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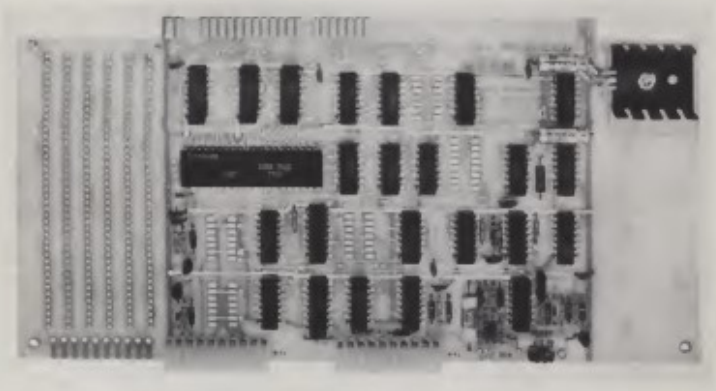
Kansas City Standard— At 1200 Baud

Although he finds some deficiencies in the CI-812 software and manual, the author is generally satistfied with Percom's I/O cassette board.



The Percom CI-812 cassette and RS-232 interface board. Strapping for the RS-232 data rate is in the center; straps to select the port address are in the lower center (A1 to A7); and the connectors for the recorder and the RS-232 device are at the top. The vacant area on the right can be used for modifications or additional features.

When I purchased the Percom CI-812 cassette and RS-232 interface board, it was my intention to write a short review of my initial experiences with it. However, in order to fit the board to my requirements, I first had to write some software. Some of the difficulties I faced and some of the solutions that I came up with should be of interest to anyone contemplating a cassette read-write interface.

I wanted to be able to read and write Kansas City Standard tapes at 300 and 1200 baud or perhaps faster. The Percom CI-812 ad struck my eye and I ordered the assembled board with remote control and test cassette (Table 1). My order arrived promptly; along with the board came a 40-page manual and a signal-level kit.

Hardware

The CI-812 is well designed and manufactured. I have had absolutely no problems with it and no component failures so far. It is made for the 8080 S-100 bus computer.

Although I purchased the assembled version, the assembly instructions were included, and I doubt anyone would have any difficulty putting it together. IC sockets are not provided or recommended by Percom unless purchased from them. The only construction required on the assembled board is the installation of the signal-level kit (a resistor and an LED) and the control and audio cables (not supplied) that go to the cassette recorder.

In addition to the cassette I/O that reads and writes tapes at 300, 600, 1200 or 2400 baud, an RS-232 compatible interface for a video terminal is provided (see "Who's Afraid of RS-232?" by Greg Pickles, *Kilobaud*, May 1977, p. 50). A simple adapter allows this to drive a 20 mil Teletype loop, also. The data rate of this interface can be strapped to 110, 300, 600, 1200, 2400, 4800, or 9600 baud. Although I haven't put the RS-232 interface to use yet, it is destined to bring my Selectric I/O to life.

Here are some of the features of the board that I particularly like:

1. Provision is made for an external monitor speaker to be connected to the board. It is nice to be able to hear what is going on when looking for trouble or trying to locate the beginning of a desired data file on the tape.

2. The signal-level kit is a joy! Start the tape, increase the volume control until the LED flickers, and you've set the playback level correctly.

3. The cassette record data rate can be set by an external switch, which I found most convenient.

4. A large area of the board is left over and can be used for modifications or additional ports as the need arises.

Factory wired, the CI-812 utilizes ports 0 and 1, but can be restrapped to use any two adjacent ports within the 8080's 256 possibilities.

I bought the remote control but found it to be of limited use. It will turn one or two recorders on or off under software control; however, this causes loss of manual control of the recorder unless I remove the remote control plug, and then I'm likely to forget to plug it back in again. Timing loops are required to allow the tape to get up to speed before reading or writing can take place. The manual quite frankly acknowledges the limitations in normal use.

Modification information is provided in case you want to interface a parallel keyboard, 110 baud Teletype or 134 baud Selectric.

My testing has shown that the average audio cassette is reliable at 300, 600 and 1200 baud, but that it takes a high-quality audio or digital tape to handle 2400 baud. A 300 baud tape can be loaded into memory and then dumped at 1200 baud to make for faster loading in the future. Keeping the original tape as insurance against accidental erasure or damage to the duplicate is a good idea.

The Manual and Test Cassette

The manual has sections on assembly, parts, schematics, modifications, theory and operation. It was written for the computer with front-panel switches and no resident operating system. The software provided consists of some test patterns at 300 and 1200 baud, a

checksum loader, and a complete micro operating system. If you have an operating system in PROM, you'd do just as well to pass up the test cassette.

The operating system has the following features: examine memory, change memory, load from tape, verify tape, dump tape, and execute program. Here is how it works: Enter the bootstrap loader via the front-panel switches; this loads the checksum loader from the tape, and this, in turn, loads the operating system. The routines (Programs A, B and C) included with this article can be entered from your keyboard if your computer already has an operating system.

Address	OP Code	Assembly Language	Remarks
C900	21 00 00	LXI 00 00	Start dump address
C903	DB 01	IN 1	Clear UART
C905	3E 03	MVI A 3	Select cassette mode
C907	D3 00	OUT 0	& set data rate
C909	DB 00	IN 0	UART ready ?
C90B	E6 80	ANI 80	
C90D	CA 09 C9	JZ C909	If not loop
C910	3E CB	MVI A CB	Output "CB"
C912	D3 01	OUT 1	(Block start)
C914	DB 00	IN 0	UART ready?
C916	E6 80	ANI 80	
C918	CA 14 C9	JZ C914	If not loop
C91B	7C	MOV A H	Output high order
C91C	D3 01	OUT 1	address
C91E	DB 00	IN 0	UART ready?
C920	E6 80	ANI 80	
C922	CA 1E C9	JZ C9 1E	If not loop
C925	7D	MOV A L	Output low order
C926	D3 01	OUT 1	address
C928	DB 00	IN 0	UART ready?
C92A	E6 80	ANI 80	
C92C	CA 28 C9	JZ C928	If not loop
C92F	7E	MOV A M	Output data byte
C930	D3 01	OUT 1	pointed by H & L
C932	FE DD	CPI DD	Is it "DD"? (Block end)
C934	CA 03 C0	JZ C003	If so exit
C937	23	INX H	Increment address
C938	C3 28 C9	JMP C928	Get another byte

Program A. A memory-to-cassette tape dump routine. Addresses C901 and C902 will determine the location where the dump starts. If you want to start dumping at address 1A09 (hex), then enter line C900 as 21 09 1A (low-order address first). First the characters CB are placed on the tape; the start dump address is output; and then the data contained in memory is dumped until the characters DD (end block indicator) are output, at which time the routine stops and an exit to the resident operating system is made. DD should be placed in memory at the end of any program or block of data that you intend to tape.

Difficulties

I expected to read the manual once or twice, plug in the board, enter a little software and start reading and writing tapes. It didn't quite work out that way! As I've mentioned, the software in the manual and on the test cassette does not take into account the computer that already has an operating system. In addition, it is designed to be located at C000 to C1FF, which is where my monitor PROM is sitting. So I decided to write my own.

For those who use the software provided with the CI-812, here is one fault that needs correction: There are two different ways to set the output-data rate for the cassette interface. It can be the same rate as that selected by an option strap for the RS-232 interface, or it can be selected separately with an external switch. Which of these two means is actually used is controlled by software.

If the RS-232 device is a video terminal, it would normally be set too fast to clock the cassette I/O; having a switch-selectable cassette data rate is more convenient, anyway. This point is well explained in the manual, but the software still uses the RS-232 rate for the cassette I/O. Once you figure out the problem, this is easily fixed.

Lines C905 and C907 in Program A select the cassette mode and the data rate that is set by the cassette data-rate switch. If I output 02 instead of 03, then the cassette data rate is the same as that strapped for the RS-232 interface.

Software

Fortunately, enough information is given in the manual to enable you to write your own dump and load tape routines,

CI-812 kit	$99.95
CI-812 assembled	129.95
IC socket kit	14.95
Remote-control kit	14.95
Test cassette	4.95

Percom Data Company
PO Box 40598
Garland TX 75042

Table. 1.

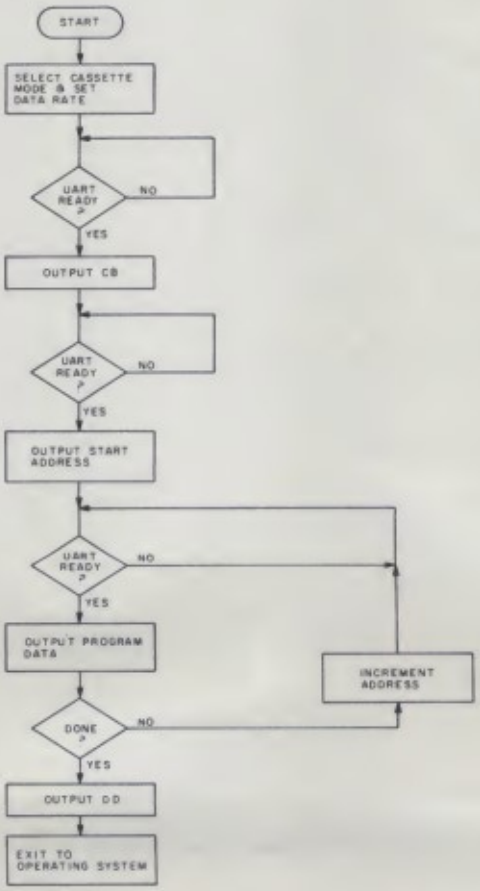


Fig. 1. Flowchart of the tape dump routine. Each symbol in the chart represents a block of assembly-language code. Compare the flowchart with the remarks in Program A to get a clearer picture.

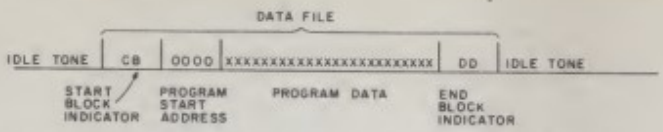


Fig. 2. A representation of how the start block indicator, program start address, program data and end block indicator appear on the tape. Before CB and after DD, the interface places a 2400 Hz idle tone on the tape. Ten to fifteen seconds of idle tone between programs on the tape makes it easier to separate them by ear with the monitor speaker.

as I did. Fig. 1 is the flowchart and Program A is the listing for my tape dump routine. The remarks column of the listing should be self-explanatory; the following information should also help.

These routines can be relocated, starting on any page boundary of memory, by replacing C9 each time it appears with the desired page number. For instance, to load these routines starting at 4000, replace C9 with 40.

Line C900 tells the routine where to find the first byte of the program that you wish to record on tape. Lines C905 and C907 select the cassette mode and set the data rate determined by the cassette data-rate switch. When the UART is ready, lines C910 and C912 record the hex characters CB on the tape. I call this my "start block indicator."

Next, C914 to C926 record the beginning address (in this case 0000) on the tape. C928 to C938 output the desired program data.

Each of my programs in memory ends with the hex characters DD. I call this my "end block indicator." When line C932 loads DD on the tape, the dump routine exits to my operating system, which gives control back to the keyboard. The data file on tape looks like Fig. 2. I chose CB and DD as my start block indicator and end block indicator, respectively, because they are not 8080-implemented operation codes and would not appear in the body of an assembly-language program.

Fig. 3 is the flowchart and Program B is the listing for my tape-load routine. C940 and C942 select the cassette mode and set the cassette data rate. (In this case, the rate is clocked by the data on the tape.) C94D, C94F and C951 keep looping until a CB is located; C95B and C95D load the high-order address byte into the H register, and C965 and C967 load the low-order address into the L register.

C96F to C978 enter the taped file into the memory pointed to by the H and L registers until DD is encountered. When this happens C974 exits to my operating system. You can write the exit in Program A and this program to any location that suits your purpose.

Fig. 4 is the flowchart of Program C, a tape-load routine intended to load tapes that do not contain CB or a load address. It normally starts with the first nonzero character but can be modified as indicated in the program caption. After being loaded with this program, a file can be dumped with Program A and then loaded with Program B from then on.

Implementation

In order to dump a program, the desired data rate is switch selected, the starting address of the program to be dumped is entered at C901 and C902, and the recorder started. After it has run for a few seconds, the command Execute (or run) C900 will record the program on tape. When the exit to the operating system is made (mine puts the cursor back on the video screen

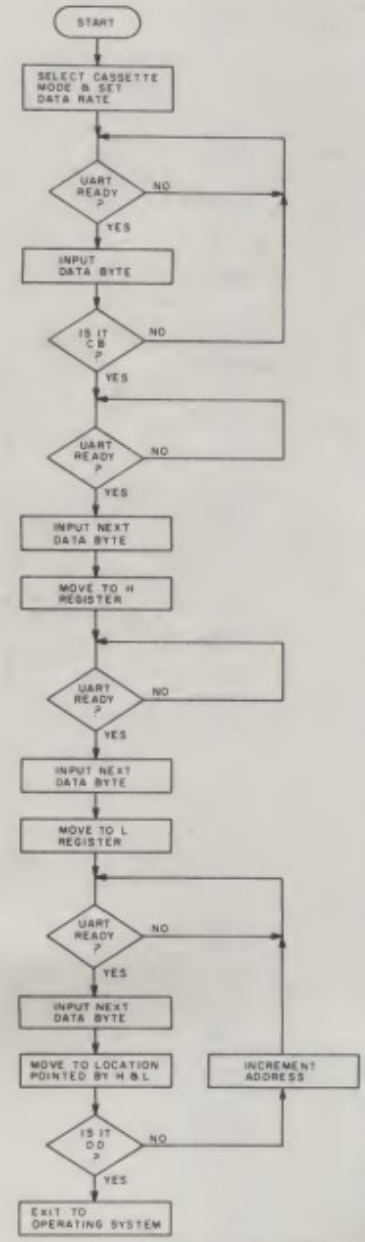


Fig. 3. Flowchart of the tape load routine listed in Program B.

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Address    OP Code        Assembly        Remarks
                          Language

C94Ø       3E Ø1          MVI A Ø1          Select cassette mode
C942       D3 ØØ          OUT Ø             & set data rate
C944       DB Ø1          IN 1            Clear UART
C946       DB ØØ          IN Ø              UART ready?
C948       E6 4Ø          ANI 4Ø
C94A       CA 46 C9       JZ C946         If not loop
C94D       DB Ø1          IN 1            INput byte
C94F       FE CB          CPI CB          Is it CB? (start block)
C951       C2 46 C9       JNZ C946        If not loop
C954       DB ØØ          IN Ø              UART ready?
C956       E6 4Ø          ANI 4Ø
C958       CA 54 C9       JZ C954         If not loop
C95B       DB Ø1          IN 1            Input high order address
C95D       67             MOV H A         Move to H register
C95E       DB ØØ          IN Ø              UART ready?
C96Ø       E6 4Ø          ANI 4Ø
C962       CA 5E C9       JZ C95E         If not loop
C965       DB Ø1          IN 1            Input low order address
C967       6F             MOV L A         Move to L register
C968       DB ØØ          IN Ø              UART ready?
C96A       E6 4Ø          ANI 4Ø
C96C       CA 68 C9       JZ C968         If not loop
C96F       DB Ø1          IN 1            Input data byte
C971       77             MOV M A         Move to memory
C972       FE DD          CPI DD          Is it DD? (end block)
C974       CA Ø3 CØ       JZ CØ Ø3        If so exit
C977       23             INX H           Increment address
C978       C3 68 C9       JMP C968        Get another byte
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Program B. A tape-to-memory loading routine. This routine will read the tape until it finds the characters CB (start block indicator); it will place the next two bytes into the H and L registers; then load data starting at the address pointed to by H and L. It will continue to load until it reads the characters DD (end block indicator), at which time it stops reading and exits to the resident operating system.

Address	OP Code	Assembly Language	Remarks
C98Ø	21 ØØ ØØ	LXI H ØØØØ	Start load address
C983	3E Ø1	MVI A Ø1	Select cassette mode
C985	D3 ØØ	OUT Ø	& set data rate
C987	DB Ø1	IN 1	Clear UART
C989	DB ØØ	IN Ø	UART ready?
C98B	E6 4Ø	ANI 4Ø	
C98D	CA 89 C9	JZ C989	If not loop
C99Ø	DB Ø1	IN 1	Input byte
C992	FE ØØ	CPI ØØ	Is it ØØ?
C994	CA 89 C9	JZ C989	If so loop
C997	77	MOV M A	Move to memory
C998	DB ØØ	IN Ø	UART ready?
C99A	E6 4Ø	ANI 4Ø	
C99C	CA 98 C9	JZ C998	If not loop
C99F	23	INX H	Increment address
C9AØ	DB Ø1	IN 1	Input data byte
C9A2	77	MOV M A	Move to memory
C9A3	C3 98 C9	JMP C998	Get another byte

Program C. A cassette-to-memory loader intended to load tapes that do not contain CB (start block indicator) or load address. This routine will read the tape until it finds the first nonzero byte and then start loading at the address indicated in line C980. If you have a listing of the program and know the first byte to be loaded, enter that byte at C993 and change C994 to C2 (JNZ). Now the routine will read until it finds the indicated byte, and then start loading.

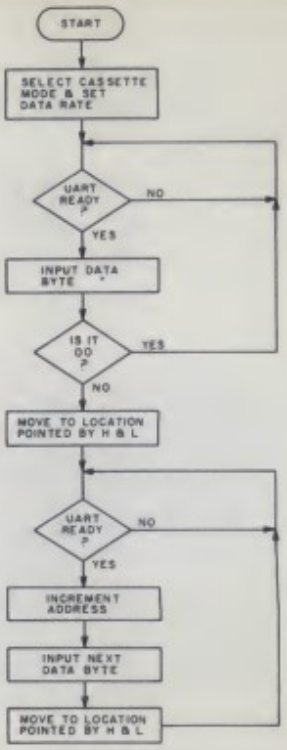

Fig. 4. Flowchart of Program C. Since the data file does not contain an end block indicator, no exit is provided for. The program is run until you hear the end of the file in the monitor speaker; then the computer is reset to end the program execution.

as an indicator), stop the tape.

When a tape is loaded with Program C, an automatic exit will not be made at the end of a file, and it is necessary to monitor the tape and push the reset button when the file has been loaded. Don't forget to write down the tape counter reading on the cassette recorder so you can find any particular file easily.

To load from tape to memory, set the data-rate switch to the rate that was used in recording, find the program on the tape if there is more than one, start the tape five to ten seconds before the beginning of the file, and command Execute C940. The routine will load all data on the tape between CB and DD into the memory locations from which it originally came.

Instead of using CB as a start block indicator for all files on a single tape, each file could have a distinctive start block indicator that would allow the load routine to find the desired file by itself. However, this is slow; it is much easier and faster to move the tape to the beginning of the file before executing the load routine.

Conclusion

Not too much has been said in this article about the RS-232 interface; not too much is said about it in the manual either. With a borrowed modem, I determined that it works properly and that I will have to develop some software in order to use it with my Selectric. I plan to pass along this information in a subsequent article.

Despite what I feel are shortcomings in the manual and software provided, I still think that the CI-812 is a good buy. It has been dependable, and, with the routines just discussed, it has given me what I was looking for when I first went shopping for a cassette interface board.■