EPROM DUPLICATOR

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NOW that the 2716 (2K x 8) and 2732 (4K x 8) EPROMs are available economically, it is advisable to replace the 2708s in older systems with one of these new EPROMs, to simplify power supplies and enhance the Read-only-memory capacity.

Professionally made equipment for EPROM duplicating is expensive and there is every reason for a simple instrument like the one described to find its place among microprocessors and home computers.

THE 2708/2716/2732 EPROM FAMILY

The 2708 EPROM is actually a second generation erasable read-only memory chip and is much superior to its predecessor, the 1702. The 1702 is a mere 256 byte type and it has rather difficult requirements for programming, such as Address complementing, a 45V program pulse etc. The 2708 fares better, because it is a 1K byte capacity and further, it requires no Address complementing and only a 27V pulse. It is also much faster than the 1702 for its memory access. However, the 2708 still needs three power supplies of +12, +5 and −5 volts, even for its normal reading mode. Most of the microprocessor based equipment built during the period prior to 1979 employed the 2708 EPROM only. Many readers may still be using them.

The 2716 EPROM which came after 1978 is much superior because it has a 2K byte capacity and works on a single +5V power supply. The TMS 2516 from TI is also an equivalent to the Intel 2716. For programming these chips, one needs a +25 volt supply, but it is just a steady 25V, unlike the pulse voltages needed for the 2708. For programming, a TTL level 5V pulse of 50ms has to be applied to the Programming pin 18. Further, it has the facility that one can program even a single byte at a time by one such pulse. The 2708 requires a series of pulses and one should apply them in sequence in order to program all the locations little by little. One pass through all address locations is defined as a Program loop. About 200 loops each with a 0·5ms pulse is needed to completely program all of its 1K locations. Individual locations also have to be programmed only by passing through so many loops.

Further, the 2708, because of its three power supplies, is prone to early failure due to power supply transients. In fact it requires that the −5V supply should be on first and switched off last in comparison with its other two +12 and +5 volt supplies.

The 2716 became available in 1979 and its price fell progressively, down to £3 or less. Since 1982, another chip, the 2732, of 4K byte capacity, has been available at or around £4. Now that the price has come down, these devices should soon replace the older 2708s.

For all these reasons, it is highly desirable that the 2708s in kits, computers and equipment should soon be changed to the 2716 so that single power supply working is possible. Two 2708s can now be replaced by a 2716: two 2716s can be replaced by a single 2732. A number of manufacturers now make these EPROMs. Hence the EPROM Duplicator described here will be well worth its construction, because it is simple in circuitry and needs no microprocessor.

CIRCUIT DESCRIPTION

Two sockets are required, one for the EPROM being copied to (marked 'B') and one for the chip being copied from ('A'), both of which should be 24-pin zero-insertion-force sockets.

Note that the data pins and address pins of both are connected in parallel, because, for any particular address location, the data from one goes into the other in the process of duplicating. However, if a 2708 is the source EPROM, then it has no A10 pin because it has only 1K byte addressing capacity. Instead, that pin no.19 in the 2708 happens to be a +12V supply. Further, pin 21 is V_{BB} which is a −5V in the 2708. If the source EPROM is also a 2716, then pin 19 is A10, the most significant address bit and pin 21 is V_{PP} which should also be +5V only.

So, a change-over switch S1 is used to copy from a 2708 or a 2716 chip in socket A. Since a 2708 has only 1K data bytes, and as the 2716 has 2K capacity in it, the data from the former could be copied either into the first or second half of the latter. In other words, two 2708s with consecutive address range can be copied into one 2716. Switch S2 selects which half of the 2716 in socket B needs to be copied, at the time. This S2 makes pin 19 (A10) either low or high and accordingly selects either the first or second half of it.

If socket B uses a 4K EPROM, the 2732, then it is possible to transfer two numbers of 2716 or four numbers of 2708s into it. Switch S3 selects either the first or the second 2K of the 2732. If the source EPROMs in socket A are 2708s, then switch S2 also has to be used.

IDEAL FOR COPYING DATA FROM ONE EPROM TO ANOTHER, FOR EXAMPLE, TO UPGRADE FROM AN OLD THREE-RAIL 2708 TO A NEW SINGLE-SUPPLY 2716.

As already mentioned, programming a 2716 or 2732 requires the application of a single 50ms pulse to pin 18 after applying the address and data to these pins. When the next address is chosen, data at that address of the source EPROM gets applied to the data input pins of the 2716. Again, another pulse is applied. This goes on until the entire memory has been programmed.

In order to sequence the address and apply the 50ms pulse after each address has settled, we require the remaining part of the circuit of Fig. 2. A clock generator is formed using a simple CD4011 astable circuit using two of its gates. The values of R2–C1 give a time of about 75ms, so that a series of rectangular pulses of 75ms half-period are applied, via a CD4049 inverting buffer to the clock input of a 12 bit binary counter CD4040. The CD4040 clocks during each negative-going edge at its clock input pin 10. The address information of the EPROMs changes at this instant, once for each pulse. So, during the positive-going swing of the oscillator output, the address gets changed every time (Fig. 1).

Note that the output of the CD4011 (pin 11) is also coupled via C2 to another CD4011 (2), which is connected as a 50ms monostable using two of its gates. So, at each negative-going edge of the 75ms clock, the 50ms pulse comes out and gets applied to the programming pin via one or two buffers, using CD4049. Thus, after the address has settled, considerable time is allowed before a 50ms pulse is given to the socket B at pin 18 to program the EPROM.

After going through a series of 2K clock periods, all of the locations will have been programmed with the corresponding data in the source EPROM. After completing 2K counts, pin 1 of 4040 goes high, which would make D2 glow via the CD4049 buffer, indicating completion of programming. Now switch S4 is opened to isolate the 25V programming supply.

Starting and Resetting is done by a pair of flip flops formed by the first 4011 i.c. When 'Reset' is pressed, it causes a high level pulse to be applied to the reset pin 11 of the 4040, so that the address bits start from 0 initially. The

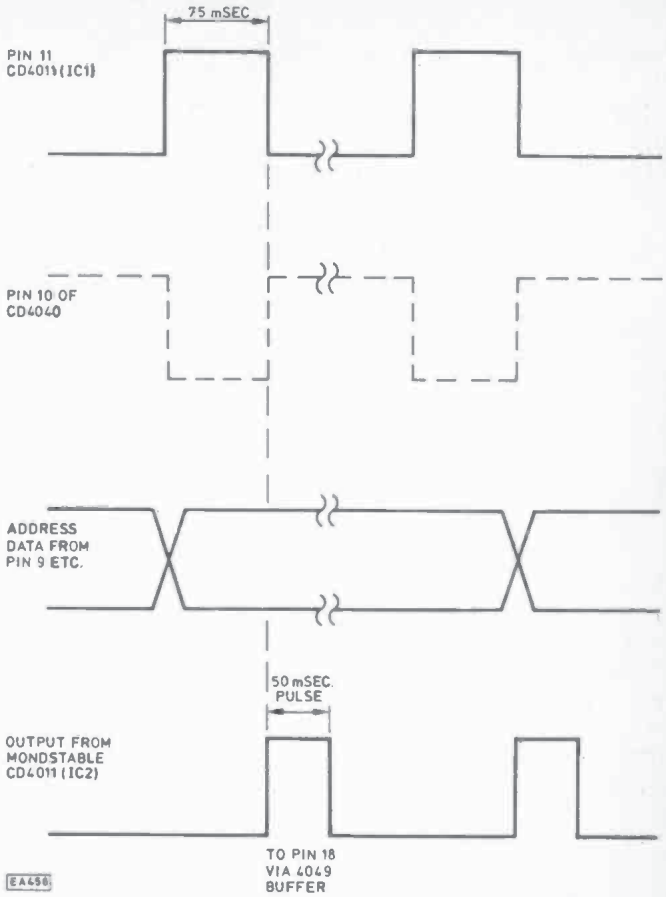

Fig. 1. Timing diagram

'Start' push switch makes pins 3 and 8 of the astable oscillator high so as to enable the clock oscillator. D1 glows to indicate that programming is in progress.

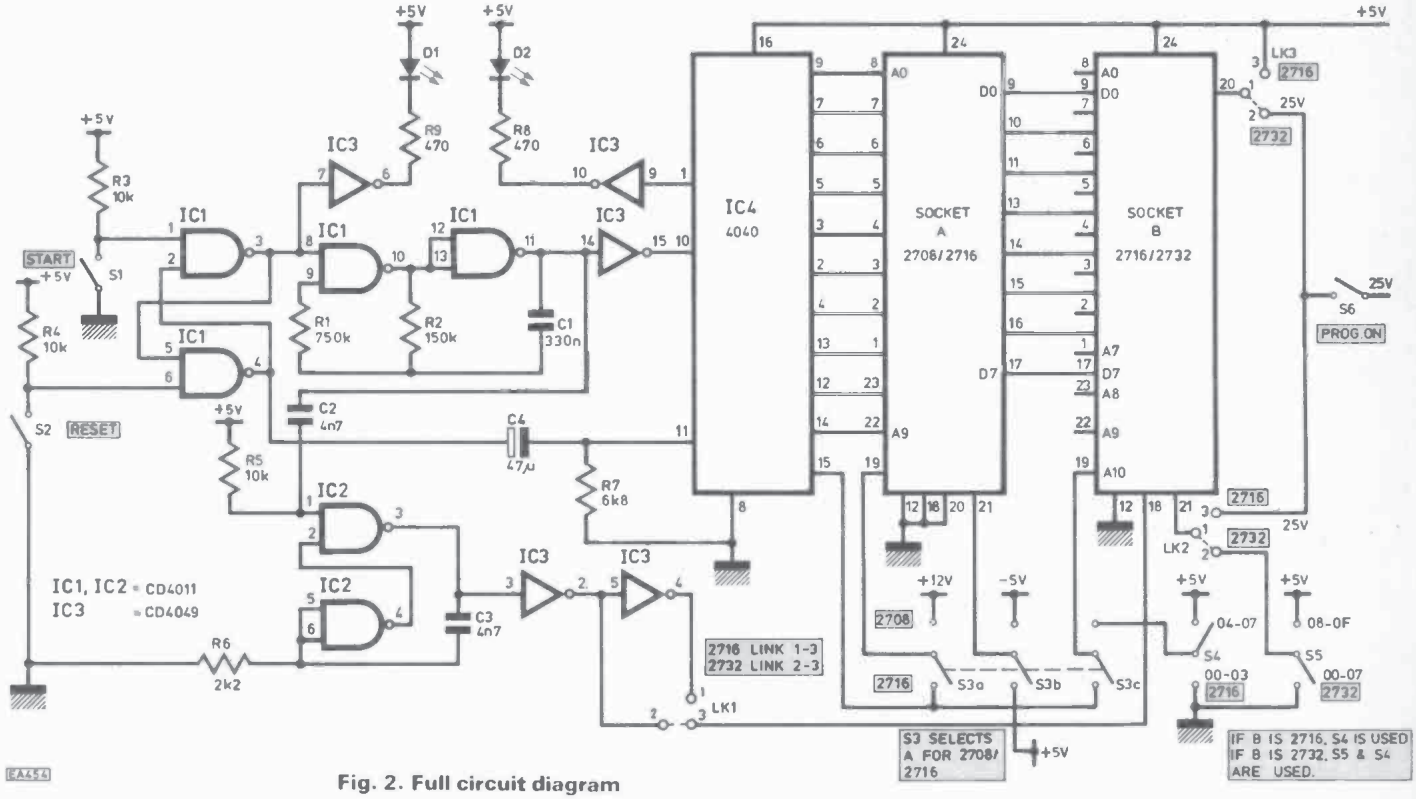

Fig. 2. Full circuit diagram

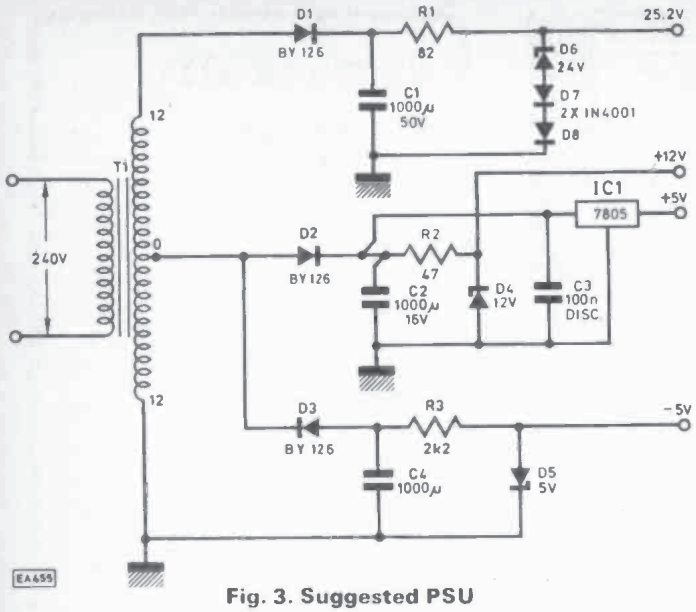

Fig. 3. Suggested PSU

USING THE DUPLICATOR

1) Insert Master or Source EPROM in socket A. It may be 2708 or 2716.

2) Select S1 for 2708 or 2716 of source chip and S2 for programming on to first or second half of the chip on socket B, if it is a 2716.

3) If the B chip is a 2732, select the first 2K part or second using S3.

4) Insert new or erased EPROM in socket B.

5) Keep S4, the programming power switch, open.

6) Apply power supply voltages, −5V first and then the +5V, +12V and +25V. For a source 2716, the −5V and +12V are not necessary.

7) Press Reset and then Start. D1 is now ON.

8) Close S4 at once. It takes about 4 minutes to go through the 2K locations. When D2 comes on, open S4. Switch off the power. Remove chip from socket B. It will have copied that part of A in it.

9) For programming the other half of the 2716 or 2732 as the case may be, proceed as above, with the switches S2 and S3 kept in the next position, as follows:

	Source chip 2708.	Source chip 2716.
Copied on 2716	S_2 down−2708(i)	
	S_2 up −2708(ii)	S_2 anywhere
Copied on 2732	S_3 down:	
	S_2 down−2708(i)	S_3 down−2716(i)
	S_2 up −2708(ii)	S_3 up −2716(ii)
	S_3 up:	
	S_2 down−2708(iii)	
	S_2 up −2708(iv)	

TABLE 1. Programming data of the EPROMs

Pin Nos.	2708	2716	2732
1 to 8	A_7 to A_0	A_7 to A_0	A_7 to A_0
9, 10, 11			
13 to 17	D_0 to D_7	D_0 to D_7	D_0 to D_7
12	Ground	Ground	Ground
24	V_{cc}(+5V)	V_{cc}	V_{cc}
23, 22	A_8 A_9	A_8 A_9	A_8 A_9
18	27V low to high prog. pulse	5V TTL low to high pulse	5V TTL high to low pulse
19	−12V	A_{10}	A_{10}
20	+12V	+5V	V_{pp} = 25V
21	−5V	V_{pp} = 25V	A_{11}

COMPONENTS . . .

EPROM PROGRAMMER

Resistors

R1	750k
R2	150k
R3–5	10k (3 off)
R6	2k2
R7	6k8
R8, R9	470 (2 off)
All ¼W 5%	

Capacitors

C1	330n/100V polyester
C2, C3	4n7/60V disc cer. (2 off)
C4	47µ/16V aluminium elect.

Semiconductors

IC1, IC2	CD4011 (2 off)
IC3	CD4049
IC4	CD4040
D1	red 0·1" l.e.d.
D2	green 0·1" l.e.d.

Miscellaneous

16-pin sockets (2 off). 14-pin sockets (2 off). 24-pin sockets (pref. z.i.f. type) (2 off).

Switches

S3	3p2w
S4	1p2w
S5	1p2w
S6	1p1w toggle
S1, S2	Push-to-make switches (2 off)

CONSTRUCTION

The unit is assembled on a printed circuit board, single-sided type of dimensions 115 x 13mm, inclusive of the switches as needed. The p.c.b. layout is shown in Fig. 4 along with component and jumper locations in Fig. 5. Note that there are three links shown in the circuit of Fig. 2. One of these chooses the system to work for duplicating on 2716 EPROMs, while the other is for the later version 2732. The alternatives for these links are also marked on the component layout diagram, one of which should be chosen.

The two i.c. sockets A and B are inserted and soldered first. One of these, at least, should be a z.i.f. socket if regular use is intended for this unit. The CMOS i.c.s are to be handled with the usual care and sockets are needed for them too. The jumpers are connected carefully, after inspecting the same with the reference made to Fig. 2. The wiring to the switches is made underneath the p.c.b. The switches are mounted below. Supporting ebonite pillars are used on four corners. If you intend copying only on 2716 type EPROMs, no S3 is needed. The power supply points are brought out to a strip screw type connector mounted at one edge of the unit. The 25V supply should also be made through this. An external switch S4 in the 25V line is necessary, if the 25V p.s.u. does not have one in itself.

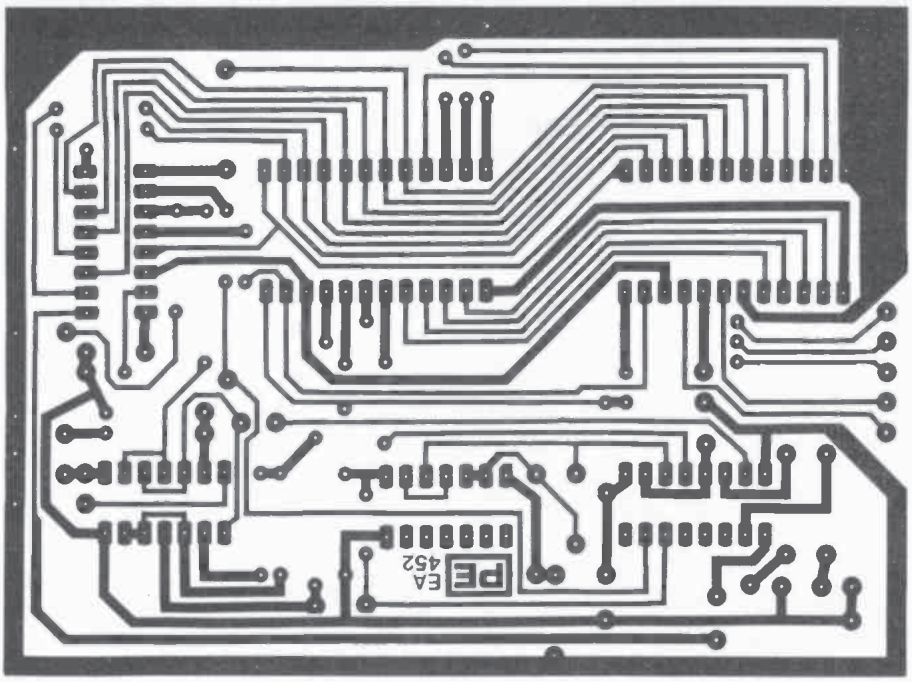

Fig. 4. P.c.b. track layout (actual size)

COMPONENTS . . .

SUGGESTED PSU

Resistors

R1	82
R2	47/½W
R3	2k2

Capacitors

C1	1000µ/50V
C2, C4	1000µ/16V (2 off)
C3	100n disc

Semiconductors

D1–3	BY126 (3 off)
D4	12V/1W Zener
D5	5V/1W Zener
D6	24V/1W Zener
D7, D8	1N4001 (2 off)
IC1	7805 regulator
T1	230V/12-0-12V @ 0·5A

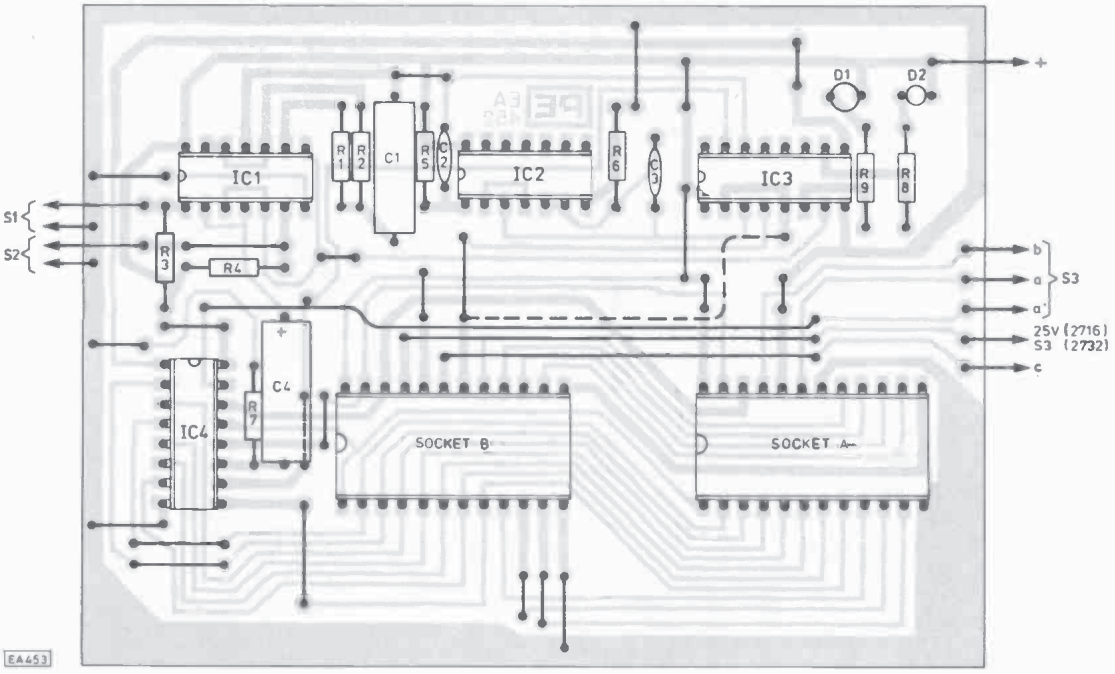

Fig. 5. Component layout of EPROM duplicator

TESTING

First apply 5V only to the unit, after just inserting the CMOS i.c.s, leaving the A and B sockets free. Pressing the start push button should enable the oscillator and at pin 11 of CD4011 (observe the waveform shown on Fig. 1). D1 should be ON. The 4040 should now be counting these pulses, as may be checked by scoping at its output pins 9 through 15. Pin 3 of the CD4011 should be producing a train of 50ms pulses. If not check the connection to pin 1 of it and also the wiring of R6 and C3.

Now check if the address pins of the EPROM sockets are all receiving the outputs of the CD4040. Pin 19 of socket A will not receive it if S1 is up, selecting the same for a 2708 chip. Likewise pin 19 of socket B will not receive it if a 2708 chip is used for A.

Then check if the 12V and —5V points on the terminal connector maintain continuity with the pins 19 and 21 of socket A in the S1 switch's up position.

After about 4 minutes, D2 should light up.

If the above does not check out properly, carefully examine the p.c.b. for solder bridges, faulty solder joints or missing jumpers. Also check that the connections to switches are wired as per Fig. 2. ★