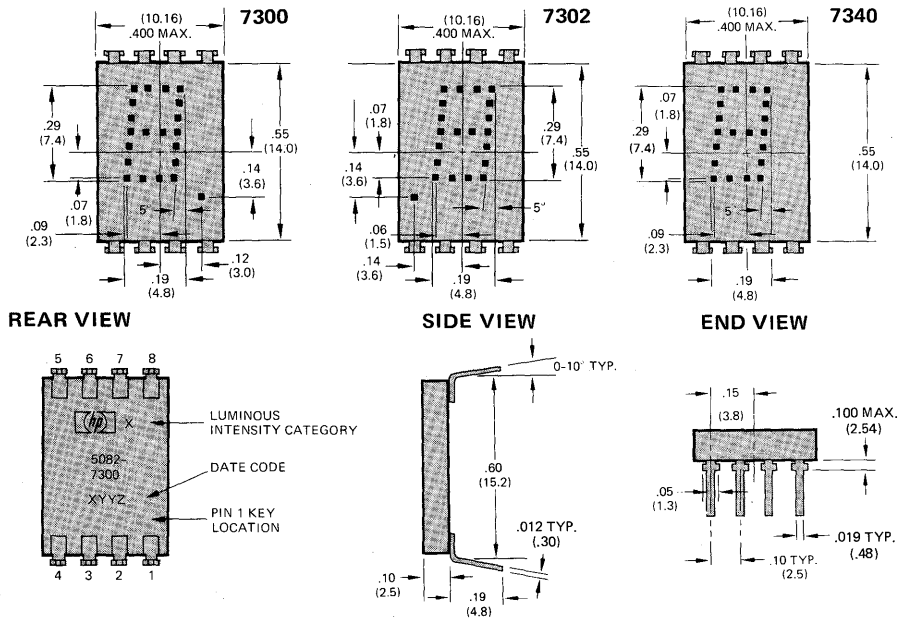
The 5082-7300 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a "-" sign, a test pattern, and four blanks in the invalid BCD states, The unit employs a right-hand decimal point. Typical applications include point-of-sale terminals, instrumentation, and computer systems.

The 5082-7302 is the same as the 5082-7300, except that the decimal point is located on the left-hand side of the digit.

The 5082-7340 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

The 5082-7304 is a "±1" overrange character, including decimal point, used in instrumentation applications.

PACKAGE DIMENSIONS



PIN	FUNCTION	
	5082-7300 and 7302 Numeric	5082-7340 Hexadecimal
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V_{cc}	V_{cc}
8	Input 1	Input 1

NOTES:
1. Dimensions in inches and (millimeters).
2. Unless otherwise specified, the tolerance on all dimensions is ±.015 inches.

ABSOLUTE MAXIMUM RATINGS

DESCRIPTION	SYMBOL	MIN	MAX	UNIT
Storage temperature, ambient	T_S	-40	+100	°C
Operating temperature, case	T_C	-20	+85	°C
V_{cc} Pin potential to ground pin	V_{cc}	-0.5	+7.0	V
Voltage applied to input logic pins and decimal point (1)	V_{in}	-0.5	+5.5	V
Voltage applied to latch enable	V_E	-0.5	+5.5	V
Voltage applied to blanking control (2)	V_B	-0.5	+5.5	V

NOTES: 1. Decimal point applies only to 7300/7302 2. Applies only to 7340

RECOMMENDED OPERATING CONDITIONS

DESCRIPTION	SYMBOL	MIN	NOM	MAX	UNIT
Supply Voltage	V_{cc}	4.5	5.0	5.5	V
Logic voltage "0" state	$V_{in(0)}$	0		0.8	V
Logic voltage "1" state	$V_{in(1)}$	2.0		5.25	V
Latch enable voltage-date being entered	$V_{E(0)}$	0		0.8	V
Latch enable voltage-data not being entered	$V_{E(1)}$	2.0		5.25	V
Blanking control voltage-display not blanked (1)	$V_{B(0)}$	0		0.8	V
Blanking control voltage-display blanked (1)	$V_{B(1)}$	3.5		5.25	V

NOTE: 1. Applies only to 7340

ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = -20°C to +85°C, unless otherwise specified)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply current	I_{cc}	V_{cc} = 5.5V		94(1)	170(2)	ma
Power dissipation	P_T	V_{cc} = 5.5V		470(1)	935(2)	mW
Luminous intensity per LED (Digit average) (3)	I	V_{cc} = 5.0V, T_C = 25°C	32	70		μcd
Time data must be presented to logic input prior to enable rising	t_{setup}	V_{cc} = 5.0V, $V_{E(0)}$ = 0.4V $V_{in(0)}$ = 0.4V, $V_{E(1)}$ = 2.4V $V_{in(1)}$ = 2.4V, T_C = 25°C		30	50	ns
Time data must be held after enable rises	t_{hold}	V_{cc} = 5.0V, $V_{E(0)}$ = 0.4V $V_{in(0)}$ = 0.4V, $V_{E(1)}$ = 2.4V $V_{in(1)}$ = 2.4V, T_C = 25°C		30	50	ns
Time required for 90% change in display luminous intensity after change of state of V_B (4)	t_{blank}	V_{cc} = 5.0V, T_C = 25°C			500	ns
Blanking control current "0" state (4)	$I_{B(0)}$	V_{cc} = 5.5V, $V_{B(0)}$ = 0.8V			200	μA
Blanking control current "1" state (4)	$I_{B(1)}$	V_{cc} = 5.5V, $V_{B(1)}$ = 4.5V			2.0	mA
Logic and latch enable currents "0" state	$I_{in(0)}$, $I_{E(0)}$	V_{cc} = 5.5V V_{in}, V_E = 0.4V			-1.6	mA
Logic and latch enable currents "1" state	$I_{in(1)}$, $I_{E(1)}$	V_{cc} = 5.5V V_{in}, V_E = 2.4V			+250	μA
Peak wavelength	λ_{peak}			655		nm
Spectral halfwidth	$\Delta\lambda_{1/2}$			30		nm
Weight				0.8		gm

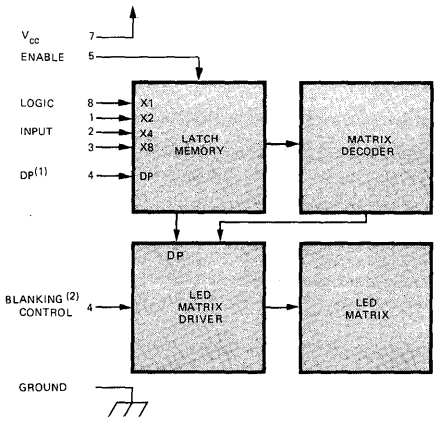
NOTES:

1. V_{cc} = 5.0V with statistical average number of LED's lit.
2. Worst case condition excluding test state on 5082-7300/-7302.
3. The digits are categorized for luminous intensity such that the variation from digit to digit within a category is not discernible to the eye. Intensity categories are designated by a letter located on the reverse side of the package contiguous with the Hewlett-Packard logo marking.
4. Applies only to 7340.

CHARACTER		INPUTS						CHARACTER		INPUTS					
5082–7300/7302 Numeric	5082–7340 Hex.	X8	X4	X2	X1	E	B(1)	5082-7300/7302 NUMERIC	5082–7340 Hex.	X8	X4	X2	X1	E	B(1)
0	0	L	L	L	L	L	L	Test	A	H	L	H	L	L	L
1	1	L	L	L	H	L	L	Blank	B	H	L	H	H	L	L
2	2	L	L	H	L	L	L	Blank	C	H	H	L	L	L	L
3	3	L	L	H	H	L	L	Minus	D	H	H	L	H	L	L
4	4	L	H	L	L	L	L	Blank	E	H	H	H	L	L	L
5	5	L	H	L	H	L	L	Blank	F	H	H	H	H	L	L
6	6	L	H	H	L	L	L	Hold	Hold	d	d	d	d	H	d
7	7	L	H	H	H	L	L	—	Blank (1)	d	d	d	d	d	H
8	8	H	L	L	L	L	L	Decimal pt. on (2)	—	DP_{in} = L					
9	9	H	L	L	H	L	L	Decimal pt. off (2)	—	DP_{in} = H					

NOTES:
1. The blanking control input, B, pertains to the 5082-7340 Hexadecimal Indicator only.
2. The decimal point input pertains to the 5082-7300 and -7302 Numeric Indicators only.

Figure 1. Truth Table for 5082-7300 Series Devices



Notes 1. 5082 – 7300/-7302 only
2. 5082 – 7340 only

Figure 2. Block Diagram of 5082-7300 Series Logic.

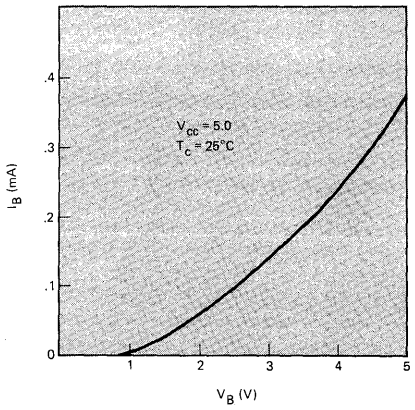


Figure 3. Typical Blanking Control Current Vs. Voltage for 5082-7340 Only.

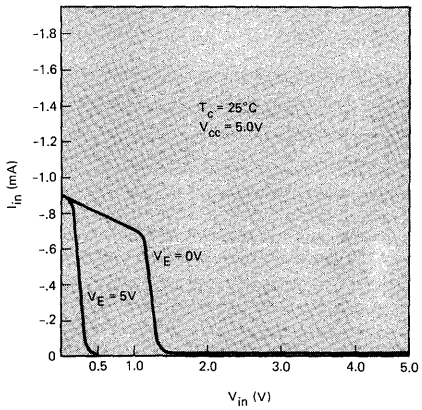


Figure 4. Typical Logic and Decimal Point Input Current Vs. Voltage for the 5082-7300 Series Devices. Decimal Point Applies to 5082-7300 Only.

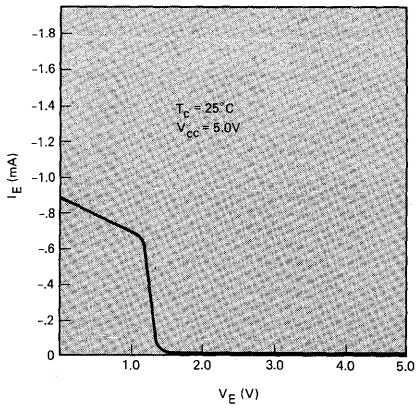


Figure 5. Typical Latch Enable Input Current Vs. Voltage for the 5082-7300 Series Devices.

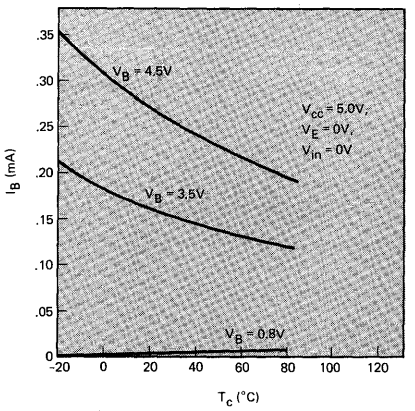


Figure 6. Typical Blanking Control Input Current Vs. Temperature, 5082-7340.

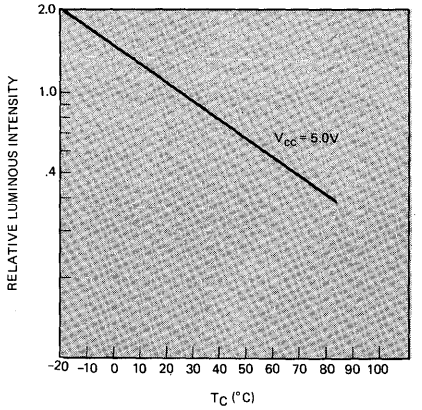
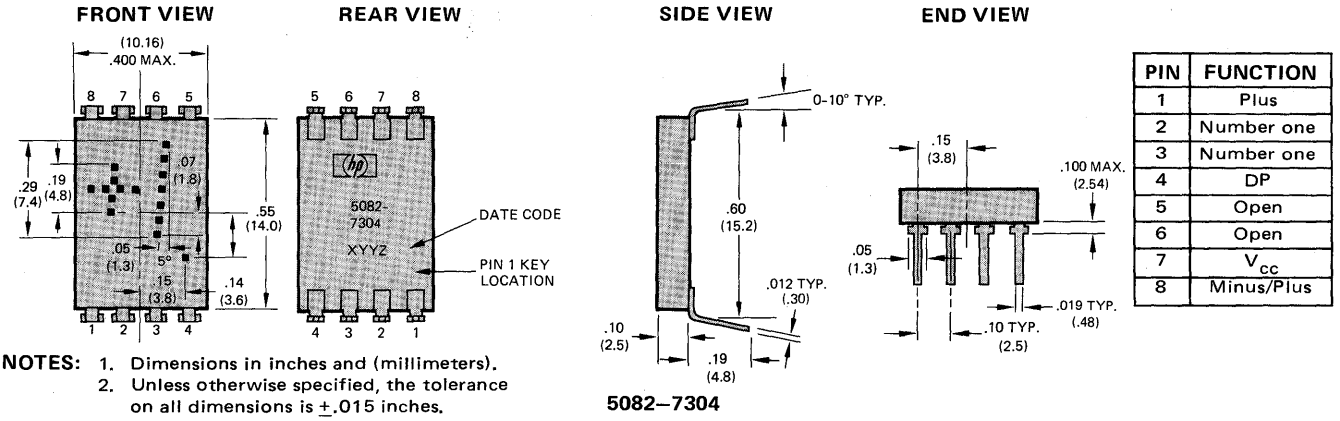


Figure 7. Typical Luminous Intensity Vs. Case Temperature for the 5082-7300 Series Devices.

SOLID STATE PLUS/MINUS/ONE SIGN

For display applications requiring a ± or 1 designation, the 5082-7304 plus/minus/one sign including decimal point is available. This display module comes in the same package as the 5082-7300 series numeric indicator and is completely compatible with it.



5082–7304

PIN	FUNCTION
1	Plus
2	Number one
3	Number one
4	DP
5	Open
6	Open
7	V_{cc}
8	Minus/Plus

NOTES: 1. Dimensions in inches and (millimeters).
2. Unless otherwise specified, the tolerance on all dimensions is ±.015 inches.

CHARACTER	PIN			
	1	2,3	4	8
+	1	0	0	1
–	0	0	0	1
1	0	1	0	0
Decimal point	0	0	1	0
Blank	0	0	0	0

NOTE: 0: Line switching transistor in Fig. 11 cutoff
1: Line switching transistor in Fig. 11 saturated

Figure 8. Truth table for 5082-7304

ABSOLUTE MAXIMUM RATINGS

DESCRIPTION	SYMBOL	MIN	MAX	UNIT
Storage temperature, ambient	T_s	-40	+100	°C
Operating temperature, case	T_C	-20	+85	C
Forward current, each LED	I_F		10	mA
Reverse voltage, each LED	V_R		4	V

RECOMMENDED OPERATING CONDITIONS

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V_{cc}	4.5	5.0	5.5	V
Forward current, each LED	I_F		5.0	10	mA

NOTE:
LED current must be externally limited. Refer to Figure 11 for recommended resistor values.

TYPICAL DRIVING CIRCUIT FOR 5082-7304.

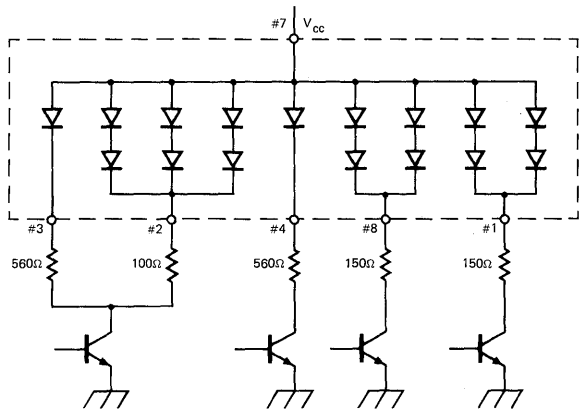


Figure 9.

ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = -20°C TO +85°C, UNLESS OTHERWISE SPECIFIED)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
LED forward voltage	V_F	I_F = 10 mA		1.6	2.0	V
Power dissipation	P_T	I_F = 10 mA all diodes lit		250	320	mW
Luminous intensity per LED (DIGIT average)	I	I_F = 6 mA T_C = 25°C	32	70		μcd
Peak wavelength	λ_{peak}			655		nm
Spectral halfwidth	$\Delta\lambda_{1/2}$			30		nm
Weight				0.8		gm

For further information concerning electrical and mechanical implementation of the 5082–7300 series devices, please refer to Application Note 934.

For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181 West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, 1217 Meyrin-Geneva

Printed In U.S.A.

5952-0300