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AM - RACK &

AM-19200B & AM-64000B

BASE BAND MODEMS

USER MANUAL

BLACK BOX® Catalogue Ltd.

15 CRADOCK ROAD, READING,
BERKSHIRE RG2 0JT

ORDERLINE: (0734) 866800.
HELPLINE: (0734) 312233.
FAX: (0734) 311727

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Contents

1. INTRODUCTION

This manual applies to the AM-19200B, AM-64000B Base Band Modem Cards and the AM-Rack.

The BABT approval numbers for these units are as follows :

(1) AM-19200B Modem Card	-NS/1284/12/M/602121	Ascom part number 1/113/025/100
(2) AM-64000B Modem Card	-NS/1284/12/M/602121	Ascom part number 1/113/002/100
(3) AM-Rack	-NS/1284/12/M/602120	Ascom part number 1/113/003/100

The modems can provide synchronous communications at user data rates between 2.4 and 64kb/sec over a 2-wire twisted pair cable. Asynchronous communication is also provided at data rates up to 19.2kb/sec.

The modem can easily be configured using the display unit front panel keys on the rack in conjunction with the Liquid Crystal Display (LCD). The display is operated in a menu type fashion with easy to understand mnemonics, which should make constant reference to this handbook unnecessary.

Once configured the operation of the modem is totally automatic, in the event of line disturbances the data link is immediately restored without operator intervention.

Chapter 4 (installation) describes the basic set up procedure and this should be read prior to setting up any link.

Chapter 5 (menu operation) is much more detailed, but should be read to gain an understanding of the full range of menu facilities available.

The unit is BABT approved for connection to private digital circuits adhering to the X21 or X21 bis recommendations. (PTO service categories 1 and 2, all rates). Connection of the unit to such circuits is described more fully in appendix F.

Contents.

The handbook comprises two sections:

SECTION 1.

AM-RACK, AM-19200B, AM-64000B

2.1 Base Band Modems

The AM19200B and AM64000B are double sided PCBs (double euro-card sized) which plug into an AM-Rack. On the front panels there are 7 LEDs and 2 push button non-locking switches. The backplane connector is a DIN 41612 with early make ground pins. The latter provides connections for power, line,and switched interface connections for X21(V11),X21bis(V28),V35 and V36.
The overall dimensions of the units are: 261H x 25W x 248D mm

Figure 2.1 shows the front panel
of an AM64000B modem.

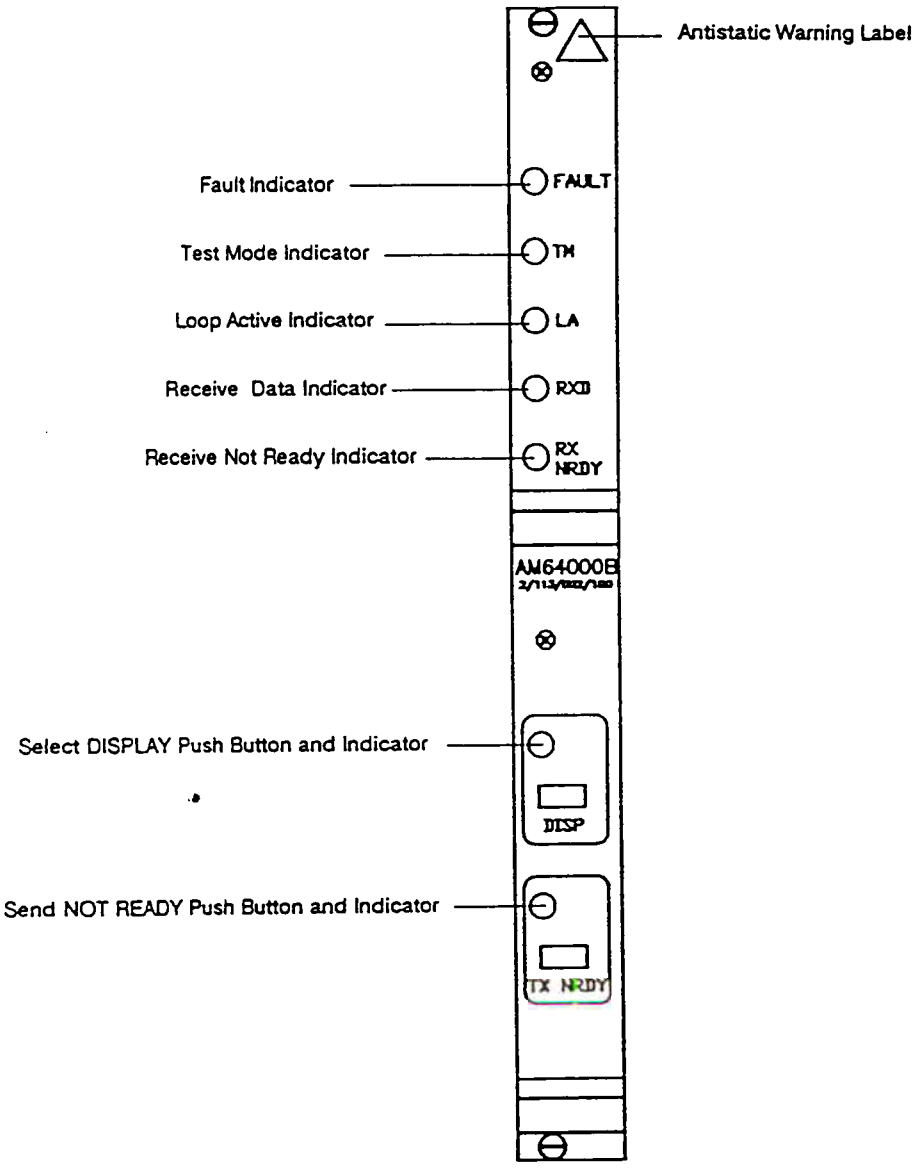


Figure 2.1 AM64000B

2.2 AM-Rack

The AM-Rack is a 19 inch DIN 41494 rack that can hold up to 12 Ascom AM Card Modems in slots numbered 1-12 from left to right (viewed from the front of the unit).It incorporates a menu driven display and an integral power supply unit.

The rack unit comprises four sub units.

(a) Rack Sub-Assembly

(b) Display Unit

(c) Power Supply

(d) Blanking Panels

Figure 2.2 shows detail of the front of the complete rack unit loaded with three AM64000B modems.

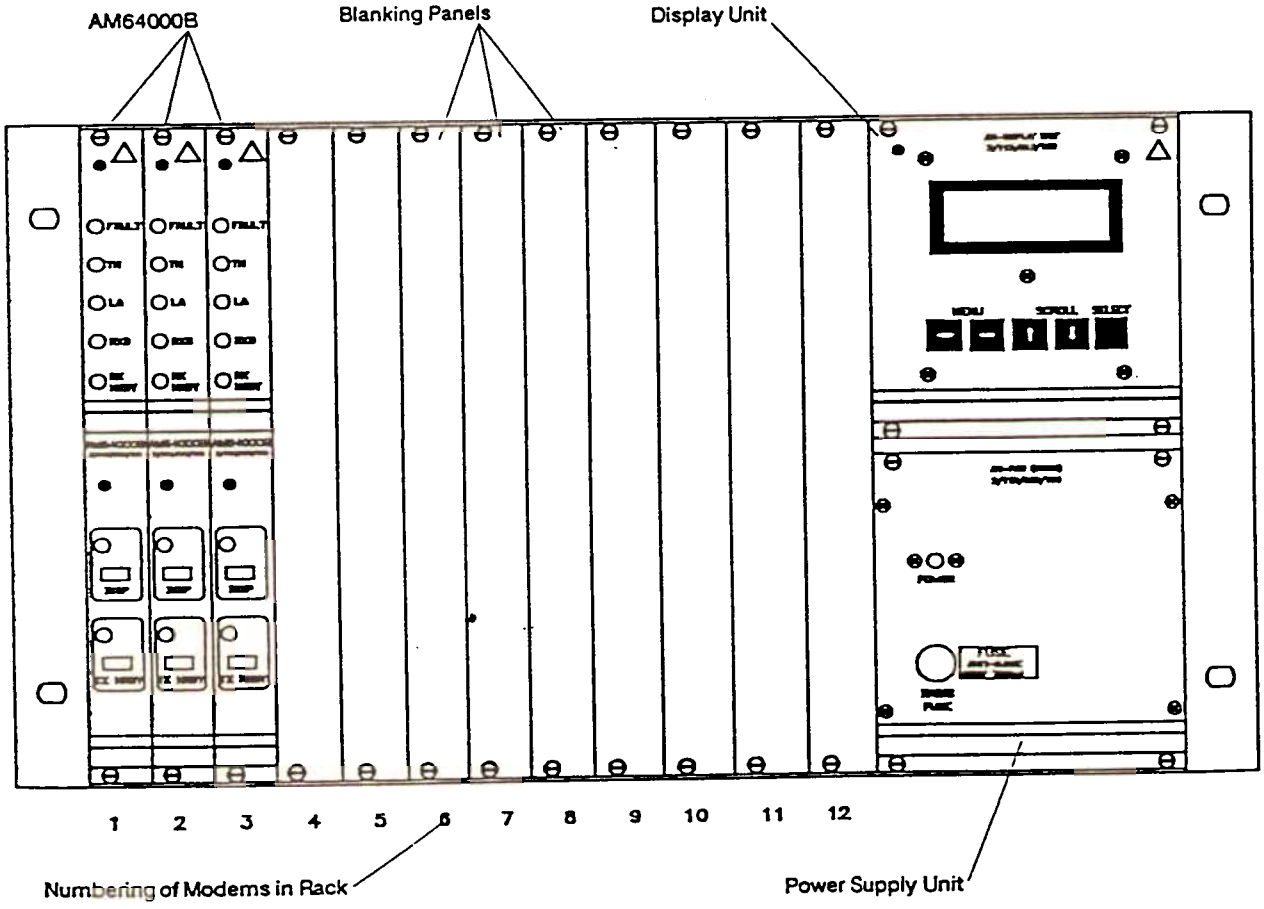


Figure 2.2 AM-Rack

2.2.3 AM-Rack Backplane Connections

There are a number of connectors mounted on the rear of the rack which may be classified as five main types with reference to figure 2.2.3 (below):

(1) Mains entry - Provides access for an IEC type mains connector to provide 250V mains power to the rack.

(2) Line connector - (25- way D-type plug) - Provides a termination point for the line connections for all twelve rack mounted modems (see appendix A-3 for detailed description.)

(3) Fault extension socket -(Line jack 431A/BS6312) - Provides a possible external indication of a fault condition on any rack mounted modem.

(4) Interface connectors - (BT Type 224 plug) - Provides connection to the interface circuits of all 12 rack mounted modems. The interface used may be selected from one of four possible types:

(i) X21
(ii) X21bis
(iii) V35
(iv) V36

Associated with these interfaces are four individual interface cables terminated with the relevant ISO/BS standard connector (X21 - 15 way D type, X21bis - 25 way D type, V35 - 34 way MRAC and V36 - 37 way D type) at one end, and at the other with a BT Type 224 socket. The latter plugs into the matching socket on the shelf to provide any one of the four interfaces for any of the twelve possible modems.

(5) Digital Ground to Earth Link - Link secured by hand operated screws which provides the installer with the option of a floating circuit digital ground.

(6) Hardwired Earth Connection Point - Provides a means of connecting an external earth to the Digital Ground, Protective Earth and Chassis of the rack unit.

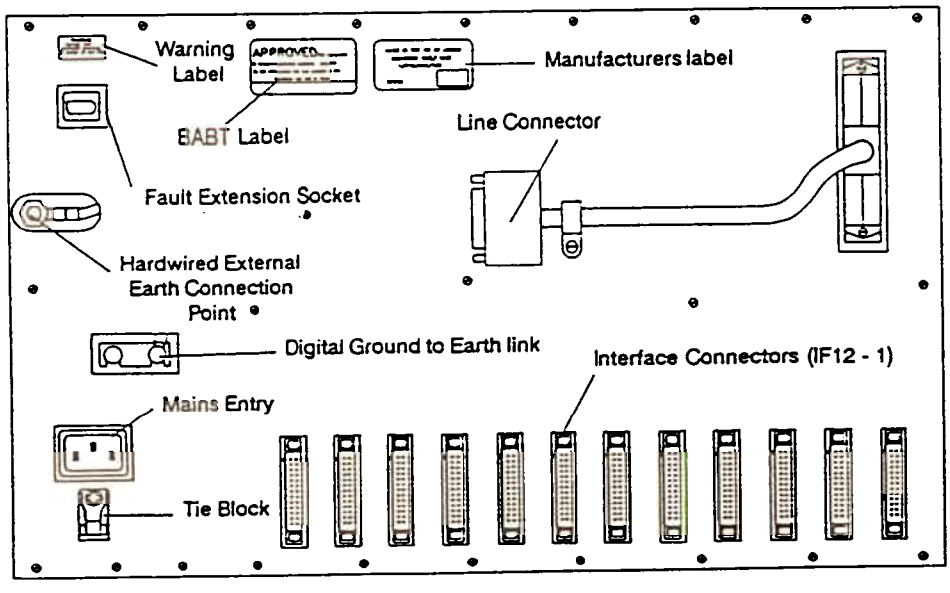


Figure 2.2.3 AM-Rack Backplane Detail

Note : The numbering of the interface sockets on the rear of the rack unit (right to left for numerical order) follows the numbering of the modems from the front of the rack (left to right for numerical order).

3. SYSTEM OVERVIEW

The AM19200B & AM-64000B modems use the digital transmission system designed and developed by Ascom Telecommunications Ltd. in Cardiff. It is intended for operation on 2-wire local telephone network circuits, such as those meeting BT EPS-9 (2-Wire). It will operate satisfactorily on unloaded lines having a wide range of characteristics; bridge taps can be tolerated, dependent upon their characteristics. Although the system requires a baseband circuit, a continuous loop at DC is not required. The system can transmit data at either 71 kb/sec or 28 kb/sec; the lower rate is useful in situations where the user rate is less than 19.2 kb/sec and transmission performance is being limited by attenuation or noise.

The line signal comprises AMI-encoded data and an embedded sync pattern which is used for timing control; the data consists of user data and a control channel for the systems own use. Echo cancellation is used to eliminate the unwanted reflections of the transmitted signal from the receiver input. The echo canceller can eliminate echoes of up to 16 bit periods duration. To counteract the signal distortion inherent in long lines the system employs adaptive decision feedback equalisation to eliminate trailing intersymbol interference; this also has a span of 16 bit periods. A fixed linear equaliser is incorporated to control the received pulse waveform and to reduce the effect of the long tails of both echo and transmission responses. Digital signal processing is used throughout to achieve high performance reproducibly.

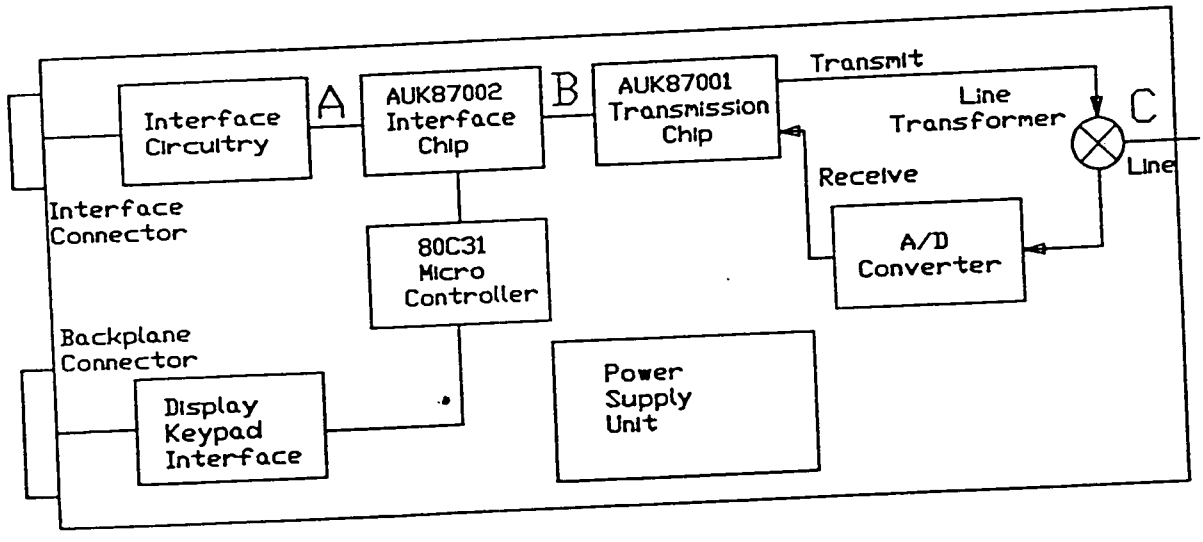


Figure 3.1 Block Diagram of System

A block diagram of the unit is shown in figure 3.1.

The line is connected to the transmission circuit via a line transformer which acts as a balun and provides isolation; there is surge protection at both sides of the transformer. The transmission circuit utilises a custom IC and a number of proprietary components to perform the signal processing described above.

The interface circuit performs a number of functions: it converts between the user data from the appropriate interface and the 64 kb/sec (or 25.6 kb/sec) which is transmitted down the line; it links the control circuit to the control channel ; it interfaces the control circuit to the control lines of the data ports . Again , these functions are performed by a custom IC supported by a number of standard components. Looking at each function in turn, user data at 64 kb/sec is sent as-is; byte-timing is maintained by the transmission system and is available if required. Data at 56 kb/sec is sent in a 7 + 1 format, i.e. data plus status information. At all lower rates the data is transmitted as octets comprising 6 data bits, 1 framing bit and 1 status bit. At rates below 48 kb/sec the octets are iterated as appropriate to fill the transmission channel.

Turning to the control channel, this uses 4 bits from each transmission frame to transmit control information to the unit at the other end of the line, e.g. user data rate selection, and to monitor the overall performance of the link.

With regard to the remaining function of the interface circuit, the control lines of the data ports mainly require buffering ; however, in the case of X21 the various control patterns have to be generated or detected. The control circuit is based on a microcontroller and determines the state of the unit according to the state of the transmission system, the state of the data interface and the configuration information received from the front panel and from the control channel. It also provides the front panel display with information on the current state of the unit which can be reviewed via a simple menu structure.

4. INSTALLATION

This chapter describes the basic steps that are required to set up a system involving an Ascom AM-Rack Mounted Modem and AM-Rack. Before concentrating on the installation of the modem refer to section 4.4 (rack installation).

There are two basic systems that will be considered:

(1) Modem connected to Modem
(2) Modem connected to Line Card

When considering the installation general pointers to the configuration of the AM-Modem's are given. It should be noted that there are many modem parameters which may be set differently and prevent the results from being as expected. If any results are not as discussed then chapter 5 on menu operation should be consulted. If this still fails to resolve the problem then the internal links can be checked, see appendix B.

The interface details should now be configured at both ends of any link. This is done using the *option menu* (section 5.6) and setting the relevant interface selection switches on the AM-Modem PCB (see section 4.3). If asynchronous working is required then the internal links will need to be set up. (Appendix B).

This apparatus is intended for use with a low-voltage supply of : 10-0-10 V ac and 15-0-15 V ac. There is no user protection in the apparatus against supplies having voltages in excess of this. Users of this apparatus should ensure that any power supply or other equipment provided for use with this apparatus complies with the relevant legal safety requirements when properly assembled, installed and maintained, and when being used with proper care having regard to the purpose for which the equipment is intended.

4.1 Modem to Modem Link

With no DTE or line connected to the rack plug the modem into a slot in the shelf.
On power up the AM-Modem will go through its self test procedure and its LEDs will come on for a few seconds (ie FAULT,TM,LA,RXD,RXNRDY). These will then go off leaving the FAULT LED on.

If the self test fails an error message will be displayed when the display unit is selected for the the particular modem by pressing the DISP button. These messages are explained in section 5.4.8

The mnemonic LTU stands for Line Terminating Unit, and this should be understood (in all cases) to be the AM-Modem itself.

For a point to point link to work, one modem must be set to *master mode*, and the other modem to *slave mode* (section 5.7.1). If the link is self contained , ie. there is a DTE at both ends and no other links are involved then it makes little difference which end is which. If another link is driven then the master modem must be connected to the external modem, (see section 5.7.3.).

Set the *line rate* (section 5.7.2) to the required setting at both ends, and set the *user data rate* up on the master (section 5.5). When the line is connected the FAULT LED should now go out. The status menu should then be examined to check that the unit is correctly configured.

The following data is provided by this menu:

(a) Overall status (ie whether ready or not)
(b) Alarm messages
(c) User data rate
(d) Line rate
(e) Interface status
(f) Interface mode

To examine this data, first locate the status menu by using the left arrow key, then use the up/down arrows to look at each item in turn.

With no DTE (Data Terminal Equipment) connected the results should be one of the following:

(a) `S > LTU Ready` or `S > LTU Not Ready` (depends upon interface details)

(b) `S > No Alarm`

(c) Data rate as required

(d) Line rate as required

(e) Interface status as required (usually all lines off, but depends on any X21bis options set)

(f) `S > Link Mode`

If the status is not correct the modem must be reconfigured. (See section 5 on menu operation.)
If the status is correct the DTE (Data Terminal Equipment) or a data tester may now be plugged into the modem. In order for end to end data transfer to take place there must be *no test loops active either locally or remotely. (The power up default for the Test Menu is no loops).*

4.2 Modem to Line Card Link

Power up the AM-Modem as described above and set the modem to slave mode.
Set the line rate as required, and connect the line cord.

Consult the line card handbook to set up the user data rate. The modem should then automatically program to this rate.

There should be an *options enable* switch/command on the line card to allow the interface details to be set either from the line card or from the modem. If the interface is to be set from the line card then the enable switch/command should be off and the the line card options set as required, (see line card handbook). If the interface is to be set from the modem, then the enable switch/command should be on, and the option menu used as in the above case.

The status menu can then be examined and the DTE connected as with the modem - modem case. The displays should be the same, except for the interface mode display (f) which should read:

(f) `S > Network Mode`

4.3 AM-Modem Interface Selection Switch Settings

Refer to Appendix B & C for details of the various Asynchronous interface and termination links settings

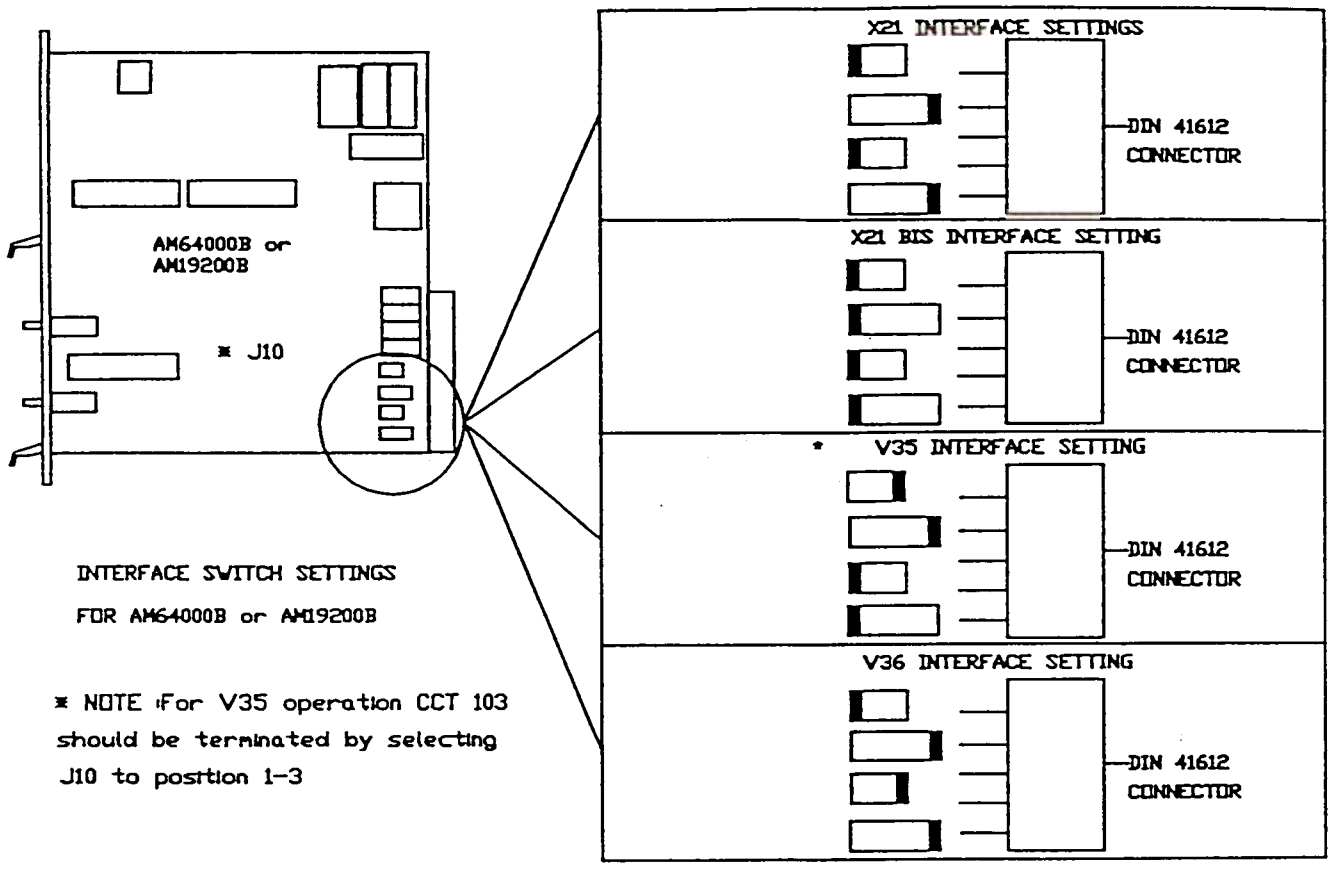


Figure 4.3 Interface Switch Settings

Before installation of the modem in the rack , selection of the desired interface type must be carried out by configuring the header switches S1,S2,S3 and S6 see figure 4.3 (above). The bar on the end of each switch aligns with the relevant bar on the PCB silk print which corresponds with the correct interface marked in the silk print legend.

Associated with this interface selection for the modem is the selection and connection of the relevant interface cable assembly for the shelf unit ;details of this are given in section 4.4.

4.4 AM-Rack Installation

Before any modems may be operated, the rack must be assembled from all its component parts and connections made to it for:

(1) Power supply.
(2) Hardwired External Earth Connection.
(3) Line connections.
(4) Interface connections.
(5) The fault extension connections (if required).

4.4.1 Unpacking the Unit

If the customer has chosen to use an AM-Interface Cable Bracket together with appropriate interface cables then the complete rack unit will be supplied in four separate cartons containing:

Carton 1 - AM-Rack (basic rack + 12 blanking panels no display or power supply) -Part number 1/113/003.

Carton 1 - AM-Display Unit. -Part number 1/113/013.

Carton 1 - AM-Power Supply Unit -Part number 1/113/012.

Carton 2 (optional) - AM-Rack Interface Cable Bracket Assembly -Part number 1/113/019.

Carton 3 (optional) - AM-Modems Interface cables chosen by the customer which may be:

(i) The AM-Rack X21 Interface Cable Assembly -Part number 1/113/016.
(ii) The AM-Rack X21 bis Interface Cable -Part number 1/113/015.
(iii) The AM-Rack V35 Interface Cable -Part number 1/113/017.
(iv) The AM-Rack V36 Interface Cable -Part number 1/113/018.

Carton 4 (optional) - AM-Rack Line Network Cable Assembly (Hard Wired or With Plugs)

Unpack the components from their cartons.

4.4.2 Installation of Interface Hardware

To assemble the Interface Cable Bracket proceed as follows: (refer to figure 4.4.1)

(1) Assemble the side cheeks to the bracket using the four M3 Pozipan screws supplied.

(2) Decide which interface cables mate with which interface connectors on the rear of the rack and corresponding modem slot on the front of the rack. Using two M3 Pozipan screws supplied screw the connector to the bracket at the correct point.

(3) Unscrew the mains cable tie block from its position on the rear panel of the rack and mount it in the corresponding position on the rear of the interface bracket.

(4) Take the rack and place it on its front edge (backplane connections upwards). Then using a 4 mm Allen key remove the six Allen bolts from its rear edge (two on one side, four on the other). Position the Interface Bracket over the rear of the rack so that the holes in its side cheeks mate up with those of the rack. Replace the Allen bolts.

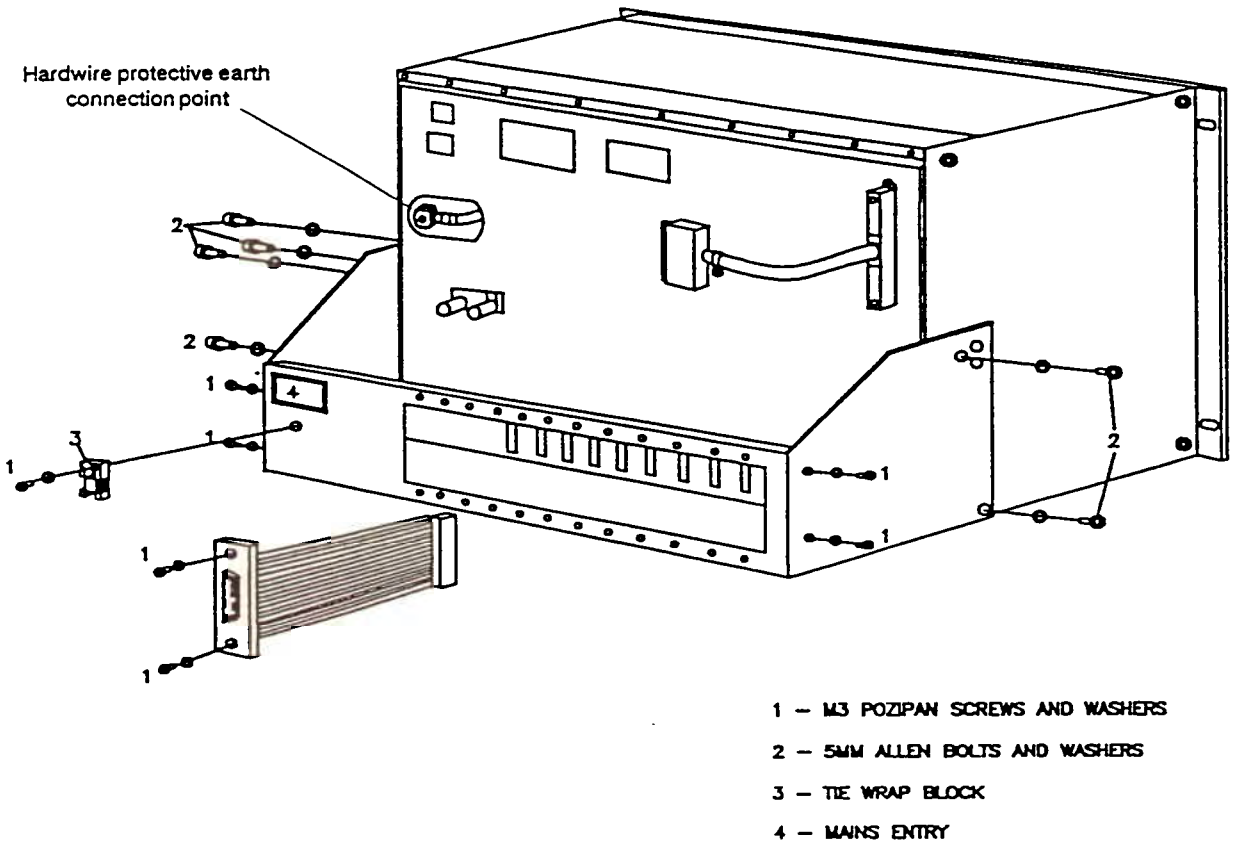


Figure 4.4.2 Assembly of Rack Interface Connections

(5) Feed the interface connector cable from the bracket to the rear of the rack and connect to the corresponding interface socket.

Repeat this operation for all the interface connections required (see Appendix A for details of the interface pin numbering.).

4.4.3 Installation of the Display Unit

Slide the display unit into its card guide position in the top right corner of the rack ensuring correct mating of the DIN 41612 connector with that of the backplane of the rack. Secure it in position by tightening the four front panel screws. Referring to figure 4.4.2 , a hardwired protective earth connection must be made to the rack before continuing, at the point indicated in the diagram.

4.4.4 Installation of the Power Supply Unit

Carefully slide the power supply unit into card guide position in the bottom right corner of the rack ensuring correct mating of the DIN 41612 connector with that of the backplane of the rack. Secure it in position by tightening the front panel screws.

WITH THE MAINS POWER SWITCHED OFF BUT THE CABLE EARTHED push the mains IEC connector through the slot in the interface bracket (if fitted) and mate with the matching connector on the rear of the rack. Secure the mains cable in position on the rear of the interface bracket or the rear of the rack using the tie wrap block and cable tie supplied. Follow the instructions below before switching on the power.

4.4.5 Installation of Hardwired Earth Connection

An M4 stud and nut are provided in order that the customer can make a hardwired earth connection to the AM-Rack. With this connection made all digital grounds and earths are joined to a point external to the rack.

NOTE: The installer may select whether the internal circuit digital ground is to be connected to Earth or left floating by making or leaving open the connection to the above hardwired earth connection.

4.4.6 Digital Ground to Earth Link

The installer may select whether the internal circuit digital ground is to be joined to earth or left floating.

4.4.7 Installation of Fault Extension Connector

If required this connection may be made as an external means of monitoring fault conditions within the rack. Details of the pin connections for this socket are given in appendix A.
SWITCH ON THE MAINS POWER TO THE RACK.

4.4.8 Installation of Modem(s)

Refer to sections 4.1 to 4.3 in order to configure the modem(s) before installation in the rack. To install one modem a blanking panel must first be removed by undoing the screws at the top and bottom of the panel. Having taken the blanking panel from its position a modem may then be slid into the corresponding card guide position of the correct slot (matching its interface connector). Secure each modem in position by tightening the front panel screws (insertion of the modem with the rack power on is possible due to the use of early make ground pins on the AM-modem). If at any time a modem is removed from the rack, then it must be replaced immediately by a blanking panel being secured in position by its front panel screws.

4.4.9 Installation of Line Connections

The line connections to the network will follow the scheme chosen by the customer but the rack terminates with a 25-way D-type connector (pin numbering details are given in appendix A) attached to the rear panel of the AM-Rack. Connections to the network from the 25-way D-type connector may be made using one of the two available cables:

i) Rack - Line Network Cable Assembly - (BS 6312 Plugs)
ii) Rack - Line Network Cable Assembly - (Hardwired)

Before undertaking any maintenance work or reconfiguring the rack the line connector (25-way D-type) MUST first be unplugged to isolate the rack from the network.

5. MENU OPERATION

5.1 Front Panel Features

The ascom AM-modems and Display Unit have uncluttered and easy to understand front panels.The modem has 7 LEDs and 2 push button non-locking switches.The Display Unit has a liquid crystal display and 5 non-locking keys. With the 16 character alpha-numeric, dot-matrix liquid crystal display it is possible to describe most of the functions in plain English, thus avoiding having to use complicated mnemonics and the need to constantly refer to a handbook.
Any one of up to twelve possible modems loaded in a rack unit may take control of the display exclusively by pressing the DISP push button on its front panel.

5.1.1 Display Unit Front Panel Features

The 5 front panel keys on the display unit are as follows:

(1,2)	MENU (left and right)	Used to change menus
(3,4)	SCROLL (up and down)	Used to scroll through items within a menu
(5)	SELECT	Used to activate/deactivate the feature displayed

5.1.2 Modem Front Panel Features

The LCD display is complemented by the use of 7 LEDs to monitor the following :-

(1) FAULT, Red LED

This lights to indicate the line signal is faulty; the main causes of this are as follows:

(1) No signal received (ie. line broken/disconnected)
(2) Incorrect line rate
(3) Incorrect user data rate

Further information is provided in the *status menu*, (see section 5.3.2).

(2) TM, (Test Mode) Red LED

This lights whenever a test mode is active, (i.e. a pattern is being generated, or a loop is being applied).

(3) LA, (Loop Active) Red LED

This lights whenever a data loop is active.

(4) RXD, (Received Data) Yellow LED

This indicates the state of the user data,it is turned on for a '1' and turned off for a '0'.

(5) RX NRDY, (Not Ready received from line) Yellow LED

This lights whenever a Not Ready pattern is being received (UNR or CNR), AND a structured user rate is in use, (a rate which has a status line).

(6) DISP, (Display selected) Yellow LED

This lights when the DISP switch is pushed to indicate the selection of display unit by the modem.

(7) TX NRDY, (Transmitting Not Ready) Yellow LED

This is provided to display the state of the TX NRDY key. When lit it means the TX NRDY key is on.

5.2 Front panel operation

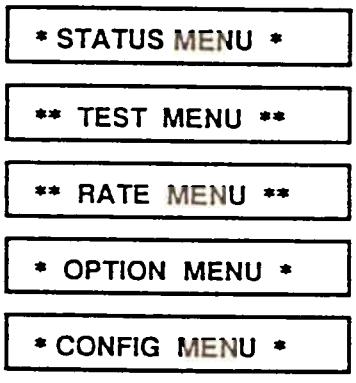
The LCD will display one of five menus at any one time, these menus are:

1.	STATUS	(Prompt is S>)
2.	TEST	(Prompt is T>)
3.	RATE	(Prompt is R>)
4.	OPTION	(Prompt is O>)
5.	CONFIG	(Prompt is C>)

In normal circumstances, the front panel LCD will display a *Status* message relating to the overall state of the data link, eg. READY. Additional status information may be displayed by scrolling down through the menu. The *Status* menu is *read- only*. To select the next menu in the list the 'RIGHT MENU' button must be pressed. To go back to a previous menu the 'LEFT MENU' button must be pressed. A prompt on the left hand side of the display will indicate which menu has been selected. On entering a menu its title will be displayed in full before the display reverts to the first menu item and the relevant prompt.

If the equipment is left in a display other than *Status* for greater than one minute the display will automatically time out and revert to the top line of the status menu. If left in the Status menu but not on the top line, the display will automatically time out and revert to the top line of the status menu after 5 mins.

The sequencing through the menus is as follows



When scrolling through the menus, the items will appear in the order detailed in the individual menu descriptions.

Each menu item display should indicate the current state of that item. For example if the loopback feature was currently inactive then the display should read: 

To change the state of a menu item the 'SELECT' button should be pressed.
The display should then change to reflect the modified status, in the example above the display should change to read: 

If a menu item is not appropriate for a given situation then it will disappear from the menu. For example it is not permissible to have a loopback on and binary keys active at the same time. The first one selected will therefore cause the other to disappear from the menu.

Any item selected in the Rate, Option, or Configuration menus is automatically stored in non-volatile EEPROM. These features will thus be restored when the modem is next powered up.
Items in the Test Menu are not stored and are lost on power off.

5.3 Status Menu

The status menu is read only, which means the select button has no effect. It provides the following data:

(1) Overall status
(2) Alarm messages
(3) User data rate
(4) Line rate (not available on AM-19200B)
(5) Interface status
(6) Interface mode

5.3.1 Overall status

The possible messages for this item are as follows:

S> Loop Active

S> LTU Not Ready

S> LTU Ready

S> Data Transfer

S> Send Data

S> Receive Data

The basic principle of operation of this display is as follows (in priority order):

(a) If a loop is applied within the modem the display reads: S> Loop Active

(b) If a fault exists or a not ready signal (including AIS) is being received from line then the display reads:

S> LTU Not Ready

(c) If the status from line (I or 109) is on while the DTE status (C or 105/108) is off then the display is:

S> Receive Data

(d) If the status from the DTE is on and the status received from line is off, then the display is:

S> Send Data

(e) If both status lines are off then the display reads: S> LTU Ready

(f) If both status lines are on then the display is: S> Data Transfer

(g) If the user rate has no relevant status line (rates 16K, 32K, 64K or X50), then the messages c,d, and f are displayed as message e.

5.3.2 Alarm Status

The possible messages for this item are:

```
S> No Alarm
```

```
S> No Signal
```

```
S> Receiving AIS
```

```
S> No Alignment
```

The `S> No Signal` display indicates that the transmission system cannot find any signal to lock on to.

Possible causes are:

(a) Broken or defective line
(b) Both ends master, or both ends slave
(c) Incorrect line rate (AM64000B only)
(d) Line attenuation / noise level too high

`S> Receiving AIS`

This display indicates that the AIS (Alarm Indication Signal)pattern is being received from the line. This should not normally occur in an modem to modem link. (It can be generated however, if the master modem is in 64k mode whilst sending binary 1's)

The `S> No Alignment` display indicates that the modem cannot lock onto the envelope alignment pattern being received from line.

Possible causes are:

(a) line attenuation / noise level too high
(b) Incorrect set up of X50 modes

5.3.3 User Rate

This item displays the user rate in current use.

For example. `S> 48K 10`

(A complete list of rates is given in the rate menu)

5.3.4 Line Rate (AM64000B only)

This item displays the line rate in use:

If the high line rate (71.1K bits/sec) is selected then the display is:. `S> High Rate`

If the low line rate (28.4K bits/sec) is selected then the display is: `S> Low Rate`

5.3.5 Interface status

This item displays the state of the lines on the DTE interface. For X21 the following messages are included: (Note individual lines can be On or Off dependent on the interface)

`S> C On I On` `S> C Off I Off`

For X21 bis the following messages are included:

`Line 105 on`	`Line 105 off`
`Line 106 on`	`Line 106 off`
`Line 107 on`	`Line 107 off`
`Line 108 on`	`Line 108 off`
`Line 109 on`	`Line 109 off`
`Line 140 on`	`Line 140 off`
`Line 141 on`	`Line 141 off`
`Line 142 on`	`Line 142 off`

There is also an X21 bis composite display with the lines ON displayed as solid blocks.

5.3.6 Mode Display

The modem is capable of operating in two basic modes:

`S> Link Mode` `S> Network Mode`

For a modem to modem link this display should read Link Mode. If however a Line Card is used instead of a master modem, then the display should read Network Mode. The essential differences of Network mode are as follows:

(1) The line card can down line load the Options. (The options X21, X21bis, 105 Set On, 106 Delay, 107 = 108, 108/1 Set On, can be set from the line card and control from the modem can be disabled)

(2) V35 mode can operate automatically in X21bis at user rates of 48k and above (AM64000B only).

5.4 Test Menu

The Test Menu can be read and written to at all times. The items are not saved on power down, therefore on power up the various tests always default to the off state. The items in this menu are as follows:

1. Local loop
2. Loopback
3. Remote loop
4. Binary pattern
5. Data error test
6. In service error test
7. Lamp test
8. Self Test
9. Comms channel loop

5.4.1 Local loop

The local loop facility is a loop applied within the local modem. It loops data back to the DTE from a point as close to the interface connector as is possible. This loop can be applied in two ways

(1) From the Menu
(2) Direct from the DTE.

5.4.1.1 Local loop from menu

This is implemented by selecting the item `T> Loc Loop Off`

On pressing SELECT the display should change to `T> Loc Loop On`

and the loop should be applied and the LA LED will light on the modem. The top display in the status menu will display *Loop Active* and the TM LED should also light up.
The data flow with the loop applied is shown in fig 5.4.1.1.

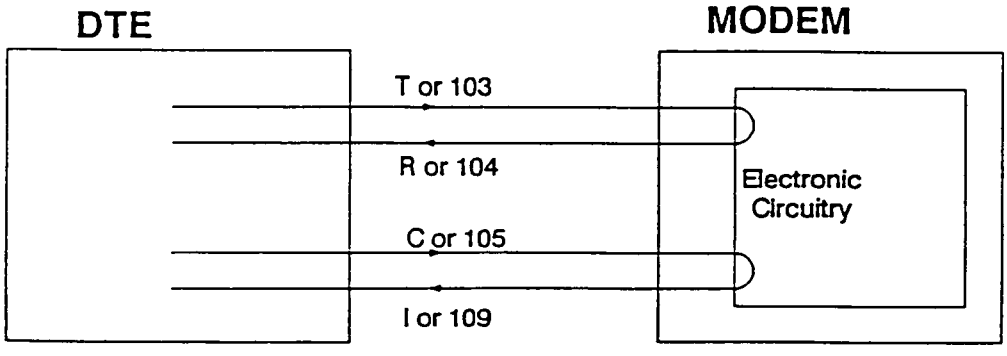


Figure 5.4.1.1 Local Loop

5.4.1.2 Local loop from DTE

When the modem receives an ALT pattern (11110000) from the DTE (in X21),or circuit 141 is active (X21bis), the local loop is applied similarly to the above.
To apply a local loop in this fashion refer to your DTE equipment handbook for details on how to send the pattern.
The modem can be in any menu when this loop is applied, it does not have to be in the Test Menu.
Note that the Test Menu *Loc Loop* message does not reflect the state of a loop applied from the DTE, but the status menu display and the TM LED will be set as in the above case.
The data flow with the loop applied is shown (as with menu activated loop) in fig 5.4.1.1.
It is possible to have a Modem Menu selected local loop operational at the same time as a DTE local loop. The actual local loop would then only be removed when both the Menu item has been deselected and the DTE has cancelled its loop, (ie the loop is removed by the last releasing action).

5.4.2. Loopback

The loopback feature places a loop on the local modem in the opposite sense to the local loop, ie the data coming from line is looped back. The DTE is effectively cut off and receives only a Not Ready signal.

The loopback is applied by selecting the item `T> Loopback Off`

Pressing SELECT should cause the item to change to `T> Loopback On`

The loop should then be applied. The TM and LA LEDs should light and the top level status display should show *Loop Active.*
The data flow for this loop is shown in fig 5.4.2.

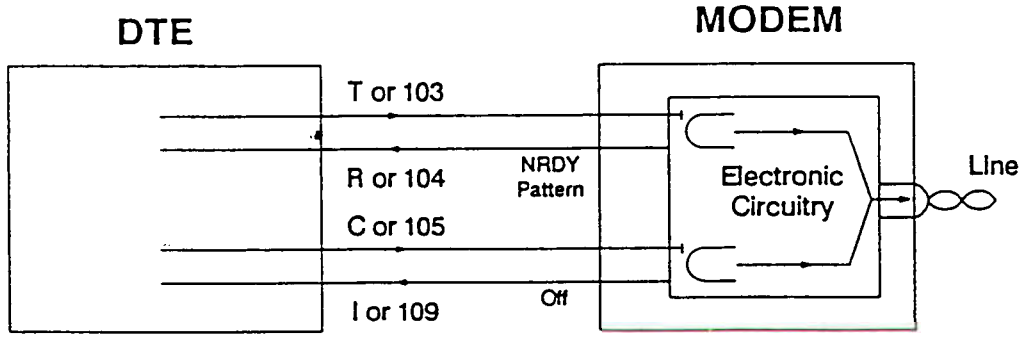


Figure 5.4.2 Loopback

This loop cannot be activated from the local DTE, only by the remote DTE, and in this case it is termed a *Remote Loop*, (see section 5.4.3).

5.4.3. Remote loop

The remote loop feature involves the turning on of a modem loopback, but from the other end of the link. This is shown diagrammatically in figure 5.4.3.

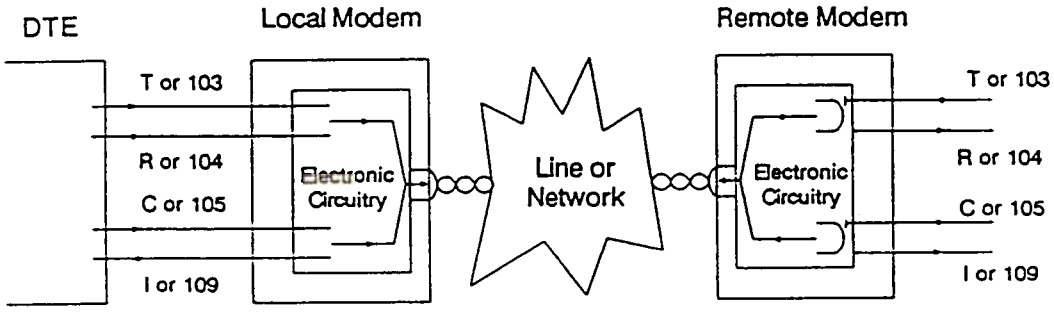


Figure 5.4.3 Remote Loop

This feature is only available from the menu if the activating modem is in X21bis mode. It is available from the DTE in either X21 or X21bis.

5.4.3.1 Remote Loop from menu

To apply the loop select the item `T>Rem Loop Off`

Press SELECT and the display should change to `T>Rem Loop On`

The loop should be applied, the TM and LA LEDs should light and the top level status display should show *Loop Active*.

Note: as this feature applies a loop at the remote end it is possible that in some circumstances (mainly fault conditions) that the actual loop can be removed without the local modem realising it. In these cases the display will show *Rem Loop On* when in fact no loop exists. If the loop has been cleared by a transient fault condition it can of course be re-applied by deselecting the Remote loop and then reselecting it. The data flow with the loop applied is shown in figure 5.4.3.

5.4.3.2 Remote loop from DTE

When the modem receives an ART pattern (00110011) from the DTE (in X21), or when circuit 140 is active (X21bis) the loopback is applied on the remote modem similarly to the above. To apply a remote loop in this fashion refer to your DTE handbook for details. The modem can be in any menu when this loop is applied, it does not have to be in the Test Menu. Note that the Test Menu *Rem Loop* message does not reflect the state of a loop applied from the DTE, but the status menu display and the TM LED will be set as in the above case.

The data flow with the loop applied is shown in figure 5.4.3.

It is possible to have a modem menu selected remote loop operational at the same time as a DTE remote loop. The actual loop would then only be removed when both the menu item has been deselected and the DTE has cancelled its loop, (ie the loop is removed by the last releasing action).

5.4.4 Binary patterns

It is possible to transmit three different patterns to the remote modem:

(1) All 1's with status ON
(2) All 0's with status ON
(3) Alternate 1's and 0's with status OFF (Controlled Not Ready's or CNR's)

The CNR pattern is sent by pressing the separate TX NRDY key on the front panel. The other patterns are accessed from the binary feature in the test menu.

The default state is sending no patterns when the display is

```
T> Bin  Keys   Off
```

If the SELECT key is pressed then binary 0's are sent and the display should change to

```
T>Sending Bin 0
```

If the SELECT key is pressed again then the binary 1 pattern is sent

```
T>Sending  Bin  1
```

A third press of select will return the function to its default (off) state

It should be noted that several factors may prevent the binary pattern being transmitted. The test menu display shows only that a binary pattern will be transmitted *if the modem is capable of it*. Factors preventing transmission are:

(1) Fault conditions
(2) Loopback active
(3) Local loop active
(4) TX NRDY key active

With most rates the patterns are sent with status ON. If an unstructured rate is used, such as 64k, there is no status line. In this case binary 1's become effectively an AIS signal, and binary 0's become a UNR signal.

5.4.5 Data test

5.4.5.1 Overview

This mode allows the user to send a binary 0's pattern to the far end modem, and monitor the received data stream for errors. The number of bits received in error is shown on the LCD display.
The time that the test has been running can also be displayed, and this allows the user to calculate the effective Bit Error Rate if so required. This is given by:

$$\text{Bit Error Rate (BER)} = \frac{\text{Error count}}{\text{User data rate} \times \text{Time}}$$

A loop must obviously exist somewhere in the line system for the test to be valid, (unless the far end modem is also sending a binary 0's pattern and a single direction test is required).

This loop can be applied by the local modem in one of three ways:

1. Remote loop selected from the Test Menu
2. Remote loop selected from the DTE
3. Comms channel loop selected from the Test Menu. (See section 5.4.9)

Loop (3) is usually most convenient. These loops MUST be applied before the *Data Test* mode is entered. The loop can of course be applied directly at the far end modem. This can be done by selecting a Loopback from its test menu.

In order to ascertain from the local modem whether or not a loop has been applied the *Data Test* has the facility to send a binary 1's pattern. This should result in every bit returned around the loop being in error. So to verify the loop the following procedure can be adopted:

1. Send 0's around loop -If loop present then RXD LED will be off with a low error count.
2. Send 1's around loop -If loop present then RXD LED will be on with a high error count (BER = 1).

A further option provided is the facility to allow a data tester to inject the binary 0's pattern. This is to allow use of the extra facilities provided by the tester, (eg injecting single errors), and/or simultaneous error testing of the X21/X21bis link.

5.4.5.2 Operation

Note: Apply any loops required before entering Data Test Mode.

The display within the test menu is

T> Data Test

To enter the mode find this entry in the test menu and press SELECT.

There are four displays within this *Data Test* sub-mode:

1. Error display
2. Pattern display
3. Transparency display
4. Time display

Once the mode is entered these displays can be changed by using the scroll keys in exactly the same fashion as in the main menus. The mode can be exited at any point by a press on one of the MENU keys. This will then bring you back to the line *Data Test* in the test menu.

1/ Error display

The modem starts to inject a binary 0 pattern immediately the mode is entered. The TM LED should light to verify this.

The display should then be

Errors nnnnnn

Where nnnnnn is the number of bits received in error. (If the line is error free then the display should remain at 000000.)

The SELECT key now performs two functions:

1. On the first press it will hold the current error count and time, (and stop counting further errors). A small "s" is displayed just prior to the error count to show this.

For example

Errors s000001

2. On the second press the error count and time will be reset, and the test restarted. If the error count overflows the display will indicate a " > " character just before the error count.

For example

Errors > 000001

Note that once the error count has overflowed no confidence should be held in the number displayed. (It does not simply wrap around at 999999).

2/ Pattern display

(2) The pattern display usually shows

Injecting 0s

If binary 1's are required (for loop verification) press select on this display. Binary 1's will now be injected and the display should change to

Injecting 1s

This pattern will continue to be injected until the select key is pressed on this item again, (or the mode is exited)

3/ Transparency display

The Transparency option is usually disabled, when the display reads:

Injection Mode

If the SELECT key is pressed on this option then the display should change to

Transparent Mode

The binary 0 injection is then disabled and the data path is direct to the DTE or data tester.

If Transparent mode is now selected the pattern display will show

No Injection

The facility to inject binary 1's remains, however, and the SELECT key will now toggle between no pattern injected and injecting binary 1's.

4/ Time display

The time display simply shows the time since the test has started in seconds.

For example

Time 000010

If the count is stopped the display is

T Stop 000010

5.4.6 In Service Test

5.4.6.1 Overview

This mode allows the user to monitor the error performance of the line whilst allowing data traffic to continue unhindered. The feature works by monitoring the accuracy of some of the overhead bits that make up the transmission frame structure. As the data channel itself is not monitored the figures produced from this mode cannot accurately be extrapolated to give the data error rate, they should be used as a general guide only.
In order to understand how this feature works a certain amount of knowledge about the transmission frame structure is required. This is included as appendix D. A brief discussion on the operation is given here.

5.4.6.2 Operation

The display to select in the test menu is

T> In Svc Test

No processes are activated upon entering this mode, it is a monitoring facility only. The mode can be exited and re-entered with no effect on any other tests or data.

There are four different displays within this mode:

(1) Comms framing error display
(2) Received envelope errors
(3) Transmitted envelope errors (master only)
(4) Time of test

The SELECT and SCROLL keys operates in the same manner as in the *Data Test.*

As this mode may be left running over a long period, an *abort* indication has been added to the displays. *The* character *a* is displayed prior to the count if the test has been aborted. The monitoring is aborted when the system error rates get so high that the envelope alignment pattern / comms framing word cannot be locked on to, or when the system loses line sync. (The error count would be meaningless if the line had been broken in the middle of a test). Note that the different displays may abort at different times, but the clock will stop when the first abort occurs.

The error count displays appear as follows:

Comms 000000	Comms word error count	This is 1/108 Data error count
Evp Rx 000000	Received envelope errors	This is 1/6 Data error count
Evp Tx 000000	Transmitted envelope errors (Master mode only)	This is 1/6 Data error count

The time display simply shows the time since the test has started in seconds.

For example

Time 000010

If the count is stopped the display is | T Stop 000010 |

If the count has been aborted the display is | T Abort 000010 |

5.4.7 Lamp test

This facility is used to check the LEDs and the LCD display.

To activate the test choose the item | T> Lamp Test |

When SELECT is pressed the LCD should show a line of blocks, and the LED's should light up, for about 3 seconds. On completion the above display is returned to.

5.4.8 Self Test

The *Self Test* facility does some simple checks on the EPROM and the EEPROM and can be activated by two means:

(1) On initial power on.
(2) Selection in the test menu.

(1) On power up the self test routine will cause all the front panel LEDs to light momentarily, except the DISP LED. If the DISP button is now pressed and the unit has passed its self test then the status menu will be entered, however if it has failed its self test it will then display one of the following messages :

| EPROM Fail | or | EEPROM Csum Fail | or | EEPROM Fail |

(2) By selecting the item | T> Self Test | in the TEST menu the following details will be displayed:

1. | EPROM Test | (This is just a breakdown of the testing procedure in step 1 above)
2. | EEPROM Test |
3. | Blocks Used 000 | (This indicates the amount of space left in the EPROM)
4. | Self Test Pass | or in the case of failure

| EPROM Fail | or | EEPROM Csum Fail | or | EEPROM Fail |

5. e.g. | LTU 1.0 1-1-91 | AM64000B (This indicates the software version number fitted)

| AM19200B Ver1.0 | AM19200B (This indicates the software version number fitted)

Obviously these last two messages will change when the software changes but the general format of: a) equipment identifier and b) software version number ; will always be followed.

The EEPROM size is designed to be sufficient for the expected lifetime of the BBM, (2×10^6 write operations). However, the usage of the EEPROM (Blocks Used) is still displayed for information.
For example;
0 means that the first block is in use and that there are 254 empty blocks, (each block has 10^4 writes)
254 means that the last block is being used and the chip is nearly full, (and needs replacing).

The failure messages have the following implications:

1. *EPROM Fail* This is a fatal error and the program will terminate.

2. *EEPROM Fail* This indicates that the internal structuring of the EEPROM data is corrupt.

If this happens an opportunity is given to reset the EEPROM.

To reset the EEPROM, press the select key in response to the | Reset EEPROM ? | prompt.

The consequence of resetting is that some sections of EEPROM memory may be written to more than the recommended maximum number of times, giving ultimately lower reliability of saved data.

3. *EEPROM Csum Fail* This indicates that data in the non-volatile memory (EEPROM) has an incorrect checksum. This can occur during normal usage if the unit was programming a new configuration when the power was turned off. Normal operation can resume, but the set up configuration must be re-entered.

5.4.9 Communication channel loopback

This loop is very similar to the remote loop feature in that it still applies the loopback at the remote modem. The main difference is that the command to turn on the loop is sent via the comms channel (see Appendix D). This means there is no reliance on the status line to control the loop. The loop can therefore be applied at all rates, even 64kb/sec. Unstructured data or data with the status line off can be sent around this loop; whereas a normal remote loop would be cancelled as soon as the status line was turned off

To activate this loop select the item | T> Comm Loop Off |

The display should then show | T> Comm Loop On |

The loop should be applied and the TM LED should come on.

Note that the status menu treats this loop differently in that the top level display is NOT *Loop Active* but *Data Transfer* etc.

5.5 Rate Menu

The rate menu is only accessible in master mode. In slave mode the user rate is dictated by the master modem, and the rate can only be viewed from the display in the status menu. The menu consists of a number of rates from which one is selected. The actual rates available depend on the X21 / X21bis setting, and the type of modem being used; only four user rates are available on the AM19200B. When the rate menu is entered the initial display is that of the current rate. The display shows the word *Rate* next to the prompt to indicate this. All of the other rates are indicated by the number alone. To view the selection of rates use the SCROLL keys. The rates increase as you go down through the list.

For example:

If the rate 4.8k is viewed only then the display is `R> 4.8K`

If the rate 4.8k is currently in use then the display is `R> Rate – 4.8K`

To change the rate, locate the desired rate and press SELECT.
The display should then change (as shown above for 4.8k) to indicate that the new rate has been selected. The full list of available rates are as follows (all shown as though they were selected); those available on the AM-19200B are shown highlighted.

`R> Rate – 2.4K`	(AM-19200B)
`R> Rate – 4.8K`	(AM-19200B)
`R> Rate – 9.6K`	(AM-19200B)
`R> Rate – 16K`	High rate only, unstructured rate (ie. no status line)
`R> Rate – 19.2K`	(AM-19200B)
`R> Rate – 32K`	High rate only, unstructured rate
`R> Rate – 48K 10`	High rate only, normal 48K mode
`R> Rate – 48K d2`	High rate, X21 only, X22/X50 division 2 with frame pulse
`R> Rate – 48K d3`	High rate, X21 only, X22/X50 division 3 with frame pulse
`R> Rate – 56K`	High rate only
`R> Rate – 64K`	High rate only, unstructured rate
`R> Rate – 64K BT`	High rate, X21 only, unstructured rate with byte timing pulse

The menu operates slightly differently when the *64k mode* is activated. This mode is described more fully in the section on the Configuration Menu. Briefly, this mode involves the master modem set to 64K +BT, and the slave modem set to some other rate. As far as the rate menu is concerned there are now two separate rates to display; and these are indicated clearly with the words *master* or *slave*. The SELECT key now only defines the slave rate, the master rate remains at 64k + BT until the 64k mode is disabled.

The master modem (local) rate is indicated by 

The slave modem (remote) is indicated by 

The slave rate is always displayed first on entry. The master rate has to be scrolled to.

Upon deselecting the 64k mode in the configuration menu both master and slave rates revert to 64k + BT.

5.6 Option Menu

This menu configures the type of DTE interface used with the modem .

There are three main selections to make:

(1) Overall protocol type	-	X21 or X21bis
(2) Interface type	-	V11, V28, or V35/V36
(3) Control line options	-	105 set on 108/1 set on, 106 delay,107 = 108/1.

This can be explained more clearly by considering the operation of the menu:
The top level display will show X21 or X21bis, the SELECT key toggling between the two.

The X21 mode is shown as `O> X21`

The X21 bis mode is shown as `O> X21 bis`

5.6.1 X21

If X21 mode is selected then the next line will always be `O> V11 Interface`

All the V11 interface lines are found on the 15 way D-type back panel connector of the X21 interface connector. (See appendix A1).
There are no other interface options in X21 mode.

5.6.2 X21 bis

If X21 bis mode is selected then there is a choice of two interface types (toggled by pressing SELECT).

(1) `O> V28 Interface`

(2) `O> V35 Interface` This is selected for V35 AND V36

If the V28 interface is selected then all of the interface lines emerge on the 25 way D-type backpanel connector of the X21 bis interface connector.
The V35 interface is used for the V35 or V36 interfaces; all interface lines being available through the 34 way MRAC or 37 way D Type interface connectors respectively for V35 and V36.
(See appendix A for connection details).

There are four control line options which can be applied to the X21bis V28 interface.

(1) `O> 105 Normal` press SELECT `O> 105 Set On`

This simply holds the control line 105 ON internally

(2) | O>106 Normal | press SELECT | O>106 Delay |

This provides a 15ms delay between the line 105 going ON and line 106 going ON

(3) | O>107 Normal | press SELECT | O>107=108/1 |

This allows control line 107 to follow control line 108/1 independent of other factors.

(4) | O>108/1 Normal | press SELECT | O>108/1 Set On |

This option holds the control line 108/1 ON internally.

There are three options for the X21bis V35/V36 interface.

(1) and (2) as before

(3) | O>107 Normal | press SELECT | O>107 Set On |

This holds control line 107 ON permanently.

There is no control line 108/1 directly associated with V35/36, so it is held ON internally. This means that although it is not displayed, the option *108/1 Set On* is active in V35/36 mode. When the mode is exited, eg. changed back to V28, no memory of the previous state of this option remains. The option is therefore left on. So when changing from V35/36 to V28 it must be remembered that the option *108/1 Set On* will be active, and should be deselected if not required.

5.7 Configuration Menu

This menu contains items that are used in the initial configuration of the modem. Once set up they are not usually required for normal modem operation. All of the configuration parameters are stored in non volatile memory, and are restored the next time the modem is powered up.

The items in this menu are as follows:

(1)	Master/Slave	
(2)	Line rate	only available with the AM-64000B
(3)	X21 loop control	
(4)	Synchronisation type	
(5)	64k mode	only available with the AM-64000B
(6)	Transmit power level	
(7)	Menu lock	

5.7.1 Master / Slave

When two modems are connected together, one modem has to be a master, and the other one a slave. The transmission signal is different for master and slave, so line synchronisation will never be achieved if two like types are connected together. Normally it makes no difference which end is which, but there are a few extra facilities included in the master mode.

These are:

(1) Selection of the user data rate, (see section 5.5)
(2) External bit/byte timing synchronisation, (see section 5.7.4).
(3) Provision of 64k mode, (see section 5.7.5) (only available with the AM-64000B).
(4) Extra error monitoring facilities, (see section 5.4.6).

The master display is `C> Master Mode`

Pressing SELECT gives the slave display, `C> Slave Mode`

5.7.2 Line Rate (AM64000B only)

The line rate is the basic bit rate of the transmission between the two modems
There are two settings *high* and *low*. The low rate gives a better range, but lower user data rates.

The high rate is shown as `C> High Rate` ; pressing SELECT gives

the low rate shown as `C> Low Rate` ; pressing SELECT gives

The high rate is 71.1kb/sec, and all user data rates are allowed. The range depends upon the cable dimensions, an example is 5km of 0.4mm cable, (corresponding to 50dB attenuation).

The low rate is 28.4kb/sec, and all user data rates up to 19.2kb/sec (except 16kb/sec) are allowed. The range on 0.4mm cable is extended to 8km, (50dB attenuation).

5.7.3 X21 Loop Control

This facility is designed for when a pair of modems are used as an extension to another modem link.

The concept is shown in figure 5.7.3

Modems A and B form part of a conventional link. However, instead of a DTE being connected to modem B another link is started with modem C. This modem may then be connected to another modem (shown as D) or even a line card feeding into a network. (Details of the second link are not important at this point). If modem A (or the DTE connected to A) attempts to apply a remote loop the loop will normally be applied at B. However if the *X21 loops off* option is applied at B , then the remote loop command will travel through to modem D. The remote loop has thus been applied at the very far end of the network. The option effectively tells the modem (B) to ignore any loop requests from the line; any internally activated loops (ie. from the front panel) behave as before. Note also that if the option is applied the RX NRDY LED in modem B will not function, this is because all the data is now treated as unstructured data. (No status line so Not Ready patterns have no meaning).

The normal loops on mode is shown in the menu as: **C> X21 Loops On**

Pressing SELECT turns the loops off, shown as: **C > X21 Loops Off**

5.7.4 Synchronisation Type (AM64000B only)

This option is only applicable to master mode with external timing and allows the user to change the type of clock synchronisation within the modem.

Normally in a point to point link, the master modem becomes the source of timing and the slave modem locks to this.
If a further link is driven as shown in figure 5.7.3, then the *external* modem (C) must supply a source of timing to the master modem (B). This timing can be of two forms Bit Timing, or Byte Timing.

Bit timing is selected with the display **C> Bit Sync**

This is the only relevant selection for the AM19200B.
The Bit timing signal must of the same frequency as the user bit rate. The circuitry is designed to be supplied with the timing clock output from another modem.
The signal connections are via the X21/X21bis interface connectors, (see appendix A).

The Byte timing signal is shown by **C> Byte Sync**

Not appropriate for AM19200B.

The Byte timing signal must be a 1/2 bit wide pulse every 8 data bits. The circuitry is designed to accept the byte timing output from a slave modem operating at 64kb/sec.
The signal connections are via the X21/X21bis interface connectors, (see appendix A).

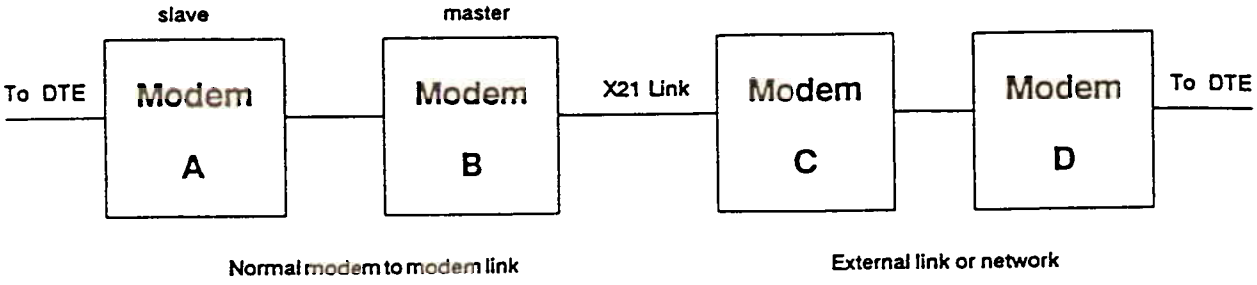


Figure 5.7.3 X21 Loop Control

5.7.5 64k Mode (AM64000B only)

This mode is designed to be used in association with the X50 framing patterns. When the mode is selected the master BBM is set to 64k and the slave to (usually) 48k X50. This allows the master modem to become transparent to the X50 framing structure, allowing it to be processed by the master DTE.

The mode is normally OFF displayed | C> 64K Mode Off | Pressing SELECT gives

C> 64K Mode On

5.7.6 Power Level

This items selects the output power level of the transmission circuitry. There are two options:

C> Power 10dBm	high power
C> Power 0dBm	low power

The 10dBm option should normally be selected. The 0dBm option should be selected for short lines to reduce interference to other equipment.

5.7.7 Menu Lock

This item allows the user to restrict accidental use of the menus.

The normal mode is displayed: `C> Menu Unlocked`

When the menu is locked the display changes to `C> Menu Locked`

When locked the SELECT key is disabled, and no items in *any* menu can be altered.
The only option available is to *unlock* the menu.

In order to prevent easy locking and unlocking the SELECT key does not function in the normal way for this feature.
The lock is activated by selecting the *STATUS MENU* and then pressing three keys simultaneously.

These keys are (1) left menu key
(2) SELECT key
(3) TXNRDY key

In order to prevent activation of the TXNRDY feature the keys should be pressed in the order above.

When these keys are pressed the display will show: `>> Menu Locked`

This message will be displayed for about 3 seconds before reverting back to the status display.
The menu is now locked and if the configuration menu is examined it will display the locked message.

Pressing the same three keys again will unlock the menu; `>> Menu Unlocked`

The operation is a toggle action (ie. lock - unlock - lock), just like the normal SELECT key operation.

GLOSSARY OF TERMS

AIS	Alarm Indication Signal.
ALT	Automatic Local Test. - Pattern sent to apply a local loop in the DCE.
AMI	Alternate Mark Inversion. - Code used for line transmission.
ART	Automatic Remote Test. - Pattern sent to apply a loopback on the remote modem.
BBM	One of the Ascom Base Band Modems (AM64000A/B, AM19200A/B, AM128000A/B).
BT	Byte Timing. - Synchronisation to every 8 bits.
BT	British Telecom.
CCITT	International Telegraph and Telephone Consultative Commitee.
CNR	Controlled Not Ready
DCE	Data Circuit-terminating Equipment.
DTE	Data Terminating Equipment.
EEPROM	Electrically Eraseable Programmable Read Only Memory.
LCD	Liquid Crystal Display
LED	Light Emitting Diode.
LTU	Line Terminating Unit. Same as Base Band Modem.
UNR	Uncontrolled Not Ready.
V11	CCITT specification. Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.
V24	CCITT specification. List of definitions for interchange circuits between DTE and DCE.
V28	CCITT specification. Electrical characteristics for unbalanced double-current interchange circuits.
V35	CCITT specification. Data transmission at 48kbit/s using 60-108kHz group band circuits.
V36	CCITT specification. Modems for synchronous data transmission using 60-108kHz group band circuits.
X21	CCITT specification. Interface between DTE and DCE for synchronous operation on public data networks.
X21 bis	CCITT specification. Use on public data networks of DTE which is designed for interfacing to V-series modems.
X50 Div 2/3	CCITT specification. Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks. (80 and 20 bit patterns).

GENERAL SPECIFICATION

1. AM19200B & AM64000B Modem BABT Approval Number NS/1284/12/M/602121

Transmission system uses DSP techniques involving echo cancellation and adaptive decision feedback equalisation.
Power output selectable 0dBm or 10dBm.
Line code is AMI with embedded sync pattern for timing control.
Line rates 71kbit/s (high) or 28kbit/s (low). AM19200B allows only low line user rate.
Line attenuation range up to 50dB (at 10dBm output level).

High line rate user data rates:	2400,4800,9600,16000,19200,32000,48000,56000,64000 bit/s.
Low line rate user data rates:	2400,4800,9600,19200 bit/s.

Synchronous working at all user rates, Asynchronous working at 2400,4800,9600 and 19200 bit/s. Most options and features software configurable.
Display Unit front panel lockable to prevent unauthorized operation.

Byte timing is available at 64kbit/s with the X21 interface.
X50 divisions 2 and 3 are supported at 48kbit/s.

User interfaces:	X21 V11
	X21 bis V28
	X21 bis V35
	X21 bis V36
Test facilities:	local loop, loopback, remote loop, comms channel loop, transmit binary 0, transmit binary 1, transmit CNR, self test, lamp test, data channel error test, in service error test.

Enviromental conditions:	Temperature range	+5 to +40 deg C	
	Humidity range	5% to 85%	
	Air pressure range	70 to 106 kPa	
Power Requirements:	10 - 0 - 10 V AC	50Hz	
	15 - 0 -15 V AC	50Hz	0.91W
Weight:		0.520 Kg	

2. AM-Rack BABT Approval Number NS/1284/12/M/602120

Power supply : 240V +6%/-10%; 50Hz +5%/-5%

Weight (unloaded with modems but including display unit and power supply unit) : 9.57 Kg

Total Power Requirements loaded with display and power unit : 9W.

Appendix A - AM19200B & AM64000B Interface Details

X21 bis Connections

Interface cable to be terminated at both ends with a 25 pin male 'D' Type connector to ISO DIS 2110.

Maximum length 20m. Typical Resistance 0.087 Ohm/m. Typical Capacitance 50pF/m.

25 way D - type	Circuit	Description	Type (SITS 89/43)	26 way shelf connector (IF1-IF12)
7	102	Common Return	Common Return	13
2	103	Transmitted Data	Load	3
3	104	Received Data	Generator	5
4	105	Request to Send	Load	7
5	106	Ready for Sending	Generator	9
6	107	Data Set Ready	Generator	11
20	108.1	Connect Data Set to Line	Load	14
8	109	Data Channel Received Line Signal Detector	Generator	15
15	114	Transmitter Signal Element Timing (DCE)	Generator	4
17	115	Receiver Signal Element Timing (DCE)	Generator	8
21	140	Remote Loopback for Point-to-Point circuits	Load	16
18	141	Local Loopback	Load	10
25	142	Test Indicator	Generator	24
24	113	External Transmitter Signal Element Timing	Load	2

X21 Connections

Interface cables to be terminated at both ends with a 15 pin male 'D' Type connector to ISO 4903.

Maximum length 100m. Typical Resistance 0.087 Ohm/m. Typical Capacitance 50pF/m.

15 way D-type A-wire	B-wire	Circuit	Description	Type (SITS 89/43)	26 way shelf conn. A wire	B wire
8	8	G	Signal Ground / Common Return	Common Return	15	15
15	1	SEXT	External Signal Element Timing	Load	14	16
2	9	T	Transmit	Load	3	2
4	11	R	Receive	Generator	7	6
3	10	C	Control	Load	5	4
5	12	I	Indication	Generator	9	8
6	13	S	Signal Element Timing	Generator	11	10
7	14	B	Byte Timing	Generator	13	12
7	14	F	Frame Start Indication	Generator	13	12

V35 Connections

Interface cables to be terminated at both ends with 34 pin male MRAC connnectors to ISO 2593.
Maximum length 20m. Typical Resistance 0.087 Ohm/m. Typical Capacitance 50pF/m.

34 way MRAC Connector			Circuit	Description	Type	26 way shelf connector		
Unb	A	B			(SITS 89/43)	Unb	A	B
B			102	Common Return	Common Return	13		
	P	S	103	Transmitted Data	Load		3	2
	R	T	104	Received Data	Generator		5	6
C			105	Request to Send	Load	7		
D			106	Ready for Sending	Generator	9		
E			107	Data Set Ready	Generator	11		
F			109	Data Channel Received	Generator	15		
	U	W	113	External Transmitter Signal Element Timing	Load		14	16
	Y	AA*	114	Transmitter Signal Element Timing	Generator		4	12
	V	X	115	Receiver Signal Element Timing	Generator		4	12
N			140	Remote Loopback	Load	8		
L			141	Local Loopback	Load	10		
NN*			142	Test Indicator	Generator	24		

* Note on some MRAC connectors pin 'AA' is marked as 'a' and pin 'NN' is marked as 'm'.

V36 Connections

Interface cables to be terminated at both ends with 37 pin male 'D' Type connnectors to ISO 4902.
Maximum length 20m. Typical Resistance 0.087 Ohm/m. Typical Capacitance 50pF/m.

V36 37-way D - type			Circuit	Description	Type	26 way shelf connector		
Unb	A	B			(SITS 89/43)	Unb	A	B
31,27,19,20,29			102	Common Return	Common Return	15		
	4	22	103	Transmitted Data	Load		3	2
	6	24	104	Received Data	Generator		7	6
7			105	Request to Send	Load	5		
9			106	Ready for Sending	Generator	8		
11			107	Data Set Ready	Generator	12		
13			109	Data Channel Received	Generator	9		
	17	35	113	External Transmitter Signal Element Timing	Load		14	16
	5	23	114	Transmitter Signal Element Timing	Generator		11	10
	8	26	115	Receiver Signal Element Timing	Generator		11	10
14			140	Remote Loopback	Load	24		
10			141	Local Loopback	Load	4		
18			142	Test Indicator	Generator	13		

LINE CONNECTOR - AM-RACK.

In order to meet BABT approval the line connector on the rear of the AM-Rack is a 25-way D-Type Plug, and is connected to the rack via the BT Type 226V/50F 50 way AMP CHAMP socket (Rack backplane PCB designation SK17). The following pin numbers are used to accomodate A and B wire connections for all twelve possible rack mounted modems as detailed below.

Modem Slot Number		50 Way Socket Pin Number	25 Way D-type Plug Pin Number
Modem Slot 1	A - Wire B - Wire	26 1	14 1
Modem Slot 2	A - Wire B - Wire	28 3	15 2
Modem Slot 3	A - Wire B - Wire	30 5	16 3
Modem Slot 4	A - Wire B - Wire	32 7	17 4
Modem Slot 5	A - Wire B - Wire	34 9	18 5
Modem Slot 6	A - Wire B - Wire	36 11	19 6
Modem Slot 7	A - Wire B - Wire	38 13	20 7
Modem Slot 8	A - Wire B - Wire	40 15	21 8
Modem Slot 9	A - Wire B - Wire	42 17	22 9
Modem Slot 10	A - Wire B - Wire	44 19	23 10
Modem Slot 11	A - Wire B - Wire	46 21	24 11
Modem Slot 12	A - Wire B - Wire	48 23	25 12

Fault Extension Socket - AM-Rack

The Fault Extension Socket on the rear of the rack is of the Line jack 431A/BS6312 type (rack backplane PCB designation SK16). It provides the facility to monitor fault conditions on one or more rack mounted modems at a position external to the rack. Basically the connector allows access to two contacts of a PCB relay which are normally open (a fault condition on any modem in the rack causes them to close). The relay used is an OMRON G6A-234P-BS and is mounted on the Display unit PCB, and as such forms an integral part of the AM-Rack independent of any rack mounted modems.

The socket carries the warning :

WARNING. CONNECT ONLY APPARATUS COMPLYING TO BS6301 TO THIS PORT.

The table below shows the connections between the socket and the relay.

	Fault Extension Socket Pin Number
Relay Contact 1	1,3,5
Relay Contact 2	2,4,6

APPENDIX B - Asynchronous Interface

The asynchronous interface operates at four data rates, these are: 2400, 4800, 9600, and 19200 bits/sec.
The modem can be set up in asynchronous mode for other data rates but no data transfer is possible.
To configure the modem for asynchronous mode the internal links must be changed. The layout and details of these are shown in appendix C. There are 4 links to be set:

(1) J16 Signalling rate
(2) J17 Character length 1
(3) J18 Character length 2
(4) J19 Asynchronous enable

1. Signalling rate

The usual position for this link (J16) is 1-2. This is termed the *basic signalling rate,* and in normal use this link will not need to be moved. The basic signalling rate allows a the asynchronous bit rate to have a tolerance of -2.5% to + 1%, (or better).
The modem can still cope if the asynchronous bit rate has a tolerance of -2.5% to + 2.3%. In this case the link must be moved to position 1-3. This is now termed the *extended signalling rate.*
If the tolerance of the asynchronous bit rate is any wider then the system will not be able to cope.
The extended signalling rate should only be used when nessessary, as it can shorten stop bits by 25% which may ultimately lead to more data errors.

2 and 3. Character Length

The character length must be set up for the particular asynchronous interface used, and must be set up indentically for both master and slave modem. The set ups are as follows:
Note: the character length above is the total length including one start bit, one stop bit and possible parity bit.

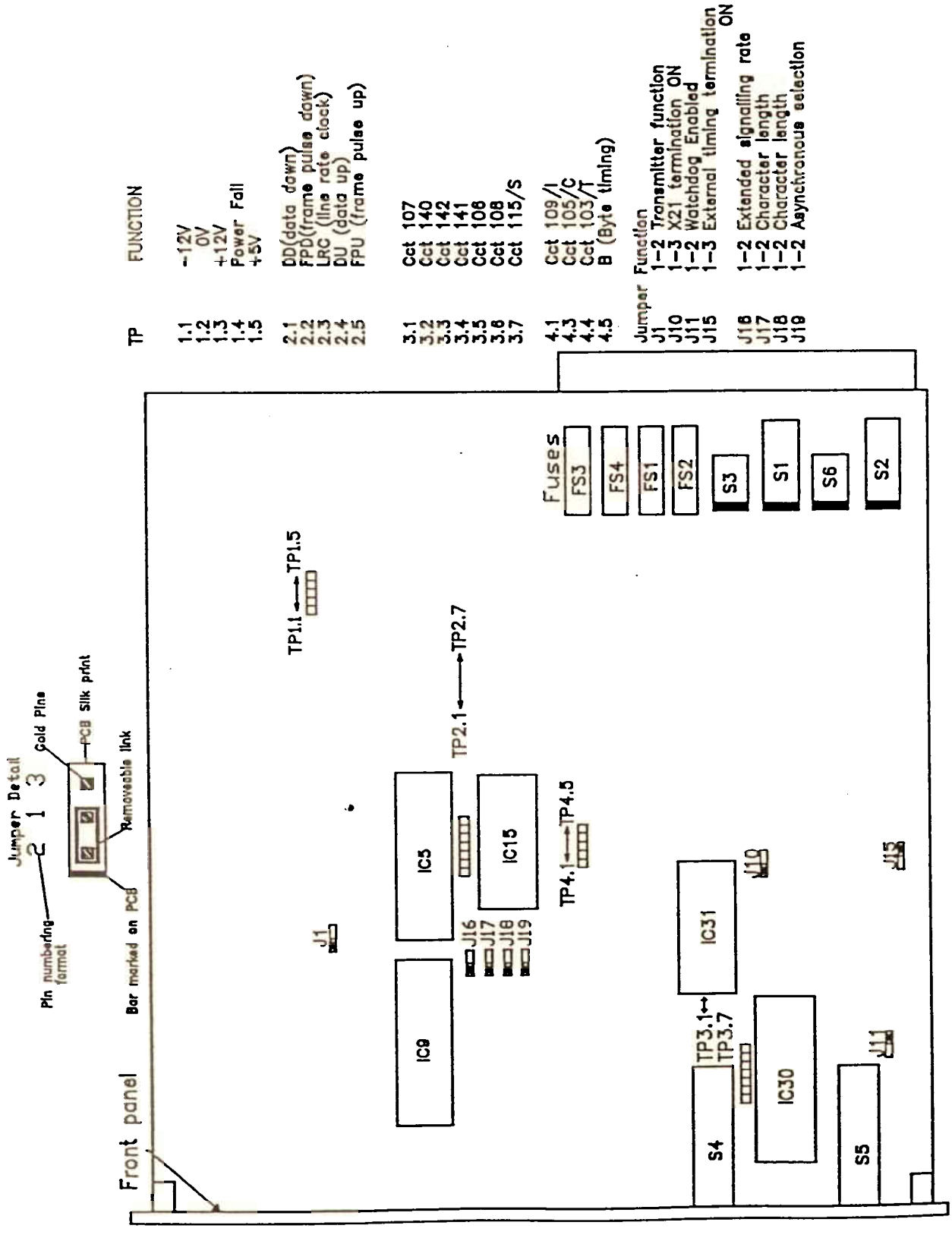
4. Asynchronous Enable

This link (J19) should be set in position 1-3 for asynchronous working and 1-2 for synchronous working.

Link Position		Character Length
J17	J18	
1-3	1-2	8 bits
1-3	1-3	9 bits
1-2	1-2	10 bits
1-2	1-3	11 bits

APPENDIX C - Internal Link Settings

The following diagram shows the location of the internal modem links:



The function of the links is as follows:

J1 Transmission disable
This link is always left in position 1-2

J10 Termination resistor for X21 T circuit (Transmit data)
This link connects a 120 ohm load resistor across the T circuit in position 1-3. This helps to maintain the signal rise time and minimise reflections at rates greater than 9.6kb/sec over long lines. It also provides termination for CCT 103 of the V35 interface. At lower rates and over short lines the termination resistor may be omitted, (link set to 1-2).

J11 Watchdog enable
This link is always left in position 1-2

J15 Termination resistor for X21 S EXT circuit, (External Signal Timing)
This link connects a 120 ohm load resistor across the S EXT circuit in position 1-3. (Similar to J10).
IMPORTANT - This link must be left in position 1-3 (terminated), otherwise the BABT approval will be invalidated.

J16 Signalling rate - see appendix B on asynchronous interface.

J17 Character length 1 - see appendix B on asynchronous interface

J18 Character length 2 - see appendix B on asynchronous interface

J19 Asynchronous enable - see appendix B on asynchronous interface

WARNING

Only authorised personnel can be allowed to change the link settings. Misuse or any modifications carried out to this unit other than in accordance with the instructions supplied, will invalidate both the guarantee and the BABT approval.

APPENDIX D - In Service Test Background Information

D.1 Frame Structure

The information passing between master and slave modems comprises user data and control data; the latter is used for controlling and supervising the operation of the transmission system. In order that these components can be separated the composite data is transmitted in frames with a fixed framing pattern to identify the frame boundary. Data is transferrred at 71.1 kb/sec at the high rate and 28.4 kb/sec at the low rate. For both rates the frame structure is the same. Figure D.1 shows the basic frame structure.

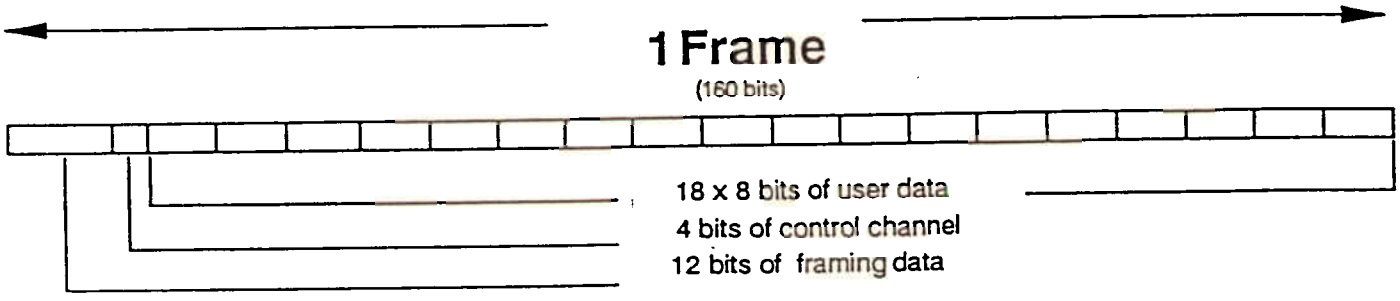


Figure D.1

Each frame consists of 160 bits of which 12 are allocated to the framing pattern and 4 to the control channel. (These 4 bits per frame are termed the *Comms channel*). This leaves 144 bits, or 18 octets for user data. With most rates the user data actually occupies 6 bits out of every octet, as one bit is used as the user status line, and the other bit is used as an *envelope alignment bit* , (this bit is used by the system for the multiplexing of lower user rates into the 71.1 / 28.4 kb/sec overall bit rates). There are several user rates which do not have an alignment bit; these are 16, 32, 56, and 64 kb/sec, consequently these rates will not be able to use the envelope alignment error monitoring schemes. At the high rate the maximum throughput for the user is 64kb/sec (no status, no alignment); at the low rate it is theoretically 25.6kb/sec but is reduced to 19.2 kb/sec by the channel structure (1 status + 1 alignment)

D.2 In Service Test facilities

The In Service Test has access to two basic sources of information:

(1) The envelope alignment bits
(2) The comms channel

The use of the envelope alignment bits is slightly more straight forward.
At either end of the link the modem monitors these alignment bits against tables held in ROM. Any bits received in error are counted and can be displayed. For each frame there are 18 envelope alignment bits for 18 x 6 bits of data. The effective data error rate can then be found from:

$$\text{Bit Error Rate (BER)} = \frac{\text{Envelope Error Count} \times 6}{\text{User Data Rate} \times \text{Time}}$$

AM-128000B

BASE BAND MODEM

USER MANUAL

Contents

1. INTRODUCTION

This manual applies to the AM-128000B Base Band Modems (BBM).

The Ascom part number is 1/113/021/100. The unit should have an identifying label carrying this number attached to the solder side of the PCB.

The BBM can provide synchronous communication at the user data rate of 128kb/sec over a 2 wire twisted pair cable.

The modem can easily be configured using the display unit front panel keys on the rack in conjunction with the Liquid Crystal Display (LCD). The display is operated in a menu type fashion with easy to understand mnemonics, which should make constant reference to this handbook unnecessary.

Once configured the operation of the BBM is totally automatic, in the event of line disturbances the data link is immediately restored without operator intervention.

Chapter 4 (installation) describes the basic set up procedure and this should be read prior to setting up any link.

Chapter 5 (menu operation) is much more detailed, but should be read to gain an understanding of the full range of menu facilities available.

The unit is BABT approved for connection to private digital circuits adhering to the X21 recommendations (PTO service categories 1 and 2, 128k rate). Connection of the unit to such circuits is described more fully in appendix E.

The BABT approval number is NS/1284/12/M/602121.

2. CONSTRUCTIONAL DETAILS

The AM128000B is a double sided PCB (double euro-card size) that plugs into the AM-Rack. On the front panel there are seven LED's and two push button non-locking switches. The backplane connector is a DIN 41612 with early make ground pins. The latter provides connections for power, line, and switched interface connections for X21 (V11).
The overall dimensions of the unit are : 261H x 25W x 248D mm.

Figure 2.0 shows the BBM front panel.

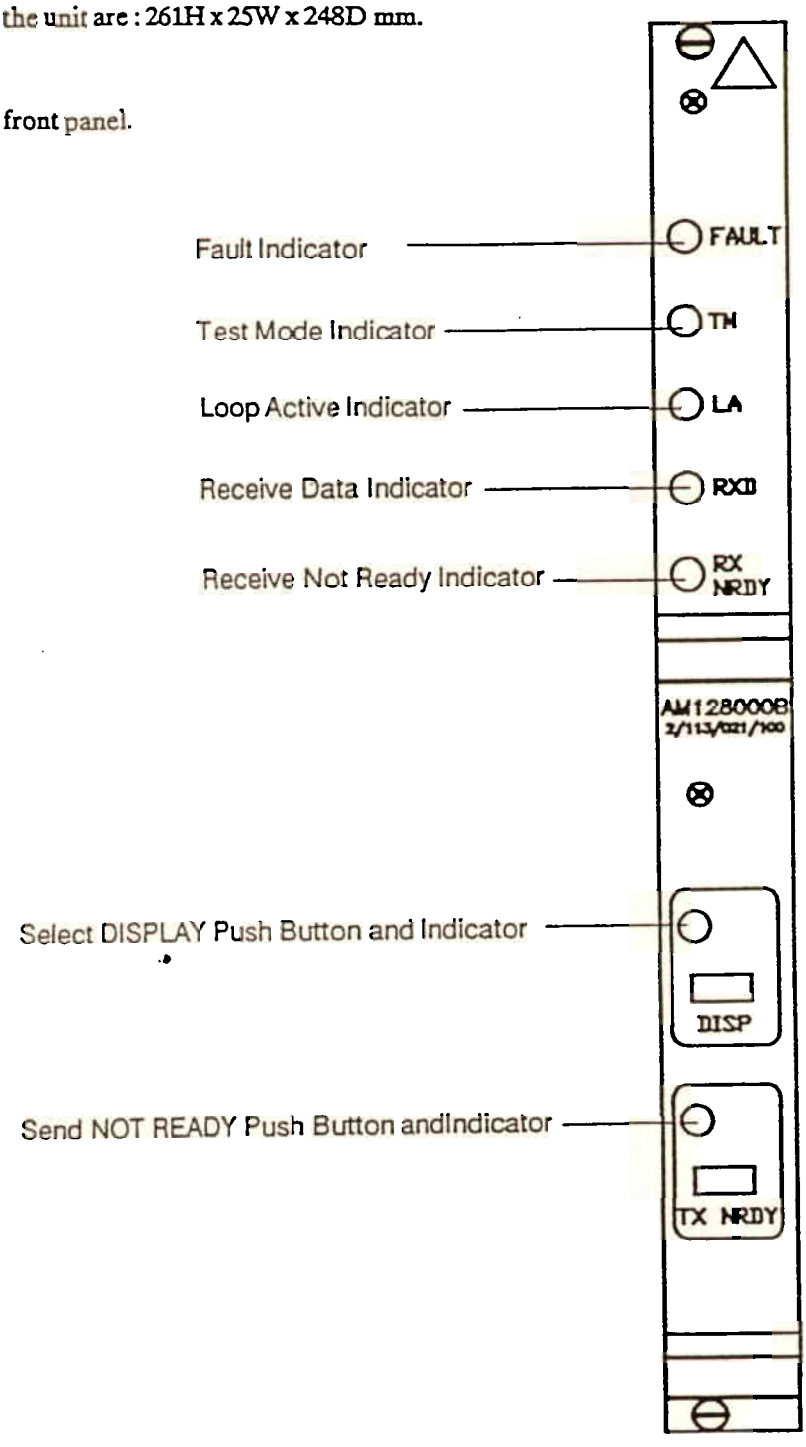


Figure 2.0
AM128000B

3. SYSTEM OVERVIEW

The Ascom AM128000B base band modem uses the digital transmission system designed and developed by Ascom Telecommunications Ltd. It is intended for operation on 2-wire local telephone network circuits, such as those meeting BT EPS-9 (2-Wire). It will operate satisfactorily on unloaded lines having a wide range of characteristics; bridge taps can be tolerated, dependent upon their characteristics. Although the system requires a baseband circuit, a continuous loop at DC is not required. The system transmits data at 142.2 kb/sec.

The line signal comprises AMI-encoded data and an embedded sync pattern which is used for timing control; the data consists of user data and a control channel for the systems own use. Echo cancellation is used to eliminate the unwanted reflections of the transmitted signal from the receiver input. The echo canceller can eliminate echoes of up to 16 bit periods duration. To counteract the signal distortion inherent in long lines the system employs adaptive decision feedback equalisation to eliminate trailing intersymbol interference; this also has a span of 16 bit periods. A fixed linear equaliser is incorporated to control the received pulse waveform and to reduce the effect of the long tails of both echo and transmission responses. Digital signal processing is used throughout to achieve high performance reproducibly. A block diagram of the unit is shown in figure 3.1.

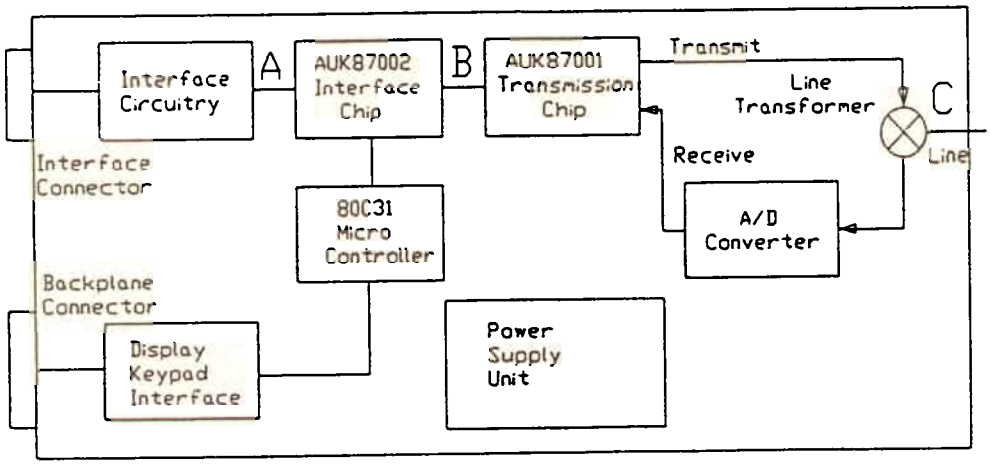


Figure 3.1

The line is connected to the transmission circuit via a line transformer which acts as a balun and provides isolation; there is surge protection at both sides of the transformer. The transmission circuit utilises a custom IC and a number of proprietary components to perform the signal processing described above.

The interface circuit performs a number of functions: it converts between the user data from the X21 interface and the 128 kb/sec which is transmitted down the line; it links the control circuit to the control channel; it interfaces the control circuit to the control lines of the data ports. Again, these functions are performed by a custom IC supported by a number of standard components. User data at 128 kb/sec is sent as-is; byte-timing is maintained by the transmission system and is available if required.

Turning to the control channel, this uses 4 bits from each transmission frame to transmit control information to the unit at the other end of the line, e.g. user data rate selection, and to monitor the overall performance of the link.

With regard to the remaining function of the interface circuit, the control lines of the data ports mainly require buffering; however, in the case of X21 the various control patterns have to be generated or detected. The control circuit is based on a microcontroller and determines the state of the unit according to the state of the transmission system, the state of the data interface and the configuration information received from the front panel and from the control channel. It also provides the front panel display with information on the current state of the unit which can be reviewed via a simple menu structure.

4. INSTALLATION

This chapter describes the basic steps that are required to set up a system involving the Base Band Modems (BBM's).

The only configuration to be considered is :- BBM connected to BBM

When considering the installation general pointers to the configuration of the BBM's are given. It should be noted that there are many BBM parameters which may be set differently and prevent the results from being as expected. If any results are not as discussed then chapter 5 on menu operation should be consulted.
If this still fails to resolve the problem then the internal links can be checked, see appendix B.

4.1 BBM to BBM Link

With no DTE or line connected to the rack unit plug the modem into a slot in the rack.
On power up the AM128000B will go through its self test procedure and its LEDs will come on for a few seconds (i.e. FAULT, TM, LA etc). These will then go off leaving the FAULT LED on.

If the self test fails an error message will be displayed when the display unit is selected for the particular modem by pressing the DISP button. These are explained in section 5.4.7

The mnemonic LTU stands for Line Terminating Unit, and this should be understood (in all cases) to be the Base Band Modem itself.

For a point to point link to work, one BBM must be set to *master mode*, and the other BBM to *slave mode* (section 5.5.1). If the link is self contained, ie. there is a DTE at both ends and no other links are involved then it makes little difference which end is which. If another link is driven then the master modem must be connected to the external modem, (see section 5.5.2.).

When the line is connected the FAULT LED should now go out.
The status menu should then be examined to check that the unit is correctly configured.

The following data is provided by this menu:

(a) Overall status (ie whether ready or not)

(b) Alarm messages

To examine this data, first locate the status menu by using the left arrow key, then use the up/down arrows to look at each item in turn.

With no DTE (Data Terminal Equipment) connected the results should be:

(a) S > LTU Ready

(b) S > No Alarm

If the status is not correct the BBM must be reconfigured. (See section 5 on menu operation.)
If the status is correct the DTE (Data Terminal Equipment) or a data tester may now be plugged into the BBM.
In order for end to end data transfer to take place there must be *no test loops active* either locally or remotely. (The power up default for the Test Menu is no loops).

5. MENU OPERATION

5.1 Front Panel Features

The Base Band Modem has an uncluttered and easy to understand front panel. It has seven LEDs, and two push button non-locking switches. Any one of twelve modems loaded in the AM-Rack may take control of the display exclusively by pressing the DISP push button non-locking switch on its front panel. With the 16 character alpha-numeric, dot-matrix liquid crystal display it is possible to describe most of the functions in plain English, thus avoiding having to use complicated mnemonics and the need to constantly refer to a handbook.

5.1.1 Display Unit Front Panel Features

The 5 front panel keys on the display unit are as follows:

(1,2)	MENU (left and right)	Used to change menus
(3,4)	SCROLL (up and down)	Used to scroll through items within a menu
(5)	SELECT	Used to activate/deactivate the feature displayed

5.1.2 Modem Front Panel Features

The LCD display is complemented by the use of 7 LEDs to monitor the following :-

(1) FAULT — Red LED

This is lit to indicate the line signal is faulty; the main causes of this are as follows:
(1) No signal received (ie. line broken / disconnected)
(2) Incompatible remote modem
Further information is provided in the *status menu*, (see section 5.3.2).

(2) TM, (Test Mode) — Red LED

This is illuminated whenever a test mode is active, (ie a pattern is being generated, or a loop is being applied).

(3) LA, (Loop Active)

This lights whenever a data loop is active.

(4) RXD, (Received Data) — Yellow LED

This indicates the state of the user data, it is turned on for a '1' and turned off for a '0'.

(5) RX NRDY, (Not Ready received from line) — Yellow LED

This LED is not used in this application.

(6) DISP, (Display Selected) — Yellow LED

This lights when the DISP switch is pushed to indicate the selection of display unit by the modem.

(7) TX NRDY, (Transmitting Not Ready) — Yellow LED

This is provided to display the state of the TX NRDY key. Lit means the TX NRDY key is on.

5.2 Front panel operation

The LCD on the Display Unit will display one of three menus at any one time, these menus are:

1. STATUS (Prompt is S>)
2. TEST (Prompt is T>)
3. CONFIG (Prompt is C>)

In normal circumstances, the Display Unit LCD will display a *Status* message relating to the overall state of the data link. eg. READY. Additional status information may be displayed by scrolling down through the menu. The *Status* menu is *read-only*. To select the next menu in the list the 'RIGHT MENU' button must be pressed. To go back to a previous menu the 'LEFT MENU' button must be pressed. A prompt on the left hand side of the display will indicate which menu has been selected. On entering a menu its title will be displayed in full before the display reverts to the first menu item and the relevant prompt.

If the equipment is left in a display other than *Status* for greater than one minute the display will automatically time out and revert to the top line of the status menu. If left in the Status menu but not on the top line, the display will automatically time out and revert to the top line of the status menu after 5 mins.

The sequencing through the menus is as follows:

```
* STATUS  MENU *
```

```
** TEST  MENU **
```

```
* CONFIG  MENU *
```

When scrolling through the menus, the items will appear in the order detailed in the individual menu descriptions.

Each menu item display should indicate the current state of that item. For example if the loopback feature was currently inactive then the display should read:

```
T>  Loopback  Off
```

To change the state of a menu item the 'SELECT' button should be pressed.
The display should then change to reflect the modified status, in the example above the display should change to read:

```
T>  Loopback  On
```

If a menu item is not appropriate for a given situation then it will disappear from the menu. For example it is not permissible to have a loopback on and binary keys active at the same time. The first one selected will therefore cause the other to disappear from the menu.

Any item selected in the Configuration menu is automatically stored in non-volatile EEPROM. These features will thus be restored when the BBM is next powered up.
Items in the Test Menu are not stored and are lost on power off.

5.3 Status Menu

The status menu is read only, which means the select button has no effect. It provides the following data:

(1) Overall status
(2) Alarm messages

5.3.1 Overall status

The possible messages for this item are as follows:

S> Loop Active

S> LTU Not Ready

S> LTU Ready

The basic principle of operation of this display is as follows (in priority order):

(a) If a loop is applied within the BBM the display reads : S> Loop Active

(b) If a fault exists then the display reads:

S> LTU Not Ready

Otherwise it reads: S > LTU Ready

5.3.2 Alarm Status

The possible messages for this item are:

S> No Alarm

S> No Signal

The S> No Signal display indicates that the transmission system cannot find any signal to lock onto

Possible causes are:

(a) Broken or defective line
(b) Both ends master, or both ends slave
(c) Line attenuation / noise level too high

5.4 Test Menu

The Test Menu can be read and written to at all times. The items are not saved on power down, therefore on power up the various tests always default to the off state. The items in this menu are as follows:

1. Local loop
2. Loopback
3. Binary pattern
4. Data error test
5. In service error test
6. Lamp test
7. Self Test
8. Comms channel loop

5.4.1 Local loop

The local loop facility is a loop applied within the local BBM. It loops data back to the DTE from a point as close to the interface connector as is possible. This loop can only be applied from the Menu.

This is implemented by selecting the item `T> Loc Loop Off`

On pressing SELECT the display should change to `T> Loc Loop On` and the loop should be applied.

The top display in the status menu will display *Loop Active* and the TM LED should also light up.
The data flow with the loop applied is shown in fig 5.4.1.1.

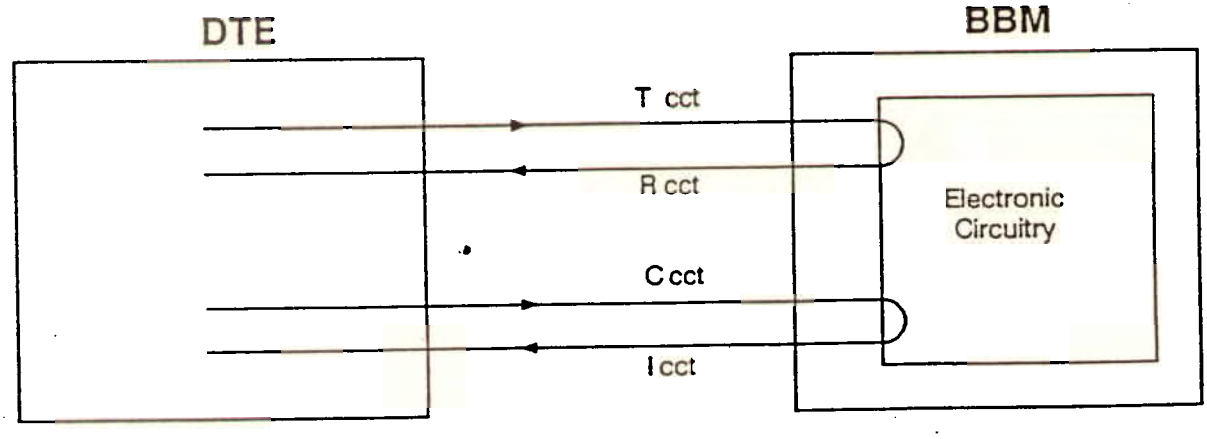


Figure 5.4.1.1

5.4.2. Loopback

The loopback feature places a loop on the local BBM in the opposite sense to the local loop, ie the data coming from line is looped back. The DTE is effectively cut off and receives only a Not Ready signal.

The loopback is applied by selecting the item `T> Loopback Off`

Pressing SELECT should cause the display to change to | T> Loopback On |

The loop should then be applied. The TM LED should light and the top level status display should show *Loop Active*.

The data flow for this loop is shown in fig 5.4.2.

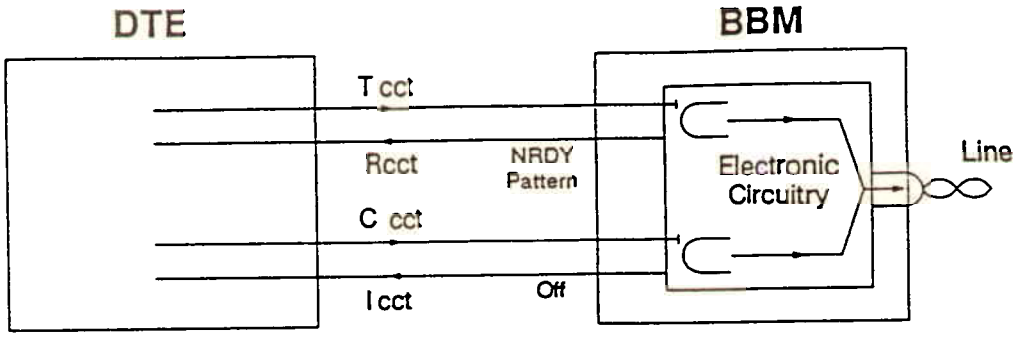


Figure 5.4.2

This loop can only be activated from the AM128000B Test Menu.

5.4.3 Binary patterns

It is possible to transmit three different patterns to the remote BBM:

(1) All 1's
(2) All 0's
(3) Alternate 1's and 0's

The alternate 1's and 0's pattern is sent by pressing the separate TX NRDY key on the front panel. The other patterns are accessed from the binary feature in the test menu.

The default state is sending no patterns when the display is | T> Bin Keys Off |

If the SELECT key is pressed then binary 0's are sent and the display should change to | T> Sending Bin 0 |

If the SELECT key is pressed again then the binary 1 pattern is sent. | T> Sending Bin 1 |

A third press of select will return the function to its default (off) state.

It should be noted that several factors may prevent the binary pattern being transmitted. The test menu display shows only that a binary pattern will be transmitted *if the BBM is capable of it*. Factors preventing transmission are:

(1) Fault conditions
(2) Loopback active
(3) Local loop active
(4) TX NRDY key active

5.4.4 Data test

5.4.4.1 Overview

This mode allows the user to send a binary 0's pattern to the far end BBM, and monitor the received data stream for errors. The number of bits received in error is shown on the LCD display.
The time that the test has been running can also be displayed, and this allows the user to calculate the effective Bit Error Rate if so required. This is given by:

$$\text{Bit Error Rate (BER)} = \frac{\text{Error count}}{\text{User data rate} \times \text{Time}}$$

A loop must obviously exist somewhere in the line system for the test to be valid, (unless the far end BBM is also sending a binary 0's pattern and a single direction test is required).

This loop can only be applied by the local BBM using:

(1) Comms channel loop selected from the Test Menu. (See section 5.4.8)

This loop MUST be applied before the *Data Test* mode is entered.
The loop can of course be applied directly at the far end BBM. This can be done by selecting a Loopback from its test menu.

In order to ascertain from the local BBM whether or not a loop has been applied the *Data Test* has the facility to send a binary 1's pattern. This should result in every bit returned around the loop being in error. So to verify the loop the following procedure can be adopted:

1. Send 0's around loop -If loop present then RXD LED will be off with a low error count
2. Send 1's around loop -If loop present then RXD LED will be on with a high error count (BER = 1)

A further option provided is the facility to allow a data tester to inject the binary 0's pattern. This is to allow use of the extra facilities provided by the tester, (eg injecting single errors), and/or simultaneous error testing of the X21 link.

5.4.4.2 Operation

Note: Apply any loops required before entering Data Test Mode.

The display within the test menu is

T> Data Test

To enter the mode find this entry in the test menu and press SELECT.
There are four displays within this *Data Test* sub-mode:

1. Error display
2. Pattern display
3. Transparency display
4. Time display

Once the mode is entered these displays can be changed by using the scroll keys in exactly the same fashion as in the main menus. The mode can be exited at any point by a press on one of the MENU keys. This will then bring you back to the line *Data Test* in the test menu.

1/ Error display

The BBM starts to inject a binary 0 pattern immediately the mode is entered. The TM LED should light to verify this.

The display should then be | Errors nnnnnn |

Where nnnnnn is the number of bits received in error. (If the line is error free then the display should remain at 000000.)

The SELECT key now performs two functions:

1. On the first press it will hold the current error count and time, (and stop counting further errors).
A small "s" is displayed just prior to the error count to show this.

For example | Errors s000001 |

2. On the second press the error count and time will be reset, and the test restarted.
If the error count overflows the display will indicate a " > " character just before the error count.

For example | Errors > 000001 |

Note that once the error count has overflowed no confidence should be held in the number displayed. (It does not simply wrap around at 999999).

2/ Pattern display

The pattern display usually shows: | Injecting 0s |

If binary 1's are required (for loop verification) press select on this display. Binary 1's will now be injected and

the display should change to | Injecting 1s |

This pattern will continue to be injected until the select key is pressed on this item again, (or the mode is exited).

3/ Transparency display

The Transparency option is usually disabled, when the display reads: | Injection Mode |

If the SELECT key is pressed on this option then the display should change to | Transparent Mode |

The binary 0 injection is then disabled and the data path is direct to the DTE or data tester.

If Transparent mode is now selected the pattern display will show | No Injection |

The facility to inject binary 1's remains, however, and the SELECT key will now toggle between no pattern injected and injecting binary 1's.

4/ Time display

The time display simply shows the time since the test has started in seconds.

For example | Time 000010 | If the count is stopped the display is | T Stop 000010 |

5.4.5 In Service Test

5.4.5.1 Overview

This mode allows the user to monitor the error performance of the line whilst allowing data traffic to continue unhindered. The feature works by monitoring the accuracy of some of the overhead bits that make up the transmission frame structure. As the data channel itself is not monitored the figures produced from this mode cannot accurately be extrapolated to give the data error rate, they should be used as a general guide only.
In order to understand how this feature works a certain amount of knowledge about the transmission frame structure is required. This is included as appendix C. A brief discussion on the operation is given here.

5.4.5.2 Operation

The display to select in the test menu is | T > In Svc Test |

No processes are activated upon entering this mode, it is a monitoring facility only. The mode can be exited and re-entered with no effect on any other tests or data.

There are two different displays within this mode:

(1) Comms framing error display
(2) Time of test

The SELECT and SCROLL keys operates in the same manner as in the *Data Test*.

As this mode may be left running over a long period, an *abort* indication has been added to the displays. The character *a* is displayed prior to the count if the test has been aborted. The monitoring is aborted when the system error rates get so high that the envelope alignment pattern / comms framing word cannot be locked on to, or when the system loses line sync. (The error count would be meaningless if the line had been broken in the middle of a test). Note that the different displays may abort at different times, but the clock will stop when the first abort occurs.

The error count displays appear as follows:

(1) | Comms 000000 | Comms word error count This is 1/108 Data error count

The time display simply shows the time since the test has started in seconds.

For example | Time 000010 | If the count is stopped the display is | T Stop 000010 |

If the count has been aborted the display is | T Abort 000010 |

5.4.6 Lamp test

This facility is used to check the LEDs and the LCD display.

To activate the test choose the item | T> Lamp Test |

When SELECT is pressed the LCD should show a line of blocks, and the LED's should light up, for about 3 seconds. On completion the above display is returned to.

5.4.7 Self Test

The *Self Test* facility does some simple checks on the EPROM and the EEPROM and can be activated by two means:

(1) On initial power on.
(2) Selection in the test menu.

(1) On power up the self test routine will cause all the front panel LEDs to light momentarily, except the DISP LED. If the DISP button is now pressed and the unit has passed its self test then the status menu will be entered, however if it has failed its self test it will then display one of the following messages :

EPROM Fail	or	EEPROM Csum Fail	or	EEPROM Fail

(2) By selecting the item | T> Self Test | in the TEST menu the following details will be displayed:

1. | EPROM Test | (This is just a breakdown of the testing procedure in step 1 above)
2. | EEPROM Test |
3. | Blocks Used 000 | (This indicates the amount of space left in the EPROM)
4. | Self Test Pass | or in the case of failure

EPROM Fail	or	EEPROM Csum Fail	or	EEPROM Fail

5. e.g. | LTU 128k V1.3 | AM128000B (This indicates the software version number fitted)

Obviously this last message will change when the software changes but the general format of : a)equipment identifier and b) software version number ; will always be followed.

The displays are then as follows:

The EEPROM is designed to be sufficient for the expected lifetime of the BBM, (2×10^6 write operations). However, the usage of the EEPROM (Blocks Used) is still displayed for information.
For example;

0 means that the first block is in use and that there are 254 empty blocks, (each block has 10^4 writes)

254 means that the last block is being used and the chip is nearly full, (and needs replacing).

The failure messages have the following implications:

1. *EPROM Fail* This is a fatal error and the program will terminate.
2. *EEPROM Fail* This indicates that the internal structuring of the EEPROM data is corrupt. If this happens an opportunity is given to reset the EEPROM.

To reset the EEPROM, press the SELECT key in response to the | Reset EEPROM ? | prompt.

The consequence of resetting is that some sections of EEPROM memory may be written to more than the recommended maximum number of times, giving ultimately lower reliability of saved data.

3. *EEPROM Csum Fail* This indicates that data in the non-volatile memory (EEPROM) has an incorrect checksum. This can occur during normal usage if the unit was programming a new configuration when the power was turned off. Normal operation can resume, but the set up configuration must be re-entered.

5.4.8 Communication channel loopback

This loop applies a loopback at the remote BBM. The command to turn on the loop is sent via the comms channel (see Appendix C). Unstructured data can be sent around this loop.

To activate this loop select the item | T> Comm Loop Off |

The display should then show | T> Comm Loop On |

The loop should be applied and the TM LED should come on.
Note that the status menu treats this loop differently in that the top level display is NOT *Loop Active* but *Data Transfer* etc.

APPENDIX A - Interface Pin Connections

15 Way D type X21 (V11) Connector pin allocation

X21 Connections

Interface cables to be terminated at both ends with a 15 pin male 'D' Type connector to ISO 4903.

Maximum length 100m. Typical Resistance 0.087Ohm/m. Typical Capacitance 50pF/m.

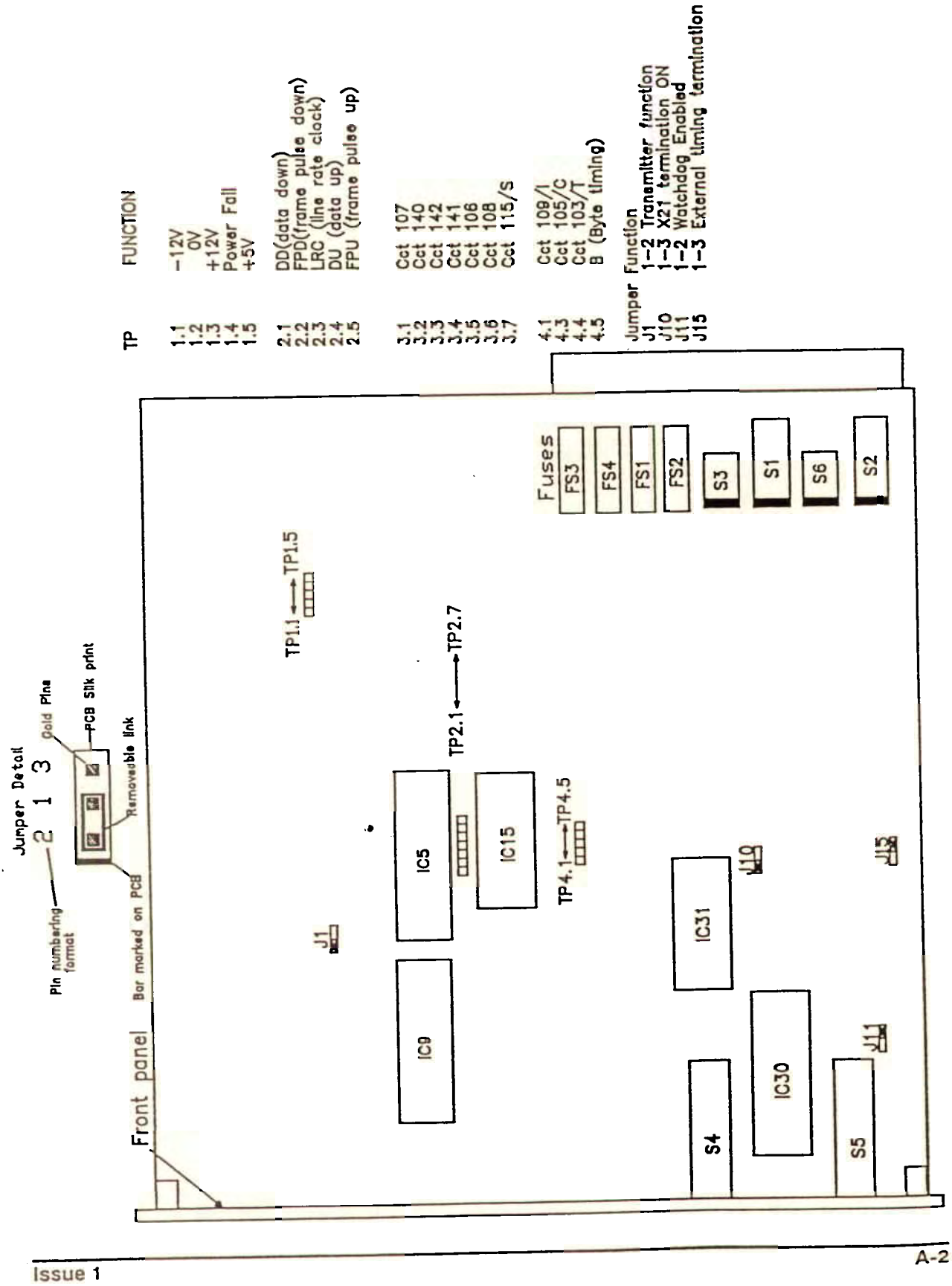
15 way D-type		Circuit	Description	Type	26 way shelf conn.	
A-wire	B-wire			(SITS 89/43)	A wire	B wire
8	8	G	Signal Ground / Common Return	Common Return	15	15
15	1	SEXT	External Signal Element Timing	Load	14	16
2	9	T	Transmit	Load	3	2
4	11	R	Receive	Generator	7	6
3	10	C	Control	Load	5	4
5	12	I	Indication	Generator	9	8
6	13	S	Signal Element Timing	Generator	11	10
7	14	B	Byte Timing	Generator	13	12
7	14	F	Frame Start Indication	Generator	13	12

LINE CONNECTOR.

The line connections are pins 1 & 6 from the telephone style cord.

APPENDIX B - Internal Link Settings

The following diagram shows the location of the internal BBM links:



All of the links have 3 pins, the bar end indicating pin 2.

The function of the links is as follows:

J1 Transmission disable
This link is always left in position 1-2

J10 Termination resistor for X21 T circuit (Transmit data)
This link connects a 120 ohm load resistor across the T circuit in position 1-3. This helps to maintain the signal rise time and minimise reflections at rates greater than 9.6kb/sec over long lines. It also provides termination for cct 103 at the V35 interface. At lower rates and over short lines the termination resistor may be omitted, (link set to 1-2).

J11 Watchdog enable
This link is always left in position 1-2

J15 Termination resistor for X21 S EXT circuit, (External Signal Timing)
This link connects a 120 ohm load resistor across the S EXT circuit in position 1-3. (Similar to J10).
IMPORTANT - This link must be left in position 1-3 (terminated), otherwise the BABT approval will be invalidated.

WARNING

Only authorised personnel can be allowed to open the Line Terminating Unit case to change the link settings. Misuse or any modifications carried out to this unit other than in accordance with the instructions supplied, will invalidate both the guarantee and the BABT approval.

APPENDIX C - In Service Test Background Information

C.1 Frame Structure

The information passing between master and slave BBM's comprises user data and control data; the latter is used for controlling and supervising the operation of the transmission system. In order that these components can be separated the composite data is transmitted in frames with a fixed framing pattern to identify the frame boundary. Data is transferrred at 142.2 kb/sec.
Figure C.1 shows the basic frame structure.

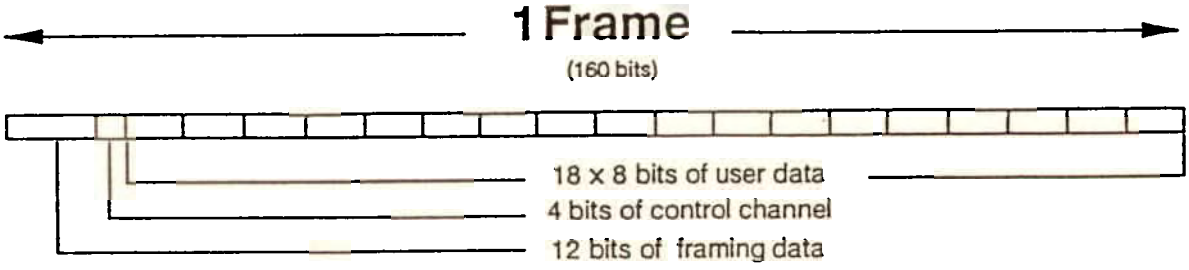


Figure D.1

Each frame consists of 160 bits of which 12 are allocated to the framing pattern and 4 to the control channel. (These 4 bits per frame are termed the *Comms channel*). This leaves 144 bits, or 18 octets for user data, giving a maximum throughput to the user of 128kb/sec.

C.2 In Service Test facilities

The In Service Test has access to the comms channel

The disadvantage of using comms channel error monitoring, however, is that the ratio of comms bits monitored to data bits is low; ie. error rates have to be high, or tests have to be very long, to accumulate any significant data.

Only one of the four comms bits per frame forms part of a 8 bit multiframe word, (the *comms framing word)* which can be monitored for errors. This gives the equation for the bit error rate to be:

$$\text{Bit Error Rate (BER)} = \frac{\text{Comms Error Count} \times 108}{\text{User Data Rate} \times \text{Time}}$$

There is a complication with the comms framing word.
The word is originally transmitted from the master BBM; when it gets to the slave it is monitored for errors, and then re-transmitted (in its errored form) back to the master. The comms error display has thus a different meaning on the master and on the slave. The master display is the error count around the loop, and the slave display is the error count in the single direction only.

APPENDIX D - BSI Requirements

COMPLIANCE WITH BS6328 PART 2

(1) The BBM is not suitable for use on circuits with British Telecommunications signalling at a nominal frequency of 2280 Hz.

(2) The BBM is suitable for point to point private circuits (EPS 9)

(3) The BBM may be connected directly to a Private Circuit and relevant branch system for baseband circuits.

(4) The BBM does not require DC from the Private Circuit for correct operation. The BBM may be damaged if connected to a circuit supplying dc current (the maximum permissable dc current is 6mA.)

(5) The approval of this BBM is invalidated if the apparatus is subjected to any modification in any material way not authorised by BABT or if it is used with, or connected to,

(a) Internal software that has not been formally accepted by BABT.
(b) External control software or external control apparatus which causes the operation of the BBM or associated call set up equipment to contravene the requirements of the standards set out in BABT/SITS/82/01/C.

(6) The BBM is suitable for household, office and similar general indoor use.

(7) All apparatus connected to this BBM and therefore connected directly or indirectly to British Telecommunications Private Circuits must be approved apparatus as defined in section 22 of the British Telecommunications act of 1984

COMPLIANCE WITH BS6301 CLAUSE 7.2 (SAFETY REQUIREMENTS)

(1) Apparatus connected to the DTE interface of the BBM must comply with BS3601.

(2) When the only earth connection to the BBM is via the 3 pin mains plug, the cable to the BT socket must be unplugged before the mains plug is removed. See also the installation information in chapter 4

COMPLIANCE WITH BABT/SITS/89/43

1. The BBM is only approved for connection to a relevant branch system for particular digital circuits. Note that the cabling and wiring itself constitutes a relevant branch system.

2. If any other apparatus, including cable and wiring, is to be connected between the apparatus and the point of connection to any particular digital circuit then all that apparatus shall conform to the following:

(a) the overall transmission characteristics of all that other apparatus shall be such as to introduce no material effect upon the electrical conditions presented to one another by the apparatus and the particular digital circuit; and

(b) all the other apparatus shall comprise only:

(i) apparatus approved (see note) for the purpose of connection between the apparatus and a particular digital circuit; and

(ii) cable or wiring complying with a code of practice for the installation of apparatus covered by this standard or such other requirements as may be applicable.

NOTE: Such apparatus may have been approved subject to limitations on its use.

APPENDIX E - Use on X21 digital circuits

The details in this appendix relate to the arrangement shown in figure E.1.

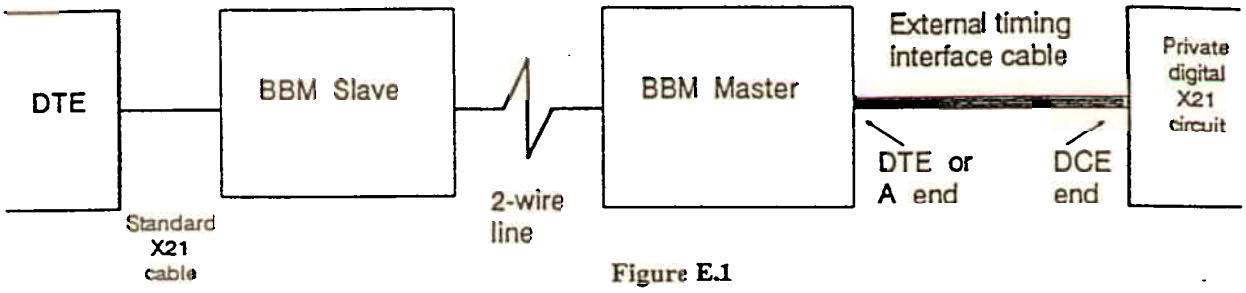


Figure E.1

The main difference between this arrangement and the conventional link is the need for a special interface cable which joins the master BBM to the private digital circuit. This cable is configured to extract the timing signal from the private digital circuit and synchronise the BBM link to this clock.

There are 2 possible types of synchronisation; bit timing and byte timing. The bit timing mode ensures correct transfer of data across the link but there is no byte alignment between the ends. The byte timing mode ensures alignment of every octet of data. There are 2 different types of cable available:

1. X21 bit timing — Part number 1/113/006/100
2. X21 byte timing — Part number 1/113/007/100

The configuration menu synchronisation type must correspond to the above cable type, (see section 5.7.4). It is important that the cables are connected correctly, (see diagram). The cable details are given below:

1. X21 bit timing cable

DCE	DTE
2	4
9	11
4	2
11	9
13	1
6	15
5	3
12	10
3	5
10	12
8	8

Both connectors are 15-way D-type plugs

2. X21 byte timing cable:

DCE	DTE
2	4
9	11
4	2
11	9
14	1
7	15
5	3
12	10
3	5
10	12
8	8

Both connectors are 15-way D-type plugs

It must be remembered that this error count is unidirectional only. There can be no looping of the envelope alignment bits. This fact can be used to advantage in determining the location of noise on a link. Consider an example where two modems are connected together. Modem 1 indicates a high error rate, and modem 2 indicates a low error rate. It can then be inferred that the noise is worse close to modem 1, (noise has the greatest effect where the signal is weakest, the signal from modem 2 is weak at modem 1. The noise has little effect on the transmitted signal from modem 1, and hence the signal arriving at modem 2 is error free).

The use of alignment bits for error monitoring is the preferred use of In Service Testing, however there are several user rates where this method will not work (because there are no alignment bits transmitted in the frame structure, see previous section).

The comms channel error monitoring can be used at all line rates. The disadvantage of using this technique, however, is that the ratio of comms bits monitored to data bits is low; ie. error rates have to be high, or tests have to be very long, to accumulate any significant data.

Only one of the four comms bits per frame forms part of a 8 bit multiframe word, (the *comms framing word)* which can be monitored for errors. This gives the equation for the bit error rate to be:

$$\text{Bit Error Rate (BER)} = \frac{\text{Comms Error Count} \times 108}{\text{User Data Rate} \times \text{Time}}$$

There is a complication with the comms framing word.
The word is originally transmitted from the master modem; when it gets to the slave it is monitored for errors, and then re-transmitted (in its errored form) back to the master. The comms error display has thus a different meaning on the master and on the slave. The master display is the error count around the loop, and the slave display is the error count in the single direction only.

There is a further method of error monitoring that is included in the master modem only. These errors are termed *Transmitted envelope errors*. This technique can allow the master modem to determine the location of noise on the line, with no help from the slave display. It is thus useful if access to the slave is difficult or inconvenient.
The envelope alignment errors counted by the slave is encoded into the comms channel and sent to the master. As the ratio of comms bits to envelope bits is fairly low, and *provided the overall error rate is fairly low* (not many comms errors, ie. bit error rate less than 10^{-3}), the master can expect to receive a reasonable account of the envelope alignment errors as counted by the slave. The master modem then has available (1) the envelope alignment errors that it has received, and (2) the envelope alignment errors that the slave has received. The relative performance of either end of the link can thus be determined.
It should be stressed that this error information in the comms channel is obviously subject to error itself and so accuracy is very limited with short tests and high error rates.

APPENDIX E - BSI Requirements

AM19200B & AM64000B Modems

COMPLIANCE WITH BS6328 PART 2

(1) The AM19200B and AM64000B modems are not suitable for use on circuits with British Telecommunications signalling at a nominal frequency of 2280 Hz.

(2) The AM19200B and AM64000B modems are suitable for point to point private circuits (EPS 9)

(3) The AM19200B and AM64000B modems may be connected directly to a Private Circuit and relevant branch system for baseband circuits.

(4) The AM19200B and AM64000B modems do not require DC from the Private Circuit for correct operation. The modems may be damaged if connected to a circuit supplying dc current (the maximum permissable dc current is 6mA.)

(5) The approval of the AM19200B and AM64000B is invalidated if the apparatus is subjected to any modification in any material way not authorised by BABT or if it is used with, or connected to:

(a) Internal software that has not been formally accepted by BABT.
(b) External control software or external control apparatus which causes the operation of the modem or associated call set up equipment to contravene the requirements of the standards set out in BABT/SITS/82/01/C.

(6) The modems are suitable for household, office and similar general indoor use.

(7) All apparatus connected to these modems and therefore connected directly or indirectly to British Telecommunications Private Circuits must be approved apparatus as defined in section 22 of the British Telecommunications act of 1984

COMPLIANCE WITH BS6301 CLAUSE 7.2 (SAFETY REQUIREMENTS)

(1) Apparatus connected to the DTE interface of the AM19200B or AM64000B must comply with BS3601.

COMPLIANCE WITH BABT/SITS/89/43

(1) The AM19200B and AM64000B are only approved for connection to a relevant branch system for particular digital circuits.
Note that the cabling and wiring itself constitutes a relevant branch system.

(2) If any other apparatus, including cable and wiring, is to be connected between the apparatus and the point of connection to any particular digital circuit then all that apparatus shall conform to the following:

(a) the overall transmission characteristics of all that other apparatus shall be such as to introduce no material effect upon the electrical conditions presented to one another by the apparatus and the particular digital circuit; and

(b) all the other apparatus shall comprise only:

(i) apparatus approved (see note) for the purpose of connection between the apparatus and a particular digital circuit; and

(ii) cable or wiring complying with a code of practice for the installation of apparatus covered by this standard or such other requirements as may be applicable.

NOTE: Such apparatus may have been approved subject to limitations on its use.

AM-Rack

COMPLIANCE WITH BS6301 CLAUSE 7.2 (SAFETY REQUIREMENTS)

(1) Apparatus connected to the Fault Extension socket of the AM-Rack must comply with BS6301.

COMPLIANCE WTH BABT/SITS/83/02C

The information provided in accordance with BS6484 clause 3.3 is valid for all operating states of the apparatus in the enclosure in which the power supply is mounted.

COMPLIANCE WTH BABT/SITS/89/43

(1) The X21 , X21 bis ,V35 and V36 ports on the rear panel do not provide isolation sufficient to satisfy the requirements of the relevant parts of BS. 6301. Apparatus connected to these ports must have been approved to the relevant part of BS. 6301. or have been previously evaluated against British Telecom (Post Office) Technical Guides 2 or 26 and given permission to attach. Other usage will invalidate any approval given to this apparatus.

APPENDIX F - Use on X21 / X21bis digital circuits

The details in this appendix relate to the arrangement shown in figure F.1.

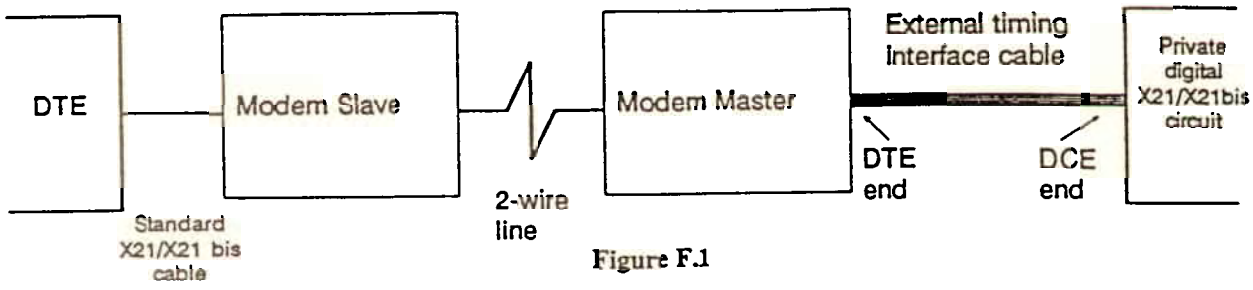


Figure F.1

The main difference between this arrangement and the conventional link is the need for a special interface cable which joins the master modem to the private digital circuit. This cable is configured to extract the timing signal from the private digital circuit and synchronise the modem link to this clock.

There are 2 possible types of synchronisation; bit timing and byte timing. The bit timing mode ensures correct transfer of data across the link but there is no byte alignment between the ends. The byte timing mode ensures alignment of every octet of data. The bit timing mode is available for every interface type and user rate, but the byte timing mode is only available for X21 at 64kbit/s.

There are 5 different types of cable available:

1.	X21 bit timing	Part number 1/113/006
2.	X21 byte timing	Part number 1/113/007
3.	X21 bis V28 bit timing	Part number 1/113/008
4.	X21 bis V35 bit timing	Part number 1/113/009
5.	X21bis V36 bit timing	Part number 1/113/010

The configuration menu synchronisation type must correspond to the above cable type, (see section 5.7.4). It is important that the cables are connected correctly, (see diagram). The cable details are given below:

1.X21 bit timing cable - (15 way to 15 way D type plugs).

DCE	DTE
2	4
9	11
4	2
11	9
13	1
6	15
5	3
12	10
3	5
10	12
8	8

2. X21 byte timing cable - (15 way to 15 way D type plugs).

DCE	DTE
2	4
9	11
4	2
11	9
14	1
7	15
5	3
12	10
3	5
10	12
8	8

3. X21bis V28 bit timing cable - (25 way to 25 way D type plugs).

DCE	DTE
2	3
3	2
4	8
7	7
8	4
17	24

4. X21 bis V35 bit timing cable - (34 way to 34 way MRAC plugs).

DCE	DTE
P	R
S	T
R	P
T	S
C	F
F	C
V	U
X	W
B	B

5. X21 bis V36 bit timing cable - (37 way to 37 way D type plugs).

DCE	DTE
4	6
22	24
6	4
24	22
7	13
25	31
13	7
31	25
8	17
26	35
19	19
20	20

5.5 Configuration Menu

This menu contains items that are used in the initial configuration of the BBM. Once set up they are not usually required for normal BBM operation. All of the configuration parameters are stored in non volatile memory, and are restored the next time the BBM is powered up.
The items in this menu are as follows:

(1) Master / Slave
(2) Synchronisation type
(3) Transmit power level
(4) Menu lock

5.5.1 Master / Slave

When two BBMs are connected together, one BBM has to be a master, and the other one a slave. The transmission signal is different for master and slave, so line synchronisation will never be achieved if two like types are connected together.
Unless external timing is required (see section 5.5.2) it makes no difference which end is which.

The master display is `C> Master Mode`

Pressing SELECT gives the slave display `C> Slave Mode`

5.5.2 Synchronisation Type

This option is only applicable to master mode with external timing and allows the user to change the type of clock synchronisation within the BBM.
Normally in a point to point link, the master BBM becomes the source of timing and the slave BBM locks to this.

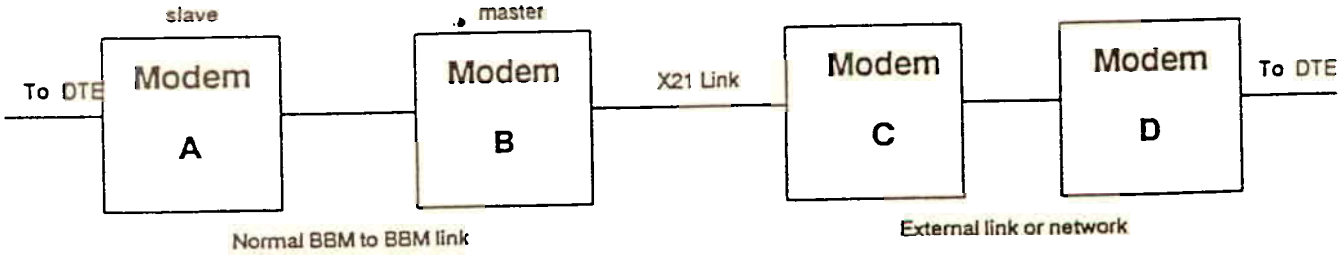


Figure 5.5.2

If a further link is driven as shown in figure 5.5.2:

then the *external* BBM (C) must supply a source of timing to the master BBM (B). This timing can be of two forms Bit Timing, or Byte Timing.

Bit timing is selected with the display `C> Bit Sync`

The Bit timing signal must of the same frequency as the user bit rate. The circuitry is designed to be supplied with the timing clock output from another BBM.

The signal connections are via the X21 interface connector, (see appendix A).

The Byte timing signal is shown by

```
C>  Bit  Sync
```

The Byte timing signal must be a 1/2 bit wide pulse every 8 data bits. The circuitry is designed to accept the byte timing output from a slave BBM operating at 128kb/sec.
The signal connections are via the X21 interface connectors, (see appendix A).

5.5.3 Power Level

This item selects the output power level of the transmission circuitry. There are two options:

```
C>  Power  0 dBm
```
low power

```
C>  Power  10 dBm
```
high power

The 10dBm option should normally be selected. The 0dBm option should be selected for short lines to reduce interference to other equipment.

5.5.4 Menu Lock

This item allows the user to restrict accidental use of the menus. When locked the SELECT key is disabled, and no items in *any* menu can be altered. The only option available is to *unlock* the menu.

The normal mode is displayed:

```
C>  Menu  Unlocked
```

When the menu is locked the display changes to

```
C>  Menu  Locked
```

In order to prevent easy locking and unlocking the SELECT key does not function in the normal way for this feature. The lock is activated by selecting the *STATUS MENU* and then pressing three keys simultaneously.

These keys are (1) left menu key
(2) SELECT key
(3) TX NRDY key

In order to prevent activation of the TX NRDY feature the keys should be pressed in the order above.

When these keys are pressed the display will show:

```
>>  Menu  Locked
```

This message will be displayed for about 3 seconds before reverting back to the status display.
The menu is now locked and if the configuration menu is examined it will display the locked message.

Pressing the same three keys again will unlock the menu;

```
>>  Menu  Unlocked
```

The operation is a toggle action (ie. lock - unlock - lock), just like the normal SELECT key operation.

GLOSSARY OF TERMS

AIS	Alarm Indication Signal.
AMI	Alternate Mark Inversion. - Code used for line transmission.
BBM	Base Band Modem.
BT	Byte Timing. - Synchronisation to every 8 bits.
BT	British Telecom.
CCITT	International Telegraph and Telephone Consultative Commitee.
CNR	Controlled Not Ready
DCE	Data Circuit-terminating Equipment.
DTE	Data Terminating Equipment.
EEPROM	Electrically Eraseable Programmable Read Only Memory.
LCD	Liquid Crystal Display
LED	Light Emitting Diode.
LTU	Line Terminating Unit. Same as Base Band Modem and AM-128000B or any AM-modem.
UNR	Uncontrolled Not Ready.
V11	CCITT specification. Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.
X21	CCITT specification. Interface between DTE and DCE for synchronous operation on public data networks.

GENERAL SPECIFICATION

Transmission system uses DSP techniques involving echo cancellation and adaptive decision feedback equalisation.
Power output selectable 0dBm or 10dBm.
Line code is AMI with embedded sync pattern for timing control.
Line rates 142.2kbit/s.
Line attenuation range up to 40dB (at 10dBm output level).

User data rate: 128000 bit/s.

Synchronous working.

Most options and features software configurable.
Front panel lockable to prevent unauthorized operation

Byte timing is available .

User interfaces: X21 V11

Test facilities: local loop, loopback, comms channel loop,
transmit binary 0, transmit binary 1, transmit alternate 1's and 0's,
self test, lamp test, data channel error test, in service error test.

Enviromental conditions:	Temperature range	+5to +40 deg C
	Humidity range	5% to 85%
	Air pressure range	70 to 106 kPa
Power supply:	240V +6 to -10%,	50Hz +5 to -5%