The BBC Microcomputer
Econet® System/Clock and Terminator Boxes

Installing an Econet network

Introduction

The Econet communications network enables a number of computers to share expensive resources such as a printer and a disc 'file server.' The system is primarily intended for schools and colleges but also lends itself to many office and business applications.

This leaflet describes the materials and constructional methods to be used when setting up an Econet network. The contents are as follows:

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1 Items required

To install an Econet network you will need the following items:

o Two terminators with power supplies
o One clock with power supply
o Cable for the network
o Sockets and plug connectors

Each of these items is discussed in the following sections.

1.1 Terminator and power supply

Two terminators are required, one for each end of the network cable. These are available ready-to-use, housed in small plastic boxes. A socket on one end of the box is provided to connect the 8 volt power supply. On the other end of the box is a 5-pin DIN socket to connect to the end of the network cable.

1.2 Clock and power supply

It is important that only one clock is connected to the network. The Econet network clock is available housed in a box similar to the terminator boxes (these are clearly marked so as to prevent you from getting the two confused). The clock box has a power supply socket to accept an 8 volt DC supply

and a 5-pin DIN socket to connect the box to the network. It is possible to alter the clock rate – this is dealt with in section 4.

1.3 Cable

The Econet network requires a four-core cable with earth screen. The four cores should preferably be arranged as two twisted pairs and the end-to-end resistance of the network cable should be less than 15 ohms, which will typically allow a network of up to 500m to be installed.

1.4 Sockets and plug connectors

Standard 180 degree 5-pin DIN chassis sockets are used for connections to the network. Good quality DIN sockets should be used. Two 180 degree 5-pin DIN plugs should be joined by a piece of cable wired pin-to-pin. This is used to connect the stations to the network. The cable *must* be less than 2 metres long.

1.5 Suppliers

The various components needed to make an Econet network can be obtained from the following suppliers. The list is by no means exhaustive and alternative parts may be suitable. Please contact your Econet dealer or Acorn Computers for further details.

Terminators and clock
These are provided by Acorn. The following parts numbers are applicable:

Terminator and power supply Acorn part no. AEH15
Clock and power supply   Acorn part no. AEH14

Cable
BICC cable number CS7227 .9mm with screen available from:
BICC in 2km reels or
Acorn, part number AEX03, by the metre.
For shorter networks (less than 300m):
RS cable 367-921 in 100m reels from RS.

Sockets
180 degree 5-pin.
RS 478-273 (screw mounting) and RS 478-633 (circular mounting).

Lead connectors
With 180 degree 5-pin plugs.
Acorn part number AEX01 (1 metre of cable with two DIN plugs fitted and one T-piece).
Local hi-fi stores (make sure that the wiring is pin-to-pin).

2 Installing the network

Installing a network basically consists of laying the network cable, connecting DIN sockets where required and connecting the terminators and clock. However, before starting to set up your network, some precautions should be noted if it is to work reliably.

(1) Good soldering is essential. Dry joints or poor contacts which may cause intermittent operation are extremely difficult to track down and rectify. It is much better to spend some time (and money) in getting good connections in the first place.
(2) Short circuits will cause the system to malfunction. Hence you are strongly advised to use rubber insulating sleeves on the back of the DIN sockets to prevent possible short circuits.
(3) Avoid cross wiring. The BICC cable recommended above has two white cores, one twisted around an orange core and one twisted around a blue core. It is very easy to get the white cores muddled up – if you do the system will not work. Unfortunately, the cores are not

twisted very tightly and it will probably be necessary to strip off about 20cm of the outer insulation to determine which white is twisted around which colour. This is important to reduce cross-talk between the data and clock lines. If possible use a cable which has four differently coloured cores. If you cannot do so, short circuit one twisted pair at one end of the cable and use an ohm-meter or battery and bulb to test for continuity. The polarity is also important. Thus the two data wires should not be switched around at any socket (similarly for the two clock wires).

The basic layout for the Econet network is shown in figure 1. The network consists of one cable without branches to which everything is connected by 5-pin DIN plugs and sockets. The sockets are all wired in parallel. The suggested colour codes for the connections are:

	RS	BICC	DIN pins
Data +	Black	White	1
Data −	Red	Orange	4
Earth	Shield	Shield	2
Clock +	White	White	3
Clock −	Black	Blue	5

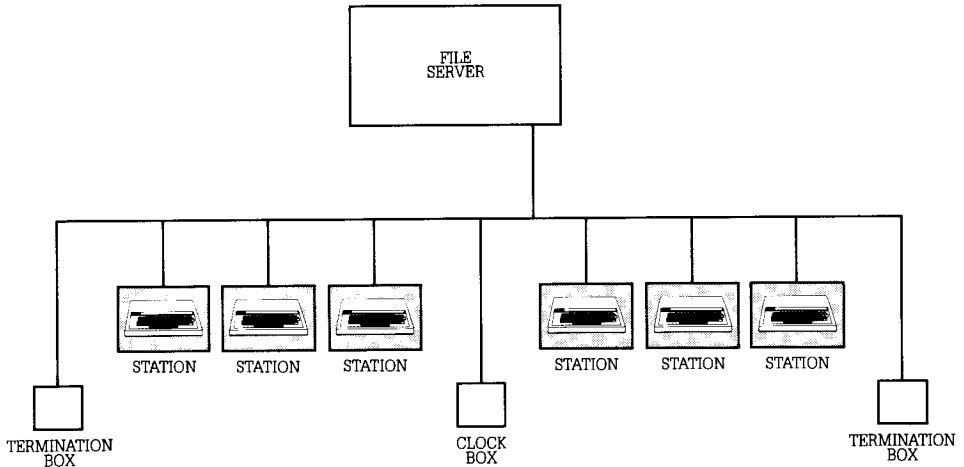The DIN plug pin number allocations are shown in figure 2.

Figure 1: A typical network layout

Before starting to install the network cable it is a good idea to plan its route very carefully. It is normally the case that a room or rooms with an obvious route for the wires may not always be the easiest to wire. A little time spent looking at the site in advance will almost certainly pay dividends.
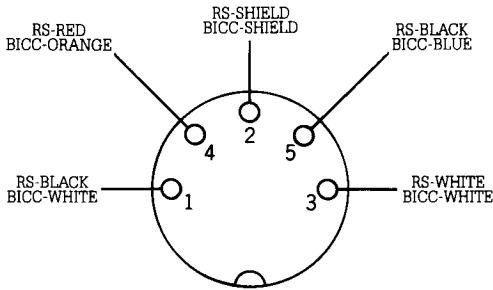

Figure 2: DIN pin number allocations

When installing the cable it is probably best to start at one end and work your way along, making sure that the similar coloured wires are not crossed before inserting each socket. For good network reliability, the sockets should be soldered into the network cable and the use of T-junction DIN sockets to connect stations avoided. This is essential for long or many-stationed networks since each T-junction introduces about 0.2 ohms into the network cable resistance.

A socket should be connected to each end of the cable to plug in a terminator. The socket for the clock is most usefully connected roughly half way along the cable. Other sockets are connected to the cable where a station is required. Note that any branches or spurs should be less than 2 metres long. Therefore the maximum length of wire connecting an Econet station to the network should be less than 2 metres. The siting of the station sockets should be carefully planned so as to minimise spur lengths.

3 Testing the wiring

To test the wiring it is suggested that you carry out the following procedure:

(1) Plug a 5-pin DIN plug wired with two 100 ohm resistors as in figure 3 into one of the sockets at the extreme end of the network cable.

(2) Connect a meter between the two clock lines at the other extreme end. The meter should read less than 140 ohms for reliable operation. If no reading is obtained move towards the other end, one socket at a time, until you obtain a reading. At this point the fault will lie between the socket under test and the socket previously tested. Note that the fault could be bad soldering in either socket or bad cable between the two sockets.

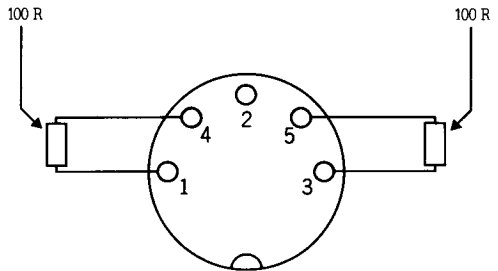(3) Once you have checked that the two clock lines are correct, repeat the tests for the data lines.

Figure 3: Wiring a test DIN plug

4 Setting up the network

By now you should be able to lay the main network cable, connect the DIN sockets and check the wiring. Before using the system you must carry out the following operations:

(1) Connect a terminator at each end of the cable, and connect the terminators to an 8 volt power supply. Connection of the supply to the terminators is indicated by a small red LED (light emitting diode) near the power supply socket.

(2) Select a suitable clock rate. The clock rate you should use will depend upon distance from the clock to the furthest station. Using the clock rates available with the Acorn clock box, recommended maximum clock rates for different distances (in metres) are:

Distance to clock	Maximum clock rate
100	307K
150	230K
240	153K
330	115K
500	76K

The following formula can be used to calculate the upper limit of the clock rate for a given clock to furthest station distance:

$$\text{Rate} = (\text{signal vel in cable}) / (\text{distance to clock} \times 4)$$

which for the BICC cable, with the clock positioned in the centre of the network, becomes:

$$\text{Rate} = 42 \times 10^6 / (\text{network length})$$

In practice a lower rate is often more reliable. The maximum clock rate is 300K for BBC machines and 200K for the ATOM and other systems. The minimum clock rate, imposed by the Econet hardware, is 70K.

To select a clock rate you will need to get inside the clock box. To do this remove the four screws, one in each corner of the base of the box. Carefully remove the top section of the box. In the middle of the circuit board in the box you should see two parallel rows of pins and a connector linking two of the pins. By the side of the rows of pins there is a series of numbers printed on the circuit board. These are the available clock rates. To select a given rate remove the connector from its present position and use it to connect the two pins to the right of the required rate. This is shown in figure 4, below, where a clock rate of 153KHz has been selected.
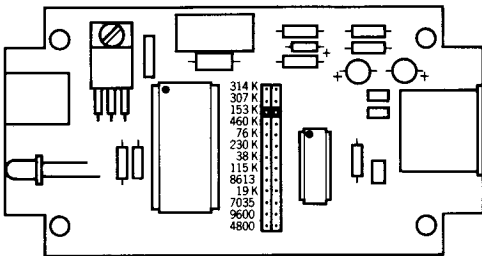

Figure 4: Selecting clock rate

(3) Connect the clock to the network, as close as possible to the centre of the cable for maximum speed. Connect an 8 volt power supply to the clock. A small red LED near the power supply socket will light up to indicate that the supply is connected.
(4) Each station connected to the network must have a unique identity code hardwired onto its

Econet interface card. This is achieved by bridging pairs of pins on two parallel rows of eight pins. The eight pins form a binary number. Where a bridge is placed, the corresponding bit in the station number will be zero. This is illustrated in figure 5, where station number 15 has been set-up. It is important that no two stations on the network have the same number. Numbers 254 and 235 are normally used for the file server and printer server respectively and the Econet software initially expects these numbers to be used.
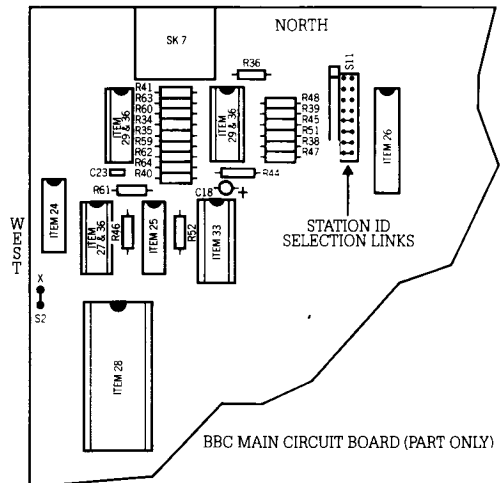

Figure 5: Selecting station identity number

5 Fault diagnosis

If the network fails to operate when attempting to communicate with either the file server, the printer server or another station, then one of the following problems could be the cause:

'No clock' message
This indicates that there is no clock signal reaching the Econet interface circuits.
Check:
o Are you plugged into the network?
o Is power connected to the clock box? (Check the power indication LED.)
o Is the clock box connected to the network?
o Are the clock lines open or shorted?

'Net error' message
Check:
○ Is the clock speed suitable (see section 4)?
○ Are the terminators connected to a power supply? (Check the LEDs.)
○ Are the terminators connected to the network?
○ Is there a network fault, eg short circuit, open circuit or crossed wires?

'Line jammed' message
This means that there is continuous information on the data lines. Carry out the following operations, testing to see if the fault is remedied after each stage:
○ Reset all stations connected to the network.
○ Remove all other stations from the network.
○ Check for faulty terminators.
○ Check for crossed wires in the network cable.
○ Check for faulty local station.

'Not listening' message
Check:
○ Are you sending your message to the correct station?
○ Is the remote station plugged into the network, powered-up and in Econet mode?
○ Is there only one station with the number you are addressing?
○ Is the network cable faulty?
○ Is the local or remote station faulty?

'No reply' message
Check:
○ Does the remote station have an attached and enabled peripheral (eg printer or disc drive)?
○ Is the peripheral switched on?

Service
Technical support and service can be obtained from a number of sources:

After sales service and advice by a national dealer network (see list); Retail Control Systems Limited, Gresham House, Twickenham Road, Feltham, Middlesex TW13 6HA; and from Acorn Computers Limited, Fulbourn Road, Cherry Hinton, Cambridge CB1 4JN.

Whilst every effort is made to ensure that the information given here is correct, this description and specification may be subject to change without notice.

Optimus Design. Cambridge

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