16 APPLE II COMMUNICATIONS

16.1 INTRODUCTION

This section contains an outline of the basic principles of serial communications and covers the following areas:

(i) Data Communications
(ii) Add-in modems
(iii) Data Encryption
(iv) Videotex.
(v) Multifunction

Apple II communications boards cover both synchronous and asynchronous transmission, a detailed review of which is covered in Chapter 29 on the RS232C serial interface.

16.2 DATA COMMUNICATIONS

The process of transferring data from one computer to another is a matter of some complexity and has many pitfalls for the unwary; it depends upon the communication medium and the conventions agreed by the transmitting and receiving devices to ensure that meaningful communication can take place. When two individuals converse over the telephone network they automatically adopt a number of conventions that are so commonplace that they are almost transparent, i.e., the communicators are almost unaware of them. At the simplest level there is 'handshaking', i.e. the talker does not launch into conversation until he has received confirmation that the receiver is listening. This handshaking also ensures that communication continues until both sides agree that they have finished. Similarly, communicating computers must exchange handshaking signals to originate and terminate communication.

Telephone communications traditionally involve a two wire circuit but with data flow there exists a choice between parallel and serial transmission. Eight wires are used with parallel transmission and the bits of individual bytes are placed simultaneously on the appropriate wire; this form of communication is fast but is only employed over comparatively short distances, e.g. from a computer to peripherals, instruments etc. With serial transmission the bits of each byte are transmitted in sequence and the signal takes one of two values corresponding to 1 and 0. Clearly the signal can only be interpreted in conjunction with a specified clock frequency and both receiver and transmitter require synchronized clocks running at the same speed.

SERIAL COMMUNICATIONS

Telephone conversations employ natural language which is rich in redundancy so that minor noise or interference on a line causes no loss of information. Whenever the transmission is seriously impaired the person at the receiving end will simply request a repeat of a phrase. Similarly, redundant coding techniques of various degrees of sophistication are employed in data communications. At the simplest level the number of bits in a block of data, e.g. a byte, are counted and an extra bit (called parity bit) is set to 1 or 0 depending whether the sum is odd or even. Thus with an agreed parity convention the receiver can check for one bit error by simply checking whether the sum of bits (including parity bit) in a block, is odd or even.

Serial transmission can be performed in synchronous or asynchronous mode. In the case of synchronous transmission large blocks of data, including redundant codes, are forwarded without interruption. It is essential that the transmitter and receiver clocks remain in synchronism throughout transmission and the communication medium must be of high quality. Asynchronous transmission is slower but makes less demands upon the communication medium and the quality of synchronization, it is commonly used in communication between a microcomputer and its peripherals and for long distance data communication.

With asynchronous communication each byte is sent as an individual entity. In between byte transmission the transmitter holds the line in an idle state, the line then goes active (or high) for one clock period, this notifies the receiver that transmission of data is about to commence. The next eight clock periods are used to send the binary digits of the byte followed by a parity bit. The line is then held low for two clock periods (called stop bits).

Asynchronous transmission makes less demands upon the technology employed, e.g. the clocks are only required to remain in synchronism for some
tenth cycles, but there is a cost of high redundancy with extra stop and start bits. Transmission rates for asynchronous communications are in terms of hundreds, or a few thousand, bits per second. The transmission rate is often expressed in baud. Strictly speaking a baud refers to the number of ‘signal events’ per second, but for all practical purposes it is largely interpreted as a bit per second.

It is clear that data communication demands a considerable degree of agreement between the transmitter and receiver, e.g. with asynchronous communications the number of stop and start bits, clock speed, parity checking etc. must be established prior to transmission. National and international standards are therefore employed to overcome the myriad incompatibilities that would arise with ad hoc conventions by individuals and manufacturers.

16.3 MODEMS

The growth of personal computing and the wide distribution of computing power led inevitably to an increased demand to link computing systems over the public telephone network. Salesmen with portable microcomputers can download daily orders to the office mainframe, from home or hotel room; reports written on word processors can be transmitted office mainframe, from home or hotel room; reports written to a screen but file transfers are uncomfortably slow, a 40 Kb file, representing only 10 pages of A4, would take 20 minutes to transmit.

Medium speed modems do not use frequency modulation, but employ phase modulation, or phase shift keying. This technique maintains a constant frequency throughout transmission but the phase is shifted, a digital one is indicated by no phase deviation while a zero is designated by a 180 degree phase shift.

The protocols employed by modems differ between the UK/Europe and the USA. In UK/Europe the protocols are based upon the V Series of CCITT Recommendations while the US use Bell and Racal-Vadic standards.

### TABLE OF FREQUENCIES

<table>
<thead>
<tr>
<th>MODE</th>
<th>SIGNAL</th>
<th>FREQ (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V21</td>
<td>ORIGINATE 0</td>
<td>1180</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>980</td>
</tr>
<tr>
<td></td>
<td>ANSWER 0</td>
<td>1850</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1650</td>
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<tr>
<td>BELL</td>
<td>ORIGINATE 0</td>
<td>1070</td>
</tr>
<tr>
<td>103</td>
<td>1</td>
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<tr>
<td></td>
<td>ANSWER 0</td>
<td>2025</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2225</td>
</tr>
</tbody>
</table>

The V21 standard (UK/Europe) and its US equivalent (Bell 103) employ frequency shift keying (see Table of Frequencies), full duplex, 300 baud operation. Since they employ different frequencies V21 modems cannot be directly connected to Bell 103 devices. V22, Bell 212A and Racal-Vadic standards operate at 1,200 baud, full duplex and employ phase shift modulation. This technique is susceptible to line noise which presents no problems in the US but UK users are advised to investigate private circuit facilities for this class of communication. Bell 212A is a subset of V22 and is compatible with it. The Bell 212A uses a different signal frequency to the Racal-Vadic and the two protocols are not, therefore, compatible. The Bell 202 modem also operates at 1,200 baud but in half duplex mode and is therefore incompatible with 1,200 baud, full duplex devices.

In the UK, V23 modems are used for 1,200 baud full duplex over 4 wire circuits or 1,200/75 over two wire circuits, full duplex (the 75 baud is the back channel). This modem works on PSK modulation and, because it is relatively inexpensive, it is often used for computer communications. In fact, Prestel, the UK videotex service, is offered at these transmission rates.

A convenient way of overcoming the different transmission standards for US/Europe data communi-