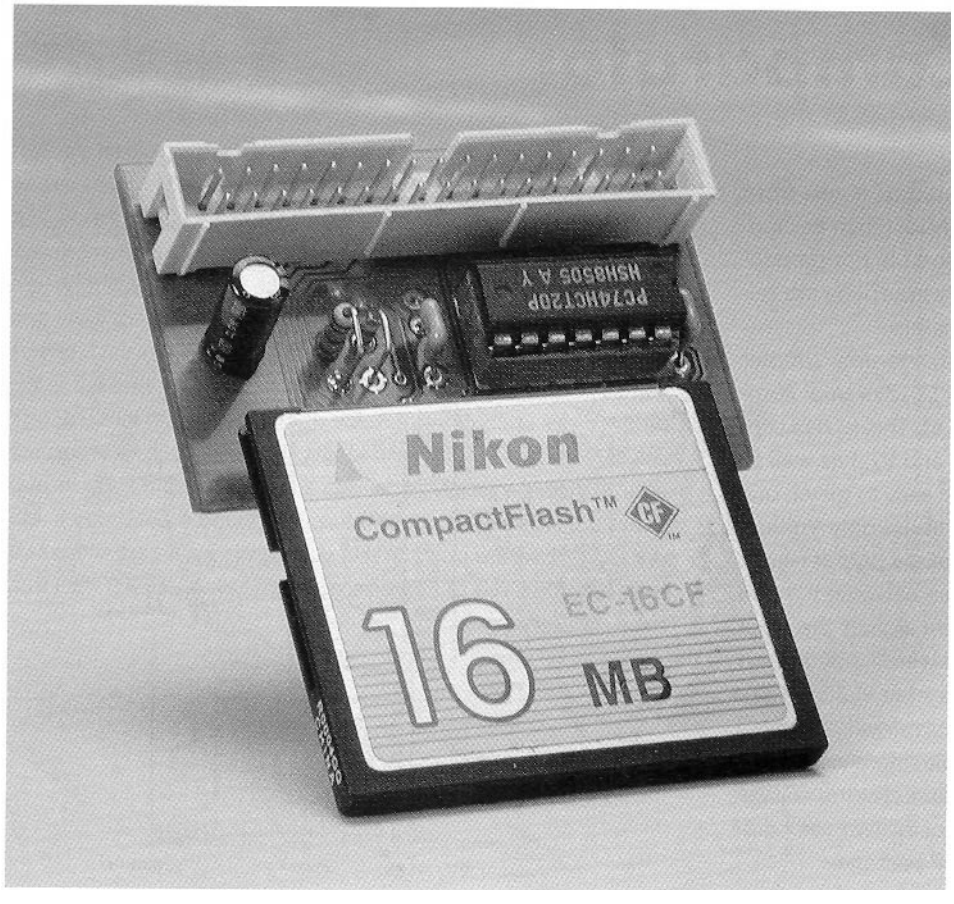
CompactFlash Interface for Microcontroller Systems

including our 89S8252 Flash board

Design by P. Goossens

CompactFlash (CF) cards are ideal for storage of large amounts of data, which is retained for years without the need for a backup supply voltage.



In the wake of our CompactFlash Drive on IDE Bus (April 2002), we now present a similar circuit for microcontroller boards. Specific attention is given to the popular 89S8252 Flash Micro board which forms the hardware basis of our Microcontroller Basics course.

The present CF interface was initially designed as an extension for the 89S8252 Flash Micro board published in the December 2001 issue of *Elektor Electronics*. The circuit may also be used in combination with other microcontroller systems provided you are able to make a suitable adapter between the CF interface and the extension connector on the system you have available.

The CF interface enables the processor to read and write data from/to a CompactFlash card. In this way, the memory capacity of the microcontroller circuit is considerably extended. CompactFlash cards are widely available these days at very competitive prices and the latest ones have a capacity of 1 GByte! Apart from their ease of use, the greatest thing about these cards is their ability to retain data without a backup supply voltage.

Applications of this interface are only limited by your imagination and could include a data logger, voice recording/playback, and so on.

Circuit diagram

The circuit diagram of the CF interface is very simple indeed, see **Figure 1**. The 'electronics' is down to an address decoder made from 1 (yes one) logic gate (IC1a). This will decode A12-A15 and select the CompactFlash card if all of these address lines are at logic High. Consequently the CompactFlash card will occupy the address range $F000_H - FFFF_H$.

The rest of the circuit connects the relevant CF card terminals to those of the processor and provides a supply voltage for the CF card.

Capacitors C1 and C2 provide the necessary supply decoupling. C3, R1 and D1 produce a reset signal when the supply is switched on.

That concludes our discussion of the circuit. For more information on the size and connection data of the CF you are referred to the article on the CompactFlash Drive in the April 2002 issue.

The artwork for the double-sided PCB is shown in **Figure 2**. Most board space is taken up by the 50-way connector for the CF card and the 34-way boxheader for the CF-to-micro links.

Although the circuit is not difficult to build, care should be taken in the soldering of the pinheader for the CF card. The reason is obvious — the pins are very close together!

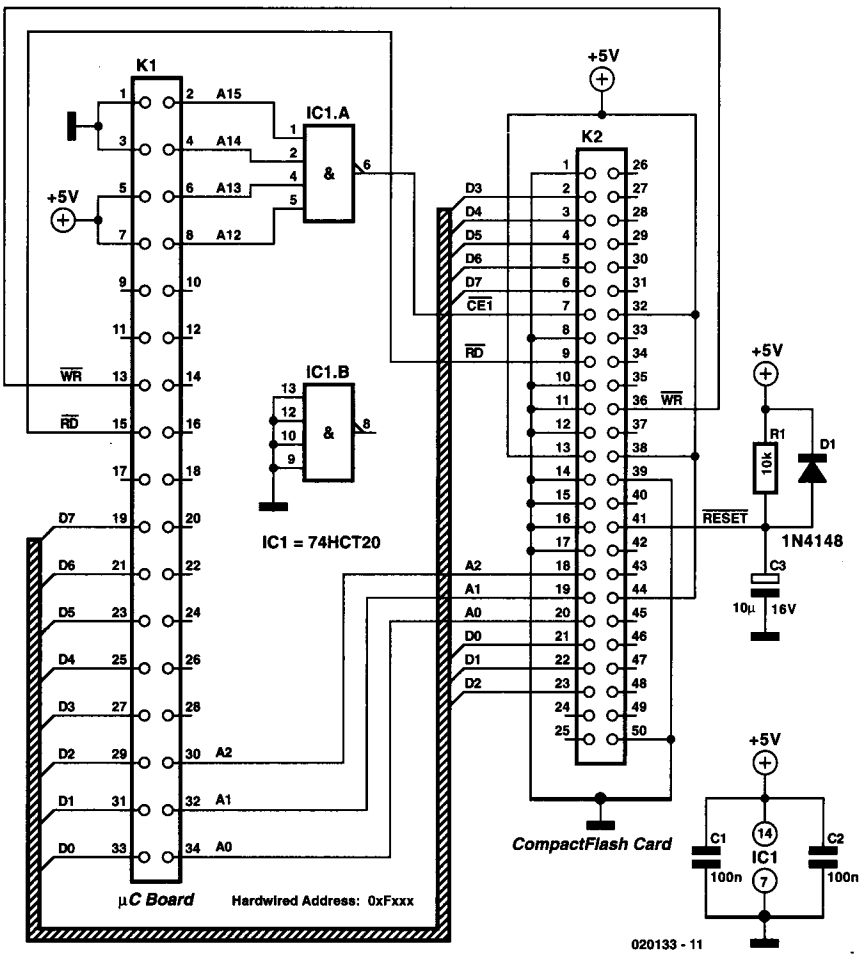


Figure 1. The circuit diagram of the CompactFlash interface consists of little more than two connectors.

The connection between the interface (K1) and the Flash Micro board (K8) consists of a short length of 24-way flatcable with two IDCs (insulation displacement connectors). The introductory photograph shows how the interface board may be placed next to the Flash Micro board. The CF card is fitted onto K2 in such a way that the side with the print on it is at the top (see photograph). Note that this extension does not work if an LCD is connected to the Flash Micro board.

Software

Without appropriate software, a processor will ignore the presence of a CompactFlash card within the memory range. It is the programmer's task to instruct the processor to read from, or write to, this memory area, **and** tell the processor how to do just that!

The full specification of a CompactFlash card is of a hefty size and could deter you from writing your own software. To remove this 'CF fear' to some extent we developed a small demonstration program intended to demonstrate the essential and useful functions of the interface. The functions actually used are listed in **Table 1**. This little program, or pieces of it, may be used as a template for

Tabel I.

Main functions of CompactFlash interface

Command Name	Command code
READ SECTORS(S)	0x20
WRITE SECTOR(S)	0x30
IDENTIFY DRIVE	0xEC

your own programs, and should avoid recourse to the 'indigestible' documentation describing all the intricacies of a CF card. The not so faint hearted will find these at the CompactFlash Association website: www.compactflash.org
The source code files for the CF interface demo program, as well as the program itself, may be obtained free of charge from the Free Downloads page on Publishers' website at www.elektor-electronics.co.uk. For

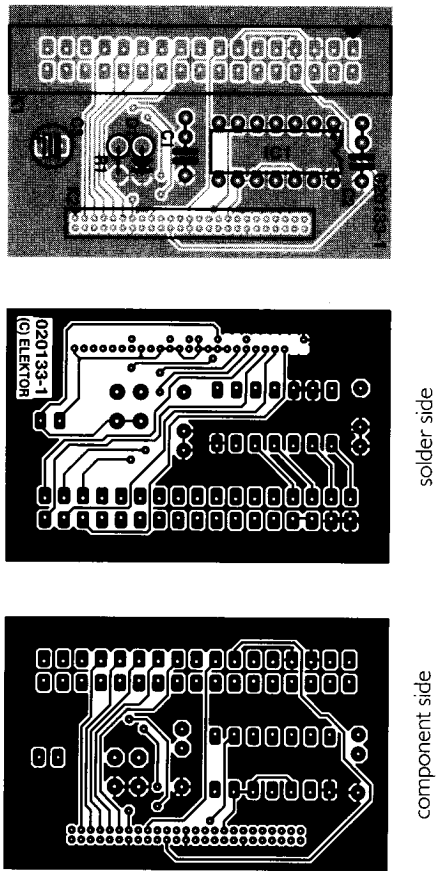
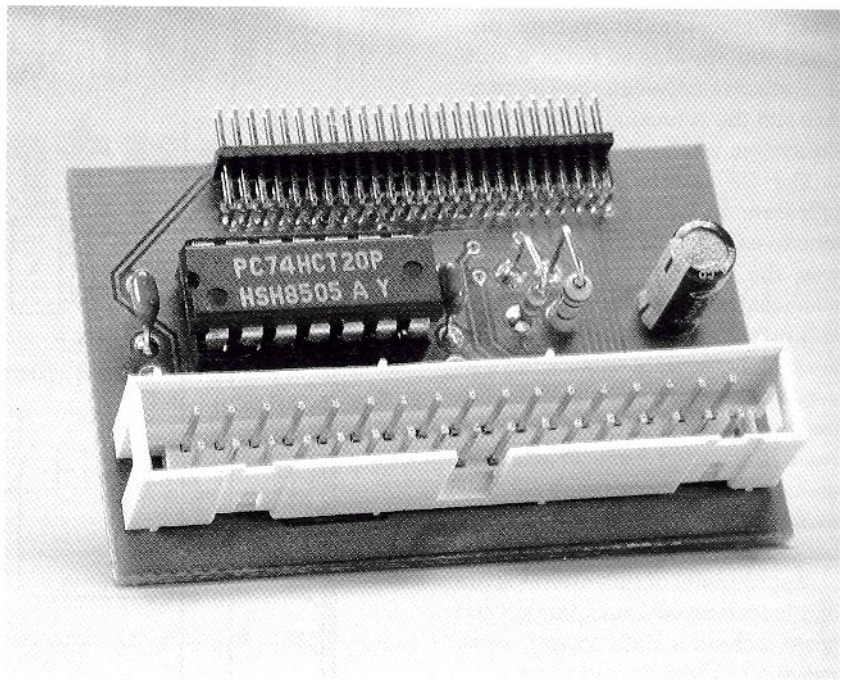


Figure 2. Double-sided printed circuit board for the CompactFlash interface board (board available ready-made).



COMPONENTS LIST

Resistors:
R1 = 10kΩ

Capacitors:
C1,C2 = 100nF
C3 = 10µF 16V radial

Semiconductors:
D1 = 1N4148
IC1 = 74HCT20

Miscellaneous:
K1 = 34-way boxheader
K2 = 50-way 0.05"-grid pinheader, angled (e.g., Farnell # 307-8127)
PCB, order code **020133-1** (see Readers Services page)
Disk, source code file of demo program order code **020133-11** or Free Download

Table 2.

CompactFlash Interface registers

Address	Read	Write
F000h (atrDATMSB)	D8 - D15	D8 - D15
F006h (atrALTERN) (atrDEVCTRL)	Alternate Status	Device control
F007h (atrDRIVEAD)	Drive Address	
F008h (atrDATLSB)	Data	Data
F009h (atrERROR) (atrFEATURE)	Error	Feature
F00Ah (atrSECCNT)	Sector Count	Sector Count
F00Bh (atrSECNR)	Sector Number	Sector Number
F00Ch (atrCYLLOW)	Cylinder Low	Cylinder Low
F00Dh (atrCYLHIG)	Cylinder High	Cylinder High
F00Eh (atrDRHEAD)	Drive/Head	Drive/Head
F00Fh (atrSTATUS) (atrCOMMAND)	Status	Command

Table 3.

Commands in example program

?	Help	Supply brief descriptions of all program functions
D	Display	Display buffer contents in hexadecimal as well as ASCII notation
I	Info	Display main data of CompactFlash card
R	Read	Read sector on CompactFlash card and copy contents into buffer
W	Write	Write buffer contents to sector on CompactFlash card
C	Cylinder	Modify currently selected cylinder
H	Head	Modify currently selected head
S	Sector	Modify currently selected sector

those without access to the Internet, there's floppy disk number **020133-11** which may be ordered through our Readers Services. The program was written using the Tasking 'C' compiler, and some details may need patching to run it on other compilers. This may include the declarations of the CF registers. Using the well-known 'MicroFlash' utility, the program may be downloaded directly into the 89C8252 chip. Next, you may use HyperTerminal or a similar terminal emulation program to test the different functions of the interface. Use these communications settings: 9,600 bits/s, 1 start bit, 8 data bits and no parity (9600N81).

When the program is started, the CF card is first reset and some salient data is retrieved from it. This includes the sector at address CYL 1, HEAD 1, SECTOR 1, whose data is copied into the buffer. Next, the program expects the user to supply a command.

Finally

Before using a CompactFlash card, it is recommended to make a backup of its contents.

It should be noted that reformatting for a specific system (digital camera, PC) may be required once a microcontroller has performed a write action on a CompactFlash card. This is caused by PCs and digital cameras employing a filing system to enable data on the CF card to be organised in folders and files. This filing system employs a part of the CF card's memory to keep track of the start of individual folders and files. File fragments may be 'scattered' all over the memory area, hence the filing system holds data that indicates the order in which certain sectors have to be read to 'assemble' a file from the fragments stored on the CF.

A full description of the structure of the various filing systems employed for CF cards would easily fill this entire magazine so it is well beyond the scope of this article. The demo program purposely avoids the use of a filing system so it can remain simple while getting the point across: demonstrate how sectors on a CF card can be read and written.

If you want to know all the ins and outs of the filing system used in Windows, you should know that Microsoft have published the full specification at
www.microsoft.com/hwdev/download/hardware/FATGEN103.doc

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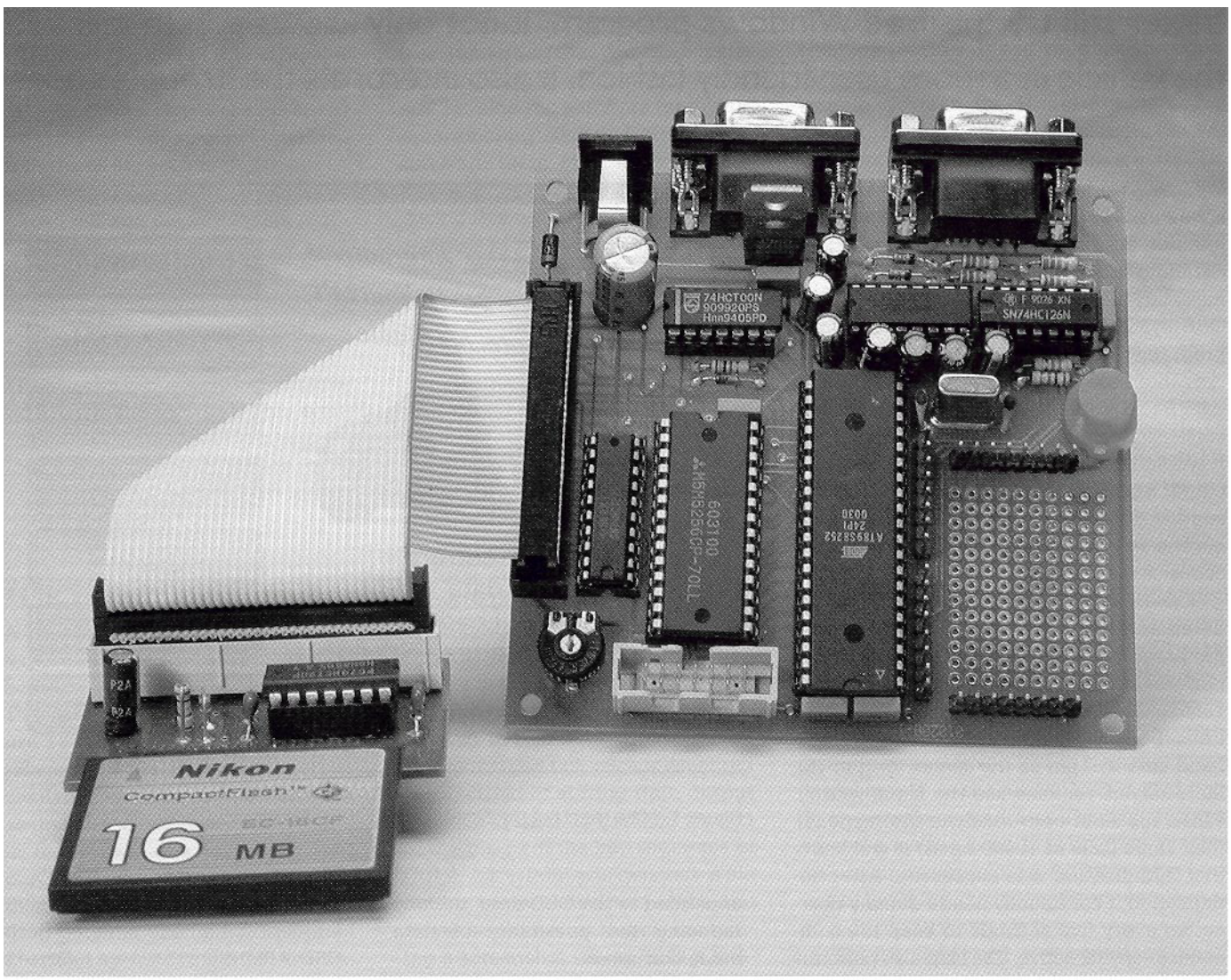

Figure 3. Connecting-up the CF interface to the Flash Micro board.