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EIGHT, FOUR, OR TWO-PORT RS-232 PC/104 SERIAL COMMUNICATION BOARD

MODELS 104-COM232-8 (4, 2)

USER MANUAL

File M104-COM232-8.B2j

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Chapter 1: FUNCTIONAL DESCRIPTION

This serial interface board contains either eight, four, or two independent ports and provides effective RS-232 communication.

The boards are designed in the PC/104 format.

It's dimensions are approximately 3.775 inches X 3.550 inches. Signal connections are made on the eight-port model through two 40 pin connectors, mounted on edges of the board; four-port models connect through only one 40-pin header and two-port models connect through only one 20-pin header.

IRQ SUPPORT

The board supports the use of IRQ resources, and includes an on-board IRQ status register for use with operating systems that support this feature, such as Microsoft's Windows NT.

The status register is located at an address of the COM A address + 400H.

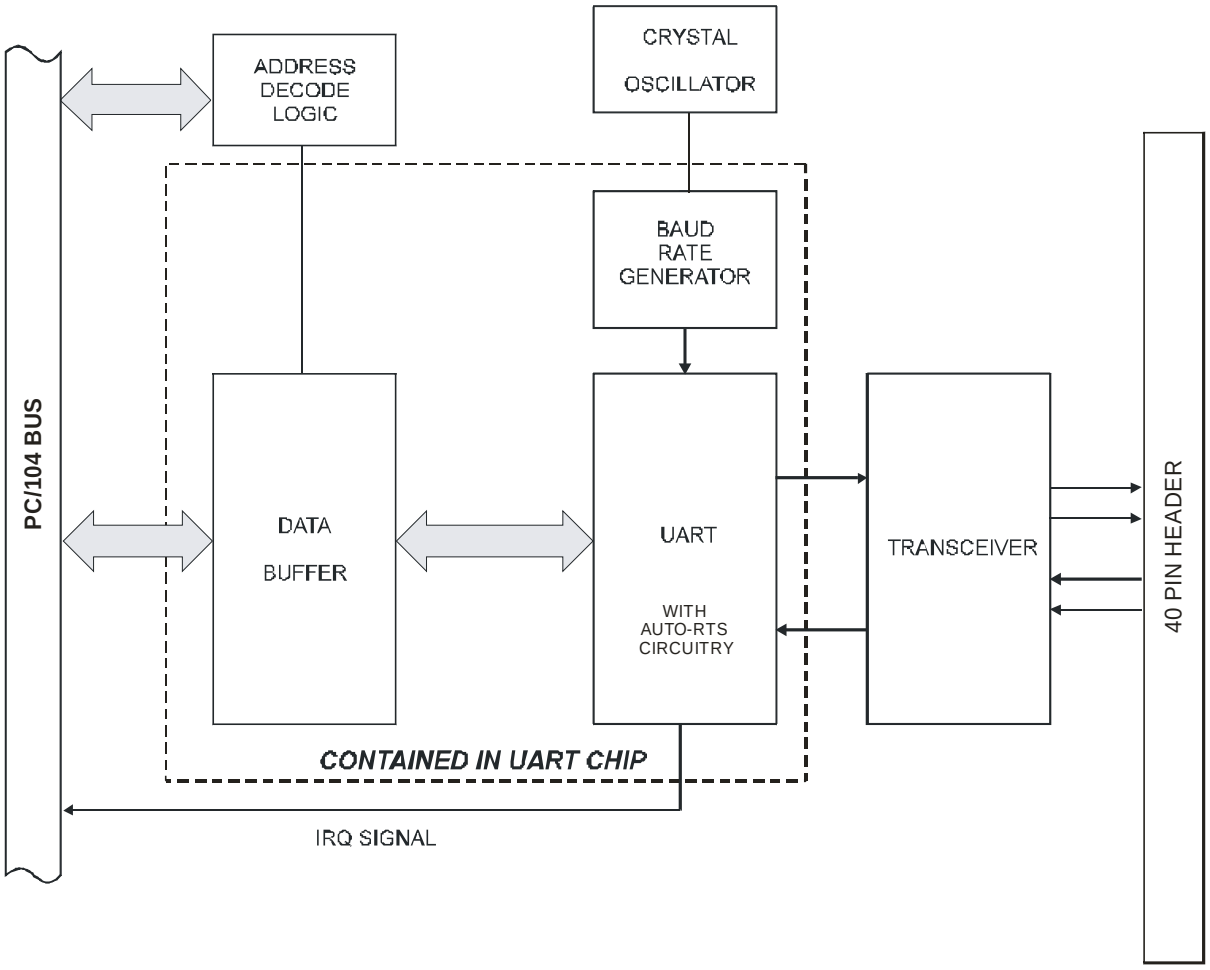


Figure 1-1: BLOCK DIAGRAM
(Only one serial channel shown)

Chapter 2: INSTALLATION

A printed Quick-Start Guide (QSG) is packed with the board for your convenience. If you've already performed the steps from the QSG, you may find this chapter to be redundant and may skip forward to begin developing your application.

The software provided with this PC/104 Board is on CD and must be installed onto your hard disk prior to use. To do this, perform the following steps as appropriate for your operating system.

CD Installation

The following instructions assume the CD-ROM drive is drive "D". Please substitute the appropriate drive letter for your system as necessary.

DOS

1. Place the CD into your CD-ROM drive.
2. Type D : Enter to change the active drive to the CD-ROM drive.
3. Type I N S T A L L Enter to run the install program.
4. Follow the on-screen prompts to install the software for this board.

WINDOWS

1. Place the CD into your CD-ROM drive.
2. The system should automatically run the install program. If the install program does not run promptly, click START | RUN and type D : I N S T A L L, click OK or press Enter.
3. Follow the on-screen prompts to install the software for this board.

LINUX

1. Please refer to linux.htm on the CD-ROM for information on installing serial ports under linux.

Installing the Hardware

Before installing the board, carefully read Chapter 3 and Chapter 4 of this manual and configure the board according to your requirements. The SETUP Program can be used to assist in configuring jumpers on the board. Be especially careful with Address Selection. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior. To help avoid this problem, refer to the FINDBASE.EXE program installed from the CD. The setup program does not set the options on the board, these must be set by jumpers.

This multi-port serial communication board uses software-programmable address ranges for each UART, stored in an onboard EEPROM. Configure the address of the EEPROM using the onboard Address Selection jumper block, then use the provided Setup program to configure addresses for each onboard UART.

To Install the Board

1. Install jumpers for selected options and base address according to your application requirements, as mentioned above.
2. Remove power from the PC/104 stack.
3. Assemble standoff hardware for stacking and securing the boards.
4. Carefully plug the board onto the PC/104 connector on the CPU or onto the stack, ensuring proper alignment of the pins before completely seating the connectors together.
5. Install I/O cables onto the board's I/O connectors and proceed to secure the stack together or repeat steps 3-5 until all boards are installed using the selected mounting hardware.
6. Check that all connections in your PC/104 stack are correct and secure then power up the system.
7. Run one of the provided sample programs appropriate for your operating system that was installed from the CD to test and validate your installation.

Installing COM Ports in Windows Operating Systems

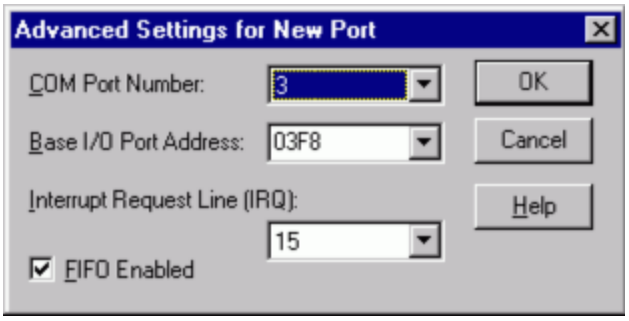
***NOTE: COM boards can be installed in virtually any operating system and we do support installation in earlier versions of Windows, and are very likely to support future version as well. For use in WinCE, contact the factory for specific instructions.**

Windows NT4.0

To install the COM ports in Windows NT4 you'll need to change one entry in the registry. This entry enables IRQ sharing on multi-port COM boards. The key is **HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Serial**. The name of the value is **PermitShare** and the data should be set to **1**.

You'll then add the board's ports as COM ports, setting the base addresses and IRQs to match your board's settings.

To change the registry value, run RegEdit from the START|RUN menu option (by typing REGEDIT [ENTER] in the space provided). Navigate down the tree view on the left to find the key, and double click on the name of the value to open a dialog allowing you to set the new data value.



To add a COM port, use START|CONTROL PANEL|PORTS applet and click ADD, then enter the correct UART address and Interrupt number.

When the “Add New Port” dialog is configured click OK, but answer “Don’t Restart Now” when prompted, until you’ve added any other ports as well. Then restart the system normally, or by selecting “Restart Now.”

Windows XP

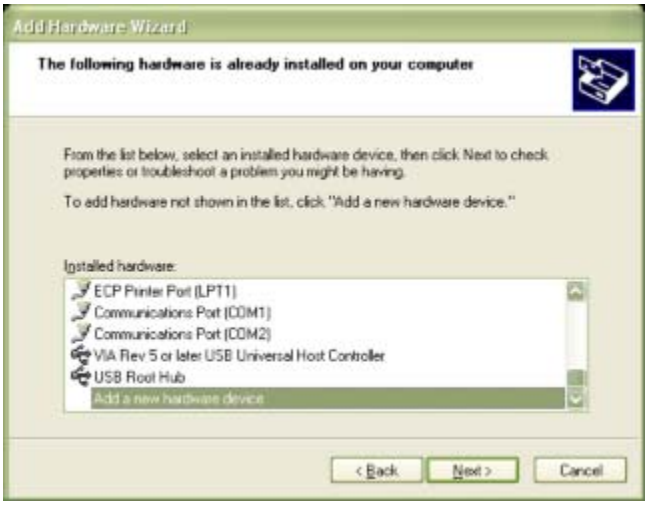
To install the COM ports in Windows XP you will be manually installing “standard” communications ports, then changing the settings for resources used by the ports to match the hardware.

Run the “Add Hardware” applet from the Control Panel.

Click “Next” at the “Welcome to the Add New Hardware Wizard” dialog.

You’ll briefly see a “...searching...” message, then

Select “Yes, I have already connected the hardware” and Click “Next”



Select “Add a new hardware device” from the bottom of the list presented and Click “Next.”

Select “Install the hardware that I manually select from a list” and Click “Next.”

Select “Ports (COM & LPT) and Click “Next”

Select “(Standard Port Types)” and “Communications Port” (the defaults), Click “Next.”

Click “Next.”



Click the “View or change resources for this hardware (Advanced)” link.

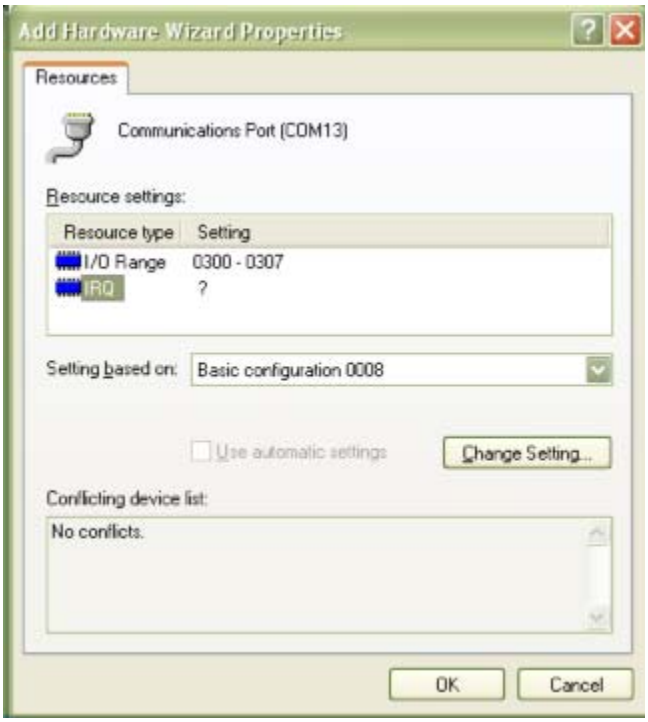


Click the “Set Configuration Manually” button.

Select “Basic Configuration 8" from the “Settings Based on:” drop-down list.

Select “I/O Range” in the “Resource Settings” box and Click the “Change Settings...” button.

Enter the base address of the board, and Click “OK”



Select “IRQ” in the “Resource Settings” box and Click the “Change Settings” button.

Enter the IRQ of the board and Click “OK”.

Close the “Set Configuration Manually” dialog and Click “Finish.”

Click “Do Not Reboot” if you wish to install more ports. Repeat all of the above steps, entering the same IRQ but using the configured Base address for each additional UART.

When you are done installing ports, reboot the system normally.

Chapter 3: OPTION SELECTION

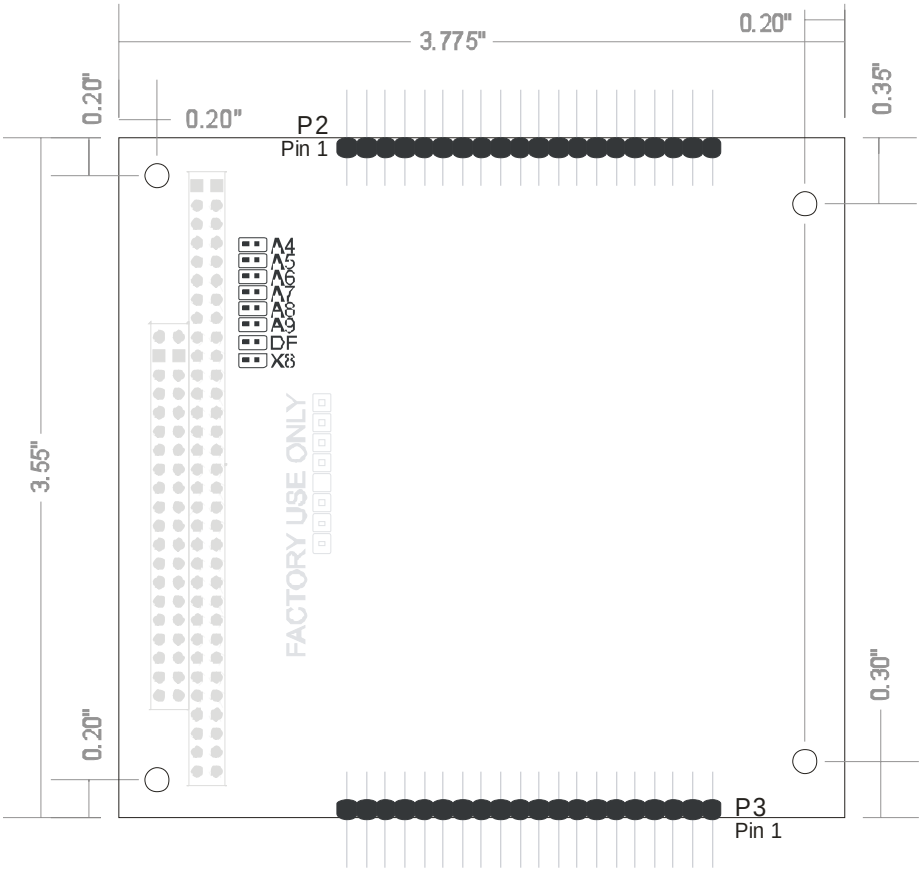


Figure 3-1: Option Selection Map

To help you locate the jumpers described in this section, refer to the Option Selection Map above. Operation of the serial communications section is determined by jumper installation as described in the following paragraphs.

DATA CABLE WIRING

The following connections are used to communicate between two ports (usually on different devices):

	Cable Pins		
Mode	Port 1	to	Port 2
	RX	to	TX
RS-232	TX	to	RX
	Ground	to	Ground

INTERRUPTS: The board supports interrupt levels 2, 3, 5, 7, 10, and 11 (Except those reserved by other installed hardware). The same interrupt is used for all channels, it must be entered into the interrupt location in the EEPROM.

Please note: In WindowsNT, changes must be made to the System Registry to support IRQ sharing. The following is excerpted from “Controlling Multiport Serial I/O Boards” provided by Microsoft in the MSDN library.Document id: mk:@ivt:nt40res/D15/S55FC.HTM, also available in the Windows NT Resource Kit. The text enclosed in brackets (“[]”) denotes a comment by ACCES.

The Microsoft serial driver can be used to control many *dumb* multiport serial boards. *Dumb* indicates that the control includes no on-board processor. Each port of a multiport board has a separate subkey under the CurrentControlSet\Services\Serial subkey in the Registry. In each of these subkeys, you must add values for **DosDevices**, **Interrupt**, **InterruptStatus**, **Port Address**, and **PortIndex** because these are not detected by the Hardware Recognizer. (For descriptions and ranges for these values, see Regentry.hlp, the Registry help file on the *Windows NT Workstation Resource Kit CD*.)

For example, if you have an eight-port COM board configured to use address 0x100 with an interrupt of 0x5, the values in the Registry are: [assuming every port is configured to use the same IRQ, and the addresses are configured to be consecutive and contiguous]

Serial2 subkey:
PortAddress = REG_DWORD 0x100
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM3
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 1

Serial3 subkey:
PortAddress = REG_DWORD 0x108
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM4
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 2

Serial4 subkey:
PortAddress = REG_DWORD 0x110
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM5
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 3

Serial5 subkey:
PortAddress = REG_DWORD 0x118
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM6
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 4

Serial6 subkey:
PortAddress = REG_DWORD 0x120
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM7
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 5

Serial7 subkey:
PortAddress = REG_DWORD 0x128
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM8
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 6

Serial8 subkey:
PortAddress = REG_DWORD 0x130
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM9
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 7

Serial9 subkey:
PortAddress = REG_DWORD 0x138
Interrupt = REG_DWORD 5
DosDevices = REG_SZ COM10
InterruptStatus = REG_DWORD 0x500
PortIndex = REG_DWORD 8

Chapter 4: ADDRESS SELECTION

The board uses a control block base address, and each port has its own base address. Each base address can be selected anywhere within an I/O address range 100-3F8 hex, providing that the address does not overlap with other functions. If in doubt, refer to the table below for a list of standard address assignments. (The primary and secondary binary synchronous communication ports are supported by the Operating System.) The FINDBASE base address locator program provided with your board will assist you to select a base address that will avoid this conflict.

Table 4-1: Standard Address Assignments for Computers

HEX RANGE	USAGE
000-00F	8237 DMA Controller 1
020-021	8259 Interrupt
040-043	8253 Timer
060-06F	8042 Keyboard Controller
070-07F	CMOS RAM, NMI Mask Reg, RT Clock
080-09F	DMA Page Register
0A0-0BF	8259 Slave Interrupt Controller
0C0-0DF	8237 DMA Controller 2
0F0-0F1	Math Coprocessor
0F8-0FF	Math Coprocessor
170-177	Fixed Disk Controller 2
1F0-1F8	Fixed Disk Controller 1
200-207	Game Port
238-23B	Bus Mouse
23C-23F	Alt. Bus Mouse
278-27F	Parallel Printer
2B0-2BF	EGA
2C0-2CF	EGA
2D0-2DF	EGA
2E0-2E7	GPIB (AT)
2E8-2EF	Serial Port
2F8-2FF	Serial Port
300-30F	reserved
310-31F	reserved
320-32F	Hard Disk (XT)
370-377	Floppy Controller 2
378-37F	Parallel Printer
380-38F	SDLC
3A0-3AF	SDLC
3B0-3BB	MDA
3BC-3BF	Parallel Printer
3C0-3CF	VGA EGA
3D0-3DF	CGA
3E8-3EF	Serial Port
3F0-3F7	Floppy Controller 1
3F8-3FF	Serial Port

The address jumpers determine the address of the control block; the addresses and interrupts of the ports are taken from the onboard EEPROM. The interrupt sharing register (mainly used in NT4) is referenced to the address of Channel A.

The address bytes entered into the EEPROM represent address lines A9 thru A3. The easiest way to determine the byte to write for a desired address is to divide the address by 8. For instance, a base address of 300 would be 300/8 = 60, an address of 308/8 = 61, and so on. (All addresses are in hex.)

ADDRESS JUMPERS

	1st Digit		2nd Digit			
Jumper Label	A9	A8	A7	A6	A5	A4
Address Line Controlled	A9	A8	A7	A6	A5	A4
Hexadecimal Value	200	100	80	40	20	10

In order to read the address jumper setup, assign a binary “1" to jumpers that are not installed and a binary “0" to jumpers installed. For example, as illustrated in the following table, jumper selection corresponds to binary 10 0000 xxxx (hex 200). The “xxx” represents address lines A3, A2, A1, and A0 used on the board to select individual registers, as described in the **PROGRAMMING** section of this manual.

EXAMPLE ADDRESS SETUP

Jumper Label	A9	A8	A7	A6	A5	A4
Conversion Factors	2	1	8	4	2	1
Jumper Installed	NO	YES	YES	YES	YES	YES
Binary Representation	1	0	0	0	0	0
Hex Representation	2		0			

Review the **ADDRESS SELECTION TABLE** carefully before selecting the board address. If the addresses of two installed functions overlap you will experience unpredictable computer behavior.

Chapter 5: PROGRAMMING

The port addresses and IRQs are selected by software through a control block; the base address of the control block is selected by jumpers. The functions within the control block are shown in the control block register map below.

Control Block Register Map

Address	Read Function	Write Function
Base Address + 0	--	Enable IRQs
Base Address + 1	--	EEPROM Address
Base Address + 2	--	EEPROM Data
Base Address + 3	--	Load EEPROM To Registers

Notes:

1) Once the EEPROM has been loaded, its data will be automatically transferred to the appropriate registers on power up. Therefore, it should normally only be necessary to issue the load to registers command when the data has been changed and it is desired to use the board without rebooting.

2) The IRQs are normally enabled when the first write to any UART occurs. It is not normally necessary to issue an enable IRQ command when using the board.

The addresses and IRQs of the ports are loaded from an EEPROM on the board. In addition to automatically loading them at power-on, they can be loaded by software by a write to the control block. The addresses and interrupts are stored in the EEPROM as shown on the EEPROM address map below.

EEPROM Address Map

EEPROM Address	EEPROM Data Meaning
1	Address for Channel A
2	Address for Channel B
3	Address for Channel C
4	Address for Channel D
5	Address for Channel E (-8 Only)
6	Address for Channel F (-8 Only)
7	Address for Channel G (-8 Only)
8	Address for Channel H (-8 Only)
9	IRQ for Channel A
A	IRQ for Channel B
B	IRQ for Channel C
C	IRQ for Channel D
D	IRQ for Channels E,F,G,H (-8 Only)

As mentioned elsewhere, the addresses entered represent A3 - A9. Therefore, the data entered is the desired address, divided by 8.

The IRQ entry is the number of the desired IRQ.

When the board is first installed in a system, the ports are not necessarily at unused addresses. To prevent conflicts with other devices in the system, the board has a jumper that disables the ports, next to the base address jumpers and labeled “DF”. The control block remains enabled in this mode, allowing software to set the port addresses appropriately. When the DF jumper is then removed, the ports will then be at the configured addresses.

To write data to the EEPROM, first write the address to the EEPROM Address register, then write to or read from the EEPROM Data register. The data transfer inside the board takes 2 milliseconds, during which the board should not be accessed. For example, to set Channel A to address 3F8, IRQ 5, with the control block base address set to 200 (by jumpers):

Write 01 to 201.
Write 7F to 202.
Wait 2ms.
Write 09 to 201.
Write 05 to 202.
Wait 2ms.
Then write anything to 203 to start using these values.

All data may be entered into the EEPROM and then written to the appropriate registers with a single write to base address + 3.

SAMPLE PROGRAMS

Sample programs are installed with the CD that ships with the board. See the CD for details.

INITIALIZATION

Initializing the chip requires knowledge of the UART’s register set. The first step is to set the baud rate divisor. You do this by first setting the DLAB (Divisor Latch Access Bit) high. This bit is Bit 7 at Base Address +3. In C code, the call would be:

```
outportb(BASEADDR +3,0x80);
```

You then load the divisor into Base Address +0 (low byte) and Base Address +1 (high byte). The following equation defines the relationship between baud rate and divisor:

desired baud rate = (clock frequency) / (16 * divisor)

Clock frequencies of 1.8432 MHz (Standard) and 14.7456 MHz (X8) are provided. Below is a table for the popular divisor frequencies:

BAUD RATE DIVISOR VALUES*

Baud Rate	Divisor (Std)	Divisor (X8)	Notes
230400	-	4	
115200	1	8	
57600	2	16	
38400	3	24	
28800	4	32	
19200	6	48	
14400	8	64	
9600	12	96	Most Common
4800	24	192	
2400	48	384	
1200	96	768	

* RS-232 communication lines have a maximum length of 50 feet, regardless of speed.

In C, the code to set the chip to 9600 baud is:

```
outportb(BASEADDR, 0x0C);
outportb(BASEADDR +1,0);
```

The second initializing step is to set the Line Control Register at Base Address +3. This register defines word length, stop bits, parity, and the DLAB.

Bits 0 and 1 control word length and allow word lengths from 5 to 8 bits. Bit settings are extracted by subtracting 5 from the desired word length.

Bit 2 determines the number of stop bits. There can be either one or two stop bits. If Bit 2 is set to 0, there will be one stop bit. If Bit 2 is set to 1, there will be two stop bits.

Bits 3 through 6 control parity and break enable. They are not commonly used for communications and should be set to zeroes.

Bit 7 is the DLAB discussed earlier. It must be set to zero after the divisor is loaded or else there will be no communications.

The C command to set the UART for an 8-bit word, no parity, and one stop bit is:

```
outportb(BASEADDR +3, 0x03)
```

The final initialization step is to flush the receiver buffers. You do this with two reads from the receiver buffer at Base Address +0. When done, the UART is ready to use.

RECEPTION

Reception can be handled in two ways: polling and interrupt-driven. When polling, reception is accomplished by constantly reading the Line Status Register at Base Address +5. Bit 0 of this register is set high whenever data are ready to be read from the chip. A simple polling loop must continuously check this bit and read in data as it becomes available. The following code fragment implements a polling loop and uses a value of 13, (ASCII Carriage Return) as an end-of-transmission marker:

```
do
{
        while (!(inportb(BASEADDR +5) & 1));    /*Wait until data ready*/
        data[i++]= inportb(BASEADDR);
}
while (data[i]!=13);                            /*Reads the line until null character rec'd*/
```

Interrupt-driven communications should be used whenever possible and is required for high data rates. Writing an interrupt-driven receiver is not much more complex than writing a polled receiver but care should be taken when installing or removing your interrupt handler to avoid writing the wrong interrupt, disabling the wrong interrupt, or turning interrupts off for too long a period.

The handler would first read the Interrupt Identification Register at Base Address +2. If the interrupt is for Received Data Available, the handler then reads the data. If no interrupt is pending, control exits the routine. A sample handler, written in C, is as follows:

```
readback = inportb(BASEADDR +2);
if (readback & 4)               /*Readback will be set to 4 if data are available*/
        data[i++]=inportb(BASEADDR);
outportb(0x20,0x20);            /*Write EOI to 8259 Interrupt Controller*/
return;
```

TRANSMISSION

To transmit a string of data, the transmitter must first check Bit 5 of the Line Status Register at Base Address +5. That bit is the transmitter-holding-register-empty flag. If it is high, the transmitter has sent the data. The process of checking the bit until it goes high followed by a write is repeated until no data remains.

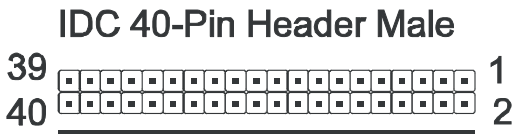
The following C code fragment demonstrates this process:

```
outportb(BASEADDR +4, inportb(BASEADDR +4)|0x02);
                                /*Set RTS bit without altering states of other bits*/
while(data[i]);                 /*While there is data to send*/
{
        while(!(inportb(BASEADDR +5)&0x20)); /*Wait until transmitter is empty*/
        outportb(BASEADDR,data[i]);
    i++;
    }
outportb(BASEADDR +4, inportb(BASEADDR +4)&0xFD);
                                /*Reset RTS bit without altering states of other bits*/
```

Chapter 6: CONNECTOR PIN ASSIGNMENTS

Two popular 40 pin IDC male connectors are used for interfacing to communication lines. Optionally, a cable is available to allow the 40 Pin Header to be split into four, 9-pin Male connectors.

The pins are numbered on each connector as shown:

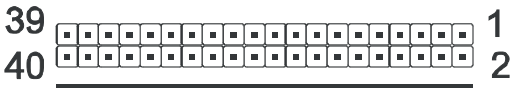


Connector pin assignments are as follows:

Connector P2 (4- and 8-port boards)

Pin	Ch	Function	Pin	Ch	Function
1	A	CD	21	C	CD
2	A	DSR	22	C	DSR
3	A	RX	23	C	RX
4	A	RTS	24	C	RTS
5	A	TX	25	C	TX
6	A	CTS	26	C	CTS
7	A	DTR	27	C	DTR
8	A	RI	28	C	RI
9	A	Ground	29	C	Ground
10			30		
11	B	CD	31	D	CD
12	B	DSR	32	D	DSR
13	B	RX	33	D	RX
14	B	RTS	34	D	RTS
15	B	TX	35	D	TX
16	B	CTS	36	D	CTS
17	B	DTR	37	D	DTR
18	B	RI	38	D	RI
19	B	Ground	39	D	Ground
20			40		

IDC 40-Pin Header Male



Connector P3 (8-port board only)

Pin	Ch	Function
1	E	CD
2	E	DSR
3	E	RX
4	E	RTS
5	E	TX
6	E	CTS
7	E	DTR
8	E	RI
9	E	Ground
10		
11	F	CD
12	F	DSR
13	F	RX
14	F	RTS
15	F	TX
16	F	CTS
17	F	DTR
18	F	RI
19	F	Ground
20		

Pin	Ch	Function
21	G	CD
22	G	DSR
23	G	RX
24	G	RTS
25	G	TX
26	G	CTS
27	G	DTR
28	G	RI
29	G	Ground
30		
31	H	CD
32	H	HSR
33	H	RX
34	H	RTS
35	H	TX
36	H	CTS
37	H	HTR
38	H	RI
39	H	Ground
40		

Chapter 7: SPECIFICATION

COMMUNICATIONS INTERFACE

Number of Ports	Varies by card version (8, 4, or 2)
Type of Port	RS232
Connectors	Two 40-pin connectors are provided on the 8-port board One 40-pin connector is provided on the 4-port board One 20-pin connector is provided on the 2-port board
Control Signals	DTR, DSR, RTS, CTS, RI, TxD, RxD, CD
Bus	PC/104, ISA
UART	16C654 (8-port board - 16L788)
Output Driver	Sipex 211E Output Voltage Swing: ±5V Minimum, ±7V Typical Input Voltage Swing: ±15V Receiver Threshold: 2.8V high, 0.8V low, Maximum input ±15V
Throughput	Individually programmed, up to 230.4 kbps
I/O Addressing	Each port address is user programmed into an onboard EEPROM Each port uses 8 consecutive addresses
Interrupts	Interrupts are user programmed into an onbbard EEPROM Individual interrupts for ports A-D and common interrupt for ports E-H on 8 channel only

ENVIRONMENTAL

Operating Temperature Range:	0 to +60 °C
Storage Temperature Range:	-50 to +120 °C
Humidity:	5% to 95%, non-condensing
Power Required:	+5 VDC at 400 mA typical, 800 mA maximum (8 channel card)
Size:	PC/104 format, 3.5” by 3.75”

Customer Comments

If you experience any problems with this manual or just want to give us some feedback, please email us at: ***manuals@accesio.com.*** Please detail any errors you find and include your mailing address so that we can send you any manual updates.

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