



COMMODORE 64 CARTRIDGE PCB (8K)

Revision 3

DIRECTIONS FOR USE

Thank you for purchasing an Alphaworks product, we hope that you find this PCB and supporting documentation to be of the highest quality.

The (C-1010 PCB) cartridge board is designed for use with 2764 series EPROM's. The EPROM may be soldered directly to the board or sockets may also be used. See diagram blow for correct placement and orientation of the EPROM.

The EPROM site is always addressed to 32768 (\$8000). When the cartridge board is plugged into the computer this EPROM takes the place of 8K of RAM at that address. See the memory map at the bottom of page 265 of the Programmer's Reference Guide for further details.

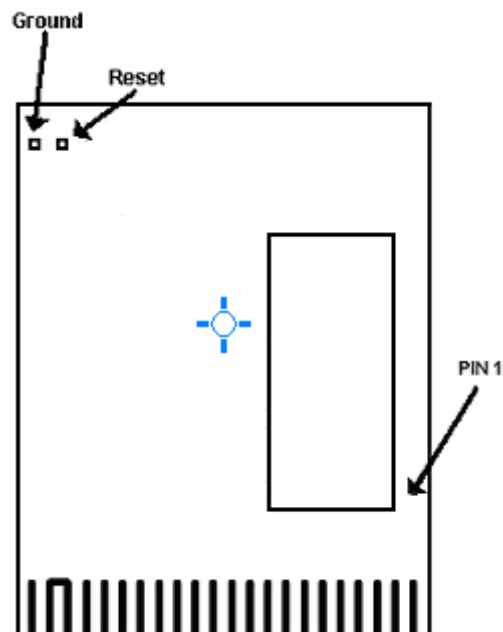


Diagram 1
Top Down
View of 8K
Cartridge

PLASTIC CARTRIDGE CASE

The (C-1010 PCB) cartridge board was designed to fit inside a standard Commodore Cartridge Case, such as the ones used to house classic Commodore programs like International Soccer. To install your cartridge board in the plastic case, lay the PCB on the bottom half of the case (with the solder pins facing down). Place the cartridge board EPROM side up. Fit the top half of the cartridge case and screw together.

IMPORTANT

It is extremely important that you insert the PCB the correct way up on your Commodore 64 as to avoid problems. On the underside (bottom) of the PCB it contains the words -

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C64-PCB REV 8K-R3

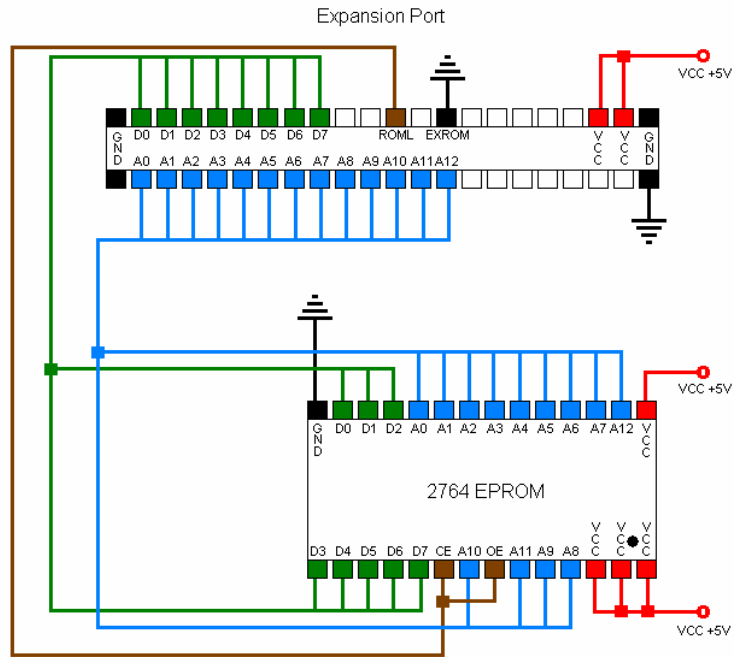
CARTRIDGE CONFIGURATION

No additional IC's are required to build an 8 Kbytes cartridge. The cartridge board maps 8K to \$8000-\$9FFF. Maximum size of file is 33 BLOCKS.

HOW TO PROGRAM AN AUTOSTART CARTRIDGE

The system provides for "auto-start" of the program in a Commodore 64 Expansion Cartridge. The cartridge program is started if the first nine bytes of the cartridge ROM starting at location 32768 (\$8000) contain specific data. The first two bytes must hold the Cold Start vector to be used by the cartridge program. The next two bytes at 32770 (\$8002) must be the Warm Start vector used by the cartridge program. The next three bytes must be the letters, CBM, with bit 7 set in each letter. The last two bytes must be the digits "80" in PET ASCII.

8K PCB Schematic



<u>PORT</u>	<u>EPROM</u>	<u>LINE</u>
Y	10	A0
X	9	A1
W	8	A2
V	7	A3
U	6	A4
T	5	A5
S	4	A6
R	3	A7
P	25	A8
N	24	A9
M	21	A10
L	23	A11
K	2	A12
21	11	D0
20	12	D1
19	13	D2
18	15	D3
17	16	D4
16	17	D5
15	18	D6
14	19	D7
A, Z, 1, 22	14	GND
2, 3	1, 26, 27, 28	+5 V (vcc)
11	20	ROML
9	20, 22	OE / CE
	14	GND

AUTOSTART 'CBM80' METHOD

The most common cartridge autostart method is known as the CMB80 method. It can be used by both 8K and 16K cartridges that reside at \$8000. Although this method is sometimes called the cartridge autostart option', it can be used equally well by RAM-based programs, and often is. One of the first things the KERNAL RESET routine does is check locations \$8004-08 for the string of characters CBM80. If these exact characters are NOT found there, the KERNAL RESET process continues normally.

If the "CBM80" is found, the RESET routine is interrupted and the processor immediately jumps to whatever location is specified by the **CARTRIDGE COLD—START VECTOR**. This vector is expected to be found at locations \$8000-01. You must place a pointer here, in standard b-byte / hi-byte order, directing the processor to the beginning of your cartridge code. From that point on, your cartridge must handle all the initialization itself for any functions it will use, such as the I/O devices or KERNAL or BASIC routines. Fortunately, you still have the KERNAL initialization routines available for use. Unless you know exactly what you are doing, your cartridge should use these routines to initialize the functions it needs.

Figure 1 presents a generic cartridge initialization routine. This routine duplicates most of the normal RESET process. In fact, its taken right from the main parts of the KERNAL (\$FCEF-FE) and BASIC (\$E394—9F) RESET routines. This generic routine will be adequate for 99% of all cartridges.

Figure1: CBM80 Cartridge Initialization

<hr style="border: 1px solid black;"/> Assembly Language Routine for Auto Starting a Cartridge <hr style="border: 1px solid black;"/>	8000 09 80			Cartridge cold-start vector = \$8009
	8002 25 80			" " warm " " ` " = 8025
	8004 C3 C2 CD 38 30			CBM80 - Autostart key
				<u>KERNAL RESET Routine</u>
	8009 8E 16 DO	STX \$D016		Turn on VIC for PAL / NTSC check
	800C 20 A3 FD	JSR \$FDA3		IOINIT - Init CIA chips
	800F 20 50 FD	JSR \$FD50		RANTAS - Clear/test system RAM
	8012 20 15 FD	JSR \$FD15		RESTOR - Init KERNAL RAM vectors
	8015 20 5B FF	JSR \$FF5B		CINT - Init VIC and screen editor
	8018 58	CLI		Re-enable IRQ interrupts
			<u>BASIC RESET Routine</u>	
8019 20 53 E4	JSR \$E453		Init BASIC RAM vectors	
8D1C 20 BF E3	JSR \$E3BF		Main BASIC RAM Init routine	
801F 20 22 E4	JSR \$E422		Power-up message / NEW command	
8022 A2 FB	LDX #\$FB			
8024 9A	TXS		Reduce stack pointer for BASIC	
8025			START YOUR PROGRAM HERE	

The cartridge cold-start vector and autostart key (CBM80) have already been discussed. The warm-start vector at \$8002-03 is a feature that allows you to re—enter your program after a full initialization has already been done. Once a cold—start has been done, it usually doesn't need to be done again. Pressing the RESTORE key calls the NMI routine (NON-MASKABLE INTERRUPT), which will see the CBM80 and jump to the location indicated by the warm-start vector. This is why many programs restart themselves when you press the RESTORE key. In our initialization routine we have pointed the warm-start vector to the start of your program; you could also point it to \$8009 to perform a full cold-start on RESTORE. If you want to disable the RESTORE key entirely, point the warm—start vector to \$FEBC (return from NMI).

We have included the BASIC RESET process in this cartridge initialization routine too. Actually, the normal BASIC RESET routine dead-ends with a jump to the BASIC direct mode interpreter, also known as “READY” mode. This prints the “READY.” prompt and then sits there waiting for, you to type a BASIC command. You won't usually want to exit into READY mode at this point since BASIC will take over and your cartridge will lose control. If you do want to exit to BASIC now or later, you may do so with JMP \$E386. By the way, the routine called at \$801F (JSR \$E422) prints the normal power-up screen and does a NEW command. If you want to skip the power—up message, just call the NEW command directly using JSR \$A644 instead of JSR \$E422.

To summarize, the CBM80 method can be used with either 8K or 16K standard cartridges (which start at \$8000). The cartridge initialization routine above will be sufficient for the vast majority of cartridges. KERNAL initialization must be done at least once (on power—up or RESET). BASIC initialization can be skipped if you're not using BASIC, and MUST be skipped if you're using a 16K cartridge. Through the cartridge warm-start vector, the RESTORE key can be set up to re—enter your program or it can be disabled entirely. The CBM80 method is by far the most common cartridge autostart method.