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Computer/Controller Technical Manual

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6. Micromint Inc. reserves the right to alter any feature or specification at any time. This right extends to fees, charges, and any other conditions or warranties contained herein.

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Introduction

The Micromint BCC180 is a single-board computer/controller featuring a new-generation 8-bit microprocessor which maintains software compatibility with the Zilog Z80 while incorporating advanced design features in a single 68-pin PLCC package. Configured primarily for process control, the BCC180 uses the same 44-pin BCC I/O expansion bus as Micromint's popular BCC52 controller board. All of Micromint's BCC-bus peripherals are compatible with the BCC180.

The BCC180 ROM monitor provides the system designer with a host of low-level development aids while the BASIC-180 multitasking BASIC compiler speeds high-level development of lightning-fast code right on board.

BCC180 Technical Specifications

* Hitachi HD64180 microprocessor running at 9.216 MHz
  Supports a superset of the Z80 instruction set
* Up to 384K bytes total memory on-board (128K EPROM or static RAM, 256K dynamic RAM)
* Two asynchronous serial ports (both support RS-232, one supports RS-422/485)
* One clocked (synchronous) serial port
* Six 8-bit parallel I/O ports (48 bits)
* 64K I/O space available through the BCC-bus edge connector
* On-board memory management unit, 2-channel DMA controller, 2 counter-timers, and 12 interrupt sources
* Requires just +5V (±12V necessary for RS-232 operation only)
* Accepts optional EPROM programmer daughter board for programming 27x256 EPROMs

Setting Up Your BCC180

Very few connections are required to bring up a functional BCC180 development system. Depending on your application, you may or may not want to connect a printer. Simply skip that step if it doesn't apply.

Power

The BCC180 requires the following voltages and current:

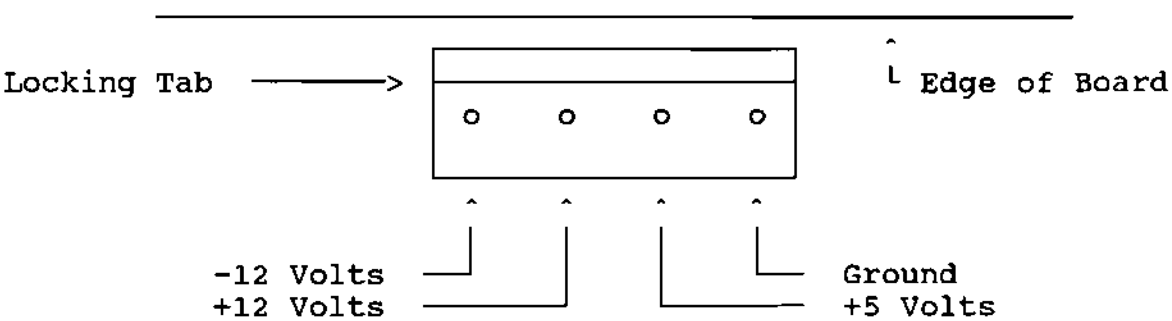
+5V ±5% @ 750 mA (fully populated)
+12V ±20% @ 30 mA
-12V ±20% @ 30 mA

* -5V may be substituted for -12V if nonstandard RS-232 operation is acceptable and -12V isn't required for use by any other board on the bus.

* ±12V are used on the BCC180 for RS-232 only. If no serial communication is to be used or TTL serial is performed through the BCC bus, and ±12V aren't necessary for any other board on the bus, then the two supplies can be eliminated and the system can be run on +5V only.

Power can be connected to the BCC180 in one of two ways: through power connector J4 or through the BCC bus.

A 4-pin Molex-type plug that mates with J4 has been included with your BCC180. The following top view of J4 should be used to properly connect the plug to your power supply. **Be sure to double check your connections before applying power to the BCC180! Boards damaged by incorrect power connections are not covered under warranty.**



J4

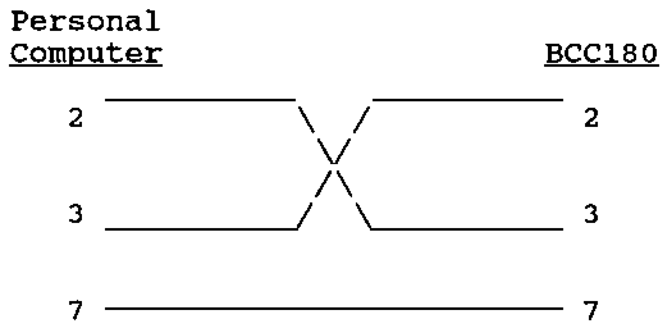
If you plan to plug your BCC180 into a backplane, power should be supplied to the board (and the rest of the boards on the bus) through the power pins on the bus. Motherboards available from Micromint use the same type of power connector as that shown above. The same procedure and cautions should be used to connect your power supply to the backplane.

When plugging the BCC180 and other BCC boards into the backplane, be sure the "A" and "Z" markings on the component side of the board match up with the "A" and "Z" markings on the motherboard. **Plugging a board into the bus backwards may damage the board. A board damaged by plugging it into the bus backwards is not covered under warranty, so exercise appropriate care.**

Terminal

Any standard RS-232 serial terminal can used as a console device for the BCC180. Alternatively, a personal computer using communication software and a serial port can be used as a console device.

The BCC180 has a standard DB-25S connector used to connect with the console device. If a terminal is being used, a straight-through DB25-to-DB25 cable can be used to connect the terminal to the BCC180. If a personal computer is to be used, a swap or "null modem" cable often must be used. The minimum requirements for this cable are that pins 2 and 3 should be swapped and pin 7 should pass straight through. The following diagram shows this minimum cable:



Please refer to the "Serial I/O" section later in this manual if your terminal requires additional handshaking lines.

The BCC180 monitor will automatically detect the baud rate being used by the terminal as long as it's one of the following: 19200, 9600, 2400, 1200, or 300. We recommend setting your terminal for 9600 bps until your system is set up and working. Additionally, be sure your terminal (or communication software) is set up with the following parameters: 8 data bits, 1 stop bit, no parity, and CR (not CR/LF) generated when "Return" is pressed. If your terminal doesn't allow parity to be turned off, 7 data bits and space (clear) parity should also work.

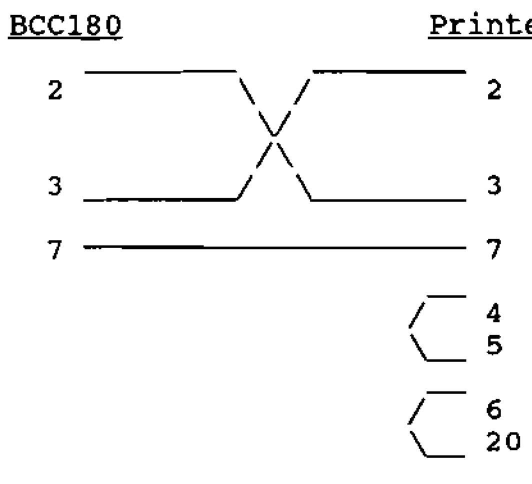
Printer

The BCC180 supports a serial printer at baud rates up to 19200 bps and will support software (XON/XOFF) handshaking. The default printer baud rate used by the BCC180 monitor is 9600 bps. See the BCC180 monitor manual for information on how to change this to another baud rate (both temporarily and permanently).

Serial printers are all different in the type of RS-232 connection they require. Some need just one data line plus ground, while others may need elaborate handshaking connections. We will attempt to show one common setup here. However, it is inevitable that this won't work with some printers. Consult the printer's manual and do some experimenting before giving up. A serial breakout box is invaluable in getting a stubborn serial connection to work. Alternatively, there are smart cables available from many computer stores and mail-order companies that look at both ends of the connection and automatically decide which pins should be connected.

Micromint has available a short cable (P/N SB180-AUX-MOD) that goes from the 20-pin Berg-type header (J3) on the BCC180 to a standard DB-25P connector. The connections shown below assume this DB-25P connector is present. If you don't have the proper adapter cable, please refer to the "Serial I/O" section later in this manual for the pinout of J3.

The following is a recommended cable configuration for connecting a serial printer to the BCC180:



Remember that hardware handshaking is not supported, so the printer's Busy output (normally pin 11) doesn't have to be connected to anything.

Powering it up

Once everything has been connected, double check all the connections. Turn on the power to the terminal and the printer (if connected). Once the terminal is warmed up, turn on the power to the BCC180. If the terminal is set up for 9600 bps and everything is connected properly, the string "BCC180" should be displayed on the terminal screen. Press "Return" once or twice and the monitor banner should come up on the screen. Your BCC180 system is now working. You should now refer to either the BCC180 monitor manual or (if BASIC-180 is installed) the BASIC-180 manual for instructions on how to proceed.

If your terminal is set for something other than 9600 bps, you should get a few garbage characters on the screen when you first apply power to the BCC180. This is what "BCC180" transmitted at 9600 bps looks like at whatever baud rate you're using. Pressing "Return" once or twice tells the BCC180 what baud rate you're really using and the monitor banner should come up as described above, but at the baud rate you're using.

If "BCC180" isn't displayed when power is applied, or there is no response to repeated presses of the "Return" key, press the BCC180's reset button (PB1) and try again. If there is still no response, check all connections once again including the power and terminal cables. If you still can't get your BCC180 to respond, you may call our technical support staff at (203) 871-6170.

BCC180 Hardware

The hardware on the BCC180 can be broken into three sections: the HD64180 microprocessor, memory, and I/O. Each of these sections will be discussed in turn.

HD64180 Processor

The power of the BCC180 is made possible by the Hitachi HD64180--a microcoded execution unit based on advanced CMOS manufacturing technology. It provides the benefits of high performance, reduced system cost, and low-power operation while maintaining compatibility with the large base of industry-standard 8-bit software.

Performance is derived from a high clock speed, instruction pipelining, and an integrated Memory Management Unit (MMU). The instruction set is a superset of the Z80 instruction set; twelve new instructions include hardware multiply, bit comparisons, and a SLEEP instruction for low-power mode.

Compared with the Z80 in the same way the 80188 is compared with the 8088, system costs are reduced because many key system functions have been included on-chip. Besides the MMU, the HD64180 boasts a two-channel Direct Memory Access Controller (DMAC), wait-state generator, dynamic-RAM refresh, two-channel Asynchronous Serial Communication Interface (ASCI), Clocked Serial I/O (CSIO), two-channel 16-bit Programmable Reload Timer (PRT), a versatile 12-source interrupt controller, and a "dual" (68xx and 80xx families) bus interface, all on one 68-pin chip.

The HD64180 comprises five functional blocks:

- o Central Processing Unit: The CPU is microcoded to implement an upward-compatible superset of the Z80 instruction set. Besides the twelve new instructions, many instructions require fewer clock cycles for execution than on a standard Z80.

- o Clock Generator: The clock generator produces the system clock from an external crystal or external clock input. The clock is programmably prescaled to generate timing for the on-chip I/O and system support devices.

- Bus State Controller: The bus state controller performs all status/control bus activity. This includes external bus cycle wait-state timing, RESET\, DRAM refresh, and master DMA bus exchange. It generates "dual" bus-control signals for compatibility with both 68xx and 80xx family devices.

- Interrupt Controller: The interrupt controller monitors and prioritizes the four external and eight internal interrupt sources. A variety of interrupt response modes are programmable.

- Memory Management Unit: The MMU maps the CPU's 64K-byte logical address space into a 1-Megabyte physical address space. The MMU organization preserves software object code compatibility while providing extended memory access and uses an efficient "common area/bank area" scheme. I/O accesses (64K-port I/O space) bypass the MMU.

The integrated I/O resources make up the remaining four functional blocks:

- Direct Memory Access Controller: The two-channel DMAC provides high-speed memory-to-memory, memory-to-I/O, and memory-to-memory-mapped I/O transfer. The DMAC features edge- or level-sense request input, address increment/decrement/no-change, and (for memory-to-memory transfer) programmable burst or cycle-steal transfer. In addition, the DMAC can directly access the full 1M-byte physical address space and transfers (up to 64K bytes in length) can cross 64K-byte boundaries.

- Asynchronous Serial Communication Interface: The ASCI provides two separate full-duplex UARTs and includes a programmable baud rate generator, modem control signals, and a multiprocessor communication format. The ASCI can use the DMAC for high-speed serial data transfer, reducing CPU overhead.

- Clocked Serial I/O Port: The CSIO provides a half-duplex clocked serial transmitter and receiver. This can be used for simple, high-speed connection to another microprocessor or microcomputer.

- Programmable Reload Timer: The PRT contains two separate channels, each consisting of 16-bit data and 16-bit timer reload registers. The timebase is divided by 20 (nonprogrammable) from the system clock and one PRT channel has an optional output allowing waveform generation.

Note: The HD64180 Microprocessor Data Book is available from Micromint for $10 plus shipping.

Memory

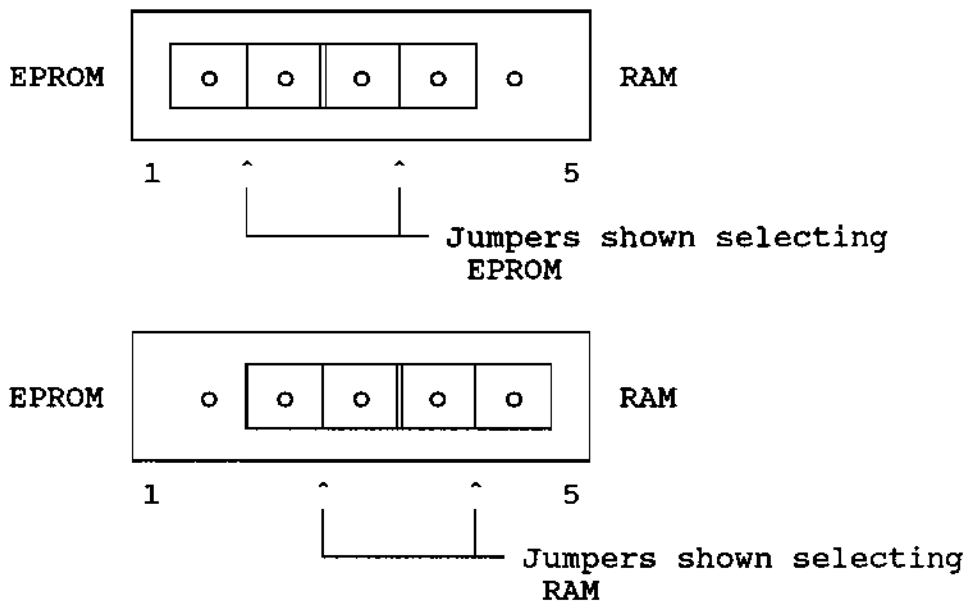
The BCC180 allows the use of up to 384K bytes of memory on the main board. Unfortunately, it isn't easy to expand the memory past this point. The BCC bus is only 16 bits wide and would only allow access to 64K bytes of memory. For this reason, the BCC bus is strictly an I/O bus and all system memory must be on the processor board.

EPROM/Static RAM

There are four 28-pin sockets on the BCC180 board (U10-U13), each of which can accommodate either a 27256 (27C256) EPROM or a 62256 static RAM chip. Both types of chips contain 32K bytes of storage and are the only kinds of memory that will work. It isn't possible to use, say, a 27512 EPROM.

The 5-pin jumper header next to each socket determines whether an EPROM or a RAM chip is installed in that socket. When there is one jumper between pins 1 and 2 and a second jumper between pins 3 and 4, that socket is set for EPROM operation. To use the socket with a RAM chip, the jumpers must be moved so they connect pins 2 and 3 and pins 4 and 5. The BCC180 is shipped from the factory with U10 (JP6) set up for EPROM operation and U11-U13 (JP7-JP9) set up for RAM operation. The following shows how these jumpers are set up:

JP6-JP9



The first socket (U10) is mapped to physical address 00000H. Each socket is mapped in 32K-byte increments above that. For example, the second socket (U11) is at physical address 08000H and the third socket (U12) is mapped to 10000H. It is up to whatever program is running to determine how the HD64180's memory management unit (MMU) maps the logical address space into the physical address space.

The default configuration of the BCC180 monitor maps the entire first socket to the first 32K bytes in the logical address space. The other 32K bytes of space is mapped to U13. See the monitor manual for more details about changing active banks while in the monitor and the HD64180 data book for details about configuring the on-board MMU under program control (specifically, the CBAR, CBR, and BBR registers).

NOTE: A 32K-byte 62256 static RAM chip must be installed in socket U13 in order for the BCC180 monitor and the ROM-based version of BASIC-180 to function properly.

Dynamic RAM

In addition to the EPROM and static RAM space provided on the BCC180, there is also provision for using a 256K-byte dynamic RAM SIMM (Single In-line Memory Module). Either an 8-bit or a 9-bit module may be used. While the SIMM socket provided on the BCC180 will allow a 9-bit SIMM to be used, the ninth bit is ignored.

The SIMM is mapped to physical address 40000H and continues through address 7FFFFH. As with the EPROM/static RAM, it is up to the program running on the machine to determine the setup of the MMU.

Wait States

The HD64180 processor has, among other things, an on-board wait-state generator. It's possible to set anywhere from 0 to 3 memory wait states and from 0 to 4 I/O wait states. Memory wait states are dealt with in this section. See the "Input/Output" section for I/O wait state details.

EPROMs and static RAM chips rated for an access time of 150 ns or better can be used with zero memory wait states on a 9.216-MHz BCC180. Memory chips slower than this will need wait states. EPROMs with 200-ns access times need one wait state. <u>The BCC180 monitor defaults to two memory wait states to allow for slow EPROMs.</u> See the BCC180 monitor manual for details on how to change this default.

The same applies for the dynamic RAM. SIMMs with RAM chips rated for 120-ns or faster access times can be used on a 9.216-MHz BCC180 with zero wait states. <u>However</u>, an exception to this must always be kept in mind! Whenever the HD64180 fetches