

## INSERTING THE CARTRIDGE:

RAM TEST ON POWER ON:

With 4K bytes of extra RAM:	X X X	7679 bytes free	X X X
With 8K bytes of extra RAM:	X X X	11775 bytes free	X X X
With 16K bytes of extra RAM:	X X X	19967 bytes free	X X X
With 24K bytes of extra RAM:	X X X	28159 bytes free	X X X

```

1Ø INPUT "MAXIMUM ARRAY SIZE:"; S: DIM A (S)
2Ø FOR I = Ø TO S: A (I) = I: NEXT
3Ø FOR I = Ø TO S: IF A (I) <> I THEN PRINT "FAILS AT" ;
    4736 + 5 * I
4Ø NEXT : PRINT "OK"

```

\* PLEASE SEE NOTE I

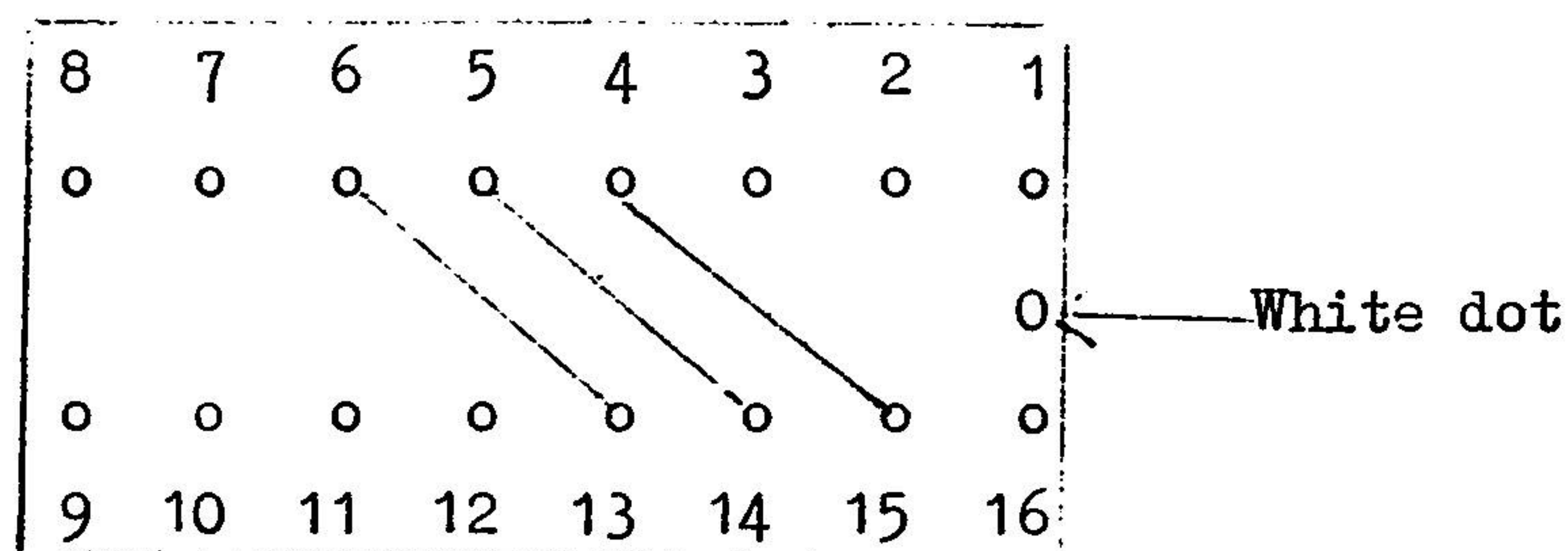
If your VCR is only partially populated for the time being, you may wish to add more RAM chips. Open the case by undoing the small screw in each corner and remove the green circuit board bearing the components. Each socket indicates the memory address where the RAM will go. If no special arrangement is required, simply add the new chip to the next free address. i.e 2000, 2800, 3000, 3800 etc. .... until the VCR is full. When inserting the chips, try not to handle the metal pins since static electricity can, although rarely, cause harm to certain electronic components. Limit handling the chip to the black



plastic part if possible. A second point to note is that the chip should be inserted so that it is facing the same way as the other chips on the board; a small notch indicates the top of the chip and its position is to be respected.

#### USING THE 3K LOW RAM AREA:

The low RAM area ( $\$0400 - \$FFF$ ) is only necessary for running certain programs written specifically for the VC 20 with  $6\frac{1}{2}$  K of RAM. You can convert the RAM on the VCR cartridge to fill this memory area by unplugging the IC marked LS 139B and installing a ready made jumper block (ref: JB 24 - 3). Alternatively, you can use small lengths of wire to form links as shown:



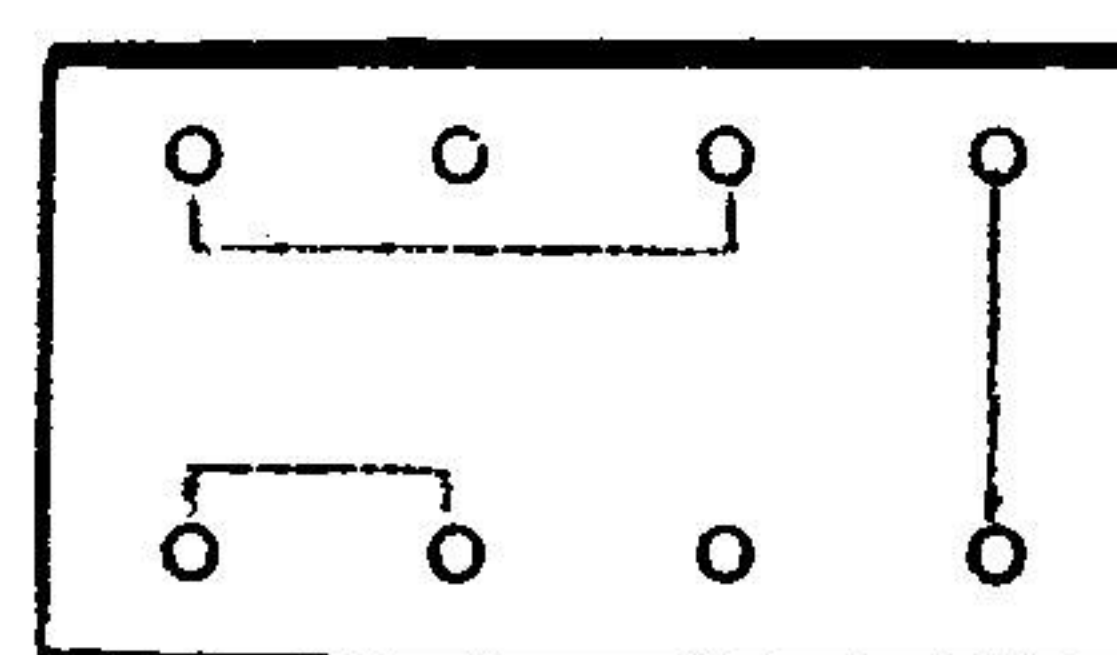
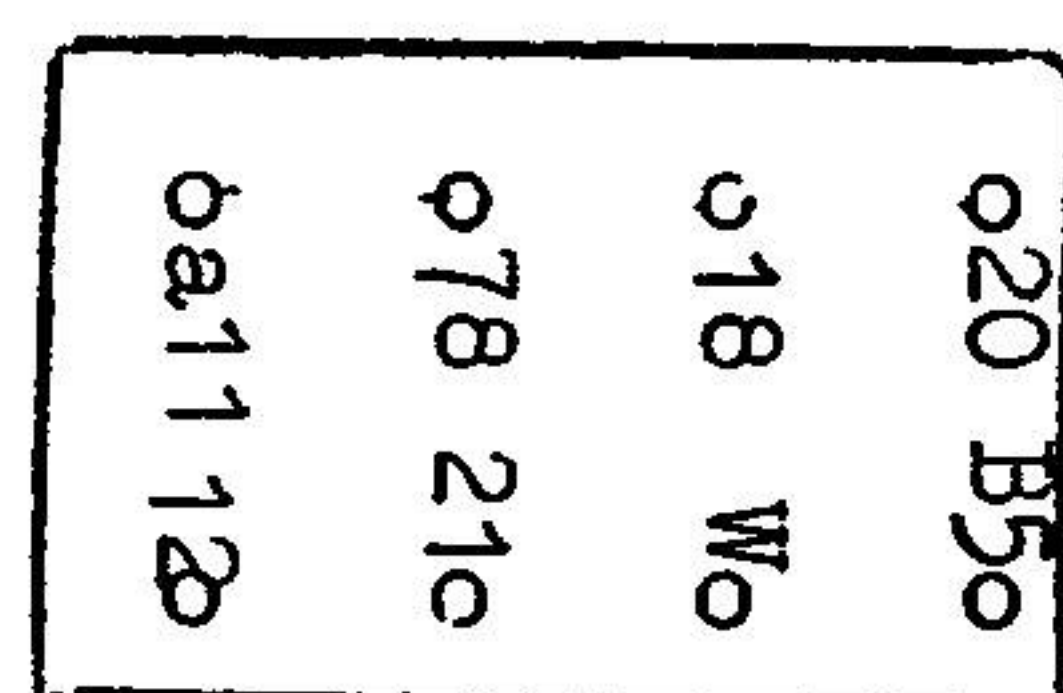
(4) to (15)

(5) to (14)

(6) to (13)

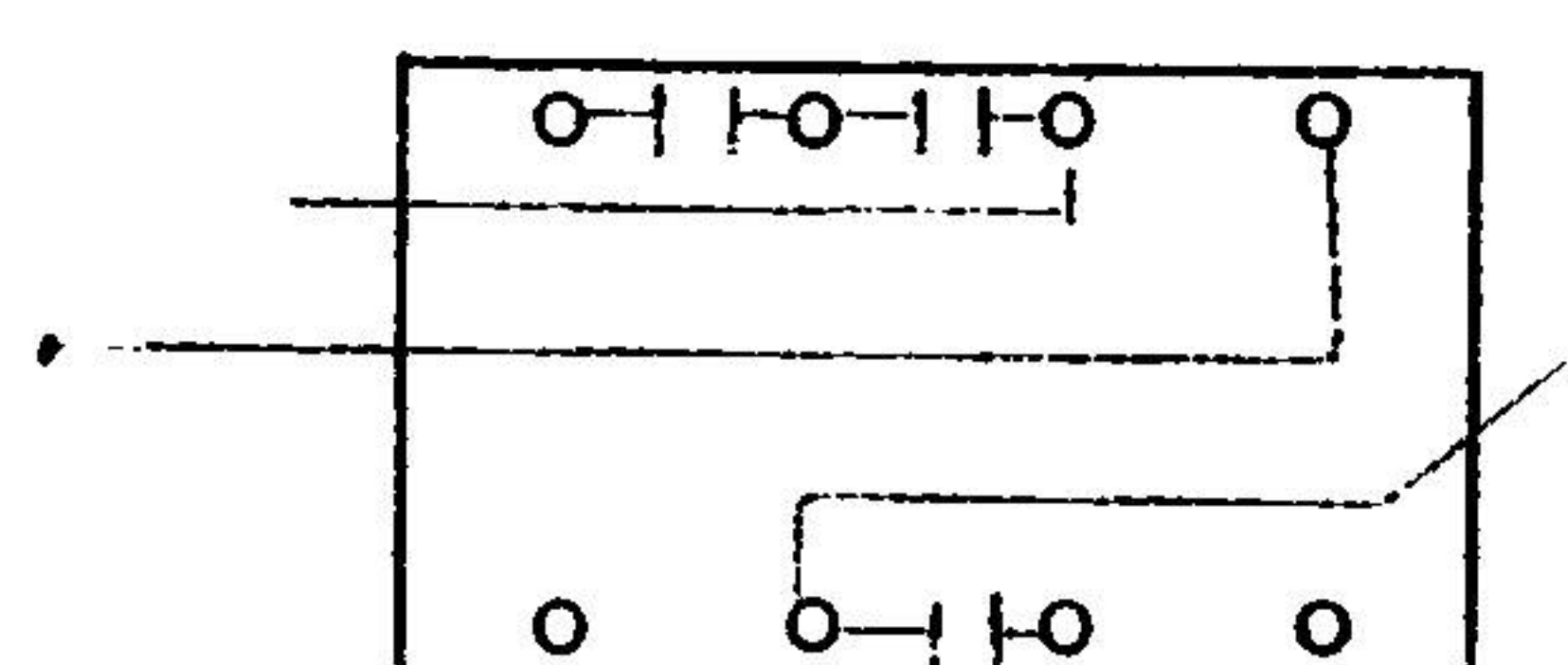
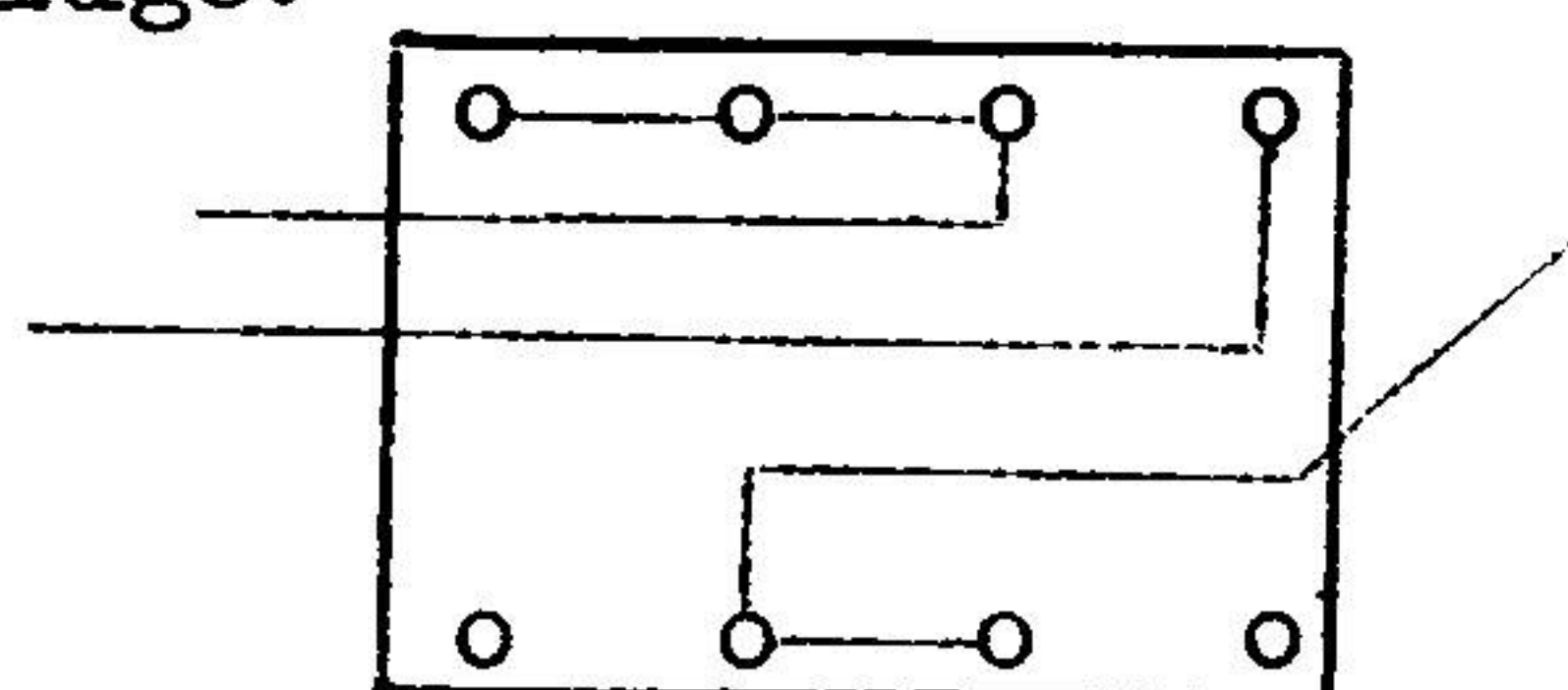
#### INSTALLING A UTILITY CHIP:

Utility chips are ready made machine code programs intended to add extra commands to your basic programs and to be run at memory address  $\$A000 - \$BFFF$ . To install the chip, the socket labelled '7800' should be used. A jumper block (ref: JB 24-5) should be inserted into the white square in the bottom left hand corner of the VCR cartridge. Alternatively, you can use wire links as shown below:



Component side

Using a Stanley knife, cut the unwanted preset links on the track side of the VCR cartridge:



Track side



## PROGRAMMING IN BASIC WITH EPROMS:

Putting basic programs on EPROMs is a simple task with the Vic Eprom programmer. The VEP adds 11 extra commands to the VIC 20, such as: W (Write EPROM), R (Read EPROM), M (Display memory), E (check for erasure) etc. ....

Take an example: you have typed in a program, which we shall call program 1.:

```
10 PRINT " 0123456789"
```

and you want to put it onto EPROM. Using the VEP, enter:

```
M = 002B, 002E
```

This displays what is used by the VIC to recall where the program is written in its memory, i.e. where it starts and where it stops (2D - 2E).

The display looks like this on a basic Vic:

```
.M = 002B, 002E
      : 002B 01 10 15 10 00
```

This means that:

```
your program starts = $ 1001
```

```
and stops           = $ 1015
```

The VIC uses the first byte as the least significant address (or lower address) and the second byte as high address (or upper address). The \$ sign denotes hexadecimal notation.

Knowing the whereabouts of your program, you can calculate the length:

```
End address: (stop) = 1015
```

```
Begin Address (start) = 1001
```

```
Length = 0014
```

Using the W command, the program is saved onto EPROM:

```
W = 0001,      0015,      1001
```

The program is saved at the speed of 1000 bytes per minute.



Now if you wish to enter the following program:

```
100 REM THIS IS MORE SERIOUS
```

```
110 .....
```

(let us call it program 2) - repeat the previous steps, but this time, the start address on ROM is:

```
W 0016 etc., 1000
```

Program 3 will be placed next to program 2 .... until the chip is full (the last address of a 2716 EPROM is 07FF, of a 2732 is 0FFF and of a 2764 is 1FFF).

The chip can now be removed from the VEP and reinserted on an empty socket on the VCR. Please remember that only six sockets on the VCR can be used by the EPROMs; these form the bottom half of the VCR card.

These programs now reside permanently in the VIC, in a very similar way to that of the VIC basic interpreter ROM, VIC character set or VIC cartridges. You can naturally use them at any time while the computer is powered on.

The programs will have an address on the memory map. This is the sum of the socket address and the start address in EPROM. For example, if the programmed EPROM is put in socket 7000, program 1 will have address 7000, program 2 address 7016 and so on. Make a list of all program titles and program addresses and stick it on top of the cartridge together with the "SYS" call to the loading utility.

#### LOADING UTILITY:

This very short program (48 bytes) can be typed in directly to any spare space of an EPROM using the VEP. This allows you to run the programs stored on your VCR EPROMs.

This utility can be programmed anywhere on the utility map. The following listing is taken from an example where the utility is appended to the VIC machine language monitor. (The monitor is copied from the cartridge to EPROM using the VEP and the utility appended to the copy).

, 6EE8 LDY #03	, 6EFF CPX #03	
, 6EEA DEC #2D	, 6F01 BNE #6F0C	:6EE8 A0 03 C6 2D 88
, 6EEC DEY	, 6F03 LDA #2F	:6EED D0 FB 84 2F 98
, 6EED BNE #6EEA	, 6F05 STA #31	:6EF2 AA E6 2F D0 02
, 6EEF STY #2F	, 6F07 LDA #2E	:6EF7 E6 30 E6 2D D0
, 6EF1 TYA	, 6F09 STA #32	:6EFC 02 E6 2E E0 03
, 6EF2 TAX	, 6F0B RTS	:6F01 D0 09 A5 2F 85
, 6EF3 INC #2F	, 6F0C LDA (#2F),Y	:6F06 31 A5 2E 85 32
, 6EF5 BNE #6EF9	, 6F0E STA (#2D),Y	:6F0B 60 B1 2F 91 2D
, 6EF7 INC #30	, 6F10 BNE #6EF1	:6F10 D0 DF E8 D0 DE
, 6EF9 INC #2D	, 6F12 INX	
, 6EFB BNE #6EFF	, 6F13 BNE #6EF3	
, 6EFD INC #2E		



Program 1 is loaded by:

POKE 47, 0 : POKE 48, 112 : SYS 28392

Program 2 is loaded by:

POKE 47, 16 : POKE 48, 112 : SYS 28392

and so on for program 3.....

The utility uses 2 bytes (47 - 48 ) as program address. Please note that the high and low addresses are converted into decimal. To get a decimal address is quite simple: 0 to 9 in Hex are the same as in decimal: a A=10, B = 11, C = 12, D = 13, E = 14 and F is 15. Multiply the first number or letter by 16 and add the result to the second number or letter.

For example: BF = 11 x 16 + 15 = 191 (B = 11, F = 15).

The loading speed is around 200, 000 bytes per minute, more than a thousand times the speed of tape and with no mess! The penalty is still the high cost of EPROM: £3.00 for every 2K of program.

#### PUTTING MACHINE CODE PROGRAMS ONTO EPROMS:

Machine code programs can be put onto Eeprom using the VEP. The only difference is that machine code programs are not flexible. They should be run from predetermined memory address. Many of them can be relocated (which means that they can be moved to run at another memory address) but not all of them. They should be inserted in the appropriate sockets. The memory addresses are clearly indicated at the bottom of each socket. Ready made programs are usually put into EPROM type 2732. Only one socket on the VCR allows the use of this type. If you have many of these ready made EPROMs, the solution is to copy them onto the electronic cassettes using the VEP. The electronic cassettes are EPROM carriers, each capable of storing up to 32K of program.

NOTE I: Please type the appropriate answer for the prompt

"MAXIMUM ARRAY SIZE" :

Standard VIC = 650

VIC + 8K = 2150

VIC + 4K = 1450

VIC + 16K = 3850

etc.

Each extra K byte will increase the maximum array size by 200.