The Peak 68K8-CP

by Dave Hardy & Ken Jackson

Peak Electronics' 68K8-CP Coprocessor card offers the S-100 user a fast and painless way to upgrade to the world of high-speed, high-powered multi-processing. Using the MC68008 (8-bit bus version of the 68000) processor at 8 or 10MHz, the IEEE-696 compatible 68K8-CP can be installed in just about ANY S-100 system in less than five minutes, and will coexist with that system's current processor.

Software provided with the 68K8-CP allows the user to switch between the system's original processor and the 68000 with just a simple command, and full source for the board's firmware is available for those users who prefer to "roll their own" operating systems.

THE HARDWARE

The 68K8-CP is a standard single-height S-100 board, well made, solder-masked, silk-screened, and fully socketed. A spare DIP socket is available for those who wish to perform any circuit modifications. All options are either switch or jumper selectable, so no soldering is necessary for user configuration.

Naturally, the 68K8-CP is fully IEEE-696 compatible (after all, Peak's president, Don Pannell, is one of the authors of the IEEE-696 standard), including the ability to do full bus arbitration and act as an IEEE-696 temporary bus master.

Communication between the master processor and the 68K8-CP is performed via two S-100 ports that provide the ability for the two processors to exchange commands and status information. This is really the key to the operation of the 68K8-CP. Each processor can talk to the other via this simple I/O interface for commands and status, but the 68K8-CP actually takes over the S-100 bus (via its TMA ability) to perform data transfers, or use other S-100 bus resources. Because the

An easy-to-install 68000 S-100 Co-processor card

IEEE-696 standard allows for up to 16 processors to exist on a single S-100 bus in this manner, it is actually possible for up to 16 68K8-CP's to live in a single S-100 frame.

Our 68K8-CP came "out of the box" with 8K of ROM and 128K of RAM on board, and with an 8MHz clock, although other configurations are available, as mentioned above. The documentation provided gives information on configuring the board for several different types of EPROMS and RAMS, and even gives information for reconfiguring the addressing PLA. Interestingly, in spite of the 8 or 10MHz clock speed, no wait

Features:
  Works as a temporary bus master with full bus arbitration and TMA ability
  MC68008 8 or 10MHz CPU
  Fully IEEE-696 compatible
  128K on-board RAM, expandable to 512K
  8K on-board EPROM, expandable to 128K
  Two on-board serial ports (requires daughter boards)
  On-board parallel printer port and sense switch
  Polled or interrupt-driven port communication with master processor (used only to S-100 I/O ports)
  Eleven on-board interrupts
  On-board timer
  Easy to configure for most S-100 systems

states are needed for any of the on-board RAM or EPROM.

The serial I/O, timer, and on-board interrupt handler are all contained in the same versatile IC, an MC 68681 DUART, which requires only the addition of RS-232 or current-loop driver (daughter) boards, if serial I/O from the 68K8-CP is desired.

The parallel printer port is actually just a simple latched output port with strobe and acknowledge lines. The input port at the same address serves as the sense switch input that is used at power-up to read configuration information into the 68K8-CP.

THE SOFTWARE

The 68K8-CP is currently available with software to allow the user to boot directly from CP/M 2.2 into CP/M 68K, although a proficient 68000 programmer could program the board to do most anything else, since it is basically an S-100 peripheral device. In fact, the manual gives several ideas for alternate uses of the 68K8-CP, including a numeric processor, and a high-speed data buffer. Although they were not ready at the time of this writing, 68K8-CP firmware is also available for use as a printer buffer and a RAM disk.

We were impressed with the implementation of CP/M-68K, especially due to the fact that the CP/M-68K system could be loaded and executed from CP/M 2.2 with just a single command. Eight single-density 8" standard CP/M format disks are provided with the 68K8-CP, along with a demo disk that contains some simple "C" programs and a benchmark program. (Because the 68K8-CP uses the host system's disk drivers after it boots up, it can read any disk that the host system can read, so transferring data files from CP/M-80 to CP/M 68K requires no additional work at all.)

Disk #1 is the CP/M 68K boot disk,

which contains all of the files necessary to run CP/M 68K, along with the files "CPM68K.COM" and "RETURN.68K," which are used to boot CP/M 68K from CP/M-80 and to return to CP/M-80 from CP/M 68K. All of the usual CP/M utilities are present with CP/M 68K, like STAT, DDT, ASM, etc., along with a few new ones. Not surprisingly, the BIOS is written in "C."

DOCUMENTATION

The 68K8-CP comes in a ring-binder containing four separate parts: the Introduction, the Hardware manual, the Software manual, and the Firmware manual.

The introduction section comes with two very important pieces of information. First, it lists the factory-shipped configuration and serial number of the 68K8-CP. Second, and most importantly, it contains a one-page mini-manual called "How to bring up your new 68K8-CP card in 5 minutes." We tried it, and it works, except that it actually takes only about 3 minutes if you have already removed the cover from your S-100 machine.

The Hardware manual is a complete little book about the 68K8-CP, including an overview of the entire board, precise explanations about how the board works and how to configure it, appendices, an index, and complete schematics. Also included are instructions on how to set up the 68K8-CP for use in older non-IEEE-696 S-100 machines.

The Software manual is only about 10 pages long (any source listings provided are on the floppy disks), and briefly covers how to use the CPM68K.COM program and how to set up a system configuration file.

The Firmware manual was not yet available at the time of this review.

INSTALLATION

In most cases, installation of the 68K8-CP should take only a few minutes. We installed the board in more than a dozen different S-100 machines with virtually no trouble at all. As shipped from the factory, the board is set up to use S-100 I/O ports 0C0H and 0C1H for data and status exchange, but it is easily reconfigurable to any other port addresses by just changing a few switch settings and editing the system configuration file to indicate the new port addresses.

Our technical staff took great delight in plugging the 68K8-CP into every S-100 machine it could find, including everything from dinosaur IMSAI's to multi-processor TurboDos-based frames, and never had
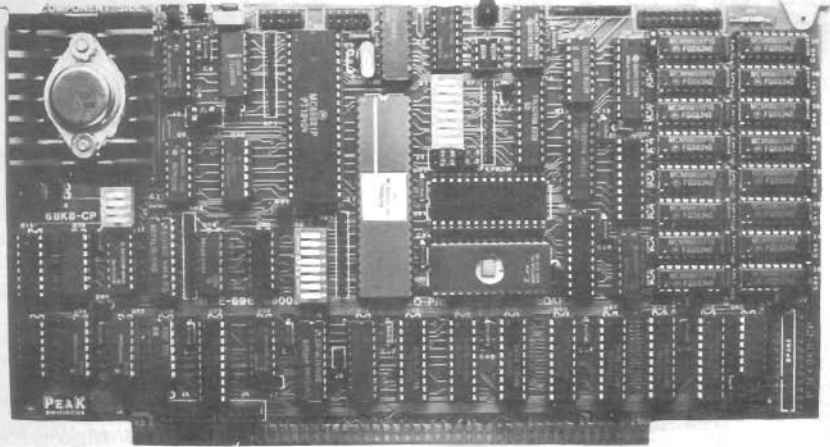
ANY problems at all. The 68K8-CP contains nine user configurable jumpers and three user configurable switches, although it can usually be installed using factory settings. The user configurable jumpers are:

J1 - Wait States for RAM, EPROM or I/O

J2 - Type of parallel I/O IC used (74LS374 or 74LS273)

J3 - Off-board RAM paging size

J4 - EPROM type (2764, 27128, 27256, 27512)

J5 & J6 - S-100 Vectored Interrupt number (VI0-VI7, NMI*, INT*)

J7 - Ground/CPU DSB for use with older front-panel machines

J8 - pSTVAL* transfer disable (for old non-IEEE-696 machines)

J9 - sM1 disable (for old non-IEEE-696 machines)

The user configurable switches are:

S1 - 8-bit sense switch (used to determine serial I/O speed at boot-up)

S2 - 4-Bit TMA priority number (needed for bus arbitration)

S3 - S-100 I/O address

TESTS

Our usual benchmark tests were of little use with the 68K8-CP, since they are meant primarily for testing other processors in stand-alone configurations. However, we did duplicate the manufacturer's tests (using the Sieve of Erotosthenes "C" language benchmark provided), and the results were:

68K8-CP @ 8MHz: 32 seconds
Z80 @ 4MHz: 141 seconds

These results are largely meaningless, except they do demonstrate the 68000's increased efficiency. The 68K8-CP could yield some very attractive time savings in a system that could off-load number-crunching from a Z80 master processor.

CONCLUSION

The 68K8-CP is a fast and easy way to expand an existing S-100 system into a multiprocessing machine, or at least a painless way to bring up a powerful 68000-based system. Although the 68K8-CP is currently only available with CP/M 68K, other operating systems (like UNIX) are almost certainly going to be available in the future.

The price of the 68K8-CP with an 8MHz CPU and 128K of RAM is $995. The 10MHz version with 512K of RAM costs $1545, and various other configurations are available. CP/M 68K is available for $350, and source code for the 68K8-CP programs is available for an additional $50 with the purchase of a board.

For more information, contact:

Peak Electronics
Box 700112
San Jose, CA 95170