BCC40R & BCC40D
Technical Manual

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Micromint, Inc.
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Caution About Switching Inductive Loads

When using the BCC40x to switch inductive loads (motors/relays) it is possible for the load to produce high EMF which can cause Electromagnetic Interference. This high current short duration noise may induce false latching on the LOGIC side of the switches. A snubbing network across the contacts may be necessary to prevent false triggering.

Start with a 15 ohm resister in series with a 0.1 ufd capacitor across the switch contacts. Adjust these values according to the size of the load you are switching.

For example, if you have a motor or solenoid connected across the Normally Open and the Common contacts of STB1 on the BCC40R, then place the series resister capacitor network across the same contacts. Additional protection may be necessary at the load in cases of extreme EMI.

An alternate solution would be to use a remote relay controlled by the BCC40x. With this method, large currents will be concentrated remotely and not affect the system.

It is suggested the BCC40D be used in applications of inductive loads.

Engineering Department

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Introduction to I/O Control

In critical control situations, more than simple on/off activation is required. Frequently, both the actions and the results must be monitored to produce reliable control conditions.

One of the prime components of any "real world" interface is discrete bit AC/DC power input and output. This is on/off control and monitoring of 115 VAC or 5-48 VDC devices. With an AC/DC Power I/O interface, we can control and monitor motors, lights, HVAC systems, and process control and monitoring devices.

What is a Discrete Bit AC/DC POWER-I/O Interface?

Generally speaking most computers are parallel in function, processing a byte (8 bits) of information at a time. A parallel printer for example, receives its character data as a 7 or 8 bit parallel word and sends its status and operating conditions back in a similar manner.

The majority of peripherals presently connected to your computer use all 8 bits at a time because they are most often communicating 8 bit data or ASCII characters. Externally connected devices such as a light and a thermostatically controlled switch are single bit devices. However, since the internal function of the computer is word rather than bit wide, each bit of the 8 bit word is used to separately receive or control an external event (If it were a 16 bit computer such as the 68000, there would be 16 discrete bits of I/O) per word.

Within the computer, one or more memory locations are set aside and address decoded as parallel I/O ports. If configured for output, each of the bits on the port(s) is then connected to a discrete module that converts the TTL logic level presented to it to a high/low on/off voltage level output. If the module is for AC control it will be 115 VAC on/off. DC output modules function as simple contact closures with the voltages dependent upon the application.

When the addressed location is an input port, each bit is attached to an input receiver that converts a high voltage input level to a TTL logic 1 and a low voltage input to a logic 0. The exact range and switch point of the module has to be selected for the application and there are differences depending whether the applied voltage is AC or DC.

With a single parallel input and output location, 8 separate devices can be controlled and 8 discrete events monitored. To properly coordinate the activity, bit rather than word manipulation becomes essential.

Isolation is the Key Ingredient

The I/O modules provide level conversion and isolation between the computer and the external device. Depending upon the components employed, I/O interfacing need not be a prodigious task.

The most important factor in I/O interfacing, especially with AC line voltages, is isolation. The BCCxx series Microcontrollers operate on 5 volts (using +/- 12 volts for RS232 communication.) If 115 VAC is applied to an un-isolated input port, you are definitely going to produce smoke! High voltage inputs must be safely converted to 5 volts and output devices must have no way to inadvertently feed 115 VAC back into the computer.

The simplest isolation device is the electromechanical relay. A reed relay can be easily attached to each output bit and the isolated contacts used to switch the AC line. Similarly, the external voltage can be connected to a relay whose contacts are attached to an input bit. When the input level is high enough (determined by series resistors) the contacts close and the computer senses the condition.

There is nothing wrong with using relays. For many years, this was the only method available and it still works. Most relays are slow, electrically noisy, and subject to wear. Today many have been replaced with solid state opto-electronic components which are small, cheap, fast, optionally noiseless, and have no wear in proper use.

Micromint's BIT/BYTE POWER-I/O Expansion Boards

Micromint offers three BIT I/O boards to compliment its line of peripherals for the BCC BUS.

The <u>BCC40R</u> **memory mapped** RELAY output board controls 8 mechanical relays accessible through the BCC BUS. Each relay is rated for 1/10HP @120VAC and 3A @30VDC or 120VAC resistive.

The <u>BCC40D</u> **memory mapped** OPTO-ISOLATED input/output board permits a mixture of 8 I/O (industry standard) modules directly accessible through the BCC BUS.

The <u>BCC40M</u> **multiplexed** OPTO-ISOLATED input/output board is selectable for either 8 input modules or 8 output modules. Up to 8 BCC40Ms as input boards and 8 BCC40Ms used as output boards are **driven through a separate I/O BUS** by one 8255 PIA. **NOTE: The BCC40M is not recommended for new designs. Please refer to Micromint's AC/DC I/O Manual for further information.**

<u>BCC40R</u>

8-Channel Mechanical Relay Output Board
Overview

The BCC40R is memory mapped into the BCCxx Address space. Jumper selections on the BCC40R allow it to be accessed at one of 16 Base addresses. Normally open relay contacts are provided for all 8 relays. In addition, the first 4 relays have both, normally open and normally closed, contacts available. The BCC40R plugs into the BCC BUS and receives control from a BCCxx processor board driving the BCC BUS. All user connections are made to the BCC40R through wire captivating screw terminal blocks mounted along the top edge of the board.

Each relay on the BCC40R has a red LED to indicate when the relay is energized. A glowing LED means the relay is energized.

The BCC40R can be RESET. Reseting insures all relays are de-energized. Reset is accomplished automatically upon system RESET or POWER-UP. In addition, a WRITE or READ to the Base address + 8 provides a <u>software reset</u> of the BCC40R.

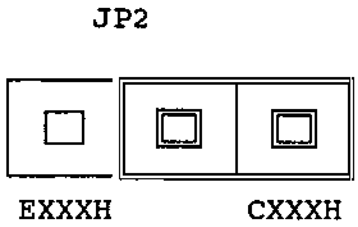
The BCC40R relays can be addressed in one of two ways.

SEPARATE BIT/RELAY MODE. This is the stock configuration of the BCC40R as it comes from the factory. In this configuration each relay is controlled by a bit in the byte written to the BCC40R. One write controls all relays. The byte value must be calculated by taking into account the appropriate state of each relay. Relay1 is controlled by D0, relay2 by D1,etc.

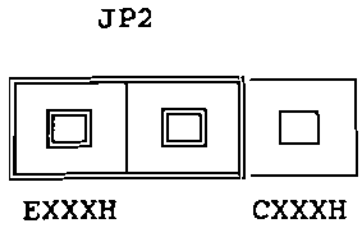
SEPARATE ADDRESS/RELAY MODE. In this configuration each relay requires a separate write to turn it on or off (each Relay is at its own address.) Relay1 is controlled by D0 of address Base + 0, relay2 by D0 of address Base + 1, etc.

Hardware

The BCC40R has a 44 pin edge card connector designed for use with any BCCxx processor and MBxx mother board. U1 and JP2 are used to select A13 or *A13 as an input which is ANDED with A14 and A15 by U2. The output of the AND gate is low for either address CxxxH (if *A13 is selected on JP2) or address ExxxH (if A13 is selected on JP2). This output, along with A11 and *A12 is used to enable U5, a 3 to 8 line decoder. Address line A8, A9 and A10 are decoded by U5 when the decoder is enabled. Decoded outputs available for selection at JP3 are:



JP2 shown selecting CXXXH



JP2 shown selecting EXXXH

When JP2 selects CxxxH

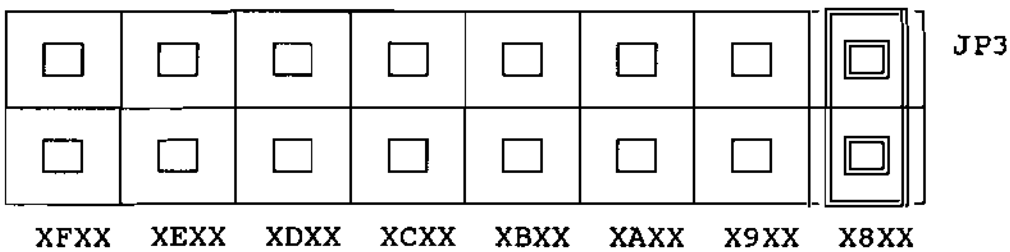
JP3 selects

C8xxH
or
C9xxH
or
CAxxH
or
CBxxH
or
CCxxH
or
CDxxH
or
CExxH
or
CFxxH

When JP2 selects ExxxH

JP3 selects

E8xxH
or
E9xxH
or
EAxxH
or
EBxxH
or
ECxxH
or
EDxxH
or
EExxH
or
EFxxH



JP3 shown selecting an offset address of X8XX (800H)

The selected BASE address from JP2 & JP3, along with DS (DATA STROBE), enable a second 3 to 8 line decoder U6, unless a READ is being executed. U6 decodes the states of A0, A1 and A2 into 8 OFFSET addresses.

Example:

When JP2 selects CXXXH and JP3 selects X8XX
(= total Base address of C8xxH)

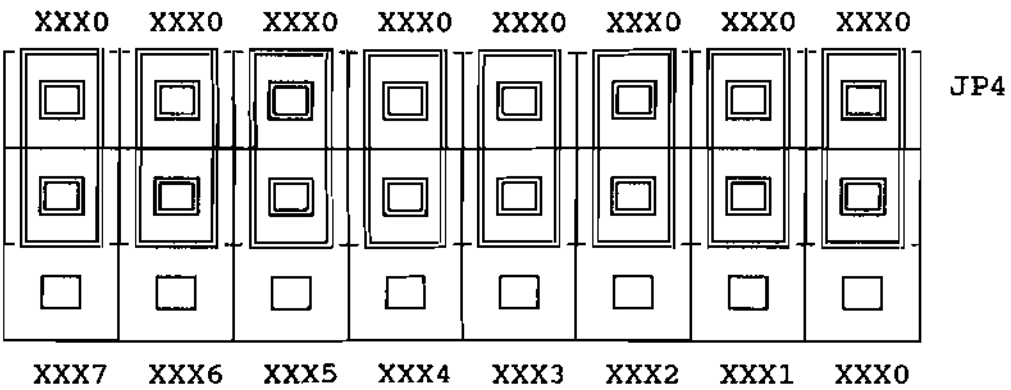
The 8 decoded addresses of U6 are:

C8x0H
C8x1H
C8x2H
C8x3H
C8x4H
C8x5H
C8x6H
C8x7H

When using the Separate BIT/RELAY mode only address C8x0H will be used. All relays are addressed as BITs 0-7 at address C8x0H.

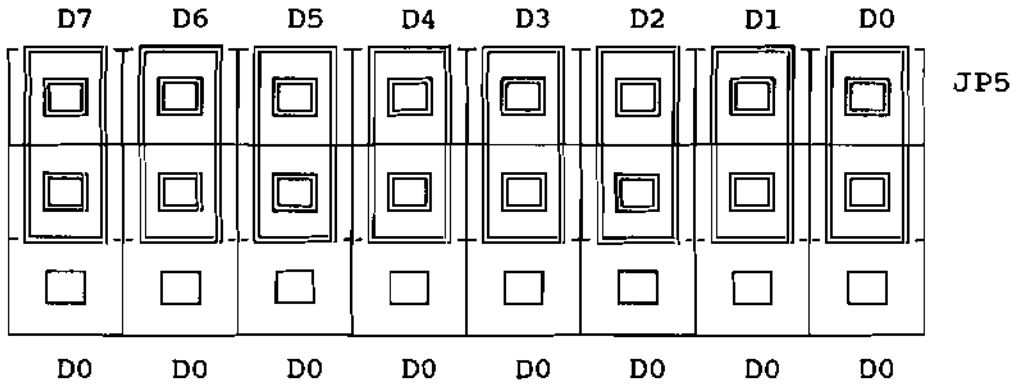
When using the Separate ADDRESS/RELAY mode all 8 decoded addresses will be used. Each relay has its own address and will require a separate WRITE operation for each relay.

The decoded addresses of U6 are more than just latched addresses, they are ACTIVE LOW only during the DATA STROBE. U7 an OCTAL INVERTING BUS DRIVER is used to invert the ACTIVE LOW STROBES into ACTIVE HIGH STROBES. When the BCC40R is in the SEPARATE BIT/RELAY MODE, only the first address, as selected by JP4 (address C8x0H in the example above), latches the DATA into all the D-flipflops (U10-U13) at once. When the BCC40R is in the SEPARATE ADDRESS/RELAY MODE, each address, as selected by JP4 (addresses C8x0H-C8x7H in the example above), latches DATA into its D-flipflop independently of the others.



JP4 shown selecting the Separated BIT/RELAY mode

U3 an OCTAL BUS TRANSCEIVER buffers the DATA BUS toward the BCC40R. U3 will never change direction as the BCC40R is an OUTPUT ONLY BOARD. U4 an OCTAL LATCH uses AS (ADDRESS STROBE) to latch A0-A7 from the DATA BUS. The buffered DATA BUS provides the DATA for each of the D-flipflops. When the BCC40R is in the SEPARATE BIT/RELAY MODE, each DATA BIT, as selected by JP5 (D0-D7), is routed to its own D-flipflops (U10-U13). When the BCC40R is in the SEPARATE ADDRESS/RELAY MODE, only BIT D0 is routed to all D-flipflop (U10-U13).



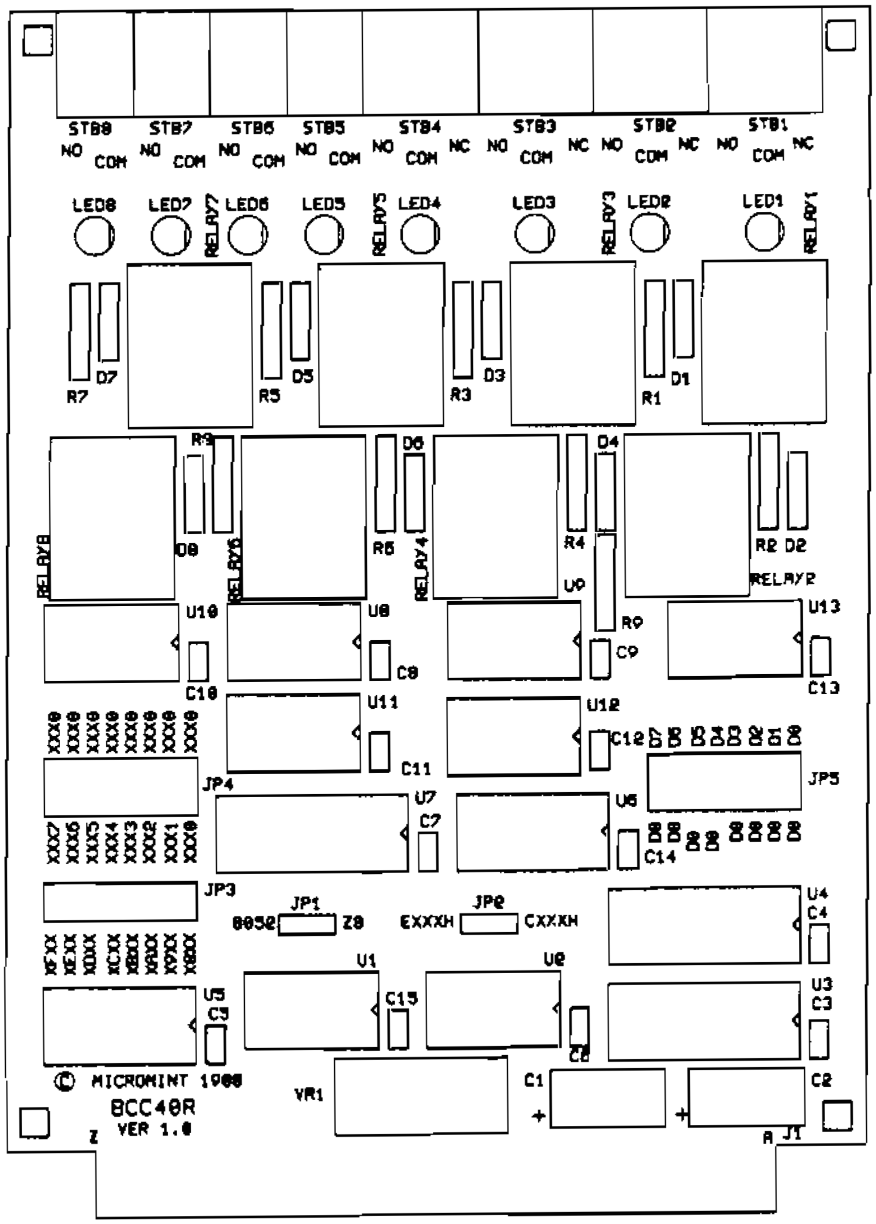
JP5 shown selecting the Separated BIT/RELAY mode

A HIGH strobed in on the D input of the flipflop generates a LOW on the *Q output. This in-turn forces the 7407 LOW, dropping 12V across the relay and LED/resistor, turning both ON. A LOW strobed in on the D input of the flipflop turns the relay and LED OFF.

All of the 8 D-flipflops have their CLEAR lines tied together. A LOW on the CLEAR input of a flipflop generates a HIGH on the *Q output. This de-energizes the relays and LEDs in the POWER-UP/ RESET condition. The CLEAR lines are driven from two open-collector sources. One source, the RESET line from the processor, clears all the D-flipflops during POWER-UP and RESET. The other source, CS (JP3 selection), DS (DATA STROBE) and A3 ANDED by U2, produces a software RESET when writing or reading the BASE address + 8. Using the example above the RESET address is C8x8H.

The following two examples (see page 11 & 12) show the BCC40R being used in each of the 2 addressing modes (SEPARATE BIT/RELAY MODE and SEPARATE ADDRESS/RELAY MODE.) Each will perform the simple task of turning each relay ON or OFF when the numbers 1-8 are pressed on the keyboard. All examples will use the same BASE ADDRESS C8xxH.

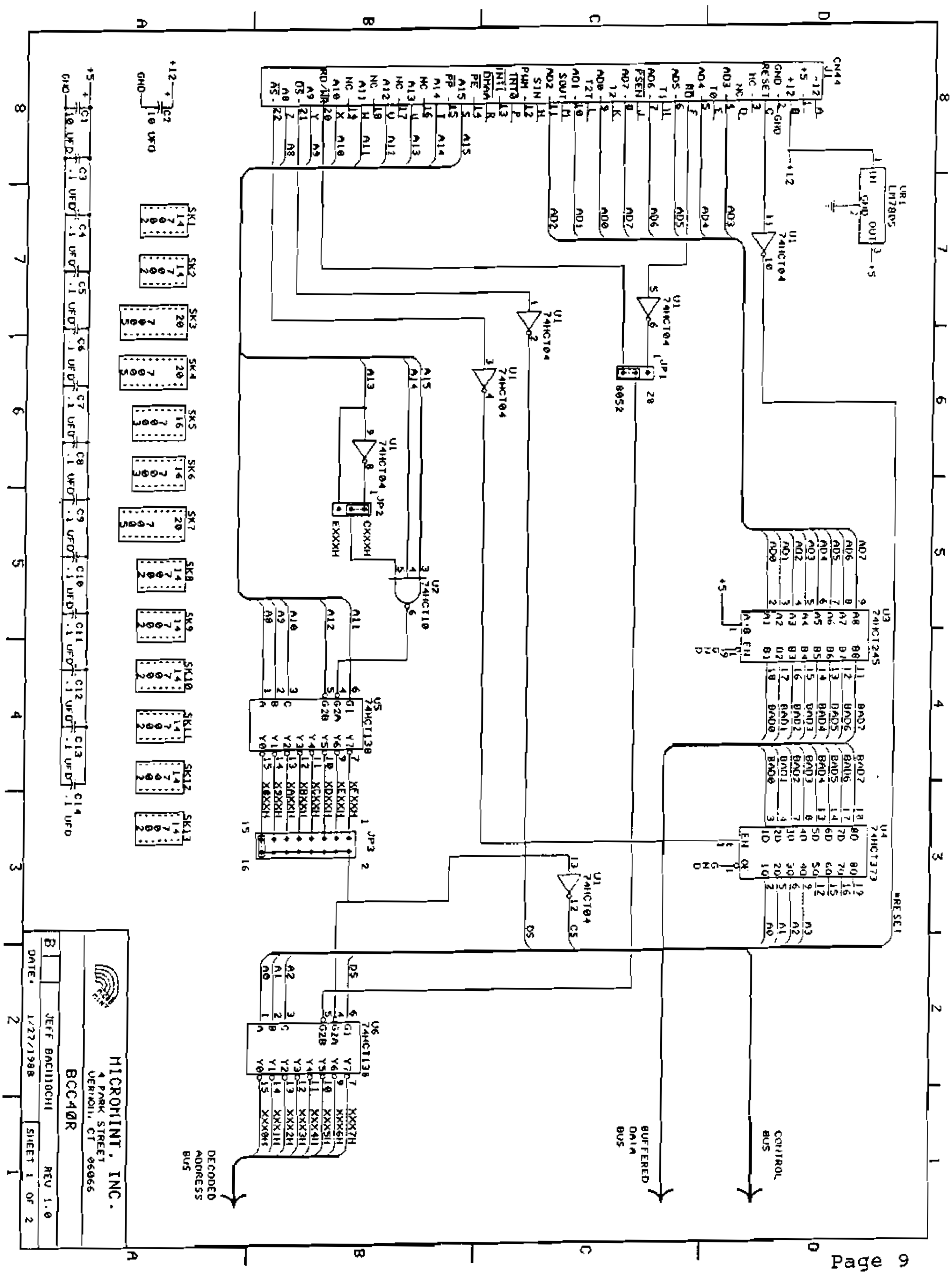
Silkscreen of BCC40R

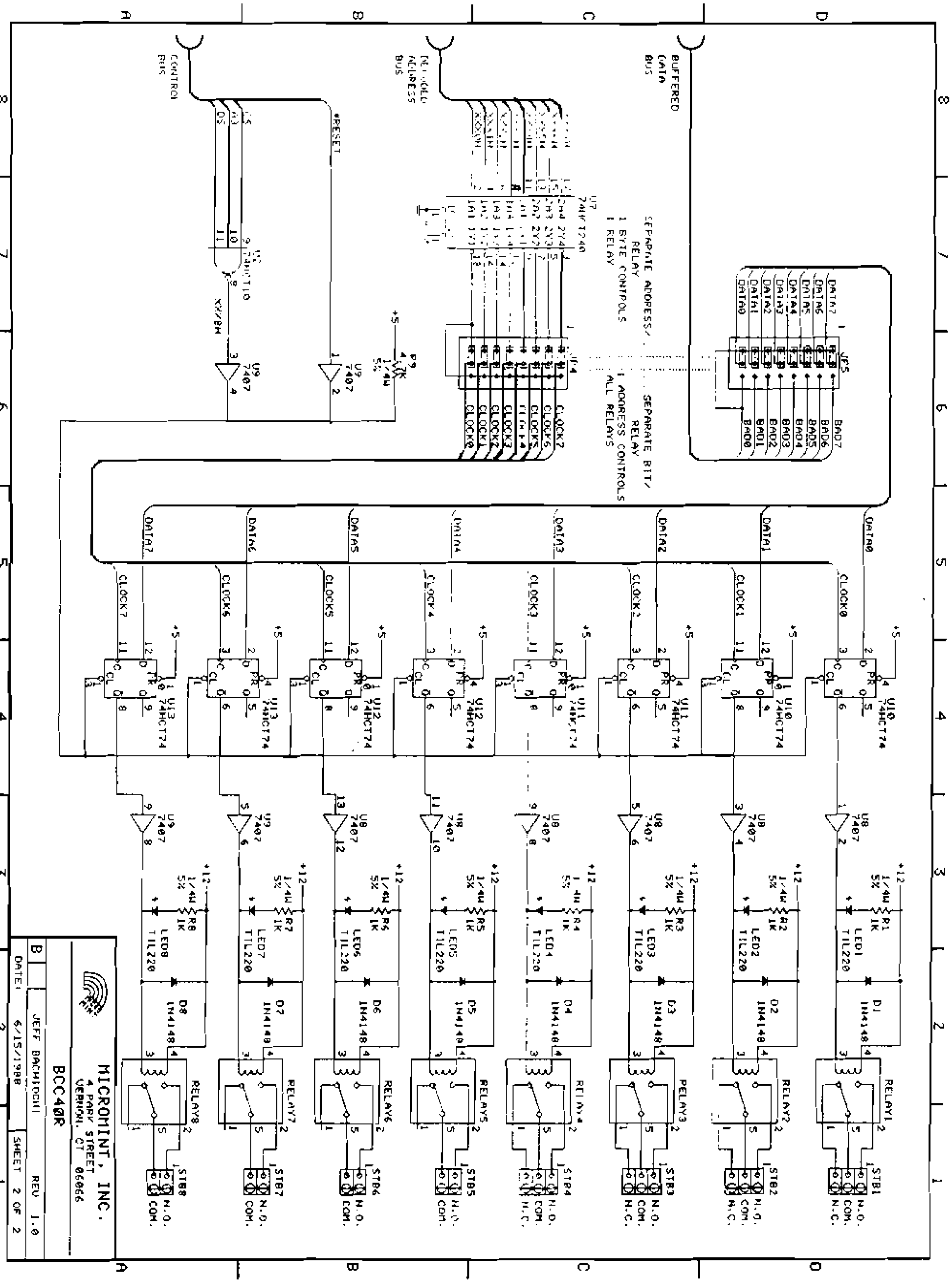


BCC40R PARTS LIST

QTY	REF. DES.	DESCRIPTION
PRINTED CIRCUTI BOARD		
1	J1	BCC40R - CIRCUIT BOARD
INTEGRATED CIRCUITS		
1	U1	74HCT04 - HS CMOS HEX INVERTER
1	U2	74HCT10 - HS CMOS TRIPLE 3 INPUT NAND
1	U3	74HCT245 - HS CMOS OCTAL BUS XCEIVER
1	U4	74HCT373 - HS CMOS OCTAL XPARENT LATCH
2	U5,U6	74HCT138 - HS CMOS 3/8 DECODER
1	U7	74HCT240 - HS CMOS OCTAL INVERTING BUF
2	U8,U9	7407 - TTL HEX BUFFER W/H V OUTPUT
4	U10 -U13	74HCT74 - HS CMOS DUAL D FLIP-FLOP
SEMICONDUCTORS		
8	D1 - D8	1N4148 - DIODE
8	LED1 - LED8	TIL220 - LIGHT EMITTING DIODE
1	VR1	LM7805C - VOLTAGE REGULATOR, +5VDC
CAPACITORS		
2	C1,C2	10 UFD - 25V ELECTROLYTIC
12	C3 - C14	.1 UFD - 50V MONOLITHIC
RESISTORS		
8	R1 - R8	1K - 1/4W,5%
1	R9	4.7K - 1/4W,5%
CONNECTORS		
8	STB1 -STB8	1X2 - SCREW TERMINAL BLOCK
2	JP1,JP2	1X3 - SQUARE PIN HEADER
1	JP3	2X8 - SQUARE PIN HEADER
2	JP4,JP5	3X8 - SQUARE PIN HEADER
SOCKETS		
8	SK1,SK2,SK8 - SK13	14 PIN - IC SOCKET
2	SK5,SK6	16 PIN - IC SOCKET
3	SK3,SK4,SK7	20 PIN - IC SOCKET
MISCELLANEOUS		
19	SJ1 - SJ19	1X2 - SHORTING JUMPER
8	RELAY1 -RELAY8	12 VOLT - SPST RELAY

Schematic of the BCC40R




MICROMINT, INC.
4 PARK STREET
VERNON, CT 06066
BCC40R
JEFF BACHIOCHI
REV 1.0
SHEET 2 OF 2

BCC40R - SEPARATE BIT/RELAY MODE
(ROM5 in BASIC DEMO EPROM)

```
10      P=0C800H                                 :REM BASE ADDRESS
20       FOR X=1 TO 8                            :REM RELAYS 1-8
30      R(X)=0                                   :REM INITIALIZE OFF
40       NEXT X                                  :REM DO ALL RELAYS
50       PRINT "BCC40R EXAMPLE USING THE SEPARATE BIT/RELAY MODE"
60       PRINT
70       PRINT "JP1=8052 JP2=CxxxH JP3=x8xxH",
80       PRINT "JP4&5=ALL JUMPERS TOWARD RELAYS"
90       PRINT
100      PRINT "PRESS 1-8 TO TURN RELAY ON OR OFF"
110      PRINT "PRESS 0 TO END"
120     G=GET                                    :REM THROW AWAY
130     G=GET                                    :REM GET CHARACTER
140      IF (G<30H.OR.G>38H) THEN GOTO 130:REM IF NO LEGAL CHAR.
150      IF G=30H THEN  GOTO 370                 :REM IF 0 GOTO END
160     G=G-30H :  REM ASC TO INTEGER
170      IF R(G)=1 THEN R(G)=0 ELSE R(G)=1:REM ON-> OFF/OFF-> ON
180     V=0                                      :REM VALUE = ZERO
190      FOR X=0 TO 7                            :REM BIT POSITIONS 0-7
200      IF R(X+1)=1 THEN V=V+2**X               :REM IF RELAY IS ON
210                                               REM ADD BIT POSITION
220                                               REM 2**0=01H (00000001B)
230                                               REM 2**1=02H (00000010B)
240                                               REM 2**2=04H (00000100B)
250                                               REM 2**3=08H (00001000B)
260                                               REM 2**4=10H (00010000B)
270                                               REM 2**5=20H (00100000B)
280                                               REM 2**6=40H (01000000B)
290                                               REM 2**7=80H (10000000B)
300      NEXT X                                  :REM CHECK ALL BITS
310     XBY(P)=V                                 :REM WRITE VALUE TO PORT
320      GOSUB 340                               :REM MESSAGE TO CONSOLE
330      GOTO 130                                :REM CHECK FOR CHARACTER
340      PH0. "WRITING ",V," TO ADDRESS ",P
350      RETURN
360     V=0                                      :REM VALUE = 0
370     P=0C808H                                 :REM PORT = RESET ADDRESS
380      PRINT "RESETTING..."
390     XBY(P)=V                                 :REM WRITE VALUE TO PORT
400      GOSUB 340                               :REM MESSAGE TO CONSOLE
410      END                                     :REM THATS ALL
```

BCC40R - SEPARATE ADDRESS/RELAY MODE
(ROM6 in the BASIC DEMO EPROM)

```
10    P=0C800H                                 :  REM BASE ADDRESS
20     FOR X=1 TO 8                            :  REM RELAYS 1-8
30    R(X)=0                                   :  REM INITIALIZE OFF
40     NEXT X                                  :  REM DO ALL RELAYS
50     PRINT "BCC40R EXAMPLE USING SEPARATE ADDRESS/RELAY MODE"
60     PRINT
70     PRINT "JP1=8052 JP2=CxxxH JP3=x8xxH",
80     PRINT " JP4&5=ALL JUMPERS AWAY FROM RELAYS"
90     PRINT
100    PRINT "PRESS 1-8 TO TURN RELAY ON OR OFF"
110    PRINT "PRESS 0 TO END"
120   G=GET                                    :  REM THROW AWAY
130   G=GET                                    :  REM GET CHARACTER
140    IF (G<30H.OR.G>38H) THEN GOTO 130 :  REM IF NO LEGAL CHAR.
150    IF G=30H THEN  GOTO 320                 :  REM IF 0 GOTO END
160   G=G-30H                                  :  REM ASC TO INTEGER
170    IF R(G)=1 THEN R(G)=0 ELSE R(G)=1 :  REM ON TO OFF  OFF TO
ON
180   XBY(P+G-1)=R(G)                          :  REM WRITE VAL TO PORT
190                                               REM RELAY # = ADDRESS
200                                               REM 1 = PORT + 1 - 1
210                                               REM 2 = PORT + 2 - 1
220                                               REM 3 = PORT + 3 - 1
230                                               REM 4 = PORT + 4 - 1
240                                               REM 5 = PORT + 5 - 1
250                                               REM 6 = PORT + 6 - 1
260                                               REM 7 = PORT + 7 - 1
270                                               REM 8 = PORT + 8 - 1
280    GOSUB 300                               :  REM DO MESSAGE
290    GOTO 130                                :  REM CHECK FOR CHAR.
300    PH0. "WRITING ",R(G)," TO ADDRESS ",P+G-1
310    RETURN
320   V=0                                      :  REM VALUE = 0
330   P=0C808H                                 :  REM RESET ADDRESS
340    PRINT "RESETTING..."
350   XBY(P)=V                                 :  REM WRITE VAL TO PORT
360    PRINT "WRITTING  00H TO ADDRESS  C808H"
370    END                                     :  REM THATS ALL
```

<u>BCC40D</u>

8-Channel Opto-Isolated Input/Output Board for the BCC BUS

Overview

The BCC40D is memory mapped into the BCCxx Address space. Jumper selections on the BCC40D allow it to be accessed at one of 16 Base addresses. Up to 8 Industry Standard Opto-Isolated Solid State Relay Modules (AC and DC - Input **'IAC5 and IDC5'** and Output **'OAC5 and ODC5'** devices) can be mixed on each BCC40D. The BCC40D plugs into the BCC BUS and receives control from a BCCxx processor board driving the BUS. All user connections are made to the BCC40D through wire captivating screw terminal blocks mounted along the top edge of the board.

Each module position on the BCC40D has a red LED to indicate the status of the module. On an OUTPUT module, a glowing LED denotes a activated output (ON). On an INPUT module, a glowing LED denotes the presence of an applied external input.

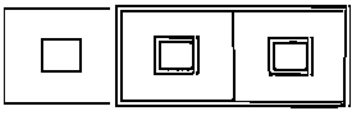
The BCC40D relays can be addressed in one way:

SEPARATE BIT/RELAY MODE. In this configuration each output module is controlled by a bit in the byte written to the BCC40D. Each input modules status is reflected by a bit in the byte read from the BCC40D. One write controls all output modules and one read reflects the STATUS of all input modules. The byte value must be calculated by taking into account the appropriate state of each relay. Module1 is controlled by D0, module2 by D1,etc.

Hardware

The BCC40D has a 44 pin edge card connector designed for use with the BCC BUS (any BCCxx processor and MBxx mother board.) U1 and JP2 are used to select A13 or *A13 as an input which is ANDED with A14 and A15 by U2. The output of the AND gate is low for either address CxxxH (if *A13 is selected on JP2) or address ExxxH (if A13 is selected on JP2). This output, along with A11 and *A12 is used to enable U5, a 3 to 8 line decoder. Address line A8, A9 and A10 are decoded by U5 when the decoder is enabled. Decoded outputs available for selection at JP3 are:

JP2



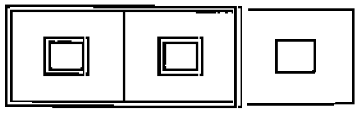
CXXXH EXXXH

JP2 shown selecting EXXXH

When JP2 selects EXXXH
JP3 selects

E8XXH
or
E9XXH
or
EAXXH
or
EBXXH
or
ECXXH
or
EDXXH
or
EEXXH
or
EFXXH

JP2

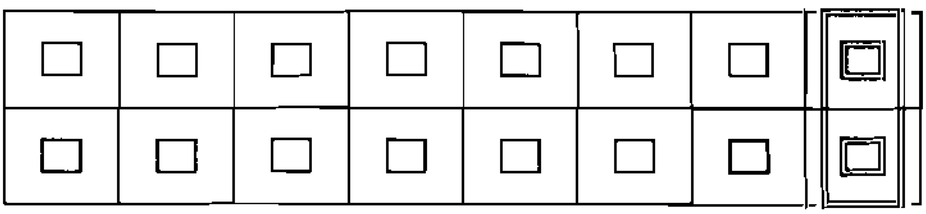


CXXXH EXXXH

JP2 shown selecting EXXXH

When JP2 selects CXXXH
JP3 selects

C8XXH
or
C9XXH
or
CAXXH
or
CBXXH
or
CCXXH
or
CDXXH
or
CEXXH
or
CFXXH



JP3

XFXX XEXX XDXX XCXX XBXX XAXX X9XX X8XX

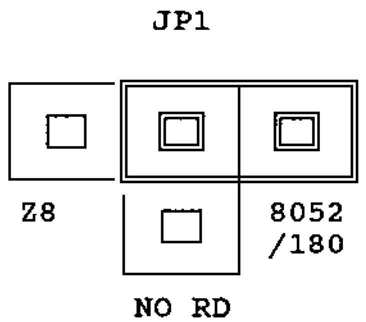
JP3 shown selecting an offset address of X8XX (800H)

Example:

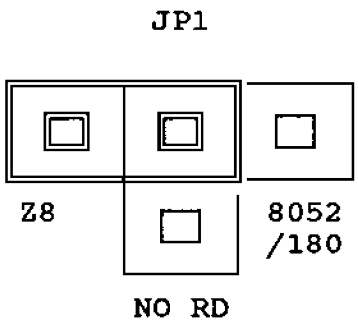
When JP2 selects CXXXH and JP3 selects X8XX
(= total BASE address of C8xxH)

C8xxH = WRITE and READ address of all modules on this board.

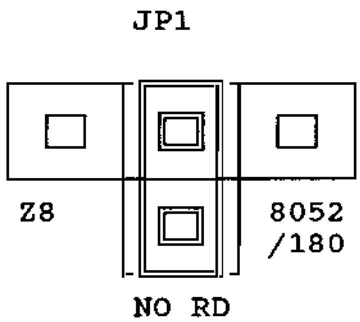
U3 an OCTAL BUS TRANSCEIVER buffers the DATA BUS toward the BCC40D. U3 will only change directions (outputing to the BCC BUS) when RD, DS and CS (JP3 selection) are NANDED by U2 to produce a LOW on the direction input of U3. (NOTE - RD can be disabled with JP1 to allow an output board and an input board to occupy a single address space.) MODULES selected by JP5 as INPUT are read and inverted by U7, a 74LS240, whenever U3 changes direction by a LOW (READ). Each INPUT bit corresponds to one of the 8 module positions.



JP1 shown selecting 8052 READ ENABLE

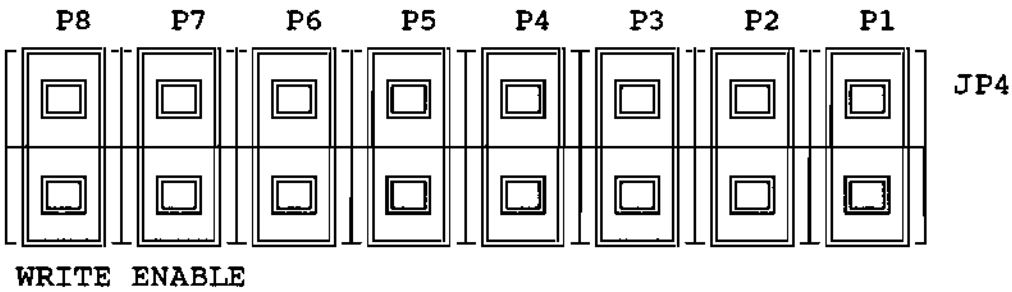


JP1 shown selecting Z8 READ ENABLE



JP1 shown selecting WRITE ONLY board

U4 an OCTAL FLIP FLOP uses WR, DS and CS (JP3 selection) ANDED by U2/U1 to latch D0-D7 from the buffered DATA BUS. U6, a 74LS240 inverts all the DATA to JP4. JP4 allows the user selection any of the bits as CONTROL for an OUTPUT MODULE located in its respective bit position. The user can plug any mix of I/O modules into the 8 module positions. Each OUTPUT bit corresponds to one of the 8 module positions. WRITing will only control a module if it is an OUTPUT module and has been selected by JP4.

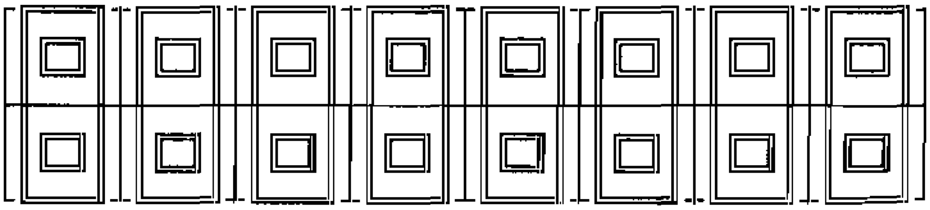


JP4 shown selecting all 8 I/O modules as OUTPUT

Writing to **BCC40D**	**Module position**	Reading from **BCC40D**
Controls		Reflects Status
Bit 0 ------------>	Module 1 ------------>	Bit 0
Bit 1 ------------>	Module 2 ------------>	Bit 1
Bit 2 ------------>	Module 3 ------------>	Bit 2
Bit 3 ------------>	Module 4 ------------>	Bit 3
Bit 4 ------------>	Module 5 ------------>	Bit 4
Bit 5 ------------>	Module 6 ------------>	Bit 5
Bit 6 ------------>	Module 7 ------------>	Bit 6
Bit 7 ------------>	Module 8 ------------>	Bit 7

READing the BCC40D (assuming JP1 has enabled READing) always reflects the status of all the module positions enabled by JP5 (disabled INPUT positions are tied HIGH and will read as 1's [ON].)

P8 P7 P6 P5 P4 P3 P2 P1



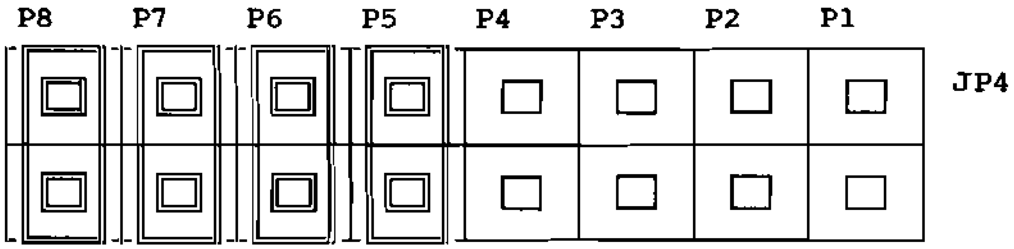
JP5

READ ENABLE

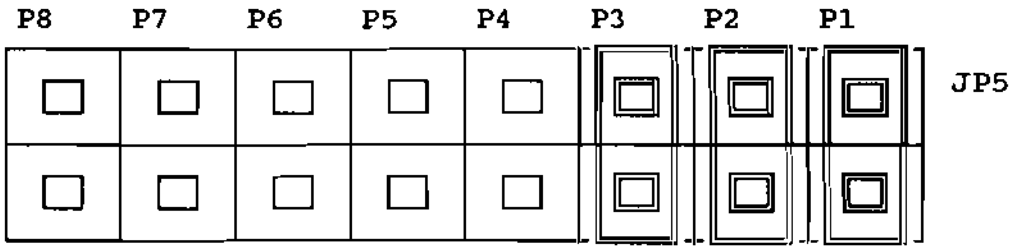
JP5 shown selecting all 8 I/O modules as INPUT

Combining Input and Output Modules

NOTE: I/O MODULES CAN BE MIXED ON ONE BOARD, THE FOLLOWING EXAMPLE SHOWS JUMPER SETTINGS FOR 3 OUTPUT AND 4 INPUT MODULES.



JP4 shown selecting modules P5-P8 as OUTPUT



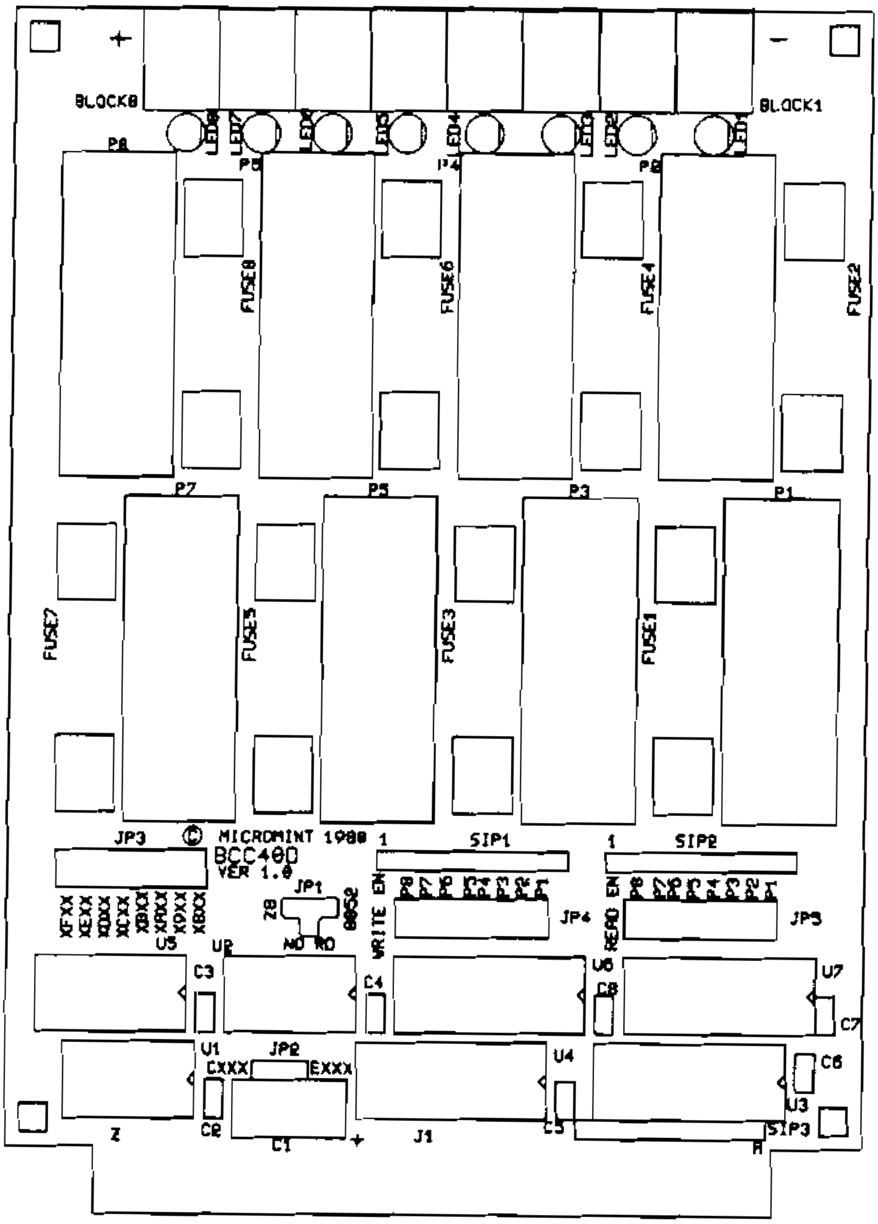
JP5 shown selecting modules P1-P3 as INPUT

```
Writing to                                  Reading from
BCC40D          Module position             BCC40D

Controls                                    Reflects Status

 Bit 0  (nothing)     Module 1 ------------> Bit 0
 Bit 1  (nothing)     Module 2 ------------> Bit 1
 Bit 2  (nothing)     Module 3 ------------> Bit 2
 Bit 3  (nothing)     Module 4  (tied high)  Bit 3
 Bit 4 ------------> Module 5  (tied high)  Bit 4
 Bit 5 ------------> Module 6  (tied high)  Bit 5
 Bit 6 ------------> Module 7  (tied high)  Bit 6
 Bit 7 ------------> Module 8  (tied high)  Bit 7
```

In this case one board serves as both output and input. Modules P1-P3 are read as the lower 3 bits (the upper bits are tied high by SIP2.) The upper 4 bits written to the port control Modules P5-P8 (the lower 4 bits are not used.)

The following examples (see pages 22 - 25) show the BCC40D being used to perform the simple task of turning each I/O module ON or OFF when the numbers 1-8 are pressed on the keyboard. All examples will use the same BASE ADDRESS C8xxH.

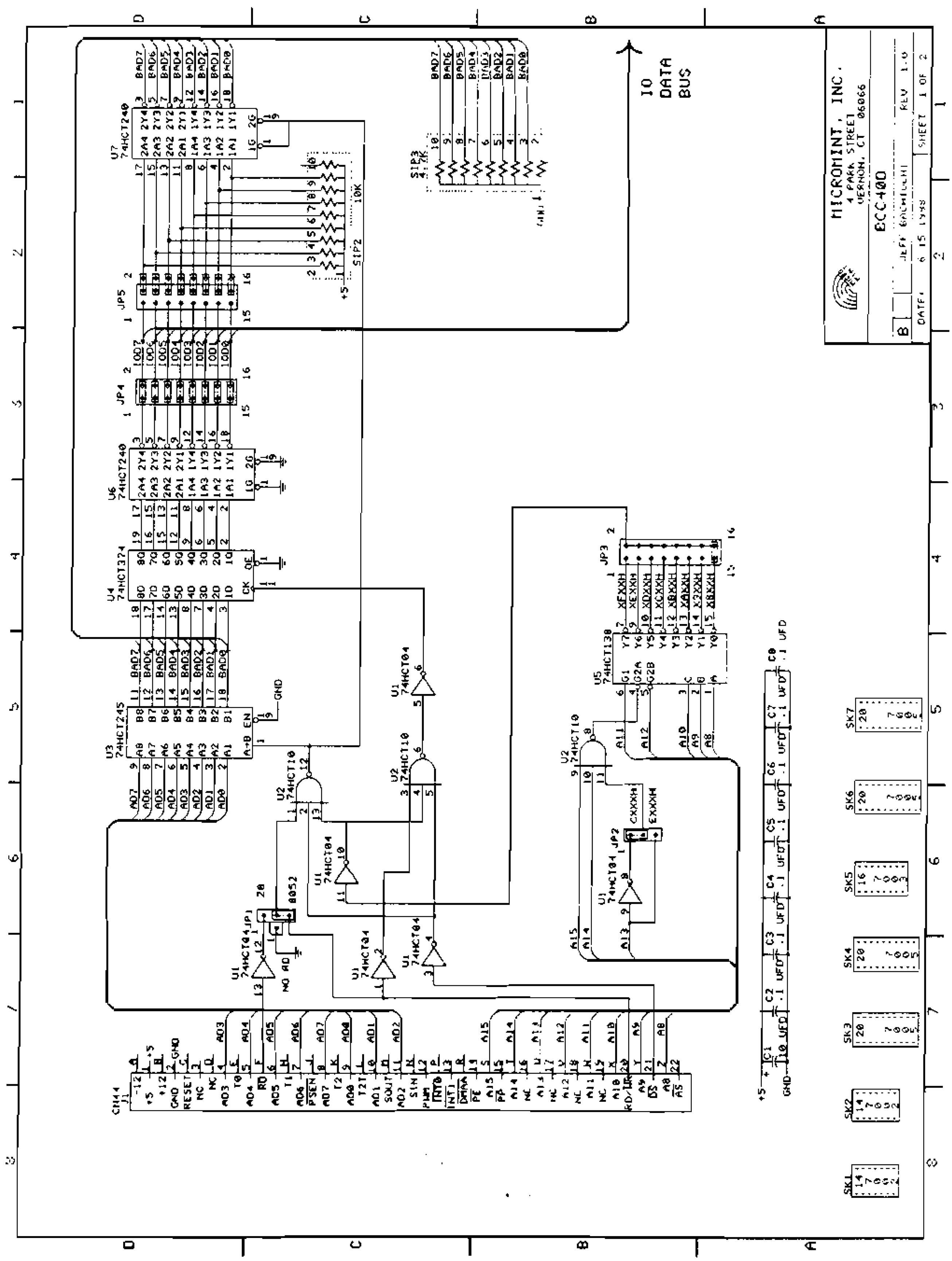
Silkscreen of the BCC40D

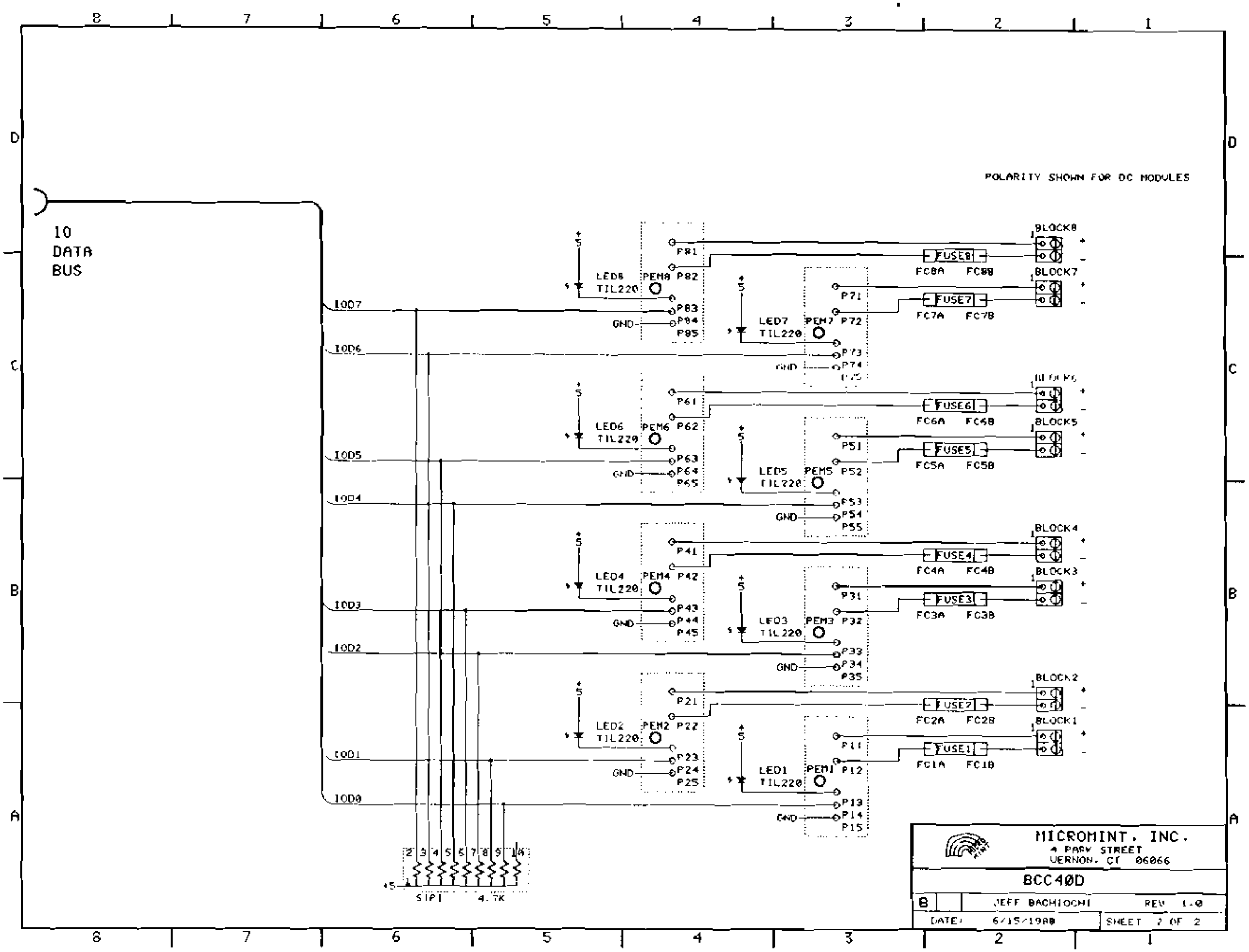


BCC40D PARTS LIST

QTY	REF. DES.	DISCRIPTION	
PRINTED CIRCUIT BOARD			
1	J1	BCC40D	- CIRCUIT BOARD
INTEGRATED CIRCUITS			
1	U1	74HCT04	- HS CMOS HEX INVERTER
1	U2	74HCT10	- HS CMOS TRIPLE 3-INPUT NAND
1	U5	74HCT138	- HS CMOS 3/8 DECODER
2	U6,U7	74HCT240	- HS CMOS OCTAL INVERTING BUFFER
1	U3	74HCT245	- HS CMOS OCTAL XSCEIVER
1	U4	74HCT374	- HS CMOS OCTAL XPARENT FLIP-FLOP
SEMICONDUCTORS			
8	LED0 - LED7	TIL220	- LIGHT EMITTING DIODE
CAPACITORS			
1	C1	10 UFD	- 25V ELECTROLYTIC
7	C2 - C8	.1 UFD	- 50V MONOLITHIC
RESISTORS			
2	SIP1,SIP3	4.7K	- 10 PIN SIP
1	SIP2	10K	- 10 PIN SIP
CONNECTORS			
2	JP1,JP2	1X3	- SQUARE PIN HEADER
3	JP3,JP4,JP5	2X8	- SQUARE PIN HEADER
8	BLOCK0 - BLOCK7	1X2	- SCREW TERMINAL BLOCK
SOCKETS			
2	SK1,SK2	14 PIN	- IC SOCKET
1	SK5	16 PIN	- IC SOCKET
4	SK3,SK4,SK6,SK7	20 PIN	- IC SOCKET
MISCELLANEOUS			
19	SJ1 - SJ19	1X2	- SHORTING JUMPER
8	FUSE0 - FUSE7	3 AMP	- FUSE
16	FC0A - FC7A, FC0B - FC7B	PC MOUNT	- FUSE CLIP
40	P1 - P5, P11 - P15, P21 - P25, P31 - P35, P41 - P45, P51 - P55, P61 - P65, P71 - P75	PC MOUNT	- MACHINE SOCKET PIN
8	PEM0 - PEM7	PC MOUNT	- PEM NUT

Schematic of the BCC40D




IO DATA BUS
POLARITY SHOWN FOR DC MODULES
BLOCK8
BLOCK7
BLOCK6
BLOCK5
BLOCK4
BLOCK3
BLOCK2
BLOCK1
FUSE8
FUSE7
FUSE6
FUSE5
FUSE4
FUSE3
FUSE2
FUSE1
LED8 TIL220
LED7 TIL220
LED6 TIL220
LED5 TIL220
LED4 TIL220
LED3 TIL220
LED2 TIL220
LED1 TIL220
SIP1 4.7K
MICROMINT, INC.
4 PARK STREET
VERNON, CT 06066
BCC40D
JEFF BACHIOCHI
REV 1.0
DATE: 6/15/1988
SHEET 2 OF 2

BCC40D - OUTPUT MODULES
(ROM9 in the BASIC DEMO EPROM)

```
10    P=0C800H                                  :REM BASE ADDRESS
20    FOR X = 1 TO 8                            :REM OUTPUT MODULES 1-8
30    R(X) = 0                                  :REM INITIALIZE OFF
40    NEXT X                                    :REM DO ALL MODULES
50    PRINT"BCC40D EXAMPLE USING OPTO-ISOLATED OUTPUT MODULES"
60    PRINT
70    PRINT"JP1=NO RD JP2=CxxxH JP3=x8xxH",
80    PRINT"JP4=ALL ENABLED JP5=ALL DISABLED"
90    PRINT
100   PRINT "PRESS 1-8 TO TURN MODULLE ON OR OFF"
110   PRINT "PRESS 0 TO END"
120   G=GET                                     :REM THROW AWAY
130   G=GET                                     :REM GET CHARACTER
140   IF (G<30H .OR. G>38H) THEN GOTO 130:REM IF NO LEGAL CHAR.
150   IF G = 30H THEN GOTO 340                  :REM IF 0 GOTO END
160   G = G - 30H                               :REM ASC TO INTEGER
170   IF R(G)=1 THEN R(G)=0 ELSE R(G)=1         :REM ON TO OFF  OFF TO ON
180   V=0                                       :REM VALUE = ZERO
190   FOR X = 0 TO 7                            :REM BIT POSITIONS 0-7
200   IF R(X+1) = 1 THEN V = V + 2**X           :REM IF MODULE IS ON
210                                             :REM ADD BIT POSITION
220                                             :REM 2**0=01H (00000001B)
230                                             :REM 2**1=02H (00000010B)
240                                             :REM 2**2=04H (00000100B)
250                                             :REM 2**3=08H (00001000B)
260                                             :REM 2**4=10H (00010000B)
270                                             :REM 2**5=20H (00100000B)
280                                             :REM 2**6=40H (01000000B)
290                                             :REM 2**7=80H (10000000B)
300   NEXT X                                    :REM CHECK ALL BITS
310   XBY(P) = V                                :REM WRITE VALUE TO PORT
320   PH0."WRITING ",V," TO ADDRESS ",P         :REM MESSAGE TO CONSOLE
330   GOTO 130                                  :REM CHECK FOR CHARACTER
340   END                                       :REM THATS ALL
```

BCC40D - ALL INPUT MODULES
(ROM10 in the BASIC DEMO EPROM)

```
10    P=0C800H                                  :REM BASE ADDRESS
20    PRINT
30    PRINT"BCC40D EXAMPLE OF USING OPTO-ISOLATED INPUT MODULES"
40    PRINT
50    PRINT
60    PRINT"JP1=8052 JP2=CxxxH JP3=x8xxH",
70    PRINT"JP4=ALL DISABLED JP5=ALL ENABLED"
80    PRINT
90    PRINT "PRESS 1 TO READ OPTO-ISOLATED MODULES"
100   PRINT "      0 TO END"
110   PRINT
120   G=GET                                     :REM THROW AWAY
130   G=GET                                     :REM GET CHARACTER
140   IF (G<30H .OR. G>31H) THEN GOTO 130:REM IF NO LEGAL CHAR.
150   G = G - 30H                               :REM ASC TO INTEGER
160   IF G = 0 THEN GOTO 370                    :REM IF 0 GOTO END
170   V=XBY(P)                                  :REM READ VALUE FROM PORT
180   FOR  X=0 TO 7                             :REM BITS 0-7
190   REM CHECK BIT ABD SAVE TO ARRAY
200   IF (V.AND.2**X) = 2**X THEN R(X+1)=1 ELSE R(X+1)=0
210                                             :REM POWERS OF 2
220                                             :REM 2**0=01H (00000001B)
230                                             :REM 2**1=02H (00000010B)
240                                             :REM 2**2=04H (00000100B)
250                                             :REM 2**3=08H (00001000B)
260                                             :REM 2**4=10H (00010000B)
270                                             :REM 2**5=20H (00100000B)
280                                             :REM 2**6=40H (01000000B)
290                                             :REM 2**7=80H (10000000B)
300   NEXT X                                    :REM DO ALL BITS
310   PRINT"READING INPUT MODULES"
320   PRINT"VALUE - BIT7  6  5  4  3  2  1  0"
330   PH0. V : PRINT"      ",
340   PH0. R(8),R(7),R(6),R(5),R(4),R(3),R(2),R(1)
350   PRINT"NOTE - FOR MODULES 1=ON 0=OFF" : PRINT
360   GOTO 130                                  :REM CHECK FOR CHARACTER
370   END                                       :REM THATS ALL
```

BCC40D - COMBINATION OF OUTPUT/INPUT MODULES
(ROM11 in the BASIC DEMO EPROM)

```
10 P=0C800H                    : REM BASE ADDRESS
20 PRINT "BCC40D EXAMPLE OF USING A COMBINATION OF I/O MODULES"
30 PRINT
40 PRINT "JP1=8052 JP2=CxxxH  JP3=x8xxH  JP4=ENABLE  EACH  OUTPUT
MODULE ONLY"

50 PRINT "         JP5=ENABLE EACH INPUT MODULE ONLY"
60 PRINT
200 B=0                        : REM INITIALIZE MASK FOR OUTPUT
210 C=0                        : REM INITIALIZE MASK FOR INPUT
220 FOR M=1 TO 8               : REM ASK ABOUT ALL MODULE POSITIONS
230 PRINT
240 PRINT "PRESS 1 WHEN USING AN OUTPUT MODULE-#",M
250 PRINT "      2 WHEN USING AN INPUT  MODULE-#",M
260 PRINT "      0 WHEN NOT  USING  ANY MODULE-#",M
270 G=GET                      : REM THROW AWAY CHARACTER
280 G=GET                      : REM SAVE A CHARACTER
290 IF (G<30H.OR.G>32H) THEN  GOTO 280       : REM IS IT LEGAL?
300 G=G-30H                    : REM ASC -30H = INTEGER (0-2)
310 IF G=1 THEN B=B+2**(M-1) : REM ADD MODULE POSITION TO MASK
320 IF G=2 THEN C=C+2**(M-1) : REM ADD MODULE POSITION TO MASK
330 NEXT M                     : REM DO ALL MODULE POSITIONS
510  IF  (B=0.AND.C=0)  THEN   PRINT  "NOT  USING  ANY  MODULES"
: GOTO 1230

780 PRINT "PRESS 1-8 TO TOGGLE/READ AN OPTO-ISOLATED MODULE"
790 PRINT "      0 TO END"
800 G=GET                      : REM THROW AWAY A CHARACTER
810 G=GET                      : REM SAVE A CHARATER
820 IF (G<30H.OR.G>38H) THEN  GOTO 810       : REM IS IT LEGAL?
830 G=G-30H                    : REM ASC -30H = INTEGER (0-8)
840 IF G=0 THEN  GOTO 1230     : REM GO TO THE END ROUTINE
850 B(G)=B(G).XOR.1            : REM  TOGGLE  BCC40D  OUTPUT  ARRAY
ELEMENT
860 V=0FFH                     : REM INITIALIZE VALUE = 0FFH
870 FOR X=1 TO 8               : REM ALL ARRAY ELEMENT
880 IF B(X)=0 THEN V=V-2**(X-1)      : REM ADJUST V USING ARRAY
890                              REM POWERS OF 2 = BIT POSITION
900                              REM 2**0=01H(00000001B)
910                              REM 2**1=02H(00000010B)
920                              REM 2**2=04H(00000100B)
930                              REM 2**3=08H(00001000B)
940                              REM 2**4=10H(00010000B)
950                              REM 2**5=20H(00100000B)
960                              REM 2**6=40H(01000000B)
970                              REM 2**7=80H(10000000B)
980 NEXT X                     : REM DO ALL BITS
```

```
990 PRINT : PHO. "WRITING TO BCC40D (",P," )"
1000 XBY(P)=V
1010 PRINT "VALUE - BIT7  6  5  4  3  2  1  0"
1020 PHO. V,"       ",
1030 FOR X=7 TO 0 STEP -1     : REM ALL BITS
1040 IF (B.AND.2**X)=0 THEN  PRINT " - ", ELSE  PRINT B(X+1),
1050 NEXT X                   : REM DO ALL BITS
1060 PRINT
1070 PRINT "DASH = NO OUTPUT MODULE PRESENT"
1080 V=XBY(P)                 : REM READ VALUE BCC40D
1090 FOR X=0 TO 7             : REM ALL BITS
1100 IF (V.AND.2**X)=(2**X)THEN C(X+1)=1 ELSE C(X+1)=0
:REM BCC40D INPUT ARRAY ELEMENTS FROM BIT VALUES

1110 NEXT X                   : REM DO ALL BITS
1120 PRINT
1130 PHO. "READING BCC40D (",P," )"
1140 PRINT "VALUE - BIT7  6  5  4  3  2  1  0"
1150 PHO. V,"       ",
1160 FOR X=7 TO 0 STEP -1     : REM ALL BITS
1170 IF (C.AND.2**X)=0 THEN  PRINT " - ", ELSE  PRINT C(X+1),
1180 NEXT X                   : REM DO FOR ALL BITS
1190 PRINT
1200 PRINT "DASH = NO INPUT MODULE PRESENT"
1210 PRINT
1220 GOTO 780                 : REM GO CHECK FOR A CHARACTER
1230 END                      : REM THATS ALL
```

USING ROM C V2.00 (ROM CX) AS BACKGROUND TASKING for the BCC52 (BCC52CX)

Overview

While the simplified hardware for the BCC40x system is important, it takes more to produce an industrial grade control system. It is counter productive to run time consuming repetitive tasks in BASIC which can be done more quickly in assembly language. For that reason, a set of interrupt driven utilities were written for the BCC52 which greatly simplifies the user I/O system interaction. It allows the use of BASIC (unless you prefer assembly language) even with 128 active I/O channels.

These assembly language routines, flow diagrammed in figure 1, operate as background tasks to any user application programs and are completely transparent. In addition to realtime clock functions, they allow the user to interact with the I/O system through a table of 128 input and output values rather than setting and reading expansion ports. To turn output channel 16 on we simply load a value greater than 0 into table loaction 16. To turn output channel 1 off we load 0 into table location 1.

Conversely, all inputs are continuously scanned and the present values loaded into a similar channel table for examination. In addition to present value, a separate indication of change of state by board and channel number is also produced. The change of state indication is maintained until the user reads the affected channels. The result is a simple BASIC single byte read and compare to find any input channels that have changed and a single byte write to make a corresponding control output.

There are fourteen subroutine calls provided in the Power I/O system. They are :

1. POWER I/O & Clock Initialization
2. Clock Only Intialization
3. SMARTIME ONLY Initialization
4. Update Clock Ram Area
5. System Startup
6. System Suspension
7. Clock Only Interrupt Vector
8. POWER I/O & Clock Interrupt Vector
9. Read an input channel's change of state flag (1 bit)
10. Read an input channel's data bit, reset change status
11. Set an output channel data bit (1/on or 0/off)
12. Read an input board's change of state flags (8 bits)
13. Read an input board's data bits, reset change status
14. Set an output board's data word (8 bits, 1/on or 0/off)

The completed software (V2.00) is distributed as ROM C on a 2764 EPROM and as ROM CX on a 27C256. The source code listing is included at the end of this manual.

Flowchart of Background Tasking