INSTRUCTION MANUAL
MODEL 4
NMOS EPROM PROGRAMMER

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OPERATORS MANUAL

MODEL 4

NMOS EPROM PROGRAMMER

1.0 INTRODUCTION

1.1 Instrument Description

The E-H Model 4 PROM Programmer is a stand alone, microprocessor controlled, NMOS EPROM Programmer. It is designed to Program, Verify, and Modify all NMOS EPROMS, 2704 (4k) through the TI 128k's.* The EPROM device selection is done using Software Personality.™ No Personality Boards are required. Two simple keystrokes select the EPROM of your choice.

The Model 4 can be easily run by any operator, but has a tremendous software package to allow in-depth data manipulation using keyboard commands.

The compact design of the Model 4 permits it to be used as a portable field service instrument, yet is also suitable for use in laboratory and production line environments.

*Assuming the EPROM manufacturers follow the announced pin out and standard program algorithm on the 64k and 128k parts.

The Model 4 has everything necessary to make it a complete programming system. It contains 2kx8 RAM which allows EPROM emulation and extensive move and list commands. The sockets are buffered and powered down (cold) after every operation.

The unit also comes standard with an RS232 and TTY serial I/O Interface allowing communication with a terminal, development system, etc.

The Model 4 is laid out for easy operation. The Hex Keypad is used to enter the device type, alter data, and enter commands for editing and emulate software. The 8 digit display shows address, master data and copy data simultaneously. The remaining five keys allow the operator to initialize the protrammer to the command mode using the Reset key, Load Master data into the RAM, Verify the Master to the Copy PROM and Program will automatically blank check the copy PROM, program it from the master using the manufacturers specifications and then verify it back to the Master. The Step key allows manual advance of the programmer, similar to a carriage return.

This manual explains the Model 4 operations in detail. Individual features are discussed in Section 2; operating instructions are given in Section 3.

1.2 Supplied Equipment

The standard accessories supplied with each Model 4 are listed in Table 1-1. Optional Accessories are listed in Table 1-2.

TABLE 1-1

STANDARD EQUIPMENT SUPPLIED

Description	Quantity	E-H Part No.
Instruction Manual	1	148-07718
Power Cord	1	786-00020
Envelope	1	800-00032

TABLE 1-2

OPTIONAL ACCESSORIES

Description	Quantity	E-H Part No.
Emulation Cable	1	747-00301
Porto-case	1	891-00052
28 Pin Sockets	1	495-00088

1.3 Inspection Procedure

The inspection procedure allows you to verify that your programmer is in the best possible condition upon receipt.

The programmer was carefully packaged to prevent any possible shipping damage. It should, therefore, arrive free of any defect, electrical or mechanical, without marks or scratches, and in perfect operating condition. Carefully inspect the programmer for any damage that may have occurred in transit, and also check that the accessories listed in Table 1-2 if ordered are present. If there is any physical damage, file a claim with the carrier and notify E-H International.

Check programmer operation only after performing the turn-on procedure, which is detailed later in this section.

1.4 Fuses

The programmer has one fuse. It is located on the rear panel. The line fuse is a one half amp (slow blow) 3AG.

CAUTION: Before changing fuse, disconnect the programmer from power source.

1.5 Power Requirements

The Programmer has the following power requirements.

1.5.1 Line Voltage: Nominally 100, 115, or 230 volts ac. Voltage selection is made on a barrier strip connected to the base of the programmer. An operating voltage is pre-selected at the factory. If it is necessary to change operating voltage, refer to Figure 1-1 for instructions. At each voltage (100, 115, or 230) the programmer will operate with the line voltage within $\pm 10\%$ of the indicated voltage. The operating voltage ranges are, therefore, 90 to 110 volts, 105 to 130 volts, or 210 to 255 volts.

FIGURE 1-1

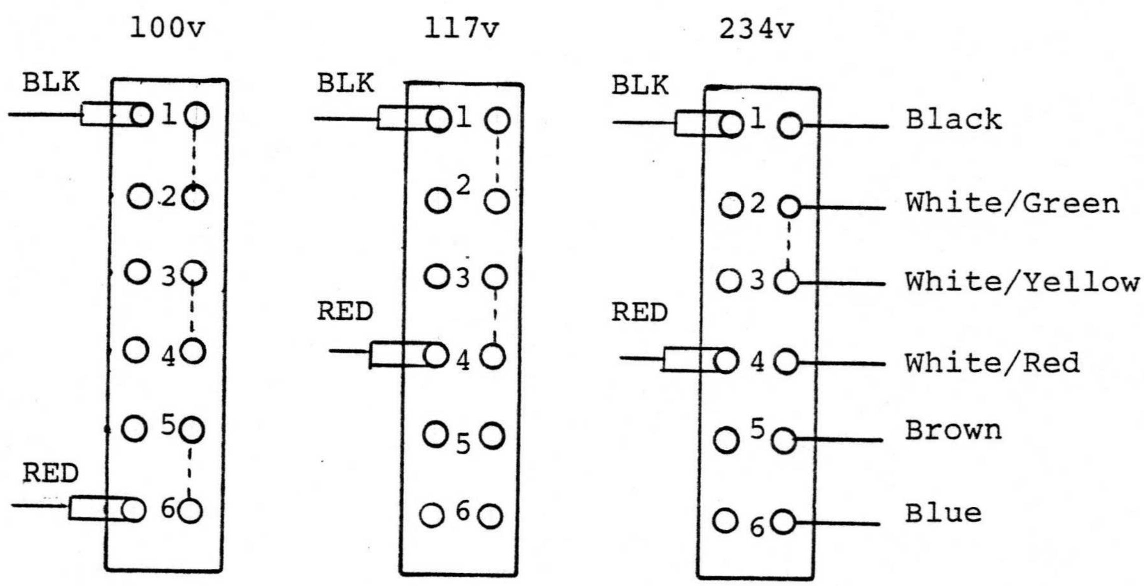


TABLE 1-3

SELECTION OF OPERATING VOLTAGE

1. Remove top panel by removing the two front feet and two screws at the back panel.
2. Move the clips to wire 4 and 5 for 100, to wire five and six for 115 or six and seven for 230.
3. Reinstall top panel.
4. Before applying power, check to see proper line fuse is installed.

1.5.2 Line Frequency: Nominally 50 Hertz to 60 Hertz; the programmer will operate within the range 48 to 66 Hertz.

1.5.3 Power Consumption: Maximum power consumption is 30 watts.

1.6 Grounding Requirements

The programmer is designed for operation from a single phase, three wire power source.

CAUTION: It is not intended for operation from two phases of a multi-phase system, or across the legs of a single-phase, three-wire system.

When the power cord is connect into a three-wire AC power sytem, the round connector serves to ground the programmer chassis and keyboard, eliminating potential shock hazards. If a three-to-two wire adapter is used to connect the programmer to a two-wire AC system, the ground lead of the adapter should be connected to earth (ground) to complete the ground system; failure to do so may cause a potential shock hazard.

1.7 Turn-on Procedure

Set the POWER switch to the OFF position. Connect the power cord to the power input connector at the rear of the programmer and plug the other end into a suitable AC power outlet. Switch Power ON; a small "d" will be displayed. The system is now ready for the first command to be entered from the Hex Keypad. See "Device Select."

1.8 Cleaning the Programmer

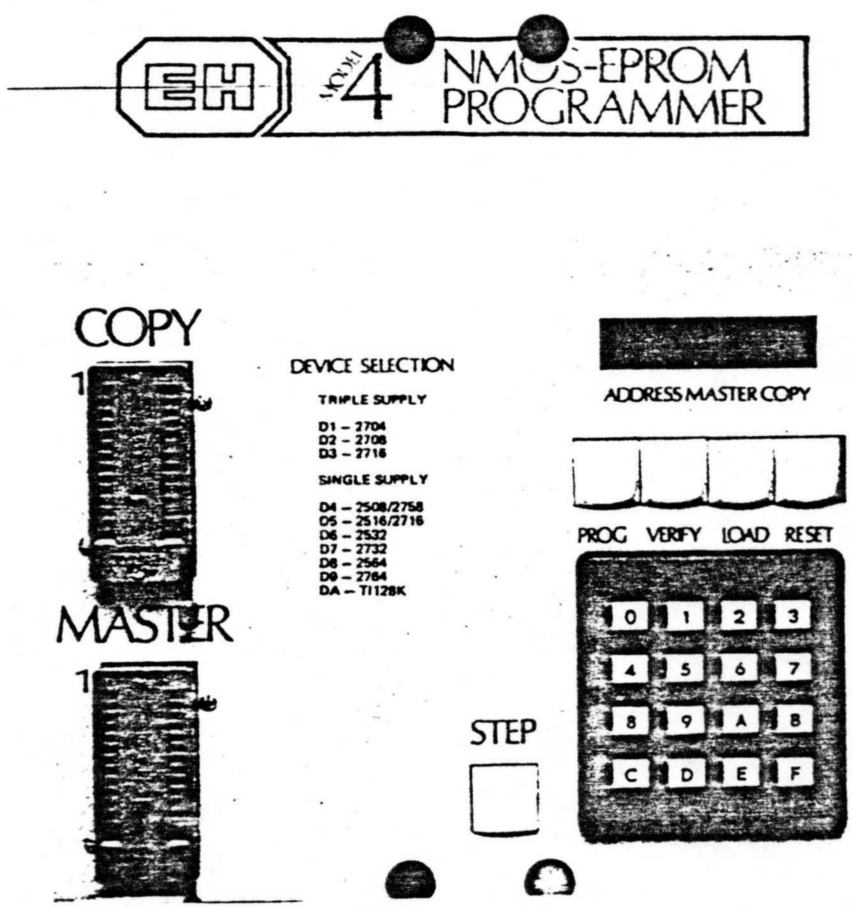
Clean the programmer using a soft cloth, dampened in clean water containing a mild detergent. Do not use an excessively wet cloth or allow water to penetrate inside the programmer. Do not use any abrasive materials, especially on the display panel.

2.0 FEATURES

This section contains a basic, general discussion of the Model 4 PROM Programmer's features. The information contained here assumes no prior knowledge of the Model 4 and is intended to provide basic information needed to understand material in the following sections.

Figure 2-1 is a representation of the Model 4 Programmer.

FIGURE 2-1



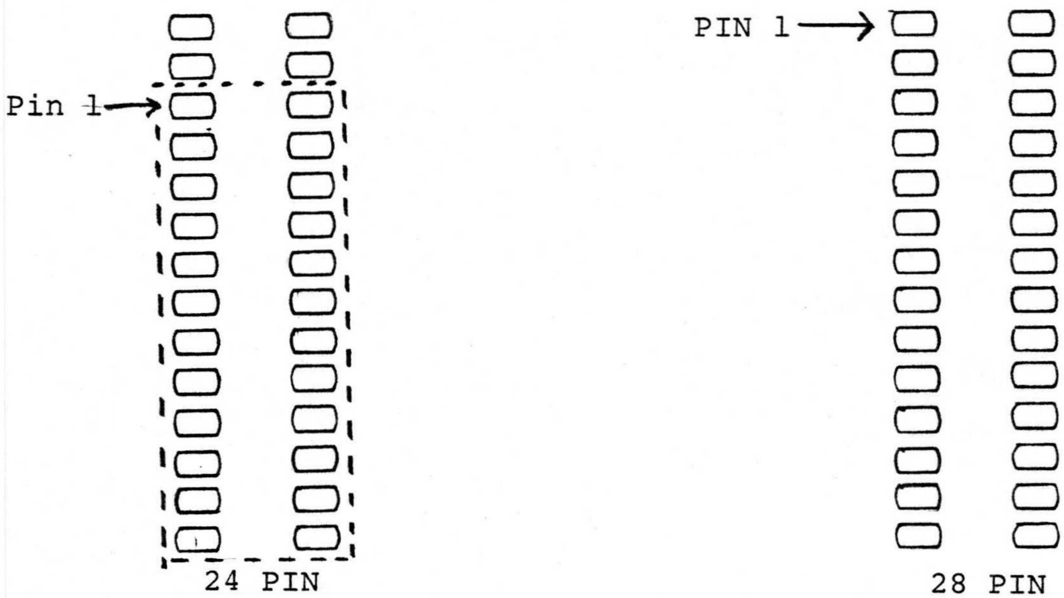
The programmer is divided into the following functional divisions:

- 2.1 PROM Sockets
- 2.2 Programmer Memory
- 2.3 LED Display
  - Address
  - Data
- 2.4 Keypad
- 2.5 Mode Select Keys
  - Reset
  - Load
  - Verify
  - Program
  - Step
- 2.6 I/O Interface

2.1 PROM Sockets

The Master and Copy sockets are both 28 pin zero insertion force sockets, mounted on mother sockets for easy replacement when worn. The Sockets are set up to handle the 2704 (4k) thru the TI 128k's. The 4k thru 32k PROMS are 24 pin devices and are placed into the socket as illustrated in Figure 2-2.

FIGURE 2-2



The top four holes are blocked off from use until the 64k and 128k PROMS are used. When the 28 pin device is to be used, remove the spacer and place the device in the socket as illustrated in Figure 2-2.

The sockets are fully buffered from the microprocessor. No power is applied to the devices in the socket until an operation is started.

2.2 Programmer Memory

The programmer contains 16,384 bits of Random Access Memory (RAM), which is used as a temporary buffer for data storage. It is organizaed 2048 words by 8 bits wide.

Throughout this manual the terms "programmer memory" and "RAM" are used interchangeably.

The RAM may be loaded with data from the keyboard, from a preprogrammed PROM, or from the serial I/O interface. Data in the RAM may be output either to a PROM or thru the serial I/O. In the verify mode, RAM contents may be compared to contents of a PROM or external peripheral.

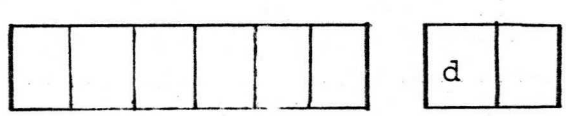
Programmer memory is volatile, meaning that memory contents are lost in the absence of AC power.

2.3 LED Display

The display is an 8-digit display. It shows the device type in operation or current operation mode. Also, the Read/Alter mode the display contains the address, Master data and Copy data.

A "B" is displayed as "b" (small B). A "D" is displayed "d". The remaining hex digits are displayed in the normal manner.

2.3.1 Device Type: When the Model 4 is first powered up a "d" shows up in the display.



See Operating Instructions Section 3 for device select. See Table 2-1 for codes.

TABLE 2-1

DEVICE DESIGNATORS

When the unit is first powered on, the display shows a "d" in the window requesting the device type. By depressing a "d" and then a "1" through "A" on the keypad the following devices can be selected:

Device Selection:

Triple Supply	D1 - 2704
	D2 - 2708
	D3 - 2716
Single Supply	D4 - 2508/2758
	D5 - 2516/2716
	D6 - 2532
	D7 - 2732
	D8 - 2564
	D9 - 2764
	DA - TI 128K

Once a device selection number is entered on the keypad, the device type and the number of the device is displayed.

2	7	1	6				d	3

This holds true in all of the devices as they are selected. The device will stay selected until the programmer is powered "off" or a new device is selected.

2.3.2 Operating Mode: The letters in this section appear in the display as that operation is being executed.

TABLE 2-2

OPERATING MODES

A	Load From Master
B	Blank Check
C	Program Operation
D	Verify
E	Emulate
AA	Move Operation
BB	Dump/List to Serial Port
CC	Checksum
FF	Receive from Serial Port
. . . .	Read/Alter Location
. . . .	Select Device
. . . .	Select Baud Rate

For detailed instructions of operating modes, see Section 3, Operating Instructions.

Example:

Load Sequence - When load is depressed an "A" goes into the display.

					A			

At the end of the load sequence, the Model 4 automatically does a checksum of the data. (See Checksum Calculation.)

							C	C

Once the checksum is calculated, it is displayed along with the device select number at the end of the operation.

F	E	0	0				d	3

Alter data - To Alter data an "A" is depressed and then the address to be altered. Once the last Hex number is entered, the Address and the data at that address will be displayed. (FF)

0	0	0	0	F	F			

To Alter data the new information will be displayed as it is entered,in the Copy LED location. (00)

0	0	0	0	F	F		0	0

To place the new information into the RAM depress "step." This will enter data and step to the next address.

0	0	0	1	F	F			

2.4 <u>Keypad</u>

The keypad contains sixteen keys arranged in a hexadecimal format (0-9,A-F). It is used for both address and data entry, and the software control selection.

After a device has been selected the unit goes into a scan operation. It is looking for any entry from the keypad or control switches. When a key is depressed, the key is read and the microprocessor enters a wait state to allow the operator to release the key. If the key is still depressed at the end of the wait, it is treated like a new keystroke. The debounce circuitry is set up to ensure a delibrate stroke is used on the keys. It will ignore a fast or light touch.

2.5 Mode Select Keys

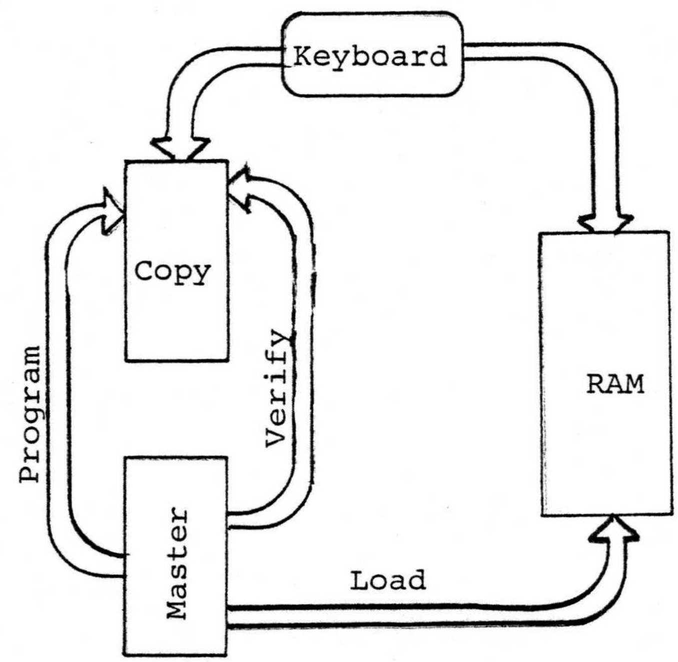
The load, verify, program and step keys are scanned as part of the keypad. The same algorithms apply.

2.5.1 Reset: When the Reset key is depressed it pulls a halt on the microprocessor and initializes back into the command loop. Once a device has been selected, the reset key will not effect that selection and does not effect data in the RAM or change the baud rate. It's only function is to initialize the programmer back into the command loop.

2.5.2 Load (A): The System has 2kx8 of RAM as a standard feature. When "load" is depressed an "A" will be shown in the display. The Model 4 will then transfer data out of the Master PROM socket into the internal RAM. This is the load key's only function. If the EPROM is larger than 2k,you will need to specify which 2k block should be loaded into the RAM. A prompt "b" is displayed, requesting a block designation be entered; a 1 means move 0000 thru 07FF into the RAM, a 2 means move 0800 thru OFFF into RAM, etc. See the Load routine in the Operating Instructions.

When the Master Socket is empty and the Load key is depressed, it will clear the RAM to all ones (F's). See Appendix A for the Check-sum Values of the different address spaces.

FIGURE 2-3



KEY INDUCED

DATA FLOW

2.5.3 Verify (D): When Verify is depressed a "d" will be displayed. The Verify Key will verify the PROM in the Master Socket to the PROM in the Copy Socket. The verification is a byte by byte compare. Once the verification is complete, it will calculate and display the checksum of the copy in the display. To Verify

RAM data to the copy see Move Routine.

2.5.4 Program (C): When PROG is depressed, the programmer will transfer the data in the Master Socket into the copy socket. This is done in four continuous operations.

(1) The PROM is first checked to insure it is blank. During this operation a "b" is displayed.

(2) A good device will automatically go into the program operation and a "C" will be shown in the display.

(3) At the end of the manufacturers programming time, the programmer will automatically do a verify back to the Master. While in this operation it will display a "d" for verify.

(4) Then the checksum is calculated. A "CC" is displayed during this operation.

(5) Upon completion, the checksum and the device selection number is displayed.

If an error is detected during this sequence, the appropriate error loop is entered. (1) During the blank check if an illegal bit is located, the programmer will stop and display the address and copy data. To check for other failures, depress the"Step"key and the programmer will continue to the next failure. To continue into program and disregard the illegal bits, depress the "Program" key again. (2) If the error is detected in the verify operation, the programmer will stop and display the address, master and copy data. To check for other errors,depress the "Step" key. The programmer will automatically step to the next failure. After the last error the programmer will do a checksum of the copy PROM.

2.5.5 Step: The"Step"key is used to manually advance the programmer or to designate data flow size in the Dump and Receive Routines. It approximates a carriage return. (See Dump and Receive in the Operating Instructions.) In the manual advance operation, the key is used in the following manners.

(1) In the program or verify operation, if an error is located the step key will move to the next error in the PROM. It stops at each error until the complete PROM is verified.

(2) During the Alter operation, when the Step key is depressed the programmer will advance the address by one location. (See Alter Operation.) If an address is to

be changed, the new data entered on the keypad is inserted into the RAM when the "Step" key is depressed.

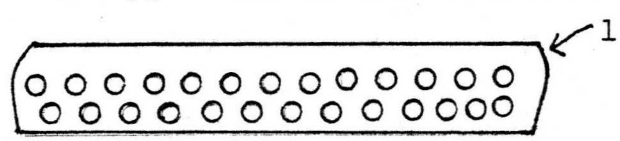
In the Dump and Receive Routines, the step key is used in the following manner:

(1) In the Dump Routine, depressing "B" and then"Step"will dump the RAM for the size of the device selected; i.e., 512 bytes if a D1 (2704) is selected.

(2) In the Receive Routine, depressing "F" and then"Step" will store the incoming data stream beginning at address 0000 in the RAM.

2.6 I/O Interface

The Model 4 comes standard with an RS232C and 20ma current loop serial interface. The 25 pin "D" connector is located on the back panel with pin 1 being on the outside upper row of the connector.



For communication cable connectors see Figure 2-4 and 2-5.

The serial to parallel conversion is done with the microprocessor. See Appendix G for schematic.

This restricts the intercharacter gap to 1.2 milliseconds in a receive to RAM and 57 milliseconds in a receive to copy. A clear to send to the programmer signal has been provided to allow the transmitting equipment to not over run the programmer in an interactive usage. The same effect is achieved by putting an appropriate delay, if required, in the transmitting equipment.

The chassis ground is tied to the signal ground which is tied to earth ground. The data set ready and carrier detect signals are constantly hi (+12v) to allow easy interface to equipment requiring these signals.

FIGURE 2-4

COMMUNICATION CABLE CONNECTION

RS232

25 PIN "D" CONNECTOR

PIN	FUNCTION
1	Chassis gnd
2	Data into Programmer
3	Data out of Programmer
5	Clear to send to Programmer
6	Data Set Ready
7	Signal gnd
8	Carrier Detect

The 20ma loop uses the same conventions as the RS232. The clear to send signal provides 20ma to drive a reader relay to ensure the reader does not over run the programmer in a receive to copy usage. See the Schematic in Appendix G.

FIGURE 2-5

20MA LOOP

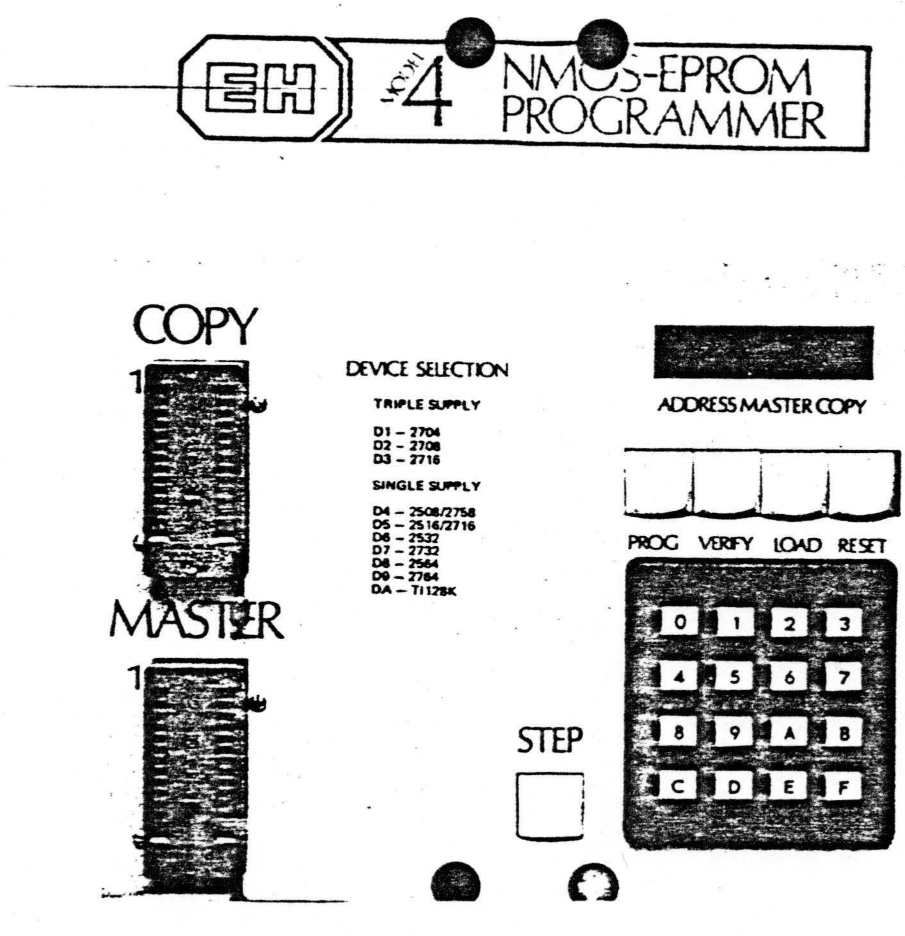
25 Pin "D" Connector

PIN	FUNCTION
5	Reader Relay (+)
9	Data out of programmer (+)
10	Data out of programmer (-)
11	Data into programmer (+)
12	Data into programmer (-)
25	Reader Relay (-)

See Appendix F for more detailed connection information.

3.0 MODEL 4 OPERATING PROCEDURES

This section explains operations with the Model 4 Portable PROM Programmer and assumes a basic familiarity with the information contained in the previous sections. Operating procedures are explained in detail, along with programmer response to the various key commands. Individual key functions are discussed in the context of desired operations but are not, however, discussed in detail. Refer to the previous section for functional details of the individual keys.



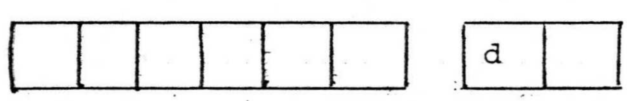
3.1 Turn-on Procedures

CAUTION: Prior to applying power to the programmer, always remove the PROM from the sockets , as voltage transients during power-up may damage sensitive PROM junctions. For the same reason, also remember to always remove the PROM prior to turning power off.

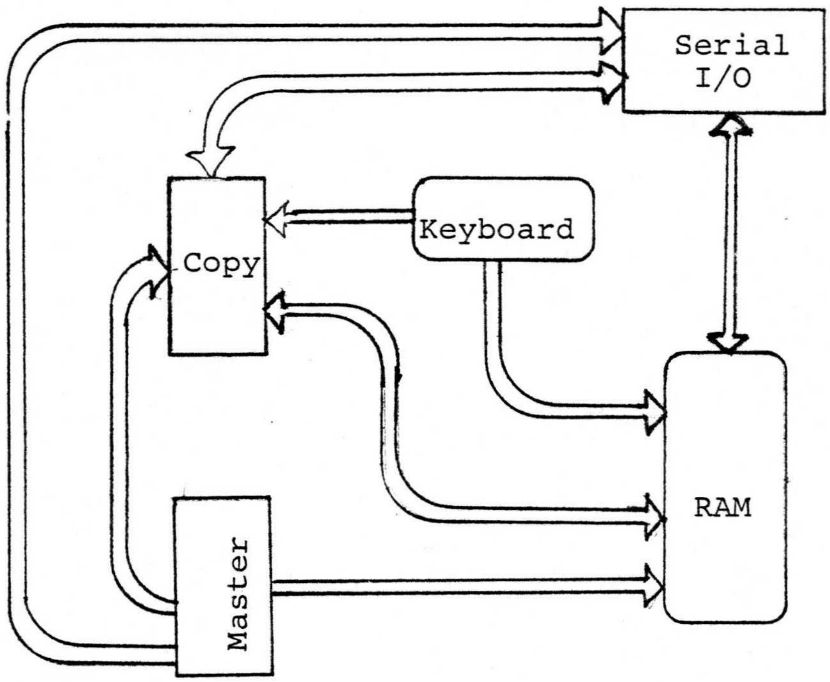
1. Assure that the line source voltage matches the preset input voltage of the programmer.
2. Plug one end of the power cord into the input voltage connection on the programmer rear panel; plug the other end into a suitably grounded voltage source.
3. Turn POWER ON.

After a slight pause, the programmer data display comes on showing a "d" into the display. Depressing "Reset" will force a "d" into the display.

An EPROM device must be selected before any operation is initiated.



3.2 Basic Operating Theory



The data paths are as follows:

1. Data can be moved from the Master PROM to the copy PROM, Internal RAM or the Serial I/O Port.
2. Data can be moved from the copy PROM to the RAM or the Serial I/O Port.
3. Data can be moved from the Internal RAM to the copy PROM or to the Serial I/O Port.
4. Data can be moved from the keyboard to the RAM or copy PROM.
5. As the data from the Master PROM, Internal RAM, or Serial I/O is being moved into the copy PROM it is programming the data and verifiying it against the data moved.

The following text explains each of the above operations in detail.

3.3 Clearing Programmer Memory

Programmer memory (RAM) may be "cleared" at any time. When memory is cleared, all resident data is erased and replaced with 1's (FF in Hex).

On Power Up, the RAM will come up with random data at all of the addresses.

To clear the RAM: D3 or D5 will ensure that the entire 2kx8 RAM is cleared.

1. Select device type.
2. Leave the Master Socket empty.
3. Depress "Load."
4. The memory space of the device selected will be cleared to all 1's. (FF in hexidecimal.)

Remember that the RAM is a volatile memory, meaning that stored data is lost in the absence of applied AC power. This means that the RAM is randomized by a power interrupt on the AC line just as if you manually turned power off, then on again.

Keyboard Entry and the five function keys:

The Model 4 is designed to be a very simple programmer to use with a very in-depth software package for data manipulation.

The keyboard and the function keys are all used to execute the software routines.

The following modes are all initiated using a function key, keypad key, or combination of the two.

3.4 Select Device

3.5 Load Internal RAM from Master EPROM

3.6 Verify Master EPROM to Copy EPROM

3.7 Program Master EPROM into Copy EPROM

3.8 Read/Alter location

3.9 Emulate

3.10 Move Routines

3.11 Dump/List to Serial Port

3.12 Receive from Serial Port

3.13 Checksum

3.14 Select Baud Rate

3.15 Jump Routine

Each operating mode is explained in detail in the following text.

3.4 Select Device

When the unit is first powered on, the display shows a "d" in the window, requesting the device type. By depressing a "D" and then a "1" through "A" on the keypad the following devices can be selected:

TABLE 3.1

DEVICE SELECTION

Triple Supply

D1 - 2704

D2 - 2708

D3 - 2716

Single Supply

D4 - 2508/2758

D5 - 2516/2716

D6 - 2532

D7 - 2732

D8 - 2564

D9 - 2764

DA - TI 128K

IMPORTANT: The unit will not function properly until a device has been selected.

Example: 1. Turn Power ON.

							d	

2. Select EPROM type - 2708. Enter a "D" then a "2". Programmer will respond with:

2	7	0	8				d	2

3. The EPROM is now selected. Any operation on a 2708 Device may now be initiated.

3.5 <u>Load Internal RAM from Master EPROM</u>

The "Load" key's only function is to transfer the Master EPROM data from the Master Socket into the RAM. As mentioned in the <u>Clearing Programmer Memory</u> section, when the Master Socket is empty and "Load" is depressed, all 1's will be transfered into the memory space of RAM of the device selected.

If a Master EPROM is inserted in the Master Socket and

"Load" is depressed, data in the EPROM is transfered into the Internal RAM.

If an EPROM that is larger than the RAM has been selected, the programmer will request which 2k of the Master should be moved into the RAM. It will display:

A					

b	

TABLE 3.2

BLOCK MOVE DESIGNATOR

Designator	Address		Space
1	0000	-	07FF
2	0800	-	0FFF
3	1000	-	17FF
4	1800	-	1FFF
5	2000	-	27FF
6	2800	-	2FFF
7	3000	-	27FF
8	3800	-	3FFF

Enter the appropriate designator, "1" through "8" on the keyboard.

At the end of the "Load" cycle, the Model 4 automatically does a checksum of the data transfered and at completion of the cycle, displays this 4 digit Hex number and the device selected number in the display. See Checksum Section for calculation techniques.

Example:

1. Select device type to be used, (D3-2716) depress "D" then "3". Programmer responds with:

2	7	1	6		

d	3

2. Place Master EPROM (2716) into Master Socket. (Checksum of Master EPROM is 2FC5).

3. Depress "Load." Programmer displays "A" during the load operation.

					A

4. At the end of the cycle, a "CC" will be quickly displayed as the unit is calculating the checksum.

C	C

5. When the cycle is complete, the checksum is displayed and device selection number.

2	F	C	5				d	3

3.6 Verify Master EPROM to Copy EPROM

The "Verify" key will verify only the Master EPROM socket to the Copy EPROM socket. Insert Master EPROM into Master socket and EPROM to be verified into Copy Socket. Depress the "Verify" key. If the two EPROM'S compare, the Model 4 will end the cycle with a checksum calculation and indicate complete with the checksum and device selection number being displayed.

2	F	C	5				d	3

If the two EPROM'S do not compare, the unit will stop at a failure and display the address, Master data, and Copy data.

0	0	0	0	A	A		F	F

To continue the verify operation until the next failure is reached, depress the "Step" key. The Model 4 will continue to compare the data until the next failure and then stop and again display the address that does not compare, the Master data, and the Copy data. When the Model 4 has shown all of the failures and completed the address space for the selected EPROM, the unit will display the checksum of the Copy EPROM and the device selection number.

The verify is done by comparing the data byte in the Master address space with the data byte in the copy address space. Hence a complete, bit to bit, verification is done.

Example: Verify - The two EPROMS compare.

1. Select device type (D5-2716). Programmer will respond with:

2	7	1	6				d	5

2. Insert Master EPROM (checksum of 2FC5) into Master and EPROM to be verified into Copy socket.
3. Depress "Verify" - a "d" will be shown in the display while the verify operation is being completed.

					d			

4. At end of verify cycle a "CC is displayed while the unit is calculating a checksum.

							C	C

5. At completion, the checksum and the device selection numbers are displayed.

2	F	C	5				d	5

Example: Verify - Does not compare at address 0000 and 03FF

1. Select device type (D5-2716). Programmer will respond with:

2	7	1	6				d	5

2. Insert Master EPROM (checksum of 2FC5) into Master socket and EPROM to be verified into Copy Socket.
3. Depress "Verify" - the Model 4 will stop at address 0000 and display Master data FF and Copy data 05.

0	0	0	0	F	F		0	5

   This tells you that the information at this address does not compare.
4. To move to the next verify failure, depress "Step." When the Verify cycle is moving from one failure to another,nothing will be displayed in the window. The next failure is at address 03FF. The programmer will display:

0	3	F	F	0	0		F	F

5. Upon completion of the verify cycle, the checksum of the copy is calculated and displayed along with the device selection number.

2	A	7	0				d	5

Notice the checksum of the Copy being displayed is not the same as the Master EPROM.

3.7 <u>Program Master EPROM into Copy EPROM</u>

When the "Prog" key is depressed, the data in the Master Socket is transfered into the copy socket. The "Prog" key will transfer data only from the Master Socket into the copy socket. Once the "Prog" key is depressed, the Model 4 does an automatic Blank check on the copy EPROM. During the blank check operation a "b" is displayed.

					b			

If the Copy EPROM passes blank check, the Model 4 automatically goes into the program cycle and displays a "C".

					C			

If the copy EPROM fails blank check, the programmer will stop, displaying address and copy data.

0	0	0	0				1	1

If the operator wants to continue into the program operation and overide the failure mode, simply depress the "Prog" key again.

To check the remainder of the PROM for non-compares, depress the "Step" key as mentioned in the verify section. If the operator "steps" through all of the blank check failures, the programmer will automatically continue into the program cycle.

At the completion of the manufacturers programming algorithm, the Model 4 will automatically do a verify cycle and compare the Master PROM to the Copy. Any address that does not compare will be displayed with the Master data and Copy data as mentioned in the verify operation. If the EPROM'S compare, the checksum of the device will be displayed along with the device selection number.

Example:

1. Select device type (D5-2716). Programmer will respond with:

2	7	1	6				d	5

2. Load Master EPROM and blank copy EPROM.
3. Depress "Prog."
4. Programmer first does a blank check. It will display a "b" during the operation:

					b			

5. If the copy is not blank, the programmer will display the address and copy data. An FF is assumed for the Master data.

0	0	0	0				E	F

   The Program cycle can be initiated by depressing "Prog" a again.
   Further failures can be investigated by depressing "step" as explained in the preceeding text.
6. If the device passes, the unit will automatically go into the program cycle. It will display:

					C

7. Upon completion of this cycle, the devices are automatically compared using a verify cycle.

					d

8. If a failure is found, the programmer follows the verify failure conventions discussed in the verify section.
9. Upon a satisfactory completion of the operation, a checksum is calculated and displayed along with the device selection number.

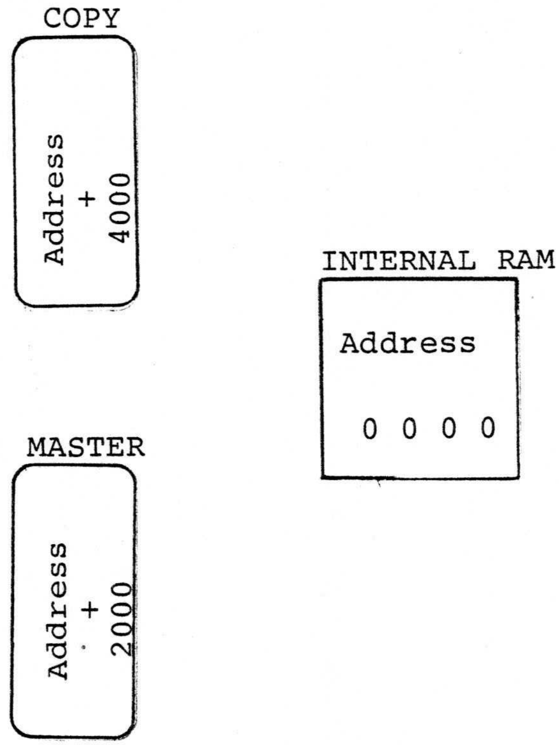
2	F	C	5		

d	5

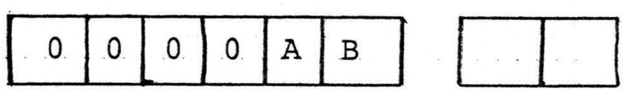
3.8 Read/Alter Location

The Model 4 programmer is set up to Read and display any location, whether it is in the Master Socket, Copy socket or Internal RAM. This is done using an address location convention.

FIGURE 3-2



If the Internal RAM is to be read, you simply depress "A" on the keyboard and the address you wish to read using 4 Hexidecimal digits. To read the data at address 0000, Depress "A", "O", "O", "O", "O" and the address and data automatically appears in the display.



The Master socket is read by adding 2000 hex to the EPROM relative address. For example, the data at 1F6 in the EPROM that is in the Master socket is desired. Adding 01F6+2000 hex gives 21F6. Depress "A", "2", "1", "F", "6". The programmer will respond with the relative address and the data at that address. The operator must remember that the data came from the Master socket.

0	1	F	6	A	B		

For another example, if an EPROM address in the Master socket of 11F6 were desired, the total would be (2000+ 11F6) equal to 31F6. Depress "A", "3", "1", "F", "6". The programmer would respond with:

1	1	F	6	C	F		

The copy socket is read by adding 4000 hex to the EPROM relative address, using the same conventions as discussed above.

To alter the address, you first call up the address using the read operation. ("A" + address) Once you have located the address to be changed, simply enter the new data and depress "step."

Addresses in the copy socket as well as the RAM can be read and modified. The single supply parts (D4-DA) will program to the manufacturers specification. Care must be taken when using this feature on the triple supply parts (D1 thru D3). The manufacturers specifically do not guarantee data retention on the

EPROM if the full program cycle is not used. The neighboring floating gates are pumped down while that address is being pumped up. It is useful in an engineering environment; however, when data retention is not a problem, the rest of the EPROM can be verified and time is of the essence.When permanent modifications on D1-D3 are needed, use the 2kx8 of Internal RAM and a move routine. See the Move Routine section.

Example:

1. Select device type (D5-2716).
2. Depress "A" and address 0000. When the last 0 has been depressed the address and data at that address is displayed.
3. To change the data, enter the new changes on the keyboard. As the new data is being entered (11) it will be displayed in the copy window.

0	0	0	0	F	F		1	1

4. Depress "step." The unit will store the new data (11) into address 0000 and step to the next address.

0	0	0	1	F	F			

5. To jump to another address out in the middle of the RAM or to go back and look at the address changed, depress "Reset." This will bring the programmer back into the command mode.

2	7	1	6				d	5

Depress "A" and the address you want to read. (0000)

0	0	0	0	1	1			

3.9 <u>Emulate</u>

To use the EPROM emulation feature, a 24 pin double ended cable is needed. This is run from the Master socket on the Model 4 to the in-circuit PROM socket. To emulate a Master EPROM, you must enter the data in to the internal RAM using a "Load" routine or directly from the keyboard. Once the data is in the RAM, depress "E" and then "Step." When the "E" is depressed an "E" is displayed.

E								

The next key selects between a software jump routine and the emulate feature. To continue into Emulate, depress "Step." The programmer will respond with:

					E			

Power up the system to be debugged. The system is now reading the Internal RAM. To change data in the Model 4 RAM, depress the "reset" key and using the Read/Alter routine, alter the necessary addresses. To go back into the Emulate routine, depress "E" and the "Step."

Example:

1. Select device type (D5-2716).
2. Insert a Master EPROM into the Master Socket.
3. Depress "Load." The programmer will respond with:

					A			

4. Upon completion of the load cycle, a checksum and device selection number will appear in the display.

2	F	C	5				d	5

5. Depress "E" and then "Step."
6. Connect a 24 pin double ended cable to the Master Socket and the in-circuit socket.
7. Power up system under test.

The Emulation feature can be used in the complete 2kx8 of RAM. Devices to be selected are the 2704, 2708, 2716 triple supply; 2758, 2516, 2716 single supply.

Timing: Data will be valid within 650ns after all the addresses and CE are valid.

Inputs: CMOS loading and levels.

Outputs: Will drive 1 TTL load.

3.10 Move Routine

The Model 4 is set up to manipulate data using two different methods, 2k block moves or generalized moves.

Block Moves: The block move routine is set up to stack 2k blocks of data into a larger copy EPROM. Thus, if you are using a 4kx8 EPROM (2532),you can Program the lower 2k and then the upper 2k. The same move is used for 8kx8 (2564) and 16kx8 EPROM'S.

To initiate the Model 4 into a move routine, depress "A", and then "Prog." Then designate a block to be moved by depressing "B" and then a number "1" through "8". A "1" moves the 2kx8 of RAM into the lower 2k of data in the copy device. A "2" command moves the RAM data into the next 2nd 2k section of the Copy PROM and "3" into the 3rd section of the copy EPROM, etc. until the complete copy device selection is programmed.

TABLE 3-2

BLOCK MOVE DESIGNATOR

Designator	Address		Space
1	0000	-	07FF
2	0800	-	0FFF
3	1000	-	17FF
4	1800	-	1FFF
5	2000	-	27FF
6	2800	-	2FFF
7	3000	-	37FF
8	3800	-	3FFF

IMPORTANT: The block move routine can only be used on a 32k EPROM or larger. If a D6 or above is not selected, you will get an error code. The smaller devices, D1 through D5, are moved enmass from the RAM to the copy by depressing "A", "Prog,","Step." The device address size is used because it is equal to or less than one 2kx8 block.

Example: Moving two 2716's into one 2532

1. Select device type D5 (2716).
2. Insert Master 2716 into Master Socket.
3. Depress "Load." The 2kx8 EPROM data is transfered into the RAM. The checksum of the Master device is displayed and the selected device number.

2	F	2	C				d	5

4. Take the 2716 out of the Master Socket.
5. Select device type D6-2532.
6. Insert a 2532 into the copy socket.
7. Depress "A" then "Prog."
8. Depress "B" then "1". When the "1" is entered, the programmer starts the move routine. An "AA" is shown in the display until the operation is complete.

							A	A

9. At the end of the move routine, the Model 4 does a verify cycle, comparing the RAM data moved to the Copy EPROM programmed. If a failure is found, the unit stops and displays the address, RAM data, and copy data. (See Verify against a Master for conventions.) A pass verify will indicate complete by jumping back into the command loop and dis-

playing the device selected.

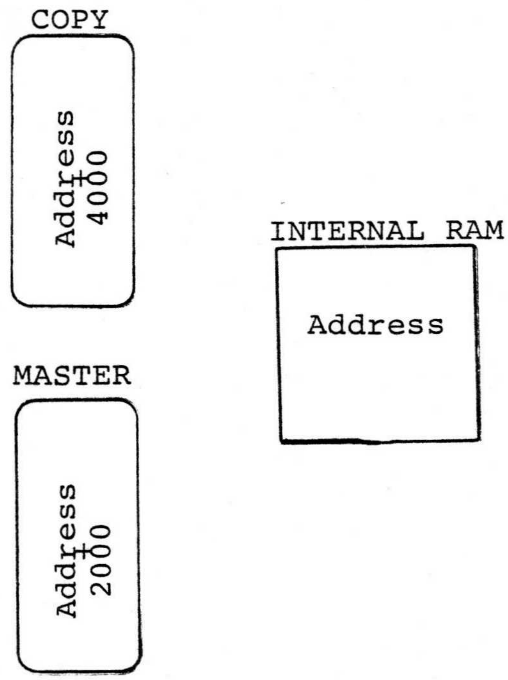
2	5	3	2				d	6

10. Once the first 2k block is moved take the 2532 out of the copy socket.
11. Select device type D5 (2716).
12. Start at Instruction 3 and continue through Instruction 7.
13. Depress "B" then "2".
14. Upon completion of the move and verify cycle the 2532 now contains the data of the two 2716's.

Generalized Moves: Any number of bytes can be moved from the Master Socket, Copy Socket, RAM or within the RAM. Using the address conventions used in the Read/ Alter routine, the data can be moved by designation of a beginning and ending address of the data to be moved and the beginning address of the destination. See Figure 3-2 for address conventions.

FIGURE 3-2

ADDRESS CONVENTIONS



Example: Move F hex addresses out of a D6 Master EPROM into the D6 Copy EPROM, insert one new byte of data and then move remainder of the Master EPROM up to the Copy.

1. Depress "A" then "Prog". This sets the programmer into the move routine.
2. Enter the beginning address to be moved 0000+2000= "2", "O", "O", "O".
3. Enter the ending address 000F+2000="2", "O", "O", "F".
4. Enter the beginning address of the designation. 0000+4000="4", "O", "O", "O".
5. An "AA" will appear in the display until the move is completed and verified.
6. Enter new data bit into address 0010 of the copy.

Depress "A" then 0010+4000="4", "O", "1", "O".

0	0	1	0	F	F		

Enter new data, for example, "1", "1".

Depress "Step" to place new data at address 0010.

7. Depress "Reset" to get back into command loop.
8. Depress "A" then "Prog."
9. Enter the beginning address "2", "O", "1", "O". This designates the 0010 address of the Master.
10. Enter the ending address "2", "F", "F", "F".
11. Enter beginning address of destination. 0011+ 4000="4", "0", "1", "1".
12. "AA" will appear in the diaply until the move operation is complete.

IMPORTANT: As the information is being transfered into the Copy it is being programmed to the manufacturers specification on the single supply parts, D4 thru DA. The triple supply parts, D1 thru D3, can only be programmed to manufacturers specifications with a block move ("A", "Prog", "Step") or a Master to Copy Program ("Prog"). They must be completely programmed in one continuous operation. Programming one address will tend to pump down adjacent floating gates while pumping up that one. These parts are entered and modified within RAM and then block moved into the copy.

Verify RAM to Copy:

RAM can be verified to the copy by depressing "A" and then "Verify." If D1 thru D5 is selected, the entire RAM is verified to the copy using the conventions discussed in the Verify section. If a D6 or larger is selected, a block designator is requested using the conventions discussed in the Load section.

3.11 Dump and List Routine

Once the baud rate has been selected (See Baud Rate Select.) and the communication cable and data flow format have been made up and matched (See I/O Interface description and Data Format), the Model 4 is now ready to Dump or list data.

Using the address conventions as mentioned in the Read/Alter and Move routines, the operator can specify the address to be dumped by depressing "B" and then the beginning and ending address. Once the ending address is entered, the dump routine is started. To simplify the dumping of the complete Internal RAM, after depressing "B", depress "Step." This will dump the complete RAM of the device size selected.

Example: Dump RAM to terminal

1. Select device type (D5-2716).
2. "Load" Master EPROM into RAM.
3. Set terminal up to receive.

4. Depress "B" then "Step."
5. A "bb" will appear in the display until the dump sequence is over. At the end of the cycle a checksum is calculated on the data flow and displayed along with the device selection number.

List routine: A list routine has been supplied to give you address information on a dump sequence.

FIGURE 3-3

LIST FORMAT

Address	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
0010	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX

To initialize the List Routine, Depress "B", "Prog", "B", and the beginning and ending address or just "Step", if you want to dump the complete device selected RAM.

At the end of the data flow a checksum will be calculated and displayed with the device selection number.

3.12 Receive from Serial Port

Once the baud rate has been selected (See Baud Rate Select), the communication cable and data flow format have been made up and matched (See I/O Interface and Data Format),the programmer is ready to receive data.

To set the Model 4 into the receive mode, depress "F" and then "Step." An "FF" will appear in the display showing a receive routine. Once the "Step" key is depressed,the Model 4 is scanning the serial I/O port looking for an SOH (01 Hex, Control A). Once that is received,it will load the data starting at address 0000 in the Internal RAM and continue until an ETX (03 Hex, Control C) is received.

To program the copy socket directly off the serial I/O, use the address conventions for the copy socket. Depress "F" and then "4", "0", "0", "0". The programmer will scan for an SOH and when received, will start programming the data flow starting at address 0000 in the copy socket.

The starting address can be selected anywhere in either the Internal RAM or copy socket by entering whatever address you want to start at, after you depress "F". Don't forget to add 4000 when using the copy socket.

IMPORTANT: As the information is being transfered into the Copy, it is being programmed to the manufacturers specifications on the single supply parts, D4 thru DA. The triple supply parts D1 thru D3, can only be programmed to manufacturers specifications with a block move ("A", "Prog", "Step") or a Master to Copy Program ("Prog"). They must be completely programmed in one continuous operation. Programming one address will tend to pump down adjacent floating gates while pumping up that one. These parts are entered and modified within RAM and then block moved into the copy.

3.13 Checksum

A checksum calculation is completed after every verify sequence or upon command.

Depressing "C" and then "1" gives you the checksum of the RAM. "C" and "2" gives you the checksum of the Master Socket and "C" and then the "3" gives you the checksum of the copy socket. See Figure 3-4.

TABLE 3-4

CHECKSUM DESIGNATORS

C1 =	RAM
C2 =	Master Socket
C3 =	Copy Socket

The checksum is a four digit Hex number that is calculated by doing a summation of all the 1's and 0's as shown in Figure 3-4. Two byte accuracy is kept, with carries from the second byte truncated.

FIGURE 3-4

CHECKSUM CALCULATION

Address	Data									Hex
	Bit	7	6	5	4	3	2	1	0	
0000		1	1	0	1	1	0	0	1	D9
0001		1	1	1	0	1	0	1	0	EA
Checksum	1	1	1	0	0	0	0	1	1	01C3

Utilizing this verification method insures the operator that the information being used is valid and also gives you a definite figure of merit with which to identify the parts. Every programmer manufacturer that does a checksum may not use the same summation method that is utilized in the Model 4. If this should happen, check the checksum on the Model 4 and document this new number on your device.

3.14 Select Baud Rate

When the Model 4 is first powered up, it automatically is set for 1200 baud. To change the baud rate to 110. 300, or 600 the following keys must be depressed. "B", "Prog", and a number from "1" to "4" corresponding to the baud rate you wish to select.

1 = 110

2 = 300

3 = 600

4 = 1200

Selection of 110 baud automatically enables the 20ma current loop receiver. Selecting 300, 600, or 1200 enables the RS232 receiver.

Example:

1. To select 300 baud depress "B" and then "Prog." The display will show:

b							b	b

2. Depress a "2". This selects 300 baud.

3.15 Jump Routine

The programmer will jump to begin execution of an operator assigned address. Depress "E" and then "Prog." The programmer will respond with:

E								b

Enter the address of the first instruction. Use the address conventions discussed in the Read/Alter section.

The microprocessor is a Signetics 2650. See Signetics for programming information.

APPENDIX A

BLANK EPROM CHECKSUM

Designator	Device	Address Size	Checksum
D1	2704	512	FE00
D2	2708	1024	FC00
D3	2716	2048	F800
D4	2508/2758	1024	FC00
D5	2516/2716	2048	F800
D6	2532	4096	F000
D7	2732	4096	F000
D8	2564	8192	E000
D9	2764	8192	E000
DA	TI 128K	16384	C000

APPENDIX B

Data Format

The data format of the I/O stream is essentially ASCII Hex. The figure B1 shows the transmitted format. The receive routine looks for an SOH (01 Hex, Control A on the keyboard,) to start. It then stores the data, beginning at the appropriate address (See Receive Routine Section.) It ignores punctuation and control characters. It will drop into an error routine if it receives a non ASCII Hex character. When it receives an ETX (03 Hex, Control C on the keyboard), it displays the checksum (See section on Checksum.) and enters the command loop.

FIGURE B-2

TRANSMIT FORMAT

ASCII HEX		Description	
00	Leader	32 nulls	
0D	Carriage Return	For formating on screen	
0A	Line Feed		
01	SOH	Begin data (Control A)	
XX	Data	High order nibble	First Address
XX	Data	Lo order nibble	
20	Space		
XX	Data	High order nibble	Second Address
XX	Data	Lo order nibble	
20	Space		
	.		
	.		
	.		
	.		
XX	Data	High order nibble	16th Address
XX	Data	Low order nibble	
0D	Carriage Return	For formating on screen	
0A	Line Feed		
XX	Data	High order nibble	
XX	Data	Lo order nibble	
20	Space		
	.		
	.		
	.		
	.		
03	ETX	End of Data (Control C)	

APPENDIX C - DEVICE PIN OUT Matrix

DEVICE	P1 Read	P1 Pgm	P2 Read	P2 Pgm	P20 (P18)[1] Read	P20 (P18)[1] Pgm	P21 (P19)[1] Read	P21 (P19)[1] Pgm	P22 (P20)[1] Read	P22 (P20)[1] Pgm	P23 (P21)[1] Read	P23 (P21)[1] Pgm	P26 (P24)[1] Read	P26 (P24)[1] Pgm	P27 Read	P27 Pgm	P28 Read	P28 Pgm
1 2704					0.8	27^4	12.6	12.6		12.6	-4.75	-4.75	5.25	5.25				
					0.0	25	11.4	11.4	$\overline{CE}$	11.4	-5.25	-5.25	4.75	4.75				
2 2708					0.8	27^4	12.6	12.6	$\overline{CE}$	12.6	-4.75	-4.75	5.25	5.25				
					0.0	25	11.4	11.4		11.4	-5.25	-5.25	4.75	4.75				
3 2716						27^4	12.6	12.6			-4.75	-4.75	5.25	12.6				
					$\overline{CE}$	25	11.4	11.4	A10	A10	-5.25	-5.25	4.75	11.4				
4 2758						PGM^5					5.6	26	5.25	5.25				
2508					V_{IL}		A10	A10	$\overline{CE}$	$\overline{CE}$	note 6	24	4.75	4.75				
5 2716						PGM^5					5.6	26	5.25	5.25				
2516					V_{IL}		A10	A10	$\overline{OE}$	$\overline{OE}$	note 6	24	4.75	4.75				
6 2532											5.6	26	5.25	5.25 (VSS)				
					A11	A11	A10	A10	PD	$\overline{PGM}^5$	note 6	24	4.75	4.75				
7 2732										26			5.25	5.25				
					V_{IL}^7	$\overline{PGM}^5$	A10	A10	$\overline{OE}$	24	A11	A11	4.75	4.75				
8 2564	5.6	26											5.25	5.25			5.25	5.25
	4.4	24	V_{IL}	V_{IL}	A11	A11	A10	A10	$\overline{CE}$	$\overline{PGM}^5$	A12	A12	4.75	4.75	V_{IL}	V_{IL}	4.75	4.75
9 2764										26			5.25	5.25			5.25	5.25
	NC	NC	A12	A12	V_{IL}	$\overline{PGM}^5$	A10	A10	$\overline{OE}$	24	A11	A11	4.75	4.75	V_{IL}	V_{IL}	4.75	4.75
A TI 128K	5.6	26											5.25	5.25			5.25	5.25
	note 6	24	A13	A13	A11	A11	A10	A10	$\overline{CE}$	$\overline{PGM}^5$	A12	A12	4.75	4.75	V_{IL}	V_{IL}	4.75	4.75
B INT 128K										26			5.25	5.25			5.25	5.25
	NC	NC	A12	A12	V_{IL}	$\overline{PGM}^5$	A10	A10	$\overline{OE}$	24	A11	A11	4.75	4.75	A13	A13	4.75	4.75

P1	1	28	P28
P2	2	27	P27
A7-1	3	26	24-P26
A6-2	4	25	23-A8
A5-3	5	24	22-A9
A4-4	6	23	21-P23
A3-5	7	22	20-P22
A2-6	8	21	19-P21
A1-7	9	20	18-P20
A0-8	10	19	17-D7
D0-9	11	18	16-D6
D1-10	12	17	15-D5
D2-11	13	16	14-D4
gnd-12	14	15	13-D3

NOTES:
1. 24 Pin devices are registered to bottom of sockets.
2. All pins are common except those called out in the ta le.
3. When a signal is noted, V_{IH}=3.0 and V_{IL}=0.65 apply.
4. Pulse width is .9 to 1.1 ms. Rise and fall time more than 500ns and less than 2 microseconds.
5. Pulse width 4.5 to 5.5 ms. V_{IH} and V_{IL} levels.
6. Minimum voltage equal to Vcc (Pin 26) minus 0.6v.
7. Copy socket has $\overline{CE}$ signal. Master is low.

APPENDIX D

CALIBRATION PROCEDURE

This procedure allows each of the supplies and timing generators to be measured. A maintenance manual is available from the factory for indepth repair. Compare values measured with those in the Device Pin Out Matrix.

1. Turn on power.
2. Select D2.
3. Depress "Prog." Programmer should drop into program cycle displaying a "C" in the display.
4. Measure Pin 26, 23, and 21.
5. Measure voltage and timing of pin 20.
6. Depress "Reset."
7. Select D5.
8. Depress "Prog."
9. Measure the timing of pin 20.

The previous procedure has checked Vcc (+5v), VBB (-5v), VDD (+12v), +25v supply, 1 millisecond clock, and 50ms clock. These measurements ensure the programmer is in calibration.

The system clock is used to time the I/O functions, not the program functions. If a calibration of the system clock is required, open the chassis and measure pin 38 of device A34, the 40 pin microprocessor. The clock should be 1 microsecond plus or minus 2%. It can be adjusted with the potentiometer near the microprocessor.

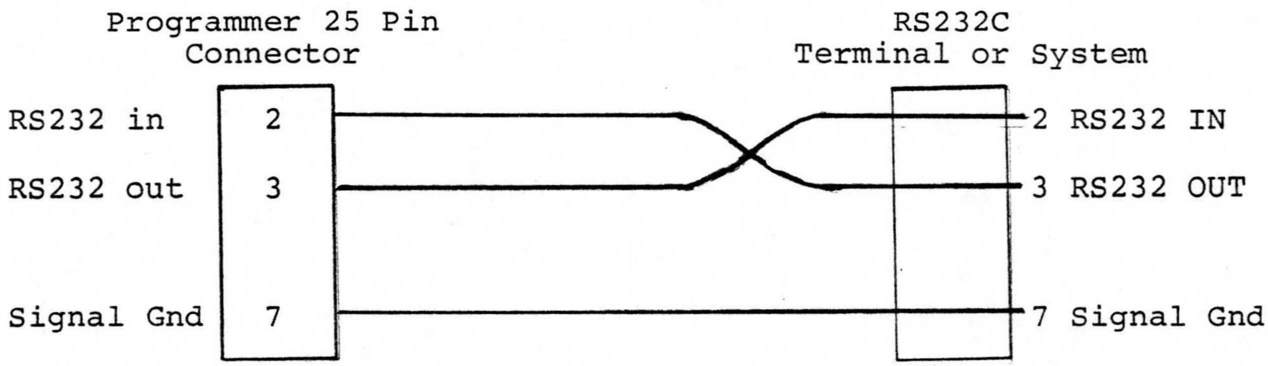
APPENDIX E

EXPECTED PROGRAMMING TIME

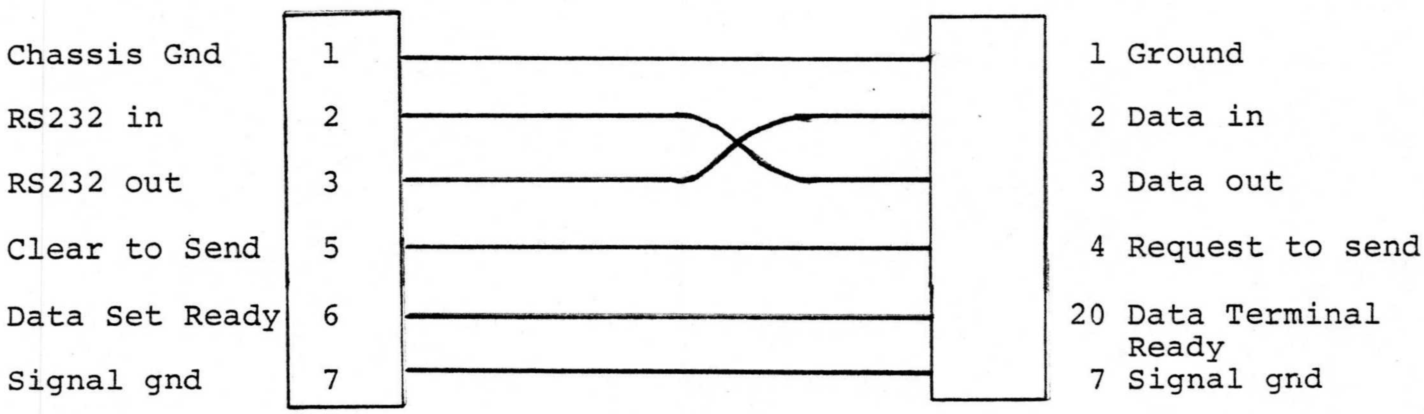
Designator	Device	Address	Minutes
D1	2704	512	1.5
D2	2708	1024	3
D3	TI2716	2048	6
D4	2508/2758	1024	1
D5	2516/2716	2048	2
D6	2532	4096	4
D7	2732	4096	4
D8	2564	8192	8
D9	2764	8192	8
DA	TI128K	16284	16

APPENDIX F

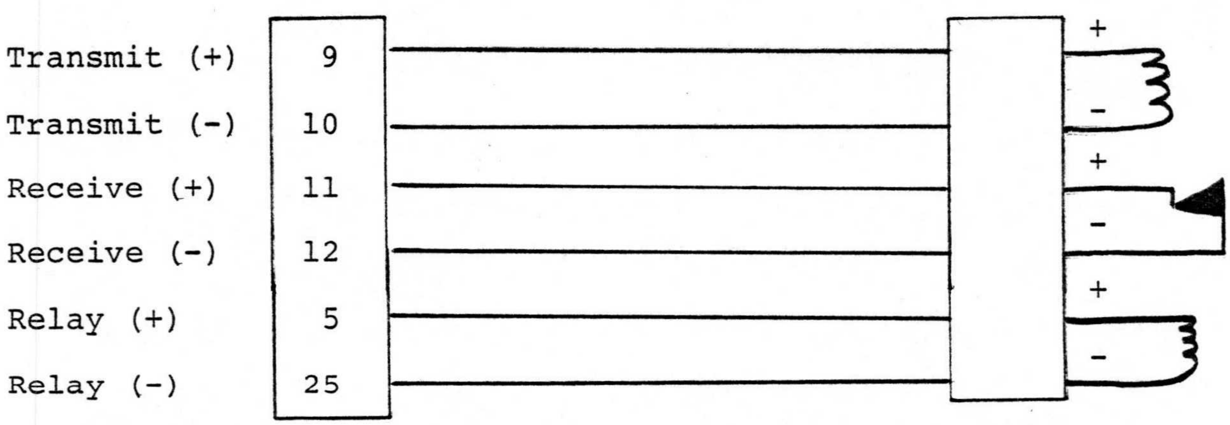
MINIMUM RS232 CONNECTION



FULL RS232 CONNECTION

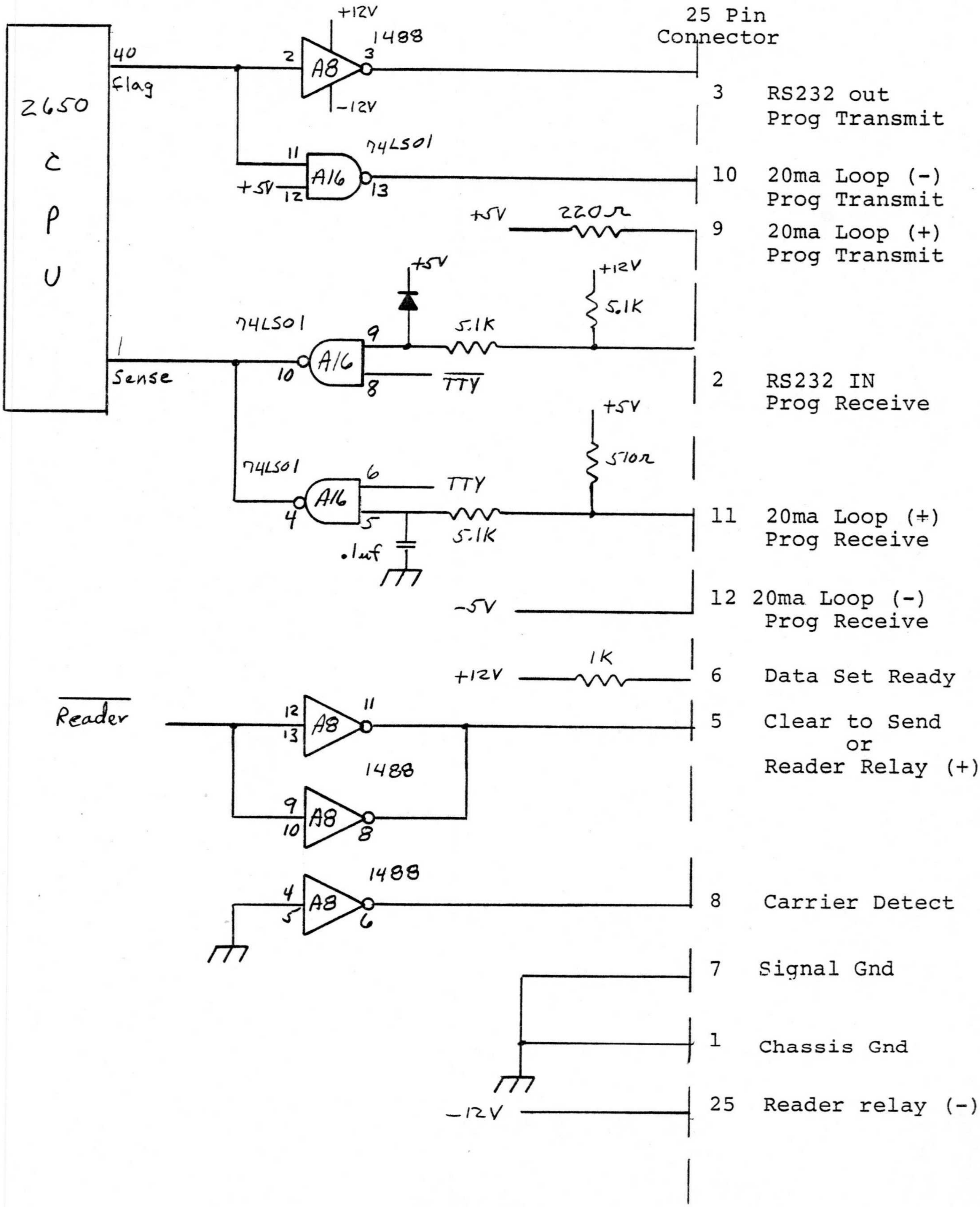


20 MA CURRENT LOOP CONNECTION



APPENDIX G

I/O SCHEMATIC



APPENDIX H

CONTROL SUMMARY

Function	Keystrokes	
Device Select	DZ	Z=Device designator
Load	LOAD	Master to RAM
Program	PROG	Master to copy
Verify	VERIFY	Master to copy
Read/Alter	AXXXX STEP	Note address convention
	YY STEP	Alter
Move		
Block	A PROG BZ	Z=Block designator
General	A PROG	
	XXXX	Beginning address of data
	XXXX	Ending address of data
	XXXX	Beginning address of destination
Verify	A VERIFY	RAM to copy
Checksum	C1	Checksum of RAM
	C2	Checksum of Master
	C3	Checksum of Copy
Emulate	E STEP	
Jump	E PROG XXXX	Address of first instruction
Baud Rate	B PROG 1	110 Baud, enable current loop
	B PROG 2	300 Baud, enable RS 232
	B PROG 3	600 Baud, enable RS 232
	B PROG 4	1200 Baud, enable RS 232, default
Receive	F STEP	Write data into RAM beginning at address 0000
	FXXXX	Write data beginning at address XXXX
Dump	B STEP	Dump RAM beginning at address 0000
	B XXXXYYYY	Dump beginning at XXXX and ending at YYYY
List	B PROG B STEP	List RAM beginning at address 0000
	XXXX YYYY	List beginning at XXXX and ending at YYYY

Block Designator

1 0000-07FF
2 0800-0FFF
3 1000-17FF
4 1800-1FFF
5 2000-27FF
6 2800-2FFF
7 3000-37FF
8 3800-3FFF

Device Designator

1	2704
2	2708
3	2716
4	2508/2758
5	2516/2716
6	2532
7	2732
8	2564
9	2764
A	TI128K

Address Convention

RAM 0000
Master 2000
Copy 4000

APPENDIX I

HEXADECIMAL-DECIMAL INTEGER CONVERSION TABLE

The Table below provides for direct conversions between hexadecimal integers in the range C-3FF and decimal integers in the range 0-1023. For conversion of larger integers, the table values may be added to the following figures:

Hexadecimal	Decimal
400	1 024
800	2 048
01 000	4 096
02 000	8 192
03 000	12 288
04 000	16 384
05 000	20 480
06 000	24 576
07 000	28 672
08 000	32 768
09 000	36 864
0A 000	40 960
0B 000	45 056
0C 000	49 152
0D 000	53 248
0E 000	57 344
0F 000	61 440
10 000	65 536
11 000	69 632
12 000	73 728
13 000	77 824
14 000	81 920
15 000	86 016
16 000	90 112
17 000	94 208
18 000	98 304
19 000	102 400
1A 000	106 496
1B 000	110 592
1C 000	114 688
1D 000	118 784

Table I-1

HEXADECIMAL ARITHMETIC

ADDITION TABLE

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10
2	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11
3	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12
4	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
5	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14
6	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15
7	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16
8	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17
9	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18
A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18	19
B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18	19	1A
C	0D	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

Table I-2

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
000	0000	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010	0011	0012	0013	0014	0015
010	0016	0017	0018	0019	0020	0021	0022	0023	0024	0025	0026	0027	0028	0029	0030	0031
020	0032	0033	0034	0035	0036	0037	0038	0039	0040	0041	0042	0043	0044	0045	0046	0047
030	0048	0049	0050	0051	0052	0053	0054	0055	0056	0057	0058	0059	0060	0061	0062	0063
040	0064	0065	0066	0067	0068	0069	0070	0071	0072	0073	0074	0075	0076	0077	0078	0079
050	0080	0081	0082	0083	0084	0085	0086	0087	0088	0089	0090	0091	0092	0093	0094	0095
060	0096	0097	0098	0099	0100	0101	0102	0103	0104	0105	0106	0107	0108	0109	0110	0111
070	0112	0113	0114	0115	0116	0117	0118	0119	0120	0121	0122	0123	0124	0125	0126	0127
080	0128	0129	0130	0131	0132	0133	0134	0135	0136	0137	0138	0139	0140	0141	0142	0143
090	0144	0145	0146	0147	0148	0149	0150	0151	0152	0153	0154	0155	0156	0157	0158	0159
0A0	0160	0161	0162	0163	0164	0165	0166	0167	0168	0169	0170	0171	0172	0173	0174	0175
0B0	0176	0177	0178	0179	0180	0181	0182	0183	0184	0185	0186	0187	0188	0189	0190	0191
0C0	1092	0193	0194	0195	0196	0197	0198	0199	0200	0201	0202	0203	0204	0205	0206	0207
0D0	0208	0209	0210	0211	0212	0213	0214	0215	0216	0217	0218	0219	0220	0221	0222	0223
0E0	0224	0225	0226	0227	0228	0229	0230	0231	0232	0233	0234	0235	0236	0237	0238	2039
0F0	0240	0241	0242	0243	0244	0245	0246	0247	0248	0249	0250	0251	0252	0253	0254	0255

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
100	0256	0257	0258	0259	0260	0261	0262	0263	0264	0265	0266	0267	0268	0269	0270	0271
110	0272	0273	0274	0275	0276	0277	0278	0279	0280	0281	0282	0283	0284	0285	0286	0287
120	0288	0289	0290	0291	0292	0293	0294	0295	0296	0297	0298	0299	0300	0301	0302	0303
130	0304	0305	0306	0307	0308	0309	0310	0311	0312	0313	0314	0315	0316	0317	0318	0319
140	0320	0321	0322	0323	0324	0325	0326	0327	0328	0329	0330	0331	0332	0333	0334	0335
150	0336	0337	0338	0339	0340	0341	0342	0343	0344	0345	0346	0347	0348	0349	0350	0351
160	0352	0353	0354	0355	0356	0357	0358	0359	0360	0361	0362	0363	0364	0365	0366	0367
170	0368	0369	0370	0371	0372	0373	0374	0375	0376	0377	0378	0379	0380	0381	0382	0383
180	0384	0385	0386	0387	0388	0389	0390	0391	0392	0393	0394	0395	0396	0397	0398	0399
190	0400	0401	0402	0403	0404	0405	0406	0407	0408	0409	0410	0411	0412	0413	0414	0415
1A0	0416	0417	0418	0419	0420	0421	0422	0423	0424	0425	0426	0427	0428	0429	0430	0431
1B0	0432	0433	0434	0435	0436	0437	0438	0439	0440	0441	0442	0443	0444	0445	0446	0447
1C0	0448	0449	0450	0451	0452	0453	0454	0455	0456	0457	0458	0459	0460	0461	0462	0463
1D0	0464	0465	0466	0467	0468	0469	0470	0471	0472	0473	0474	0475	0476	0477	0478	0479
1E0	0480	0481	0482	0483	0484	0485	0486	0487	0488	0489	0490	0491	0492	0498	0494	0495
1F0	0496	0497	0498	0499	0500	0501	0502	0503	0504	0505	0506	0507	0508	0509	0510	0511
200	0512	0513	0514	0515	0516	0517	0518	0519	0520	0521	0522	0523	0524	0525	0526	0527
210	0528	0529	0530	0531	0532	0533	0534	0535	0536	0537	0538	0539	0540	0541	0542	0542
220	0544	0545	0546	0547	0548	0549	0550	0551	0552	0553	0554	0555	0556	0557	0558	0559
230	0560	0561	0562	0563	0564	0565	0566	0567	0568	0569	0570	0571	0572	0573	0574	0575
240	0576	0577	0578	0579	0580	0581	0582	0583	0584	0585	0586	0587	0588	0589	0590	0591
250	0592	0593	0594	0595	0596	0597	0598	0599	0600	0601	0602	0603	0604	0605	0606	0607
260	0608	0609	0610	0611	0612	0613	0614	0615	0616	0617	0618	0619	0620	0621	0622	0623
270	0624	0625	0626	0627	0628	0629	0230	0631	0632	0633	0634	0635	0636	0637	0638	0639
280	0640	0641	0642	0643	0644	0645	0646	0647	0648	0649	0650	0651	0652	0653	0654	0655
290	0656	0657	0658	0659	0660	0661	0662	0663	0664	0665	0666	0667	0668	0669	0670	0671
2A0	0672	0673	0674	0675	0676	0677	0678	0679	0680	0681	0682	0683	0684	0685	0686	0687
2B0	0688	0689	0690	0691	0692	0693	0694	0695	0696	0697	0698	0699	0700	0701	0702	0703
2C0	0704	0705	0706	0707	0708	0709	0710	0711	0712	0713	0714	0715	0716	0717	0718	0719
2D0	0720	0721	0722	0723	0724	0725	0726	0727	0728	0729	0730	0731	0732	0733	0734	0735
2E0	0736	0737	0738	0739	0740	0741	0742	0743	0744	0745	0746	0747	0748	0749	0750	0751
2F0	0752	0753	0754	0755	0756	0757	0758	0759	0760	0761	0762	0763	0764	0765	0766	0767
300	0768	0769	0770	0771	0772	0773	0774	0775	0776	0777	0778	0779	0780	0781	0782	0783
310	0784	0785	0786	0787	0788	0789	0790	0791	0792	0793	0794	0795	0796	0797	0798	0799
320	0800	0801	0802	0803	0804	0805	0806	0807	0808	0809	0810	0811	0812	0813	0814	0815
330	0816	0817	0818	0819	0820	0821	0822	0823	0824	0825	0826	0827	0828	0829	0830	0831
340	0832	0833	0834	0835	0835	0837	0838	0839	0840	0841	0842	0843	0844	0845	0846	0847
350	0848	0849	0850	0851	0852	0853	0854	0855	0856	0857	0858	0859	0860	0861	0862	0863
360	0864	0865	0866	0867	0868	0869	0870	0871	0872	0873	0874	0875	0876	0877	0878	0879
370	0880	0881	0882	0883	0884	0885	0886	0887	0888	0889	0890	0891	0892	0893	0894	0895
380	0896	0897	0898	0899	0900	0901	0902	0903	0904	0905	0906	0907	0908	0909	0910	0911
390	0912	0913	0914	0915	0916	0917	0918	0919	0920	0921	0922	0923	0924	0925	0925	0927
3A0	0928	0929	0930	0931	0932	0933	0934	0935	0936	0937	0938	0939	0940	0941	0942	0943
3B0	0944	0945	0946	0947	0948	0949	0950	0951	0952	0953	0954	0955	0956	0957	0958	0959
3C0	0960	0961	0962	0963	0964	0965	0966	0967	0968	0969	0970	0971	0972	0973	0974	0975
3D0	0975	0977	0978	0979	0980	0981	0982	0983	0984	0985	0986	0987	0988	0989	0990	0991
3E0	0992	0993	0994	0995	0996	0997	0998	0999	1000	1001	1002	1003	1004	1005	1006	1007
3F0	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023

APPENDIX J

ERROR CODES

EØ1	First key was not a command key.
EØ2	Illegal first address digit for selected memory.
EØ3	Non Hex Entry.
EØ4	Any key other than "STEP" depressed at end of alter.
EØ5	Attempting to access beyond selected memory space.
EØ6	Illegal device select digit.
EØ7	First key was not "D" after power up.
EØ8	Illegal baud rate digit.
EØ9	Checksum error.
E1Ø	Receive character error.
E11	Starting address greater than ending address.
E12	Key other than step or B after load.
E13	Illegal move destination.
E14	Selected illegal block number for selected device.
E15	Selected block move for D1-D5.
E16	Illegal checksum key.