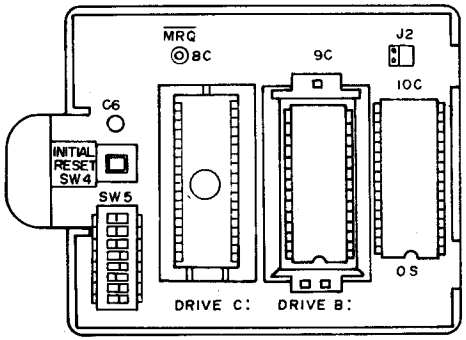
4. Insert the new ROM capsule.Verify that the pins of the ROM capsule are seated properly in the socket, and make sure that the end with the notch is positioned as shown in the figure below.



5. Replace the ROM capsule compartment cover.
6. Turn on the power switch.

NOTE:
System operation may be disrupted if a ROM capsule is removed or installed without turning off the power.

Chapter 3

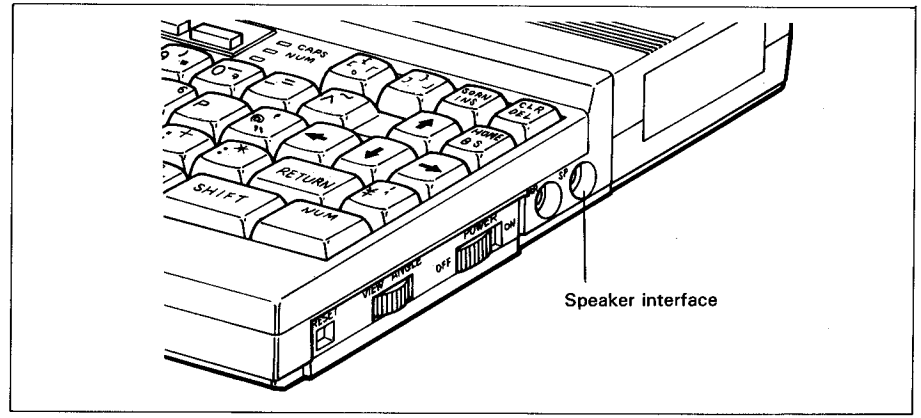
STANDARD INPUT/OUTPUT INTERFACES

Input/output interfaces are the part of the hardward system through which PX-4 exchanges data with external devices such as printers or other computers. These signals make it possible for PX-4 to receive data for processing from other external devices, or to output drive/control signals and data to optional devices. All interfaces except the bar code reader are supported by BIOS of CP/M or BASIC (no standard software support is provided for the bar code reader interface).

This chapter describes the functions of PX-4's eight standard input/output interfaces and procedures for using them.

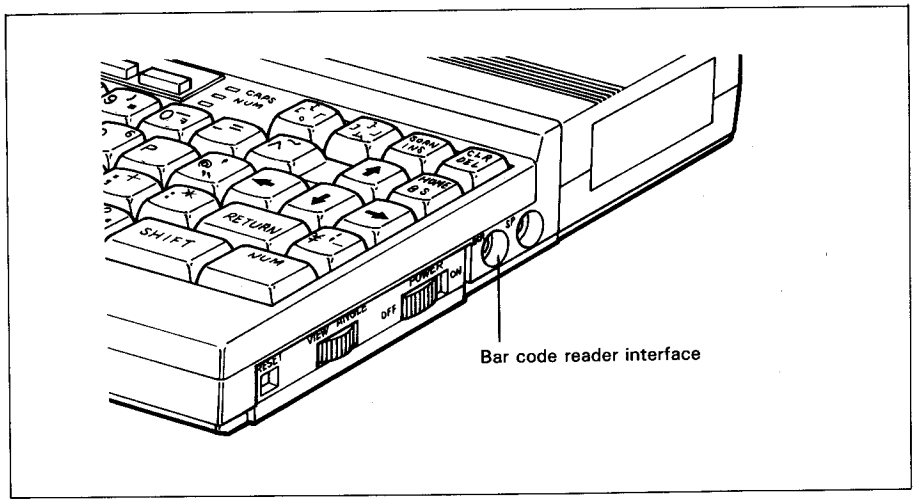
3.1 Speaker Interface

An external speaker can be connected to PX-4's external speaker interface. When an external speaker is connected, speaker output goes to the external speaker instead of to the speaker which is built into PX-4. Speakers (or earphones) which can be connected must have a nominal impedance of at least 100 ohms.



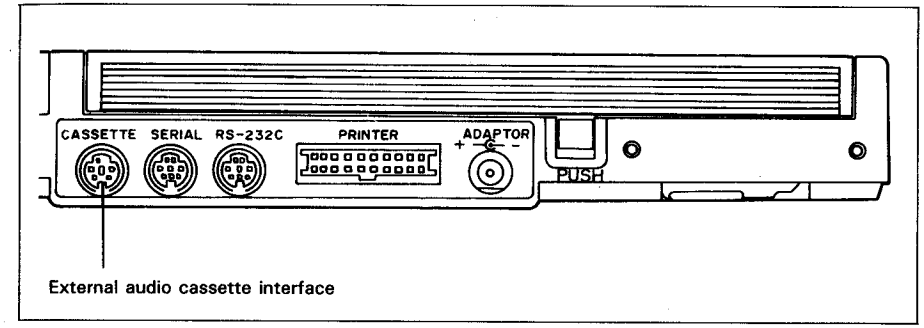
3.2 Bar Code Reader Interface

The bar code reader interface makes it possible to connect an optional bar code reader (the H00BR CODE JA) to PX-4. Utility software (sold separately) which supports the bar code reader must be installed in order to use the bar code reader.

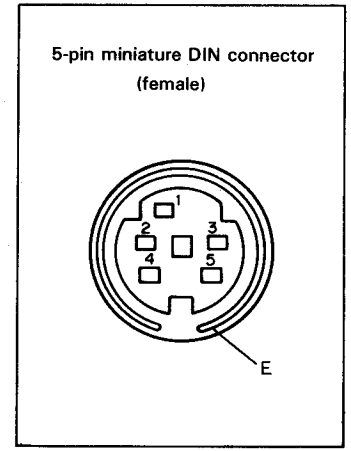


3.3 External Audio Cassette Interface

PX-4 supports the external audio cassette interface as a sequential input/output device. When an external cassette recorder is connected to this interface, it can be accessed from BASIC under the device name "CAS0:".



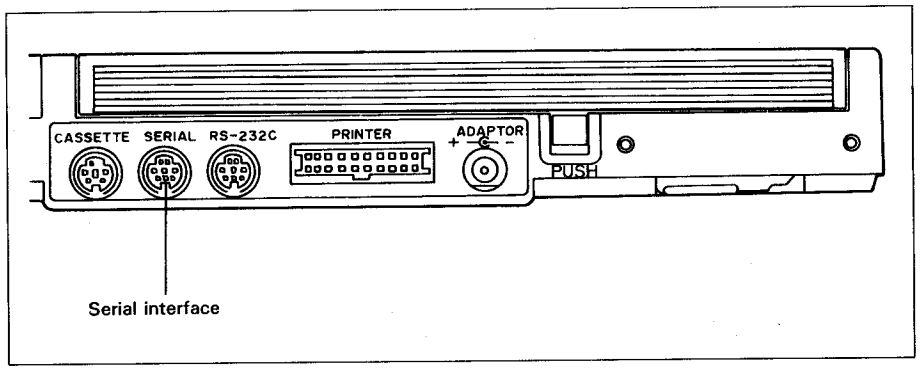
If you wish to use an external cassette recorder, connect it to PX-4 using cable set #732.



Pin No.	Symbol	Signal Direction	Signal Name
1	GND	—	Ground
2	RMT	OUT	Remote output
3	RMT	OUT	Remote output
4	MIC	IN	Microphone input
5	EAR	OUT	Earphone output
E	—	—	—

3.4 Serial Interface

PX-4's serial interface makes it possible to connect a floppy disk unit (the PF-10, TF-15) or serial printers (printers which are equipped with the RS-232C interface) to PX-4.



The communication protocol used with floppy disk units differs from that used for printers as shown below.

Floppy disk units

Bit rate:	38,400 bps
Control lines used:	None (control is by software)

Printers

Bit rate:	4,800 bps (see Note 2 below)
Control lines used:	Printer DSR line

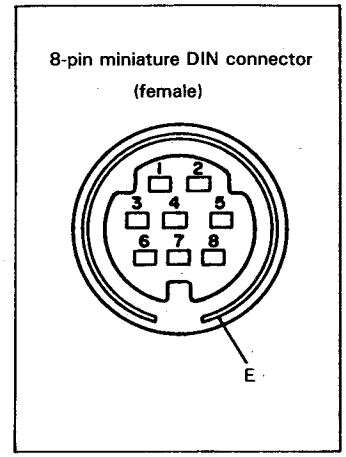
Cables which can be connected to the serial interface must be equipped with an 8-pin miniature DIN connector. When connecting a printer, use cable set #725; when connecting a floppy disk unit, use one of the cable sets indicated below.

PF-10 or TF-15	Cable set #726

The assignments of connector pins on PX-4 are as follows.

NOTES:

1. *When connecting the P-40 or P-80 printer, use cable set #723.*
2. *Bit rate settings which can be made with the optional CONFIG command are as follows.*
   110, 150, 200, 300, 600, 1100, 2400, 4800, 960, 19200, or 38400 bps

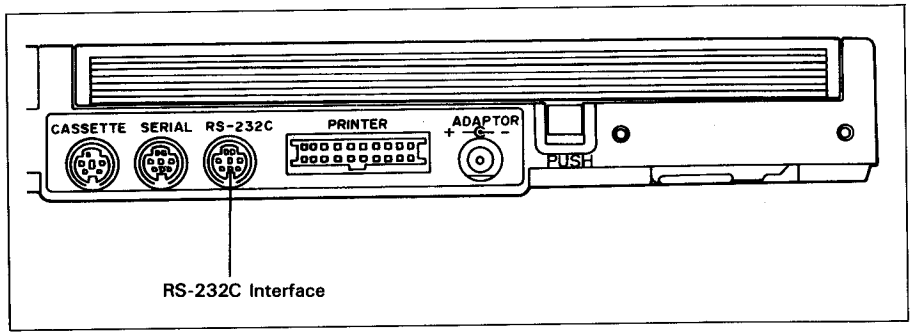


Pin No.	Symbol	Signal Direction	Signal Name
1	GND	—	Ground
2	PTX	OUT	Transmitted data
3	PRX	IN	Receive data
4			
5			
6	PIN	IN	Status ready
7	POUT	OUT	Control signal
8			
E	CGND	—	Frame ground

NOTE:
Signal direction is as viewed from PX-4.

3.5 RS-232C Interface

RS-232C is the designation of the Electronic Industries Association (EIA) for a standard which defines interfaces for connecting computer terminals to acoustic couplers or modems.



The RS-232C interface is provided primarily to allow the CX-21 acoustic coupler to be connected to PX-4, enabling communications with other computers via public telephone lines. The interface can also be used to connect PX-4 directly to other computers (such as another PX-4 or the QX-10) which are equipped with the RS-232C interface. In the later case, a special cable must be used to connect the two computers.

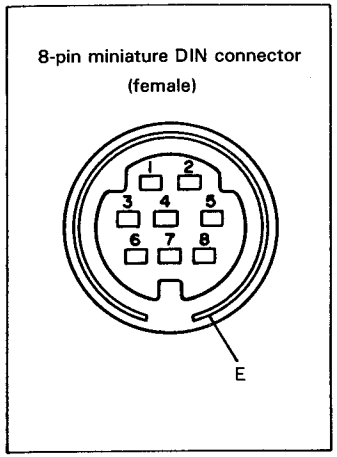
When a printer which is equipped with an RS-232C interface is used, it can be connected to this interface or the serial interface.

3.5.1 Signal lines

Cables which are connected to the RS-232C interface must be equipped with an 8-pin miniature DIN connector. When connecting the CX-21 acoustic coupler, use cable set #725. When connecting PX-4 to another PX-4 or the QX-10, use cable set #726.

NOTE:
When connecting the P-40 or P-80 printer, use cable set #723.

The assignments of RS-232C connector pins on PX-4 are as follows.



Pin No.	Symbol	Signal Direction	Signal Name
1	GND	—	Ground
2	TXD	OUT	Transmitted data
3	RXD	IN	Receive data
4	RTS	OUT	Request to send
5	CTS	IN	Clear to send
6	DSR	IN	Data set ready
7	DTR	OUT	Data terminal ready
8	DCD	IN	Data carrier detect
E	CGND	—	Frame ground

NOTE:
Signal direction is as viewed from PX-4.

Functions of the various signals are as follows.

GND (Ground)
Provides the reference voltage (ground) with respect to which the levels of other signals are determined. Connected to the ground line on the modem or acoustic coupler.

TxD (Transmitted data)
Signal line used for data output to the connected device.

RxD (Receive data)
Signal line used for data input from the connected device.

RTS (Request to send)
Signal line used by the computer to control a modem or acoustic coupler. When this signal is ON, the modem's carrier signal is output to prepare for transmission.

CTS (Clear to send)
Line which informs the computer of the status of the modem or acoustic coupler. When ON, the modem (acoustic coupler) is ready to receive data for output to the telephone line, indicating that the computer may begin sending.

DSR (Data set ready)
This signal line informs the computer of the status of the data set (the modem or acoustic coupler connected to the interface). When ON, the modem (acoustic coupler) is turned on and is ready for operation.

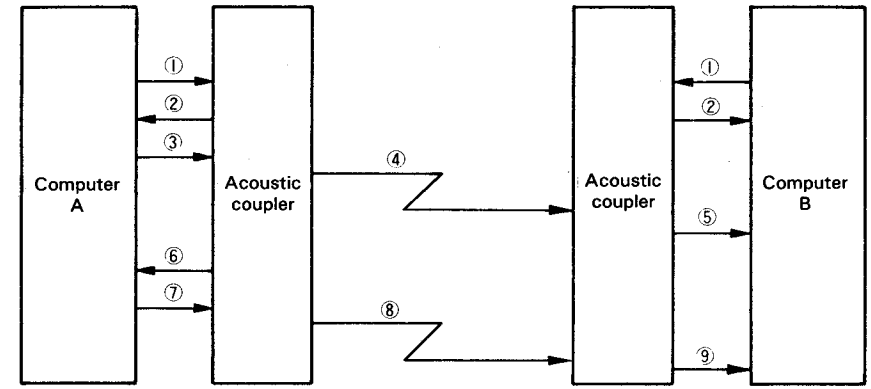
DTR (Data terminal ready)
This signal line informs the modem (acoustic coupler) of the computer's status. When ON, the computer is turned on and ready for operation.

DCD (Data carrier detect)
Signal line used for detecting the carrier signal from the connected device (modem or acoustic coupler).

CGND (Frame ground)
Connected to the PX-4's chassis. Ordinarily, also connected to the corresponding terminal on the other device.

3.5.2 Data transfer prototol — Data transfer via acoustic coupler

The figure below illustrates the steps involved in data transfer between two computers over a telephone using the RS-232C interface and acoustic couplers. In this figure, data is transferred from computer A to computer B.



1. Computers A and B inform their acoustic couplers that they are ready for operation by outputting the DTR signal.
2. Computers A and B check the DSR signal to verify that the acoustic couplers are ready for operation.
3. Computer A outputs the Request to send (RTS) signal to its acoustic coupler.
4. The acoustic coupler prepars for transmission by outputting the carrier signal to the telephone line.
5. Computer B verifies that the carrier is present by checking the Data carrier detect (DCD) line.
6. Computer A verifies that its acoustic coupler is ready for transmission by checking the Clear to send (CTS) line.
7. Computer A outputs data to the acoustic coupler over the Send data (TxD) line.
8. Computer A's acoustic coupler converts data into an acoustic signal (modulates it) and outputs it to the telephone line.
9. Computer B's acoustic coupler receives the acoustic signal from the telephone line, converts it back into a digital signal (demodulates it), and sends it to computer B over the Receiv3e data (RxD) line.

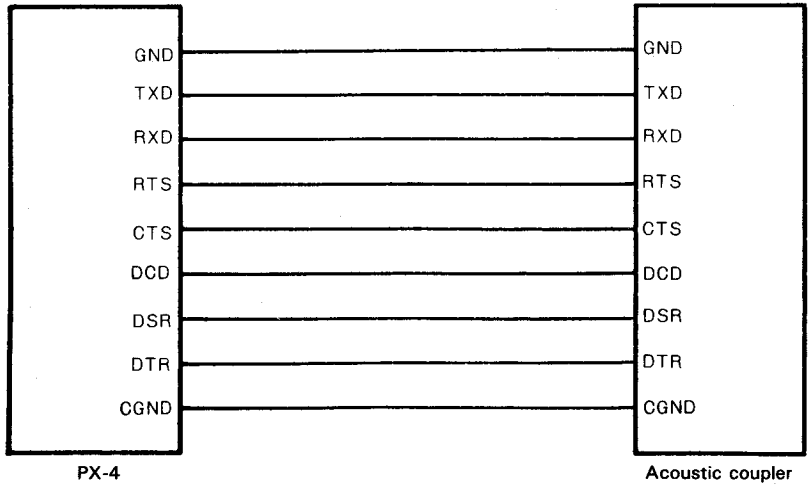
3.5.3 Pin connections of the RS-232C interface

The manner in which the pin of the RS-232C interface are connected differs according to whether PX-4 is being connected directly to another computer or is connected via an acoustic coupler.

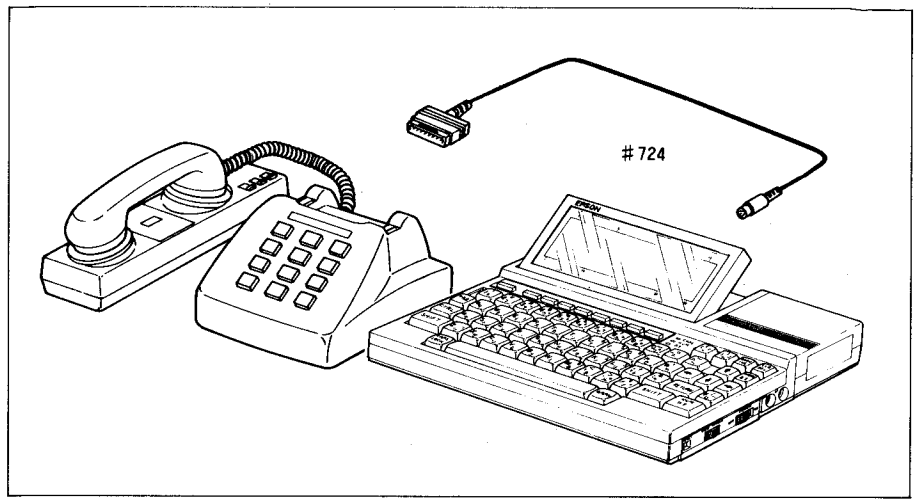
NOTE:
The communication format (bit rate, parity, number of stop bits, number of bits per character, etc.) which is used may also differ according to whether an acoustic coupler is used. See section 3.5.4 concerning the communication format.

Connection to an acoustic coupler

When an acoustic coupler is connected to PX-4, pins in the acoustic coupler must be connected to their counterparts on PX-4. This is illustrated below.

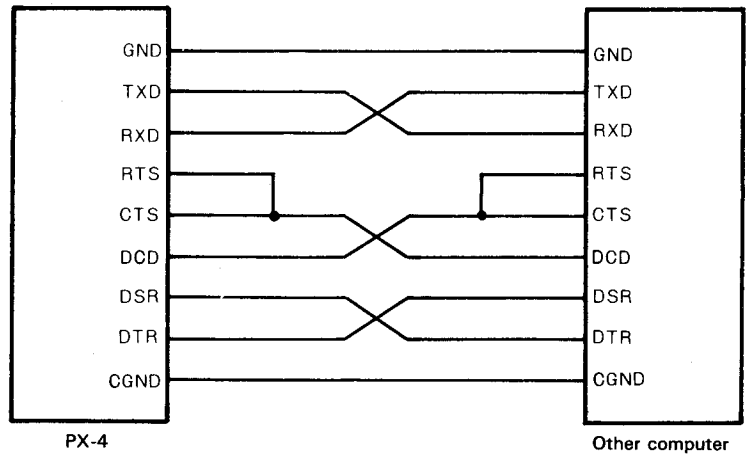


When using an acoustic coupler, connect it to PX-4 using cable set #724.

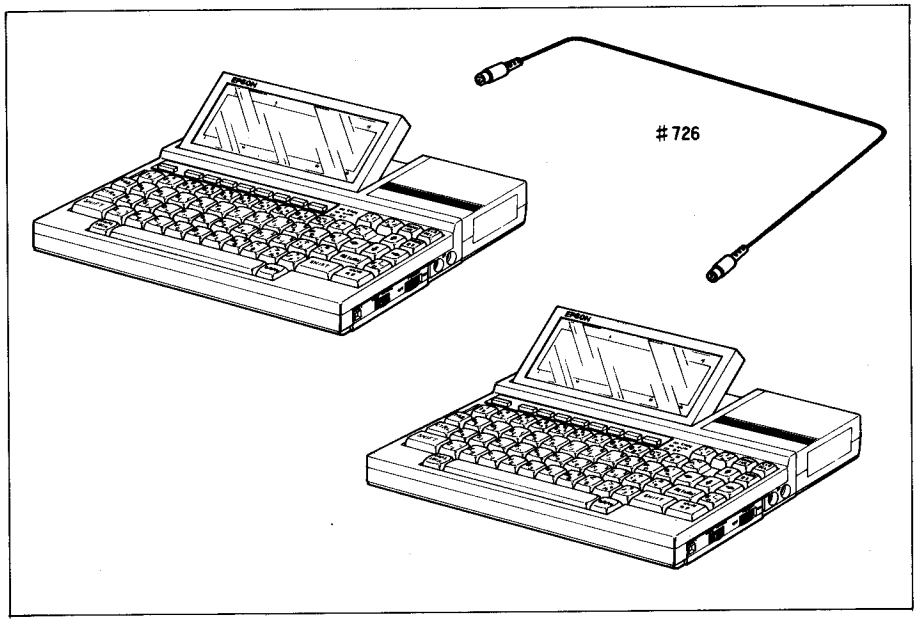


Direct connection to another computer

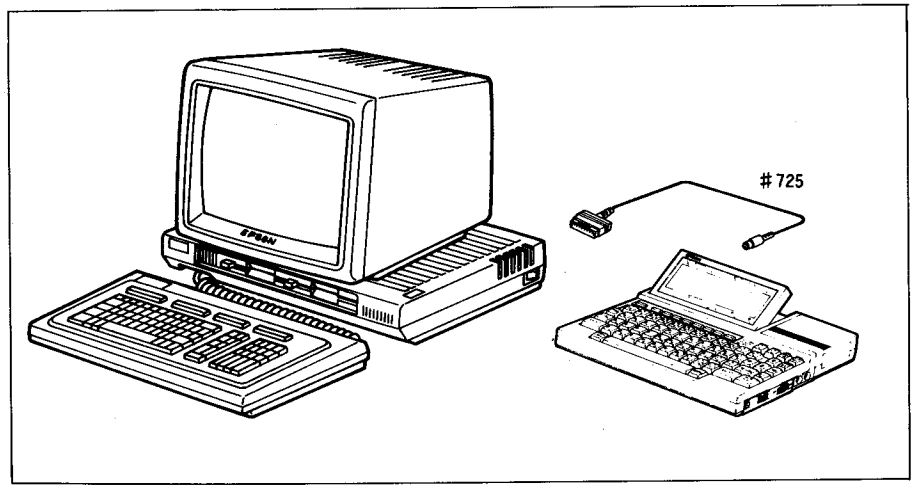
The figure below illustrates one of several possible methods which can be used to connect PX-4 directly to another computer via the RS-232C interface.



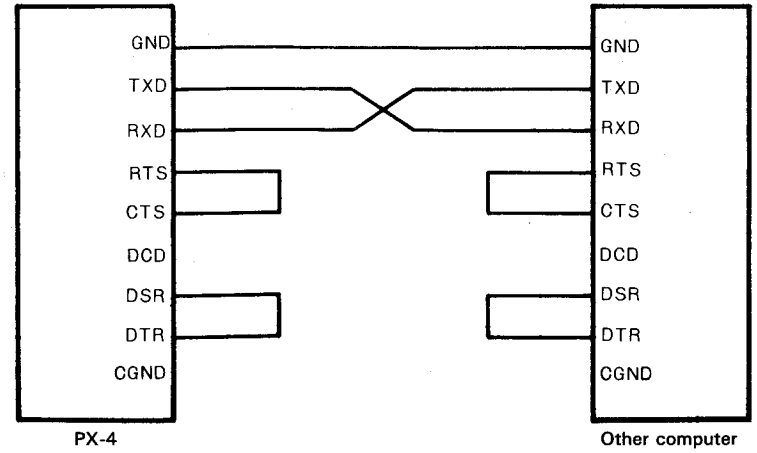
When connecting PX-4 to another PX-4 computer, use a null modem cable (cable set #726).



When connecting PX-4 to a printer which is equipped with an RS-232C interface or to an EPSON QX-10, use cable set #725.



If data is to be transferred between PX-4 and another computer without using the data transfer protocol described above, connections may be made as shown below.



EPSON does not currently provide any cable for making the type of connection shown above.

NOTE:
The BIOS subroutine which provides control over the RS-232C interface is the RSIOX routine. See Appendix C "BIOS SUBROUTINES" for further information.

3.5.4 Data transfer format

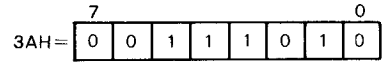
When data is transferred via the RS-232C interface, the bits of each byte (character) are transferred serially, starting with the least significant bit (bit 0) and ending with the most significant bit (the highest bit). The bits of data making up each byte are preceded by a start bit and followed by one or two stop bits; the start bit and stop bit(s) make it possible for the receiving computer to keep track of the where each character starts and stops (this method is referred to as start-stop transmission).

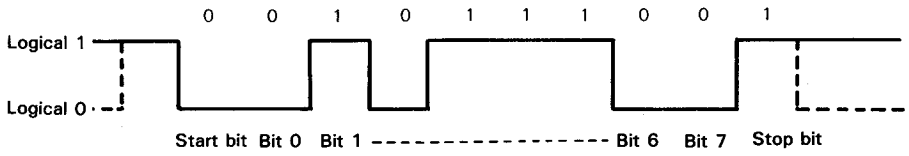
As was explained in the previous section, start-stop transmission involves connection of various control signal lines and two data signal lines. Separate data signal lines are used for sending data (the TxD line) and receiving data (the RxD line).

The data transfer format (TxD and RxD) is as follows.

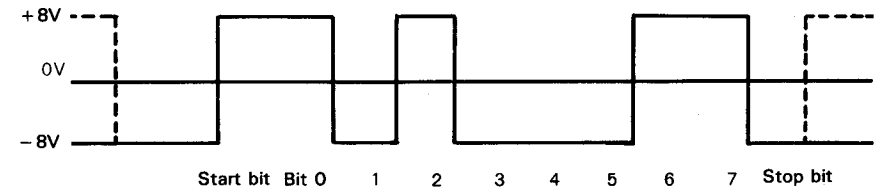
- Each character of data is separated from the others by a start bit and one or two stop bits.
- Each character of data is made up of 7 or 8 data bits.
- A parity bit may be included immediately before the stop bit. When parity bits are included, either even parity or odd parity may be specified (with even parity, the parity bit is "0" if there is an even number of "1" data bits, and is "1" if there is an odd number of "1" data bits; the opposite is true when odd parity is used).

For example, the data format is as follows when there is one stop bit, each byte consists of eight data bits, and no parity bit is included. (The data transfer format can be set with the OPEN statement of BASIC or with the RSIOX routine of BIOS.) Here, it is assumed that the character being transmitted is that whose hexadecimal code is 3AH.





Since the actual voltage level on the signal line is −5V for a logical "1" and +5V for a logical "0", the voltage level on the line changes as follows when 3AH is sent as shown above.



3.5.5 Communication speed

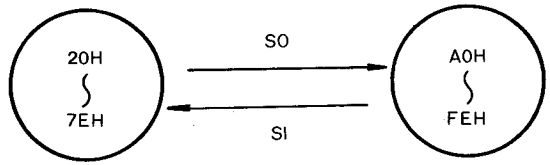
PX-4's RS-232C interface supports communication speeds from 110 to 38,400 bits per second (bps).

The communication speed can be set with the OPEN statement of BASIC, the RSIOX routine of BIOS, or the optional CONFIG command.

3.5.6 Shift-in/shift-out (SI/SO)

"Shift-in" and "shift-out" are control codes which are used for converting characters between the 7-bit and 8-bit code systems. When these codes are included in data transferred, conversion is performed as shown below.

During transmission



During reception

- After receiving an SI code, the receiving computer unconditionally sets bit 7 of all characters received to zero.
- After receiving an SO code, the receiving computer converts the following codes as indicated and leaves other codes unchanged.

20H ~ 7EH --------► A0H ~ FEH

3.5.7 XON/XOFF

When the speed of data transmission is higher than the speed with which data received can be processed, a receive buffer overflow is likely to occur; in other words, the receive buffer becomes completely full and incoming data is lost (this never occurs if the size of the receive buffer is greater than the amount of data received). The XON/XOFF function is provided to make it possible to avoid data loss in such cases. When the function is used, the receiving computer outputs an XOFF code to the RS-232C interface whenever the receive buffer becomes 3/4 full. When the sending computer is also using the XON/XOFF function, this tells it to stop sending.

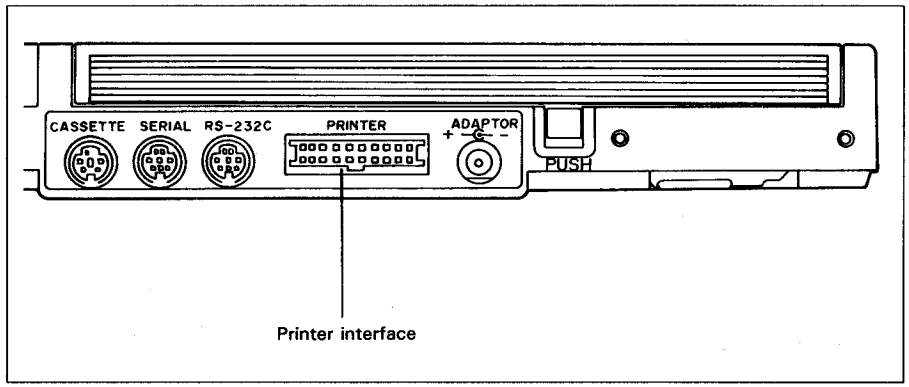
While the sending computer waits, the receiving computer continues processing data in the receive buffer. When the buffer becomes 3/4 empty, the computer outputs the XON code to the sending computer to tell it that transmission can be resumed. When the sending computer receives the XON code, it resumes transmission at the point at which it was interrupted.

The XOFF command is [CTRL] + [S] (13H), and the XON command is [CTRL] + [Q] (11H).

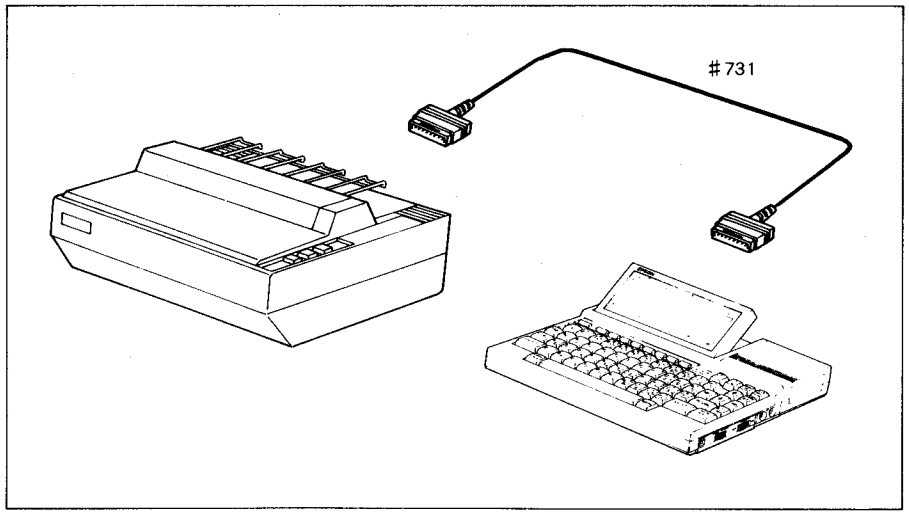
Whether or not the XON/XOFF function is used is determined at the time the RS-232C interface is opened by the OPEN statement of BASIC or the RSIOX routine of BIOS.

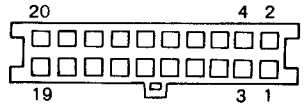
3.6 Printer Interface

PX-4 is equipped with a Centronics-type parallel interface which makes it possible to connect PX-4 to similiarly equipped printers. When connecting such a printer to PX-4, use cable set #731.



Types of printers which can be connected to PX-4 are listed in 4.2 "Printers".



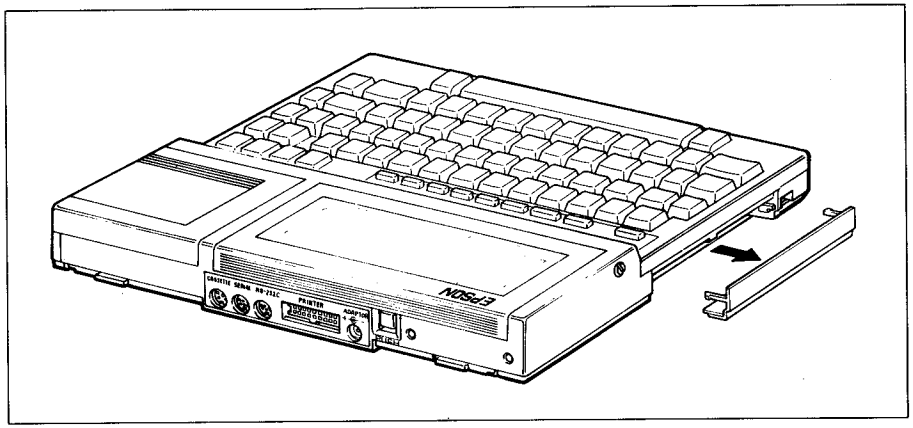


Pin No.	Symbol	Direction	Signal Name
1	CG	—	Ground
2	CG	—	Ground
3	PD7	OUT	Parallel data
4	BSY	IN	Printer busy
5	PD6	OUT	Parallel data
6	+5	—	+5V power supply
7	PD5	OUT	Parallel data
8	+5	—	+5V power supply
9	PD4	OUT	Parallel data
10	GND	—	Signal ground
11	PD3	OUT	Parallel data
12	$\overline{\text{ERR}}$	IN	Error signal from printer
13	PD2	OUT	Parallel data
14	GND	—	Signal ground
15	PD1	OUT	Parallel data
16	$\overline{\text{INIT}}$	OUT	Reset signal
17	PD0	OUT	Parallel data
18	GND	—	Signal ground
19	$\overline{\text{STB}}$	OUT	Strobe signal
20	—	—	—

NOTE:
Signal direction is from the point of view of PX-4.

3.7 System Bus

The connector on the inside of the cover on the side of PX-4 is the system bus. The external RAM disk unit is connected to this connector.

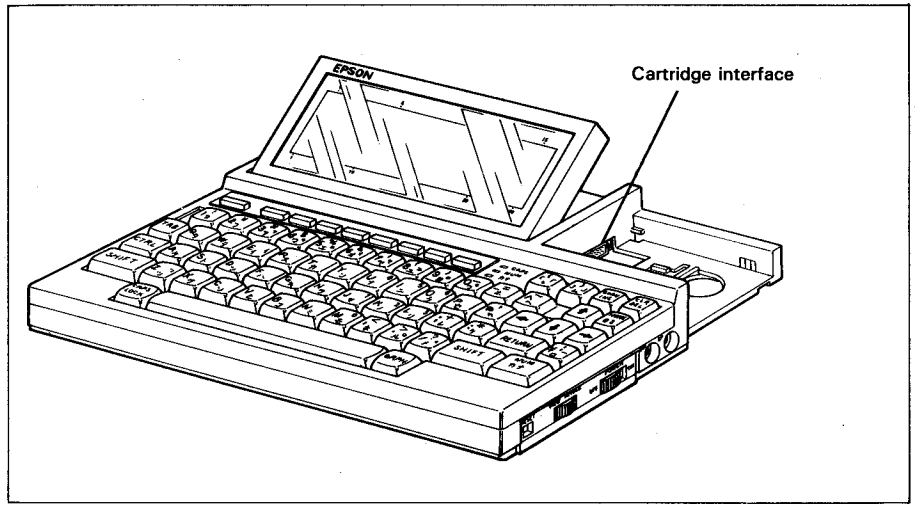


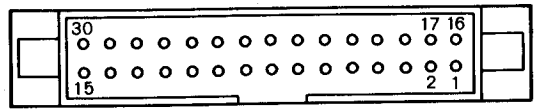
See Appendix A "HARDWARE SPECIFICATIONS" for details on the system bus.

3.8 Cartridge Interface

A cartridge interface is provided to the side PX-4's LCD screen which makes it possible to connect a variety of cartridge-type options. Options currently available as cartridges are as listed below. For details, see 4.1 "Cartridge Options".

1. RAM cartridge
2. ROM cartridge
3. Microcassette drive
4. Universal cartridge
5. Digital multimeter cartridge
6. Cartridge printer





Pin No.	Symbol	Direction	Signal Name
1	GND	—	Signal ground
2	CAUD	IN	Digital audio input signal
3	CDB4	I/O	Data bus
4	CRD	I/O	Read signal
5	CDB0	I/O	Data bus
6	CITO	OUT	Interrupt signal to cartridge
7	CCS	I/O	Chip select
8	CRS	OUT	Reset
9	CAB0	I/O	Address bus
10	CSEL	IN	Option select signal
11	GND	—	Signal ground
12	CDB2	I/O	Data bus
13	VB1	—	Battery
14	CRXD	IN	Serial receive data
15	−5V	—	−5V power supply
16	+5V	—	+5V power supply
17	CG	—	Frame ground
18	CDB1	I/O	Data bus
19	CG	—	Frame ground
20	CAB1	I/O	Address bus
21	FPOF	OUT	Power failure signal
22	CDB7	I/O	Data bus
23	CDB3	I/O	Data bus
24	CEN	IN	6301EN signal
25	CWR	I/O	Write signal
26	CTXD	OUT	Serial send data
27	CDB6	I/O	Data bus
28	RS	OUT	Hardware reset
29	CDB5	I/O	Data bus
30	VB2	—	Backup power supply

NOTE:
Signal direction is from the point of view of PX-4.

Chapter 4

OPTIONAL DEVICES

This chapter describes optional devices which can be used with PX-4 and procedures for connecting them.

4.1 Cartridge Options

The cartridge interface located next to PX-4's LCD screen makes it possible to connect a variety of cartridge-type options. The cartridge options are as listed below.

1. RAM cartridge
2. ROM cartridge
3. Microcassette drive
4. Universal cartridge
5. Digital multimeter cartridge
6. Cartridge printer

These optional cartridges are installed in the location indicated in the figure below.

WARNING:
Be sure to turn the power off before installing or removing any cartridge option.