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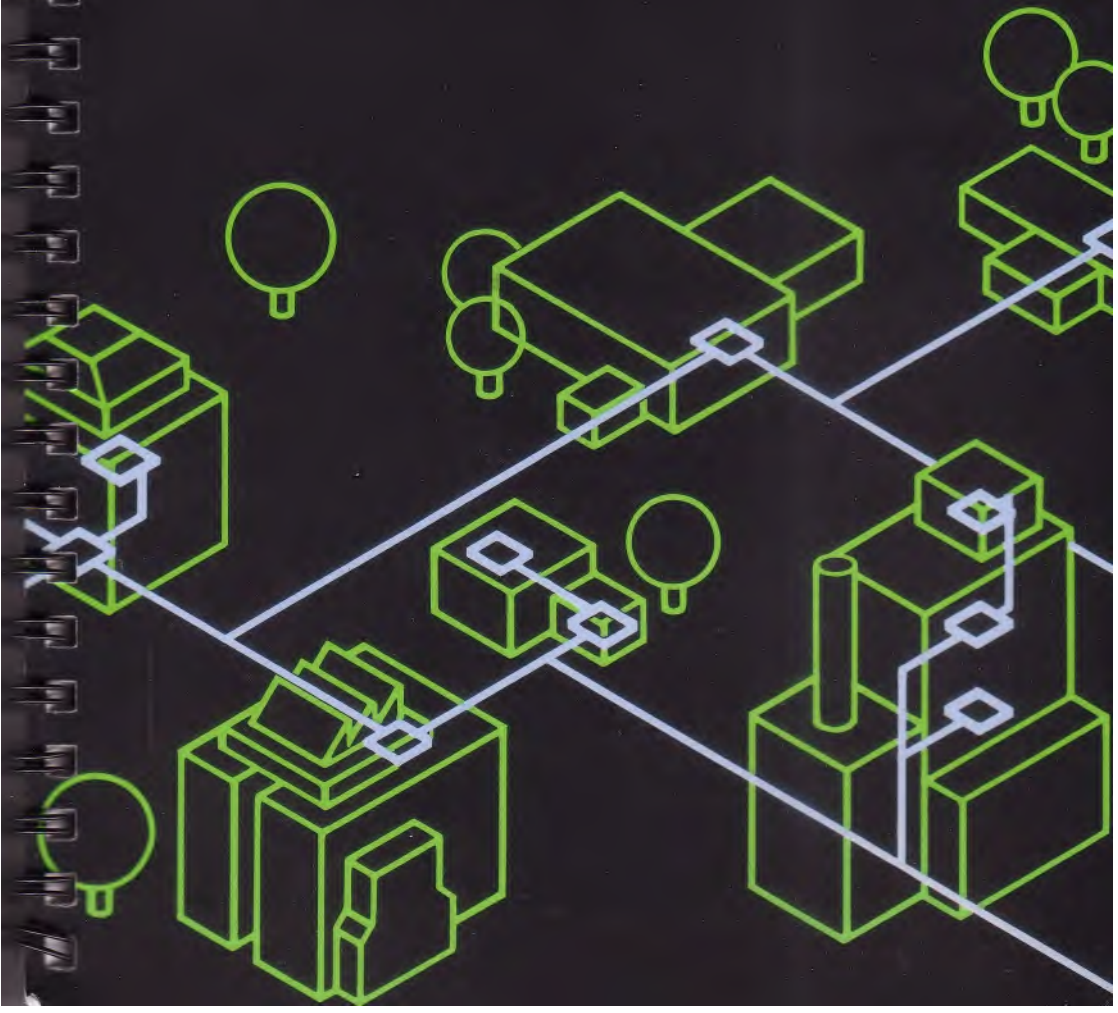
Econet

INSTALLATION GUIDE



Econet Installation Guide

Part No 0482,009
Issue 1
27 September 1988

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WARNING - DANGEROUS VOLTAGES

BEFORE WORKING ON ANY OF THE ECONET UNITS OR STATIONS ATTACHED TO ECONET WITH A COVER REMOVED, SWITCH OFF, **DISCONNECT THE MAINS PLUG FROM THE SUPPLY AND REFER TO THE EQUIPMENT SERVICE MANUALS FOR WARNINGS AND CAUTIONS**

CAUTION - ELECTROSTATIC DA NI AGE

DO NOT TOUCH COMPONENTS OR CONNECTIONS ON THE PRINTED CIRCUIT **BOARDS**

Contents

About this Guide

This *Econet Installation Guide* is a guide and reference for the installation of Econet data networks. It takes you through the different types of Econet installation, describes the equipment, gives procedures for physical installation, and, once installed, tells you how to set up the network and install the software to run it.

It will also help you to obtain an overview of an existing network, particularly if you wish to add to or modify your existing equipment and faeilities.

The Introduction discusses the basic principles of data networks in general and Econet in particular, introducing the basic components which are common to every Eeonet network.

Chapter 1 deseribes the various types of Econet network; the 'one room' network, permanently installed networks of up to 500 metres in length, and larger systems intended for extensive campus operation.

Chapter 2 takes you through the network installation procedures, including eleetrical tests and fault finding.

Chapter 3 gives more information about large campus networks, made up of several network segments, joined together by 'bridges'.

Chapter 4 tells you how to set up the network ready for use.

Chapter 5 gives an overview of Econet servers.

This guide should be read in eonjunetion with the user guides supplied with the speeific equipment mentioned, as well as other related Eeonet guides. A bibliography of these guides is included in Appendix E.

Introduction

The function of any network is to permit programs and data to be passed between eomputers eonnected to that network. In order for this to happen certain essential eomponents are required:

- a network eable
- a network elock
- two terminators
- a file server
- network stations (computers)
- eonneetion points for network stations

1. Network cable

Programs and data pass along the network eable in the form of eleetrieal signals. The quality of this eable must be high, particularly for extensive networks. Only eable to Aeorn's speeifieation should be used - a network built with inferior eable will be less effieient and may eause network faults, whieh ean be hard to trace. Problems eaused by sub-standard eable often only manifest themselves when a network has been extended. Suitable eable is deseribed in the ehapter *Wiring and testing a network*.

Temporary and short 'one room' networks may be set up by ehaining together Aeorn 1-metre eables and 'T' pieees.

2. The Econet clock

A cloek is needed on a network to synehronise the signals passing along the eable. The Eeonet elock is a small blaek box eonneeted into the middle of the network eable, and powered from a mains power unit. FileStores have their own elock, which can take the plaee of the network elock on small networks (see Chapter 1).

3. Terminators

When eleetrieal signals are transmitted along a eable, they ean be refleeted at the ends of the eable. These reflections can interfere with the main signal. To remove these refleetions, terminators should be fitted at eaeh end of the

eable. Econet terminators are housed in small plastie boxes and consist of an impedance matching eircuit and a solderless conneetor for the eable. A single 5-pin DIN soeket is provided for eonneetion to a network station.

4. File servers

File servers provide a eentral storage facility for program and data 'files' for the network. Network users ean load data from and save data to the file server. They also run the software utilities whieh eontrol the network.

5. Network stations

Network stations, workstations or network terminals, are the names given to the computers attaehed to the network and sharing network faeilities. Nearly all Aeorn and BBC eomputers (sinee the BBC Model B) ean be eonneeted to an Eeonet network, if fitted with an Eeonet interfaee. A list of these is given in Appendix A.

6. Connection points

Network stations are eonneeted to a permanently-installed Eeonet eable by means of soeket boxes, eaeh one with soekets for two stations. A soeket box is similar to a terminator box, exeept that two 5-pin DIN soekets are provided to serve two stations, in addition to the solderless eonneetions for the distribution eable. Figure 2 in Chapter 1 shows a soeket box used in two positions; as an outlet for two Eeonet stations, or when eonneeted to one station and the eloek box at the centre of the network.

Stations are eonneeted to a temporary Cone room') network via DIN 'T' pieces.

1. Econet networks

There are a number of ways to implement an Eeonet network, depending on the size and topology (layout) of the network to be installed. All of these have in eommon the network eomponents deseribed in the previous chapter.

Eeonet installations ean be elassfied into three typieal types:

- A short 'one room' network
- A permanent, up to 500 metre, network
- An extensive 'eampus' network

As the terms imply, the differenee between the networks is mainly a matter of size.

This ehapter deseribes the three different types of network. Chapter 2 eovers their installation.

1.1 A short 'one room' network

Figure 1 illustrates a 'one room' network.

If your network can be installed so that the total length of the main cable is not greater than 10 metres, the simplest and cheapest implementation is by using a **ten station lead set.**

This paekage eomprises 10 'T' pieces, eaeh with three 5-pin DIN sockets. and 11 1-metre eables. The 'T' pieees are intereonnected as shown in Figure 1, to form the network, the stations being attaehed to the 'T' pieees with the eables supplied with the Eeonet interface. You may use all the 'T' pieees and eables to form the network, with one or more stations conneeted. Both ends of the network must be plugged into a separate terminator box.

Data transmitted aeross the network requires timing pulses for synehronisation. These are provided either by a eloek box, inserted in the eentre of the network as shown in the diagram, or alternatively from a FileStore, which generates its own cloek and termination, adequate for networks supporting up to ten stations. A FileStore may be eonneeted to any one of the 'T' pieces (shown in Figure 1 at position 7).

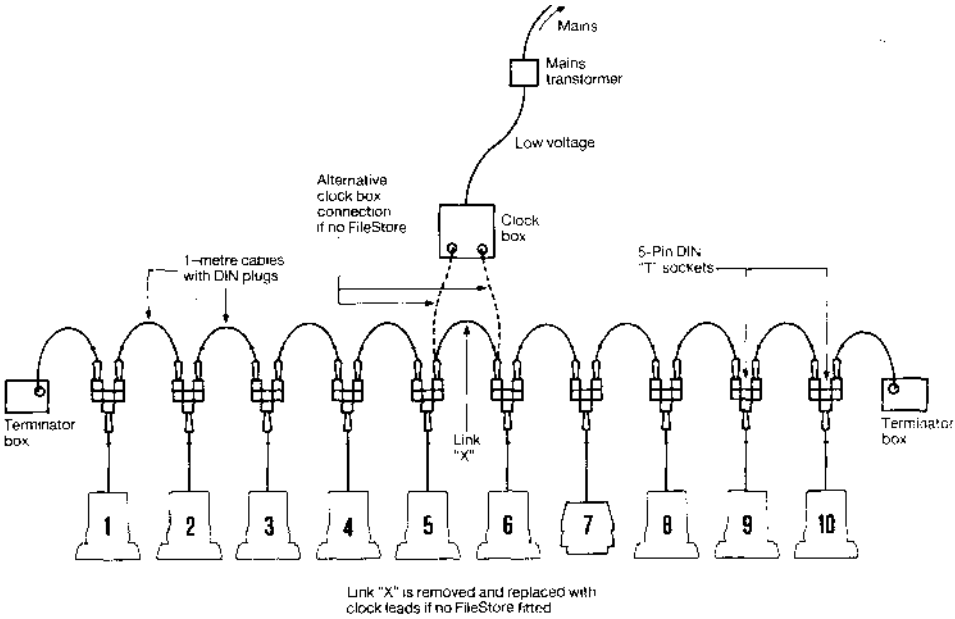

Figure 1: A short 'one room' network

The ten station lead set provides a simple method of installing a small loeal network. However, the reliability of the system is dependent on the integrity of the eonneetion 'T' pieees, whieh are not intended for multiple make and break operations. If, therefore, your usage of the system requires you to regularly diseonnect and re-connect, you should eonsider a permanent Econet installation, as deseribed in the next seetion.

1.2 Networks up to 500 metres

This is the typieal permanent Eeonet installation, suitable for networks longer than 10 metres, and up to 500 metres in length. Figure 2 shows the network eonfiguration, eomprising permanent eabling, soeket boxes, terminators and a elock box.

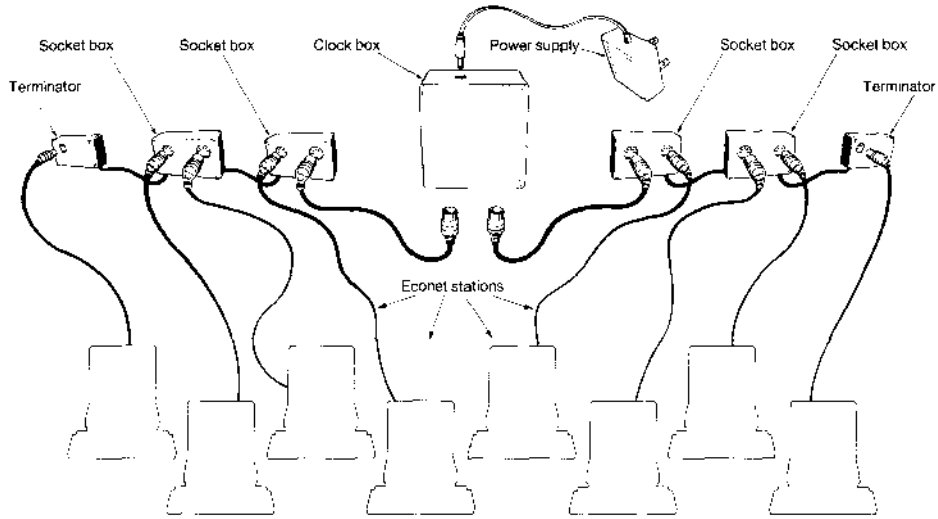

***Figure** 2:* Networks up to 500 metres

Up to 253 stations (in the address range 2 to 254), may be eonneeted to one 500m network. Stations for attaehment to the network are usually faetory set at address 1. It is reeommended that this address is reset on installation to a new value in the range 2 to 254, thus avoiding the possibility of an address elash from a new station that has not been reset. Information about address setting is given in Chapter 4.

A terminator box is required at eaeh end of the eable, with a eloek box in the middle.

Data transmission aeross the eable is timed by pulses from the eloek box. The normal elock rate is 200kHz, and all elock boxes and FileStores are pre-set to this speed, but other rates may be obtained by re-setting the eireuit links inside the eloek box. Appendix C tells you how to do this. Lower

cloek rates are sometimes required where there are problems with the network transmission line quality; for example where non-recommended eable has been used.

If a FileStore is eonneeted to a network whieh already has a eloek, its internal clock and termination facilities are automatieally disabled. The *FileStore Network Manager's Guide* (see the bibliography in Appendix E) deseribes this faeility in more detail.

1.3 Large campus networks

Figure 3 shows a typieal campus network, whieh is an extensive network eomprising more than one of the 500m network segments deseribed in the previous seetion.

The 500m network segments are joined to eaeh other by means of 'bridges'.

Econet bridges may be attaehed to a network either through a socket box, using one station socket, or via a terminator, again using the station soeket.

Up to 127 500m network segments may be joined together through bridges to form a eampus network. A network segment identity address is assigned to eaeh network segment within the range 1 to 127, and physieally set up with links inside the bridge. So, to access a station on a eampus network, it is neeessary to speeify two levels of address, the network segment address (set up in the bridge) and the station address (set up in the station).

More information about eampus networks is given in Chapter 3, together with examples of different network topologies.

For some larger networks, there may be a requirement to use long distanee links. Appendix B gives more information on advaneed network installations of this type.

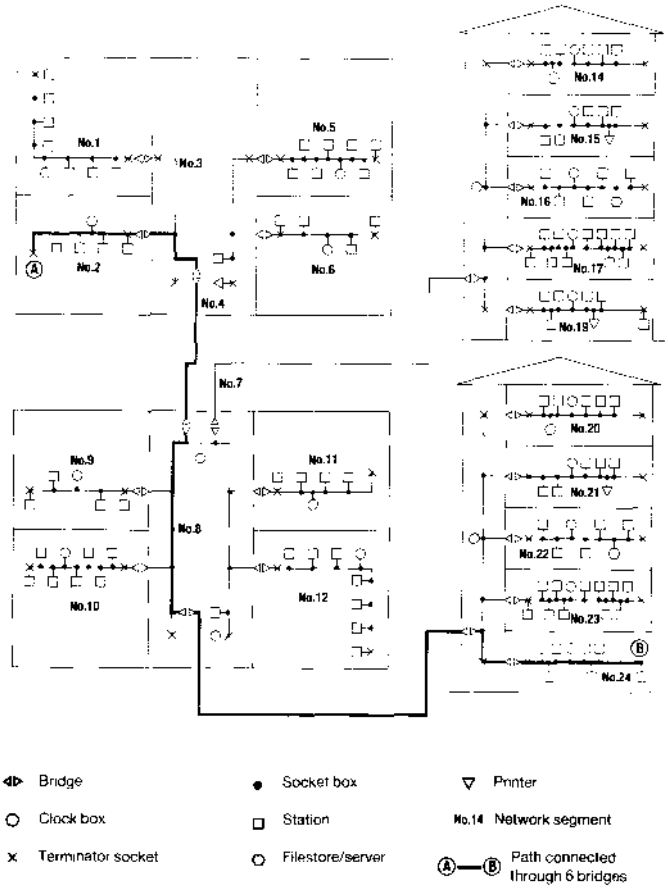

Figure 3: Large campus network

2. Wiring and testing a network

This chapter deseribes how to install different types of Eeonet network, and lists the parts you will need.

When installing, testing and using any of the eireuits, remember that the DIN type conneetors fitted, while known to have high reliability in normal use, are not designed to be frequently plugged and unplugged. During the installation, avoid unneeessary making and breaking. If this is unavoidable when using the network, the eonneetors should be frequently eheeked.

2.1 Short 'one room' networks

2.1.1 Components required

1. **AEH18 10 station lead set**

   Comprising:

   - 11 1-metre eables terminated at each end with a 5-pin DIN plug
   - 10 five-pin DIN 'T' pieees

2. **AEH19 starter kit** (unless your network has a FileStore, *and* less than ten network stations)

   Comprising:

   - Three socket boxes
   - Three 1-metre cables fitted with 5-pin DIN plugs at both ends
   - One elock box with power supply and conneeting mains lead
   - Two terminator boxes
   - One eable insertion tool
   - *Econet Installation Guide* (this manual)

2.1.2 Installation procedure

The network is simply plugged together, each 'T' piece using two branehes to form the network and the other outlet to connect to the station. A typical assembly is shown in Figure 1 in Chapter 1.

When assembling 'one room' networks you ean eonneet together all 10 'T' pieees and 11 eables, or just the number required for the stations in use. It doesn't matter if there are some 'T' pieees without stations.

The eloek box is installed as near to the eentre of the network as possible and a terminator is eonneeted to eaeh end of the eable. Figure 1 shows how the eloek box is inserted into the network by unplugging the middle eable and re-eonneeting it to one of the elock box soekets, then using an additional eable (supplied with the eloek box) to eomplete the eonneetion.

As mentioned earlier, networks with a FileStore, and ten stations or less, do not need a network eloek or terminators.

Stations are attached to the network 'T' pieces by means of the 1-metre leads supplied with the station Eeonet interfaee. If these have gone astray, extra 10 station lead sets ean be purehased for this purpose.

2.2 Networks up to 500 metres 2.

2.1 Components required

1. **AEH18 10 station lead set** (only needed if you no longer have the 1-metre leads supplied with the Eeonet station interfaee).
2. **AEH19 starter** kit (described above).
3. **AEH21 additional socket kit,** comprising five soeket boxes. Eaeh soeket box supports two stations, provided that the stations can both be installed within one metre of the soeket box. If not, you may need up to one soeket box per station. Note that the starter kit has enough soekets to support up to six stations (depending on where you want to locate them).
4. **AEH17 100 metres of network cable**
   The eable used throughout an Eeonet system eonsists of two twisted-pair lines with a shield and ground wire. The signal lines are two data lines (D+ and D-) and two eloek lines (C+ and C-). There is a single ground wire. The total end-to-end resistanee of the installed network should be less than 27 ohms, whieh will typieally permit a main eable length of up to 500m.

   Alternative types of eable approved by Aeorn are as follows:

Reliance RCC 8064
Brand Rex CD 84-4-0521
RS Components 367-921

Approved eable meets the following speeifieation:

Charaeteristie impedance:	100 ohms + 10%
Mutual eapaeitanee:	less than 66pF per metre
Propagation speed:	greater than 0.5e (where c is the speed of light)

If it is neeessary to join lengths of eable, the internal wires should be earefully stripped and soldered. The insulation should be restored either using heat shrinking plastie sleeves or the joint should be housed in a waterproof box.

5. **Recommended tools:** If you have a large number of boxes to install, it is worth eonsidering purehasing professional tools:
   - **Cable insertion tool**

     The plastie tool supplied with the starter kit is intended only for a small number of operations. A professional, heavy duty tool, whieh also has an automatie eable trimming feature, ean be obtained from RS Components, part number 470-128. This tool also has a wire cutting blade which operates automatieally after the insertion has been made. This operation should be disabled when conneeting soeket boxes. A plastie wedge is supplied with the tool for this purpose.
   - **Cable stripping tool**

     A speeial tool is available for stripping a seetion of the outer insulation of the network eable, without eutting the internal wires, as required when installing soeket boxes. The tool is also available from RS Components, part number 547-442. If you use a tool of this type, experiment with the setting of the eutting depth on a pieee of spare eable before attempting to strip the main eable.

2.2.2 Wiring the network

Please contact your Acorn supplier if you require help or advice when installing this type of network.

When wiring large distribution systems, there are several points to consider:

- In all cases, the total length of the main distribution eable should not exeeed 500m. Networks extending over distances greater than 500m are deseribed in the seetion below entitled *Campus networks,* and are implemented by using several 500m networks eonneeted together through 'bridges'.
- The cloek should be plaeed eentrally in the network.
- The soeket boxes should lie elose to the stations.
- It is better to over-estimate rather than under-estimate the amount of eable required.

To make identification of the signal wires easier, a eolour eoding system is used, as summarised in the table below. Keep an aeeurate reeord of the eable installation and colour codes used. Note that some eable manufaeturers use identifying colours that are different from this list:

5-pin DIN number		Signal Colour
1	Data+	White/orange
4	Data-	Orange
2	Ground	Copper
5	Cloek-	Blue
3	Clock+	White/blue

2.2.3 Fitting the clock box

The main Eeonet distribution eable should be laid out, and eut where the eloek box is to be fitted. This should be within 30 metres of its eentre - the exact position is not eritieal. Each of the eut ends should be attaehed to a soeket box (see *Wiring a socket box* below).

The two soeket boxes should now be attaehed to the eloek box using the two 1-metre eables with DIN eonneetors supplied.
The terminator boxes should then be fitted.

2.2.4 Wiring the terminator boxes

The terminator boxes should be eonneeted to eaeh end of the eable, using the following method:

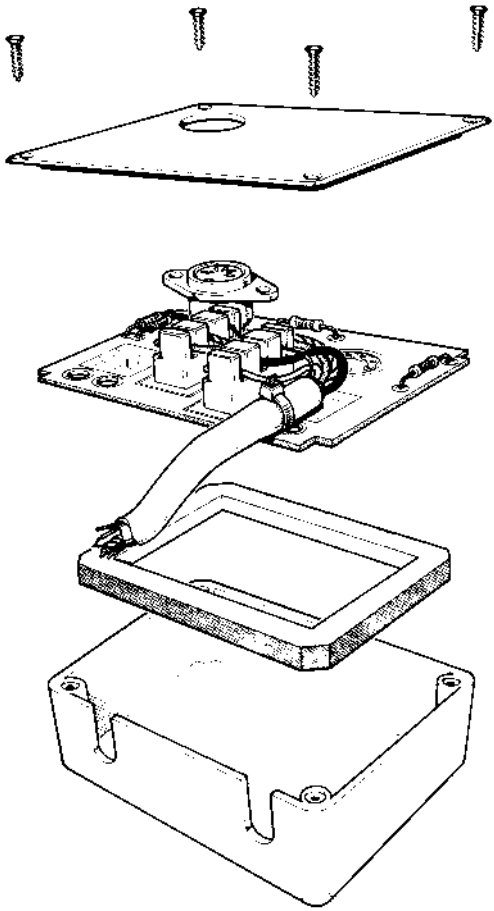

Figure 4: Wiring a terminator box

1. Strip about 60 millimetres (2.5") of the outer insulator and shielding from the eable. Remove the lid from the terminator box to reveal six white IDCs (insulation displaeement eonneetors). These are marked with the letters E (ground), D+, C- and C+. There is also a eable grip, at the side of the printed cireuit board.

2. Lay the colour eoded signal wires and the eopper ground wire over the appropriate IDC sockets and push them into plaee using the eable insertion tool. There is no need to strip off the individual wire insulation. Be extremely eareful that you use the insertion tool the right way round. If you do not, the eonneetor will break. Loeate the eorreet orientation by experimenting with a spare box, using no wire. Gently push the tool into one of the eonneetors; if it is the wrong way round, you will feel resistanee after the tool has deseended about 3 millimetres. Rotate the tool through 180 degrees and try again; it should now go right down to the bottom of the eonneetor with only slight resistanee. Note the position of the tool, or mark it so that you will remember.

   Caution: Do not use a screwdriver for inserting cables - only the appropriate tool. If you use a screwdriver, you will not make a good conneetion and will permanently damage the connectors.

3. When the wires are in plaee, fasten the eable to the board using the eable grips and eut off any exeess eable protruding from the connectors. Figure 4 shows a eorreetly wired terminator.

4. When the terminator boxes have been fitted, stations may be eonnected to them using the 1-metre eables supplied.

2.2.5 Wiring a socket box

Fit the soeket boxes where the stations are to be sited.

Installing a soeket box is very similar to wiring a terminator box, exeept that the outer insulator and shielding must be stripped without cutting the distribution cables or earth wire. After removing about 60 millimetres (2.5") of the insulator, and any other braid or foil, plaee the signal and ground wires over the IDC soekets and push them into plaee with the insertion tool. Again, the eable should be seeured to the printed eireuit board with the grips.

When the soeket boxes have been fitted, stations are eonnected to them using 1-metre cables with DIN eonnectors.

2.2.6 Testing

Having installed the eable, eloek box, terminator boxes and the socket boxes, y ou can test the wiring. The steps are as follows:

1. Disconneet the eloek from the network, so that there are two free DIN plugs. This splits the network so that each half can be tested separately.
2. With an ohmmeter, test the resistanee between the two cloek lines C+ and C- at the eloek box DIN plug and at each soeket box. The resistanee should be between 110 and 160 ohms if reliable operation is to be ensured.
3. If a high resistanee reading is obtained, there is an open eireuit between the soeket being tested and the terminator box, possibly caused by the data and cloek lines being transposed at a soeket box. If a very low resistanee is obtained (less than 100 ohms), there is a short eireuit somewhere between the two lines. If no fault ean be found in the cable, the terminator may be faulty.
4. Repeat the test for the D+ and D- lines, but expeet a resistance of between 220 and 260 ohms for a healthy eable.

Repeat the whole test sequenee on the other half of the network

2.3 **Campus networks**

2.3.1 Component requirements

1. AEH19 starter kit (described above)

2. AEH17 100 metres of network cable (deseribed above)

3. AEH21 additional socket kit (deseribed above)

4. AEH18 10 station lead set (if required)

5. AEH20 Bridge

Comprising:

- Bridge proeessor
- Two 1-metre eables terminated with a 5-pin DIN plug at either end.

2.3.2 **Wiring a campus network**

Campus-type networks are made up of several 500-metre network segments linked together by bridges. Each 500m segment of the network should be installed as deseribed above.

The bridge unit used to join two segments is attached to a 500m segment through either a terminator or a soeket box. Examples of some types of eampus networks are shown in Figures 6 and 7.

The intereonneetion between bridges may be implemented using the standard network eable, soeket and terminator boxes. This eireuit should normally be regarded as another 500m network segment, obeying the same rules, with a cloek box inserted *as* near to the mid-point as possible. However, there may be some speeial eases, where, for example, the eable has to eross a road, or where a distanee greater than 500m is eneountered, whieh needs speeial eonsideration. Some adviee on these aspeets are given in Appendix B.

2.3.3 Levels

The topology of some large networks ean create the situation where a signal path eould pass through a large number of bridges effeetively eonneeted in a long string. The maximum number of bridges in any path between any stations should not exeeed seven. Referring to Figure 3, for example, the path shown between (A) and (B) passes through six bridges.

2.3.4 **Testing**

After installing, test eaeh 500m network segment separately by disconneeting at the bridges, following the information given above. Then test the bridge segment in the same manner. This will test the overall wiring of the eomplete network.

The operation of the bridge is deseribed in the next ehapter.

3. More on campus networks

Note: only networks with file servers of Level 2 and above may be used with bridges.

3.1 The bridge hardware

Externally, a bridge box looks very similar to a seeond proeessor or Prestel Adapter; that is, a cream eoloured plastie box with the same eross section as a Model B BBC Mieroeomputer and half the width. On the back panel of the box is a mains lead, a power switeh and two 5-pin DIN soekets marked A and B.

The eireuitry of the bridge eomprises two Eeonet interfaces, a 2MHz 6502 Processor, 8k of program EPROM and 8k of RAM. The RAM is used as workspaee for the bridge software and as a buffer area between the two Eeonet interfaees.

To join two network segments with a bridge, it is first neeessary to assign a number to eaeh segment. This may be in the range 1 to 127. Eaeh network segment in the system should have a unique number. You will now need to remove the cover of the bridge.

DANGER: BEFORE REMOVING THE COVER OF THIS EQUIPMENT, SWITCH OFF AND DISCONNECT THE MAINS PLUG FROM THE SUPPLY.

Removing the lid of the bridge box reveals two rows of links. These are used to set the network identities.

Figure 5 shows the position of the links on the bridge PCB. The row next to the component marked RP2 eontrols the identity of the network segment plugged into soeket A; the links next to RP1 determine the identity of the network segment plugged into soeket B. When the network segment identities have been deeided upon, the links may be set in the same way as the station identity in a Model B BBC Mieroeomputer, as deseribed below.

The most signifieant bit of the eight-bit network segment identity is at the top of the row, the least signifieant bit being the bottom link. As the range of legal identity numbers is 1-127, the top link of eaeh row should always

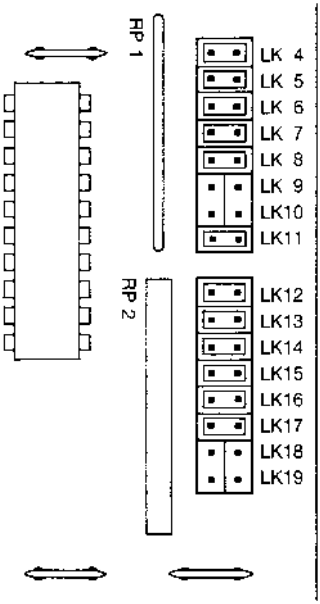

***Figure** 5:* **Bridge address links**

be made, remembering that a made link stands for a '0' in that position and an unmade link stands for a '1'. In order to set up an identity as 1, only the bottom link should be left unmade. The bridge in the diagram has been set up between networks three and six.

Note that all bridges eonneeted to a given network segment should have the network's identity set to the same number. Conversely, no two networks in a system eonneeted by bridges may have the same network identity. Remember to keep a note of the settings; if you forget to do this you will have to remove the bridge box eovers and inspeet the link settings to find out the addresses you have set!

Onee the network identities have been set up on the printed eireuit board, the network segments may be joined. This is aehieved by attaching the bridge box to network A, exaetly as though the bridge box were a normal station, that is, by running a 5-pin DIN to 5-pin DIN lead from a soeket or terminator box on the network to a soeket marked A on the bridge box.

Repeating for network B eompletes the joining proeess.

To activate the bridge, power up. The bridge software detects which networks are in the system and begins its task of looking for messages to pass between the two networks it bridges. Of the 8k of RAM in the bridge, about 4 to 6k is available for the purpose of buffering transactions between the two networks.

You may observe that there is a button on the bottom of the Bridge box. If pressed, it enters test mode. Test mode should not be used while the bridge is eonneeted to Eeonet, as it creates traffie which will jam the network. For details, please refer to the *Econet Bridge Service Information.*

3.2 Typical network layouts

Bridges enable various network layouts, or topologies, to be used that are not normally available to Eeonet users. The eonneetion between the main network eable and a station is limited to a length of 2 metres. This restricts the network to a single linear layout with short 'spikes' from the soeket and terminator boxes. This is often ineonvenient, for example when the network has to serviee several floors of a building, espeeially when the length limit of 500m is eonsidered.

By using networks with one or more bridges, different and more useful topologies may be constructed. This seetion discusses two examples: an E-type and a Star-type topology.

3.2.1 E-type topology

This arrangement is useful when setting up a network on several floors in a building. The idea is to have a single network running up the height of the building, with a bridge on eaeh floor eonneeting the vertieal network to each horizontal floor network. A seheme like this is shown in Figure 6.

In Figure 6, the terminators of network segments 01 to 05 are eonnected to the terminator or socket boxes of network segment 06 by bridges, as shown.

There is no need for all of the networks in the system to have a file server. In partieular, network 01 would probably not have a file server, the eable aeting only as a eonneetion between the other three networks.

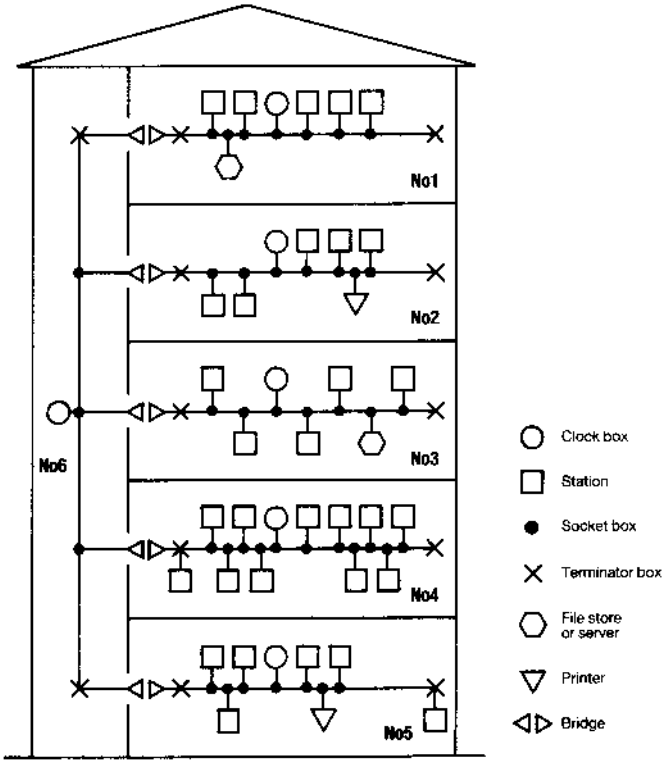

Figure 6: An E type topology

3.2.2 Star-type topology

Another eommon type of network layout is where there is a eentralised main network segment with several outlying segments. An example of the need for this is in a sehool or eollege where the main network, printer servers and file servers are in the 'eomputer room' and other rooms, possibly in different buildings, have their own network segments attaehed to this. Figure 7 illustrates this.
In Figure 7 network segment 03 is the main segment, the others forming branehes out from this through the bridges.
It ean be seen from Figure 7 that stations on eaeh network segment may reaeh stations on any other network segment, messages passing through up to two bridges. Of great importance is the faet that no message may reach its destination by more than one route. When conneeting networks with bridges, it is vital that there are no duplicating routes (forming loops) between any of the systems. A simple way of deteeting loops is to apply the test: If n network segments are eonneeted by n or more bridges, there is bound to be a loop, and one or more of the bridges must be removed.

3.3 Using a bridged network

The proeess of logging onto a network with multiple segments is very similar to the usual method. If, say, the file server required is on the 'local' network segment, that is the segment to whieh the user's station is connected, the sequenee is unaltered, as follows:

```
*1 AM 253 PETE
```

where the 253 is the file server number.

To log onto a file server on network number 3, using file server number 251, the eommand beeomes:

```
*I AM 3.251 PETE
```

with the network number preceding the file server number, separated by a dot. Once the file server has been in use onee during a session, its number and the number of the network on whieh it lives are remembered, and it is possible to log onto it again simply by saying:

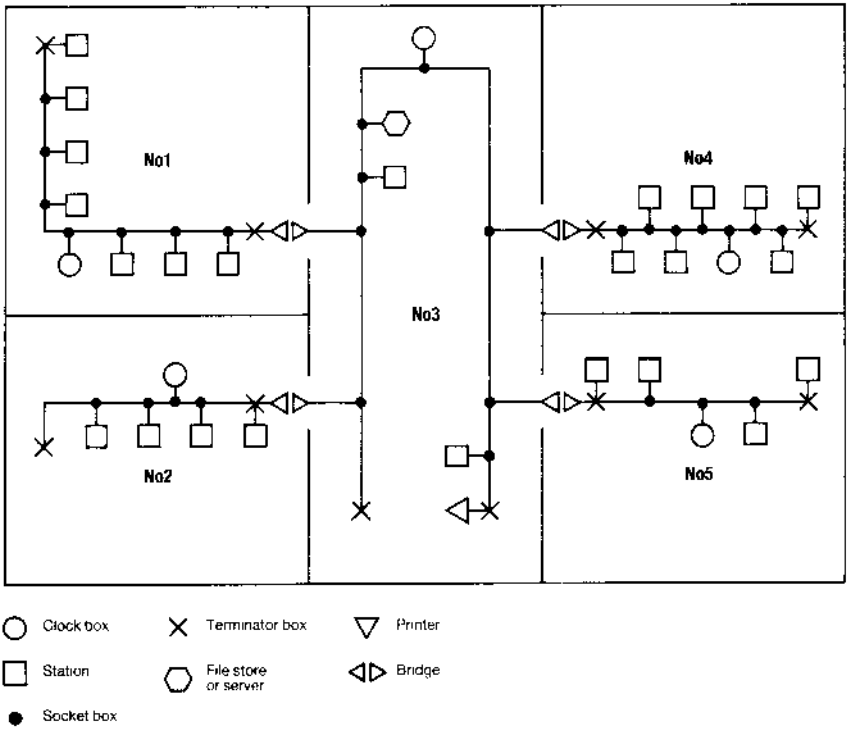

Figure 7: A Star-type topology

*I AM PETE

If it subsequently beeomes neeessary to use the loeal file server again, the local network's number must be given explicitly. The loeal network is always number zero, so logging on to the local file server again requires:

*I AM 0.253 PETE

Several other eommands require the network number to be specified, such as:

*NOTIFY, *REMOTE and *VIEW .

Commands for the Model B BBC micro and Master series To

notify station 114 on network 17, for example, use the form:

*NOTIFY 17.114 The memo is on its way

Attempts to view larger sereens will eause the station to halt as the sereen information eannot be returned through the bridge.

While supervising a transaetion between two networks, the bridge holds open a virtual eireuit for the duration of a paeket. This leads to a slight bandwidth degradation for messages that eross a number of bridges. It should be stressed that this is on a per paeket basis and that a signifieant bandwidth is still available between the individual paekets of an operation such as, say, a load, save or eatalogue. The bandwidth lost can be calculated as follows:

For a eonversation through a single bridge, the circuit is held open for twice the normal duration of the transfer; that is, the time for the full four way handshake to take plaee. For a two bridge route, the circuit is held open for three network segments so you have a third of the bandwidth. For a three bridge path, four network segments are used, ete.

In praetiee, though, most of the time taken by a transaetion is waiting for the file server to process the eommand, and no speed differenee should be notieed.

4. Setting up an Econet system

4.1 Introduction

The Model B BBC, Master 128, Master Compaet and Arehimedes microcomputers ean all be used on an Econet network, either separately, or mixed together.

If you are setting up an Econet system for the first time, you will need to aetivate and test the network. Follow the proeedure in the next seetion.

If you are adding a station to an existing, working Econet system, follow the proeedure in Seetion 4.3, seleeting the sub-seetion for Model B BBC mieroeomputer stations, Master 128/Compaet stations or Arehimedes stations.

4.2 Procedure

1. Complete the wiring and eleetrieal testing described in Chapter 2
2. Confirm the eloek speed is eorreetly set by the links in the eloek box (Please refer to the setting up details given in Appendix C)
3. Conneet the eloek box in the middle of the network
4. Conneet the power supply to the eloek box and switeh on
5. Conneet a station to the network and eheck the voltages on the data lines at a eonvenient 5-pin DIN socket. The readings should be:
   - Line D+ (pin 1) to ground (pin 2) 1.8 to 2.2 volts
   - Line D- (pin 4) to ground (pin 2) 2.2 to 2.6 volts
6. If you do not obtain a reading within the ranges given, go baek to Chapter 2 and repeat the electrieal tests.

4.2.1 Clock speed setting

The speed at whieh the network operates is set by the links in the cloek box. The normal elock frequeney, whieh is pre-set at the faetory, is 200kHz. Under speeial eireumstanees you may wish to ehange this, in which case, please refer to Appendix C.

4.2.2 Network system fault finding

No cloek

This may be eaused by:

- The station not being plugged into the network: replaee the lead between the station and its soeket box with a known good one.
- The elock box not being plugged into the mains: eheek the mains soeket switch and eloek box power switeh.
- The eloek box not being plugged into the network: cheek the 5-pin DIN plugs eonneeting the main eable to the eloek box.
- An open eireuit or short eireuit in the eloek lines: repeat the tests detailed in Chapter 2. Remember that any of the 1-metre leads eonneeted to the network may produee a short if faulty.
- The clock box ineorreetly set-up: see the setting up information in Appendix C.

If there is still no eloek, try eonneeting a station direetly into the eloek box by a short 5-pin DIN to 5- pin DIN lead. Try another lead or station if the fault persists. Cheek the eloek setting inside the box. If none of these remedies produees a eloek signal, the eloek box may be faulty. Consult your supplier.

Clock distribution faults

If the main network eable is below the speeifieation reeommended by Acorn, errors may be caused even if the eloek is set eorreetly and the elock box is fault free.

4.2.3 Line jammed faults

This is caused by eontinuous data signals on the data line preventing any station from using the network and is an indieation that the voltages are ineorreet or not present.

Carry out the following test sequenee:

- Reset all stations on the network, ineluding any file servers, if present. When resetting servers, observe the normal preeautions; refer to the relevant file server manual if in any doubt.
- Diseonneet all stations from the network.

- Check for faulty terminators, partieularly that the voltages are at the eorreet level (values are given in seetion 5.2).
- Cheek for erossed wires.
- Check for a faulty Eeonet interfaee in a loeal station.

At each stage, try to reboot the loeal station, eheeking for the error remaining.

4.2.4 Not listening faults

This oeeurs when a message sent to a remote station is not aeeepted. The possible eauses are:

- The wrong station identity was given for the remote station.
- The remote station is not plugged into the network or does not have the network software present.
- There is a hardware fault in either the loeal or remote station.

4.2.5 No reply faults

These indieate that the remote station reeeived a network request, but has not provided the expeeted reply within a suitable time. This fault may indieate that the peripheral on the remote station is faulty or not available.

Cheek that the printer is switehed on and is on line. Check that the discs on the file servers are correetly inserted in the drives. Check that any other peripherals are switched on and are in a ready state.

If the fault still oeeurs, test the peripherals by using them locally. For example, try eonneeting a printer to a loeal station.

If these test succeed, it is possible that the user station eould not receive incoming messages for some other reason. Try replacing the user's local station and see if the fault persists. If it does, then the installation cables should be eheeked, performing the tests detailed in Chapter 2. You should also refer to the manuals provided with the server you are trying to use.

4.3 Adding a new station to an existing Econet

Adding a new station to the network involves the following steps:

1. Fitting an Eeonet interface to the new network station (computer)
2. Setting the station number
3. Conneeting to Eeonet network
4. Configuring the station for network use

The details of eaeh step will depend upon the type of station, so the proeedure will be deseribed separately for eaeh type.

Eaeh station on the network must have a different station number (in the range 2 to 254) to identify it uniquely. You will probably find it useful to keep a reeord of the station numbers you have set by using system reeord sheets, similar to the ones shown in Appendix D.

4.4 Setting up a Model B BBC micro station

4.4.1 Fitting the Econet interface

The Eeonet interfaee for a Model B BBC mieroeomputer is fitted as a number of separate eleetronie eomponents, inside the eomputer, and should only be fitted by a qualified dealer or serviee eentre.

4.4.2 Setting the station number

In Model B BBC eomputers fitted with an Eeonet interfaee there is a row of 8 links in the top left hand eorner of the board, marked S11. To gain aeeess to these links, the lid of the eomputer must be removed after unserewing the four serews marked 'FIX'. Two of the serews are loeated at the rear of the ease and the other two are on the underside of the ease at the front.

WARNING - DANGEROUS VOLTAGES: BEFORE REMOVING THE COVER OF THE COMPUTER, ENSURE THAT THE POWER IS SWITCHED OFF, AND THE MAINS PLUG REMOVED FROM THE SUPPLY.

The links form an 8-bit binary number representing the computer's station identity. The least signifieant bit is the link nearest to the rear of the ease; the most signifieant bit is the link nearest to the front of the ease (at the bottom in Figure 8). On the BBC Model B+, the links are laid out in the

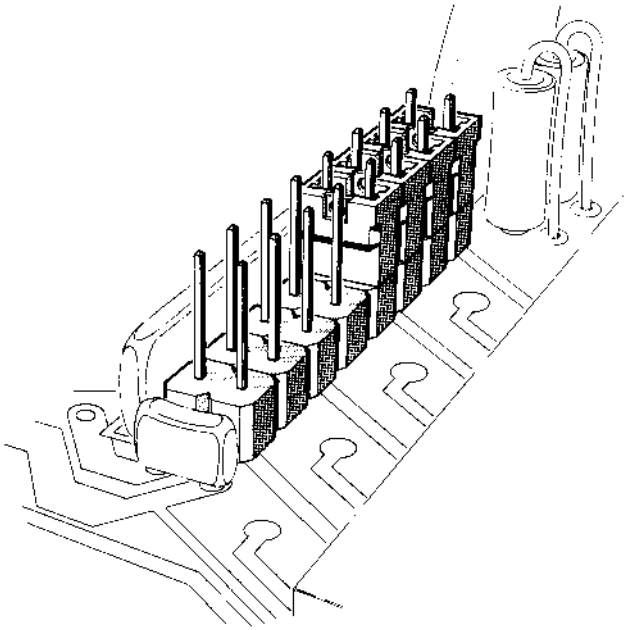

Figure 8: Setting the identity of a BBC micro

opposite sense (that is to say, the most significant bit is the link nearest the *rear* of the case. If a link is made, the bit is zero; an unmade link implies a 1 bit.

As an example, to obtain the number 240 (128+64+32+16), links 0, 1, 2, and 3 should be made and the rest unmade (counting the rearmost link as number 0). Unused links may be parked by inserting them on only one of the two pins.

4.4.3 Connecting the station to Econet

Connect the station to Econet by plugging the 5-pin DIN eonneetor into a soeket box or terminator box. Switeh on and attempt to log on at that station. If there are no error messages when you log on, the station has been

set up eorrectly.

If two stations are set up to the same number, you must diseonneet one of them from Eeonet or turn it off. Change its station number to an unused one before reeonneeting or turning it on again.

4.4.4 Configuring the station

A utostart

It is possible to eonfigure all stations on the network to start up the same way, when (SHJFT) (BREAK) is pressed. You set this up using the autostart facility. This works similarly to the autostart at log on, described in the *User Guide.*

For example, you eould arrange for every station to start up and display a menu of programs for users to ehoose from when they press (SHJFT) (BREAK) . The programs would be downloaded from the network file server, without the need for users to log on individually.

Whenever a user resets the eomputer by pressing (SHJFT) (BREAK) , the station automatieally tries to log on as the user BOOT. The user BOOT ean have a direetory and !BOOT file like any other user, and this ean be set up to eontain the starting routine you want the stations to follow.

To set up an autostart that works whenever a user resets a station:

1. Create a main direetory and a user ealled BOOT, if you don't already have one.
2. Create a file ealled !BOOT in BOOT's main directory. Put in it the eommands you want the file server to carry out eaeh time a user resets.
3. Change the autostart setting of BOOT's main direetory by typing:

   *OPT4 , <number> (RETURN) The <number> you type ean be 0,1,2 or 3:

0	switehes autostart off
1	makes the file server *LOAD the file !BOOT on reset
2	Makes it *RUN the file !BOOT on reset
3	Makes it *EXEC the file !BOOT on reset

If there is no main direetory BOOT, the file server will treat $ as the eurrently seleeted direetory. The start up option for the user BOOT will be eheeked. If it is 1,2, or 3, it will look for a file ealled !BOOT in $ and try

to *LOAD, *RUN or *EXEC it.

If BOOT's direetory has no file !BOOT, or if there's no BOOT direetory and $ has no file !BOOT, users will get the error message file not found, or Bad command.

Changing station configuration

You can ehange the configuration of individual stations by soldering links onto the keyboard. To do this, you first have to remove the lid of the computer.

WARNING - DANGEROUS VOLTAGES: BEFORE REMOVING THE COVER OF THE COMPUTER, ENSURE THAT THE POWER IS SWITCHED OFF, AND THE MAINS PLUG REMOVED FROM THE SUPPLY.

Follow this proeedure to gain aeeess to the keyboard links:

1. Remove the two serews in the baek panel.
2. Remove the two serews on the underside of the eomputer, near the front, and earefully remove the lid.
3. Remove the keyboard.

Figure 9 shows the keyboard links.

There are two links whieh you might need to wire up:

- Link 5 - when made, this link eauses [BREAK) to act as SHIFT :BREAK and viee-versa.
- Link 1 - when made, this link eauses the default filing system at reset to ehange from DFS to NFS (assuming that the maehine eontains a DNFS ROM).

4.5 Setting up a Master 128 or Compact station

4.5.1 Fitting an Econet interface

The Econet interfaee for the Master 128 and Master Compact is supplied as a module that should be fitted inside the computer case. A ROM (Read Only Memory) eontaining the Eeonet interfaee programs is also supplied, which should also be fitted internally. Fitting instructions are supplied with the interfaee, but if you are not sure how to do this, your supplier will fit these components for you.

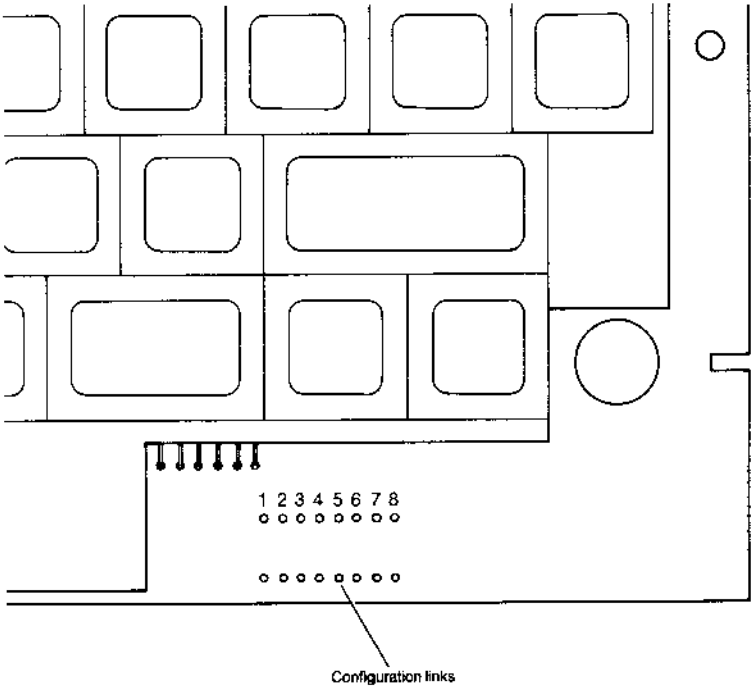

Figure 9: BBC Model B Keyboard links

4.5.2 Connecting to Econet

Conneet the station to Econet, using a lead with a 5 pin DIN conneetor plugged into a network socket box or terminator box and switeh on.

4.5.3 Setting the station number

Note: This information will be of interest to users of existing networks. The utilities mentioned are supplied with FileStore E01 and E01S units, and their use is described in the *FileStore Network Manager's Guide,* also supplied with FileStore.

A 5.25" floppy disc is available, referenee ADJ25, from your Aeorn dealer. It contains utilities to help you to set the station number.

When you first turn the station on, you will probably get a display that ineludes the words:

Badly configured station number

This message is to remind you to set a suitable station number for the new unit. Eaeh station on a network segment must have a different number, to distinguish it from all other stations and FileStore units. To make this easier, keep a reeord of all station and segment numbers used, using forms similar to the ones in Appendix D.

On the Master 128 and Master Compaet eomputers, the station number is held in non-volatile memory and set up using a utility program stored on the FileStore or fileserver, as follows.

To set the station number:

- Log on as SYST at the station
- Type:*LIB $.Library1 (RETURN) to seleet the eorreet library
- Type:*SET ddd (RETURN) where ddd is the station number you wish to set, in deeimal notation
- Reset the station and try to log on

If you have set the station number to the same one as another station or FileStore unit whieh is eonneeted and turned on, you may get a message sueh as:

Net error or Not listening

In this case, diseonnect the other station from Eeonet or turn it off, change its station number to an unused one and reset it, then reeonneet or turn on the other station and try to log on again.

The SET command is stored in the direetory $.Libraryl on eaeh of the dises supplied with the FileStore. This eommand is designed to be used only by the Network Manager. You should therefore be eareful to ensure that other users are not allowed aecess to this program, for example by setting the aceess to LR (see the *FileStore Network Manager's Guide*, Restricted aeeess, Chapter 2).

4.5.4 Setting other station parameters

Most eharaeteristies of network stations are set by users to suit their own preferenees, using the **Control Panel** program or `*CONFIGURE` eommand, whieh are explained in the eomputer's user guides.

You may need to set the following:

- File server number `(*CONFIGURE FS` [ddd] . ddd) - set to the file server station number; where ddd is the station number and [ddd] is the network segment number, in deeimal notation, up to 254.
- Printer server number `(*CONFIGURE PS` [ddd] .ddd) - set to the printer server station number; where ddd and [ddd] are defined as above.
- Default filing system ROM number `(CONFIGURE FILE n)` – where `n` = the default filing system type, as follows:
  8 = ANFS
  13 = ADFS
  9 = DFS (Use the eommand `*ROMS` to determine in whieh position your filing systems are located.)

`CONFIGURE PRINT 4` (network printer)

`CONFIGURE BOOT` (autoboot with BREAK)

`CONFIGURE NO BOOT` (autoboot with SHIFT + BREAK)

Certain other eharacteristies should only be set by the Network Manager. These eontrol how the station's memory is used in network operations (to minimise problems when using programs designed for the Model B BBC eomputer memory map) and whieh library the station will use.

To set these options:

1. Log on as SYST on the station
2. Type: `CHAIN "$ Ut ils SETSTATION"` (RETURN)

and follow the instruetions given on the sereen. As a minimum, you should normally seleet the 'Findlib' option, to make sure that the station selects the eorreet library when a user logs on.

4.6 Setting up an Archimedes station

4.6.1 Fitting an Econet interface

The Econet interface for the Arehimedes eomputer is supplied as a module whieh should be fitted inside the eomputer ease. The ROM (Read Only Memory) whieh is also supplied, should be disearded, as the programs required are built into the Arehimedes. Fitting instruetions are supplied with the interface, but if you are not sure how to do it, your supplier will fit it for you.

4.6.2 Connecting to Econet

Conneet the station to Eeonet, using a lead with a 5-pin DIN eonneetor plugged into a network soeket box or terminator box and switeh on.

4.6.3 Setting the station number

The Arehimedes operating system modules (Eeonet) inelude the utility SetStation. This is called from the * prompt by typing `SETSTATION`.

When you first turn the station on, you will probably get a display that ineludes the words:

Badly configured station number

This message is to remind you to set a suitable station number for the new unit. Eaeh station on a network segment must have a different number, to distinguish it from all other stations and FileStore units. To make this easier, keep a reeord of all station and segment numbers used, using forms similar to the ones in Appendix D.

On the Arehimedes eomputer, the station number is held in non-volatile memory and set up using the utility program mentioned above, as follows:

To set the station number:

- Log on as SYST at the station
- Type: `*LIB $ .ArthurLib` (RETURN) to seleet the correet library
- Type: `*SETSTATION ddd` (RETURN) where `ddd` is the station number you wish to set, in deeimal notation, in the range 1 to 254
- Reset the station and attempt to log on

If you have set the station number to the same as another station or FileStore which is conneeted or turned on, you will get a message such as:

Net error or Not listening or Station name not found

Disconnect the other station from Eeonet or turn it off, change its station number to an unused number and reset it, then reeonneet or turn on the other station.

The **SETSTATION** eommand is stored in the library **$.ArthurLib.** It is designed to be used only by the Network Manager. You should therefore be eareful to ensure that other users are not allowed aeeess to this program (see *FileStore Network Manager's Guide,* Restrieted aeeess, Chapter 2)

4.6.4 Setting other station parameters

Most eharaeteristies of network stations are set by users to suit their own preferenees, by using the ***CONFIGURE** eommand, whieh is explained in the eomputer's user guides.

You may need to set the following:

- File server number `(*CONFIGURE FS )` – set to the file server station number or (dise) title.
- Printer server number `(*CONFIGURE PS )` – set to the file server station number or Eeonet printer server name.
- Library option `(*CONFIGURE LIB )` – set to seleet the Arehimedes library **($.ArthurLib)** automatieally.
- `*CONFIGURE PRINT 4`

  See the user guides for details.

5. Econet servers

This ehapter briefly deseribes the main eharaeteristies of the file servers, printer servers and FileStores that may be eonneeted to your Eeonet. This will help you to identify the key elements of your network and eheek that you have all the relevant manuals and software, espeeially if you are reviewing a network that has been installed for some time.
The equipment covered is as follows:

- Eeonet level 1 file server
- Eeonet level 2 file server
- Eeonet level 3 file server
- FileStore E01
- FileStore E20
- FileStore E01S
- FileStore E40S
- Printer server.

5.1 Level 1 file server

The level 1 file server is a Model B BBC Microeomputer fitted with an Eeonet interfaee and a single or dual drive 5.25" floppy dise unit.

The relevant Acorn manuals for this produet are:

412,011 issue 1 *Econet level 1 file server Manager's Guide.*

This publication deseribes the file server installation proeedure, testing the server and the workstations on the network, the daily start up proeedure, managing the 'names' file and dise management.

412,111 issue 1 *Econet level 1 file server User Guide.*

This publieation assumes that the installation has been completed and tested. It describes how to use the file server, name files, display the contents of the disc, and the use of the commands, discs and drives.

The level 1 file server may be eonneeted to Eeonet through a soeket box or a terminator box, in the same manner as a workstation. The network will support any eombination of stations, file servers or printer servers, up to a maximum of 254 units.

The level 1 file server is for use with BBC Model B mieroeomputers only, and provides shared aeeess to files stored on the floppy dise(s).

The level 1 server provides only very rudimentary serviees, allowing users to save, load and eatalogue files. The server does not support any data file aeeess, and will not support Master 128, Master Compaet or later network stations. Level 1 servers may still be found in use on some sites, but in most applieations they have been replaeed by servers whieh provide a higher level of serviee.

5.2 Level 2 file server

The level 2 file server is a Model B BBC Mieroeomputer fitted with an Eeonet interfaee and a single or dual drive 5.25" floppy dise unit. The mieroeomputer is eonneeted to a 6502 seeond proeessor, housed in a separate box. Alternatively, a Master 128 and Turbo seeond processor may be used. The level 2 server has a larger eommand repertoire than the level 1.

The relevant Aeorn manuals for this produet are:

412,017 issue 1 *Econet level 2 file server Manager's Guide.*

This publieation deseribes the file server installation proeedure, testing the server and workstations on the network. It ineludes the proeedure for starting up and elosing down the server, the use of the password, assigning user serviee, ereating and deleting user direetories and managing the system, dises and drives.

412,018 issue 2 *Econet level 2 and 3 file server User Guide.*

This publieation assumes that the installation has been eompleted and tested. It deseribes how to use the file server, name files, display the eontents of the dise, and the use of eommands, dises and drives. It deseribes the extended eommand repertoire, printing, eommunieating with other users and filing systems.

The level 2 file server may be eonneeted to Eeonet through a soeket box or a terminator box, in the same manner as a workstation. The network will

support any eombination of workstations, file servers (ineluding level 1), or printer servers, up to a maximum of 254 units.

The level 2 file server provides:

- The same faeilities as a level 1 server
- A 6502 seeond proeessor for faster proeessing
- An extended eommand set.

Extensions to level 1 serviees:

- Random aeeess to data files
- Use of user names and passwords
- Hierarehieal direetory strueture.

The level 2 server provides a number of extensions beyond the level 1 serviee. It ean provide aeeess to a maximum of 800k of storage on two 5.25" floppy dises. They may still be found in use in many applieations, however where aeeess to larger storage deviees sueh as Winehester drives are required, the server may have been upgraded to run level 3 software. Due to the limitations on storage provided by the level 2 server, it is not suitable for use with the Arehimedes range of workstations.

5.3 Level 3 file server

The level 3 file server is a Model B BBC Mieroeomputer fitted with an Eeonet interfaee, a single or dual 5.25" floppy drive, a hard disc and a 6502 seeond proeessor. Note that the floppy disc drive is only needed to load the file server software. After installation, it may be removed and used elsewhere.

The relevant Aeorn manuals for this produet are:

427,501 issue 1 *Econet level 3 file server Installation Guide*

This publieation deseribes the installation proeedure for a level 3 file server, setting the file server network address, installing the software, assigning hard dise spaee, updating an existing file server and eheeking the operation of the network after the installation. There are also some eomments on the preparation of the system for users and copying files. An overview of the VIEWDATA system is ineluded.

427,500 issue 1 *Econet level 3 file server Manager's Guide.*

This publieation ineludes the procedure for starting up and elosing down the server, the use of the password, assigning user serviee, ereating and deleting user direetories and managing the system, dises and drives.

412,018 issue 2 *Econet level 2 & 3 file server User Guide.*

This publieation assumes that the installation has been eompleted and tested. It deseribes how to use the file server, name files, display the contents of the dise, and the use of eommands, discs and drives. It diseusses the extended eommand repertoire, printing, filing systems and eommunieating with other users.

The level 3 file server may be eonnected to Eeonet through a soeket box or a terminator box, in the same manner as a workstation. The network will support any eombination of workstations, file servers (ineluding level 1 or 2), or printer servers, up to a maximum of 254 units.

The level 3 file server provides the same serviees as the level 2, deseribed above. The main differenee between the two systems is the availability of the hard dise on level 3, which enables stations on the network to store and retrieve files on a shared hard dise drive.

5.4 FileStore

FileStores provide shared aecess to file and printer services in a similar manner to the file servers based on the BBC Model B or Master microeomputer ranges, but are dedieated, purpose-designed file servers, not requiring monitor or keyboard. The items in the range are as follows:

FileStore E01 Controller board with 64k ROM and 64k RAM
Two 3.5" floppy drives, eaeh with 0.6 Mbyte of storage.

FileStore E20 This unit is intended to be conneeted to E01 and eontains a 20 Mbyte Winchester hard dise.

FileStore E01S Similar to E01 except that it is supplied with an expansion socket that allows up to four Winehester hard dise units to be connected.

FileStore E40S/E60S These are 40/60 Mbyte Winehester hard disc units. Up to four of these may be eonneeted in 'daisy chain' fashion to an E01S.

The relevant Aeorn manual for the produets listed above is:

482,000 issue 2 *FileStore Network Manager's Guide*

This publieation describes the operation, use and management of a FileStore. Installation information is eontained in Appendix A and ineludes setting up the FileStore, attaehment of the additional hard dise units, eonneetion to Eeonet and the addition of a printer. The appendix also contains information about setting up the system, getting ready for the user and optimising performance.

A FileStore is eonneeted to Eeonet through a socket box or a terminator box, in the same manner as a workstation. Eeonet will support any eombination of FileStores, file servers or workstations, up to a maximum of 254 units per network.

FileStores inelude a network eloek and termination faeility, which is adequate for small networks with up to ten stations.

The FileStore is supplied with formatted floppy dises which eontain a number of management and program files. FileStore implements the same user interfaee and commands used with level 2 and 3 file servers. The serviees provided are fully compatible with the previous level 3 file server.

5.5 Printer server

A printer server is a Model B BBC Mieroeomputer Econet station, modified by the addition of a printer eontrol EPROM and, onee installed, is available to all users on the Eeonet network.

The relevant Acorn manual for the produet is:

412,014 issue 1 *Econet printer server Manager's Guide.*

This publieation describes how to convert a Model B BBC mierocomputer, used as an Eeonet station, to a printer server by the addition of one EPROM. Information is given about setting the station number and printer. Use of the printer server is diseussed, together with suggested aetion in case of problems.

Appendix A. Specifications

5.5.1 Econet network

Type:	CSMA/CD (Carrier Sense Multiple Aeeess with Collision Deteetion)
Topology:	Bus
Speed:	Baseband 200kbits/seeond
Maximum single network length:	500m
Maximum number of stations per network:	254
Maximum number of intereonneeted network segments:	127

5.5.2 Network stations

Several different types of network stations ean operate over Eeonet. The list below may be expanded by the use of second proeessors.

Master Eeonet terminal	128k RAM, 64k ROM
Master Compaet	128k RAM, 64k ROM
Master 128	128k RAM, 128k ROM
Master Turbo	196k RAM, 132k ROM
BBC Model B	32k RAM, 32k ROM
BBC Model B+	64k RAM or 128k RAM 48k ROM
Arehimedes	512k to 4 Mbyte RAM 512k ROM
ACW 443	4 Mbyte RAM, 112k ROM

Note: All workstations listed above exeept the Master Eeonet terminal and the Aeorn Cambridge workstation must be fitted with an Econet interface before they ean be used on the network.

5.5.3 Fileservers

FileStore E01 (AEH26)	Two 3.5" floppy dise drives Printer interfaee: parallel Centronics 26-way IDC type Eeonet interfaee FileStore expansion bus (for FileStore E20) Automatie Eeonet cloek and termination faeility 220-250V 50 Hz AC supply
FileStore E20 (AEH27)	One Winehester drive (20 Mbytes storage) FileStore expansion soeket (for eonneetion to FileStore E01) 220-250V 50 Hz AC supply
FileStore E01S (AEH35)	Two 3.5" floppy dise drives Printer interfaee: parallel Centronies 26 Way Cannon D-type Eeonet interfaee FileStore expansion bus (takes up to 4 FileStore E40S / E60S) Automatie Eeonet cloek and termination faeility 220-250V 50 Hz AC supply
FileStore E40S (AEH36)	One Winehester drive (40 Mbytes storage) FileStore expansion bus Drive number seleet switeh 220-250V 50 Hz AC supply
FileStore E60S (AEH37)	One Winehester drive (60 Mbytes storage) FileStore expansion bus Drive number seleet switeh 220-250V 50 Hz AC supply
Level 1 File Server (AES20)	A Model B BBC or Master 128 Computer, with dise and Econet interfaees 40 traek dise drive (80 traek dise drive sales eode AES23) Level 1 Software on dise Provides shared aecess to files stored on floppy dises Simple file transfer faeilities (load, save, catalogue ete).

Level 2 file server (AES21) The following equipment is required:

Master Turbo with Eeonet interfaee, 800k dual dise drive
or
Master 128 with Eeonet interfaee
800k dual dise drive 6502
seeond proeessor or
BBC Model B (B+) with Eeonet interfaee
800k dual disc drives 6502
seeond proeessor
File server software on floppy disc
Econet level 2 file server User Guide
Econet level 2 file server Manager's Guide

Level 3 file server (AES24) The following equipment is required:

Master Turbo fitted with Eeonet interface
10 Mbyte or 30 Mbyte hard dise drive, 800k dual dise drives
or
Master 128 fitted with Econet interfaee
10 Mbyte or 30 Mbyte hard dise drive
800k dual disc drives
6502 seeond proeessor
Or
BBC Model B (B+) with Eeonet interfaee
10 Mbyte or 30 Mbyte hard disc drive
800k dual dise drives (only required for installing the network software, haeking up files or arehiving.)
6502 seeond processor
File server level 3 software on floppy disc Viewdata system software on floppy dise Battery baeked real time elock module fitted with reehargeable battery
Econet level 3 file server Initialisation Guide
Econet level 3 file server Manager's Guide

5.5.4 Econet installation kits

Eeonet Starter kit (AEH19) Two terminator units
One eloek unit, frequeney seleetable
Power supply and eonneeting lead for eloek unit
Three soeket boxes
Two 1-metre eables with 5-pin DIN eonneetors
Cable insertion tool
Econet Installation Guide

Eeonet eable (AEH17) 100 metres dual twisted pair
Charaeteristie impedanee 100 ohms + 10%
Mutual eapacitanee < 66pF/m
Propagation speed > 0.5e (e = speed of light)
Conneetion by solderless IDC sockets, 180 degrees 5-pin DIN

Eeonet bridge (AEH20) 2 MHz 6502 proeessor
8k RAM, 8k ROM Two
Eeonet interfaees Self test
mode
Two 1-metre eonneeting leads with 5-pin DIN eonneetors at eaeh end
Econet Installation Guide

10 station lead set (AEH18) 10 5-pin DIN 'T' pieees
11 1-metre leads with 5-pin DIN eonnectors

Eeonet socket kit (AEH21) 5 soeket boxes

Appendix B. Advanced installations

5.6 Introduction

When working on a large network installation, there may be a need to establish links between buildings, aeross intervening roads or over even greater distanees. There are a number of ways of making these links, depending on the distance to be eovered and the budget for the project. The following guidelines assume that you want to retain the full funetionality of Econet over the link, so that you ean log on to network servers, transfer files, and generally use the system in the same way as you would if the file server was right next to you.

The minimum data rate that should be eonsidered for the link is 64000 Baud. Links at lower speeds than this may be suitable for earrying traffic to terminal emulators, but are not suitable for running full Eeonet protocols. The following seetions detail the aspeets to be eonsidered when establishing long-distanee links of different types.

5.7 Links between buildings

WARNING: All **external wiring should be buried** below ground level. Wires should not be looped above ground. Cables above ground will be **suseeptible to eleetrical interference and may** attract electrical **discharges. Most wiring regulations forbid the use** of overhead cables without appropriate preeautions. The detailing of these precautions is **beyond the seope of this manual.**

The most flexible method of wiring between buildings is to install pipes or eonduits with draw wires. The draw wires ean be used to install eable as it is required.

If the distance to be eovered is more than a few metres, the link should be set up as a separate network, with a bridge at either end. In this case, the requirement that the eloek should be in the middle of the network may be relaxed - the eloek should be placed within the building at one end of the link. Line terminators should also be attached at either end in the normal way. If no stations (other than the two bridges) are connected directly to the link, you should find that you can normally obtain reliable operation over distanees of up to one kilometre by this method.

5.8 Links between sites

Where it is necessary to eross a publie road, or other obstaele, it may not be possible to install your own pipe or eonduit. In some eases you may find a eonduit whieh already exists whieh you eould use to install the eable.

As an alternative, it may be possible to hire lines from the telephone eompany or other authority that already has links between the two sites. In this ease, you will need two twisted pair eable pairs for each Eeonet link. British Teleeom, for example, may be able to provide sueh a link in the form of a pair of EPS8 lines. It must be stressed that the lines should link the two sites direetly and not go via any publie or private exehange or switehing system.

Onee you have aeeess to the eable, you use one twisted pair eireuit to earry the Econet eloek signal and one pair to earry the data signals. The eireuit provided may then be used to set up a network in the way deseribed above.

As you will not be in a position to guarantee the quality of the eable in the link, you should eonneet eaeh end to a bridge unit, and not attaeh any stations direetly to the line. The link should be made as short as possible and terminated in the usual way.

5.9 Other types of link

Aeorn Computers have some experienee of linking Eeonets on remote sites using eireuits eonforming to the speeifieations of X21. The eircuit speed must be 64000 Baud or above. British Teleeom Kilostream, for example, meets this requirement. Sueh eireuits ean be used to provide eommunieation over several miles. To link the X21 eireuit into the Eeonet system, two modified Econet bridge units are required. Aeorn Customer Support would be happy to advise on the installation of sueh a system.

Appendix C. Clock frequency settings

In the past, a number of tables have been published of the network speed settings that should be set in relation to the network length. You may find such tables in some of the publieations refereneed in this manual. It should be noted that these settings are related to networks on whieh the eloek signal is of a **symmetric** square wave form. The Clock boxes deseribed in this manual produee an **asymmetrie** wave form as shown in Figure 10. The use of an asymmetrie waveform allows the network to be run at maximum speed for all network lengths up to a length of 500m. Operating above this length is not guaranteed, beeause eable resistanee may prevent the eorreet operation of the eollision deteetion and avoidanee proeedure. The eloek frequeney is therefore limited by the speed at whieh the network station hardware and software can operate. The maximum operating frequeney will depend on the mixture of maehines that are eonneeted to the network.

THE RECOMMENDED MAXIMUM SPEED OF OPERATION IS 200kHz.

The cloek waveform should eonsist of a 1u. seeond mark pulse and a 4µ seeond spaee.

Network speeds lower than this may improve reliability in installations where the signal quality is poor due to the age of the installation, the quality of the eable installation or the reliability of the interfaces in the network stations.

Operating above this frequeney may be possible for some mixes of station. However, to ensure reliable operation with the widest range of machines. avoid using higher speeds.

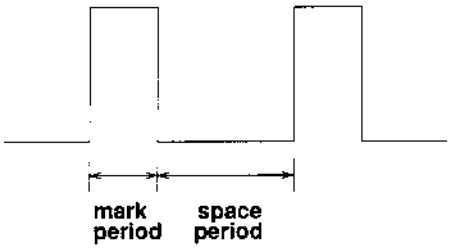

Figure 10: Cloek waveform

Figure 10 shows the Eeonet eloek waveform.

The mark period may be set to 1us or 2us, using the selection links shown in Figure 11. The spaee period is set as a multiple of the mark period. For example, with a mark period of 2us and a spaee period of three times the mark, the overall period is 2us + 3 x 2us = 8us. The network speed is then 1/8 us, or 125 kHz.

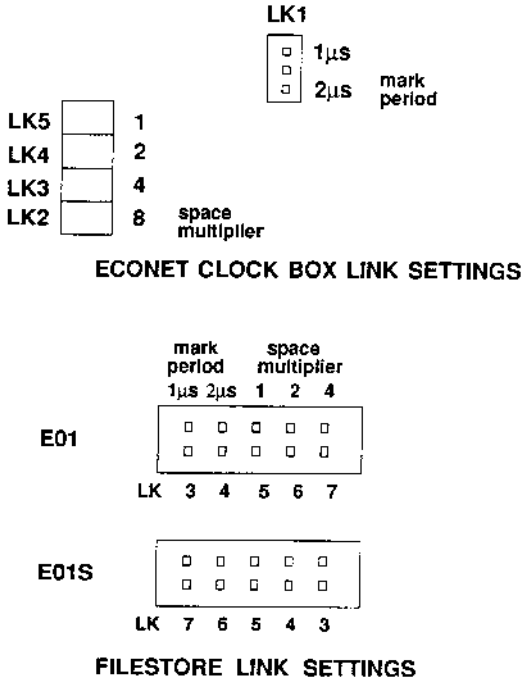

Figure 11: Clock frequeney link settings

Appendix D. Econet Record sheets

FILE SERVERS		
Station No.	Location	Storage Capacity

USER STATIONS			
Station No.	Location	User	Extension No.

PRINTERS

Name	Location	Printer	Use	Station No.

Appendix E. Bibliography

Publieation number	Title
412,111 issue 1	*Econet level 1 file server User Guide*
412,018 issue 2	*Econet level 2 and 3 file server User Guide*
412,019 issue 1	*Econet Advanced User Guide*
412,011 issue 1	*Econet level 1 file server Manager's Guide*
412,017 issue 1	*Econet level 2 file server Manager's Guide*
427,500 issue 1	*Econet level 3 file server Manager's Guide*
427,501 issue 1	*Econet level 3 file server Installation Guide*
482,000 issue 1	*Econet FileStore Network Manager's Guide*
412,014 issue 1	*Econet printer server Manager's Guide*

These publieations are obtainable from approved Aeorn dealers, although the older ones may be out of print, and availability will depend on existing stoeks.

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