a   **telecom**

User Guide

High Speed Modems

AM64/384A, AM64/512A, AM64/768A, AM64/1024A.

Contents

1. Introduction

This manual applies to the AM64/384 – AM64/512 - AM64/768 – AM64/1024 High Speed Baseband Modems. These modems are manufactured in the U.K. by Ascom Telecommunications Ltd.
The mnemonic BBM stands for Base Band Modem, and this should be understood (in all cases) to be the BaseBand Modem itself.

There are six variations of interfaces available, each with a different physical data interface circuit. The Ascom Telecommunications Ltd. part numbers are as follows:

- AM64/384   V.11 :   1/226/011/100
- AM64/384   V.24 :   1/226/012/100
- AM64/384   V.35 :   1/226/013/100
- AM64/384   V.36 :   1/226/014/100
- AM64/384   RS530 :   1/226/015/100
- AM64/384   G.703 (64kbps)   1/226/016/100

- AM64/512   V.11 :   1/226/001/100
- AM64/512   V.24 :   1/226/002/100
- AM64/512   V.35 :   1/226/003/100
- AM64/512   V.36 :   1/226/004/100
- AM64/512   RS530 :   1/226/005/100
- AM64/512   G.703 (64kbps)   1/226/006/100

- AM64/768   V.11   1/226/111/100
- AM64/768   V.24   1/226/112/100
- AM64/768   V.35   1/226/113/100
- AM64/768   V.36   1/226/114/100
- AM64/768   RS530   1/226/115/100

- AM64/1024   V.11 :   1/226/101/100
- AM64/1024   V.24 :   1/226/102/100
- AM64/1024   V.35 :   1/226/103/100
- AM64/1024   V.36 :   1/226/104/100
- AM64/1024   RS530 :   1/226/105/100

The units should have an identifying label carrying this number attached to the underside.

Separate interface modules can also be purchased in order to modify the units for operation with a different DTE interface at a later date.

The BBM's can provide synchronous communications at user data rates between 64kbps and 1024kbps over twisted pair cable.

The BBM can easily be configured using the front panel keys 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 will be 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 6 (Front Panel Features) is much more detailed, but should be read in full to gain an understanding of the full range of menu facilities available.

2. Constructional Details

2.1 Baseband Modems

The BBM is housed in a professionally styled plastic case. On the front is a menu driven LCD with six keys and five LED's. On the rear panel there is a 3-pin IEC mains inlet socket, an 8 way, 8-loaded RJ45 line cord socket, one data interface connector and a VT100 Management Port (9-way D-type). The modem's line connection is via an 8-way, 8-loaded RJ45 line connector cable. The line connections for pair 1 are to pins 7 (brown with white stripe) and 8 (white with brown stripe) and pins 4 (blue with white stripe) and 5 (white with blue stripe) for pair 2 in the RJ45 plug. The data interface connector type will be from one of the six user specified interfaces available. They are detailed in section 5.3. Inside the plastic cover is a metal case, which contains the main PCB. The metal case is for EMC screening purposes. There is also a front panel assembly, comprising of the LCD, the keys and the LED's which are attached to the main PCB by two connectors feeding through the metal case.

The BBM is also packed with a 2.4 metre long mains lead, terminating on one end with a U.K. 3-pin mains plug as standard (or other plug if specified) and 3-pin IEC connector on the other. Also included is a 3 metre long double-ended RJ45 connector 8 way, 8-loaded line cord or alternatively, an RJ45 to bare ended cable for direct connection. These cables are both packed with the unit in separate tie-wrapped polythene bags.
The overall dimensions of the unit are 274mm(L) x 251mm(W) x 55mm(H).

3. System Overview

The AM High Speed baseband modems use the digital transmission system designed and developed by Ascom Telecommunications Ltd. in Cardiff, U.K. It is intended for operation on 2-wire local telephone network circuits, such as those meeting BT EPS-9 (2-wire), (Note: the AM64/768 and AM64/1024 require two such circuits). They 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 rates between 64k and 1024k. The lower rates are useful in situations where transmission performance is being limited by attenuation or noise.

The line signal comprises of 2B1Q or 3B1O data and an embedded sync pattern, which is used for timing control.

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 long tails of both echo and transmission responses. Digital signal processing is used throughout to achieve high performance reproducibly.

The line is connected to the transmission circuit via a line transformer, which acts as a balun and provides isolation; there is surge protection across the transformer line connections. 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 data which is transmitted down the line, it also links 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 between 64kbps and 1024kbps is sent as-is; byte timing is maintained by the transmission system and is available if required.

The control channel uses 21 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 the monitoring of 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 X.21 the various control patterns have to be generated or detected.

The control circuit is based on a micro-controller 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 BaseBand Modems (BBM's). There is one basic system that will be considered and that 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 discussed then Chapter 7 to 10 on menu operations should be consulted. If this still fails to resolve the problem then the internal links can be checked, see Appendix B.

4.1   Start up

With no DTE or line connected to the BBM, plug the mains cord into the IEC connector, and the mains plug into the 110V/260V supply. On power up the following message format will be displayed:

Testing	For 2 seconds, Power, Fault and Test LED's will be on.
Self Test Pass	For 2 seconds, Power, Fault and Test LED's will be on.
AM64/xxxxA V2.x	For 2 seconds, Power, Fault and Test LED's will be on.
Status Menu	Power and Fault LED's lit (Assuming no line connection).
S> LTU Not Ready	This can signify that there is no link or that a fault has occurred.

4.2   BBM to BBM Link

For a point to point link to work, one BBM must be set to *Master mode*, while the other BBM is set to *Slave mode*. If the link is self contained, i.e. 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. The following instructions describe the steps to be taken to set up a link for point to point working;

Turn on the power to both modems.
Connect one end of the line cord into the modem and the other to the line connection point / socket.
Connect a DTE / BERT tester to the interface port as appropriate.
The factory "default" settings (which can be viewed in the Config Menu) are as follows ;

C> Slave Mode
C> 1 Pair
C> Rate = 64k
C> Line Clock
C> Controls EOC
C> Power Auto

Therefore, one unit (designated as the Slave unit) can be left with the factory "default" settings, whilst the other (designated as the Master unit) should be set (via the Config Menu) as follows ;

Using the right arrow key, go to

> * Config Menu*

After 2 seconds

> C> Slave Mode   appears.

Press "SELECT" until

> C> Master Mode   shows in the LCD.

Press "PROG" to reset Mode.

After approximately 1 minute, the units will gain synchronisation and the fault LED will turn off. Any changes to the Master unit settings (ie ; Rate of Data Transfer speed) are passed to the Slave automatically as part of the synchronisation process. Note: the power settings must be carried out manually.

5. Interfaces

5.1 Mains

Mains is fed in via the IEC style mains socket on the rear panel.
The voltage range covers 110-260VAC via an Auto ranging PSU.
Alternative power supply leads are available for country specific requirements.

5.2 Line

The line interface connector on the unit is an 8-way style RJ45 socket.
Its pinouts are as follows:

Pins	Function
7 and 8	Line Pair 1
4 and 5	Line Pair 2

Note : Line pair 2 is only applicable to AM64/768 and AM64/1024 modems.
The line cables supplied have a RJ45 plug on one end (to connect to the unit), and an RJ45 plug on the other end (standard), alternatively, one end is `bare wire' to enable connections to country specific lines.

5.3 Interface Modules

Interfaces available are X.21 (V.11), X.21bis (V.24/V.28), V.35, V.36, R.S.530 and G.703 (64kbps codirectional).
These are fully interchangeable to suit the requirements of the user. A pluggable module is used for each type of interface and this can be supplied as a separate item to enable the installer to set up the system to the individual requirements of the customer. (These modules are also compatible with the AM64/128 modems.
Six different Interface module types are available from: X.21, X.21bis, V.35, V.36, R.S.530 and G.703 (64kbps codirectional). Each interface module is physically different from the others:

X.21	-15 way D-type socket	Part number – 2/203/102/101.
X.21 bis	-25 way D-type socket	Part number – 2/203/202/101.
V.35	-34 way MRAC socket	Part number – 2/203/302/101.
V.36	-37 way D-type socket	Part number – 2/203/402/101.
RS530	-25 way D-type socket	Part number – 2/203/502/101.
G.703 (64k)	- 9 way D-type socket	Part number – 2/203/602/101.

The existing interface module can be changed out using a pluggable replacement unit. These can be ordered separately as per the part numbers detailed above.

5.4 Serial Control

A VT100 compatible terminal can be plugged into the 9-way D-type on the rear panel.
The socket is wired as to allow a straight connection to a PC serial port.
There are two versions of VT100 software. The early version requires a separate document for use.
Software versions 3.x and higher consist of an easy to follow menu structure.

In order to initialise VT100 control, plug in the cable between the PC and serial control port. Start up the VT100 terminal, or Windows based terminal emulator.
Set up the VT100 communications parameters as :

Baud Rate	: 9600
Data Bits	: 8
Stop Bits	: 1
Parity	: None
Flow Control	: Hardware

Note:
Carefully set up the connection on to the correct PC Com port, initialise power on to the modem and then follow the steps / options on the monitor.

6. Front Panel Features

6.1 LCD

The LCD interface is menu based and has the following menus:

STATUS	- reports on overall condition of the unit	(Prompt is S>)
TEST	- allows application of test loops	(Prompt is T>)
OPTION	- configures any interface specific features	(Prompt is O>)
CONFIG	- sets up the unit when operating in master mode	(Prompt is C>)

These menus can be selected by using the left and right arrow keys.

<div align="center">

STATUS ⇔ TEST ⇔ OPTION ⇔ CONFIG

</div>

The and keys move through the items in the menu. All actions in the Config and Options menu require programming in order to take effect, all other actions are carried out automatically. The SELECT (S) key changes the state of each item.

6.1.1 LCD Contrast

The LCD Contrast and viewing angle can be adjusted as follows:
Press the LEFT MENU key. With this key still pressed, press the RIGHT MENU and keys together.
The display should now read **Con Adj ^ & SELECT** (Release the keys).
Use the SCROLL UP and SCROLL DOWN keys to select a suitable value of contrast.
When this is set use the SELECT key to enter it into the system and return to the Status Menu.

6.2 Front Panel LED's

The following indicators exist on the front panel:

(1) Power (Green)

This will always be illuminated whenever the unit is powered up.

(2) Fault (Red)

The fault LED will be illuminated for any of the following conditions:
Self test fail.
Loss of sync with the remote modem.
When a fault occurs within the modem.
When a fault occurs on the line the modem is using.

(3) Test (Red)

This will be illuminated whenever the unit has a loop locally or remotely applied.
When the unit is applying a remote loop.
When the unit is running a data test, Lamp Test or Self Test.

(4) Data (Yellow)

This will illuminate in response to a sample taken of the received data. The LED is lit for a binary 1.
Note: It is not uncommon for this LED to flicker or flash during normal operation.

(5) Program (Yellow)

This LED indicates that changes have been made to the Option or Config settings which have not yet been entered into the system. Once the changes have been programmed, the LED will automatically be turned off.

7. Status Menu

The status menu will display information indicating the overall status of the modem. The Status Menu display has two levels ; The top level indicating the general status, the second level (down arrow key) giving further details. The highest priority status message is;

S> Loop Active

This indicates that a loop is active within this unit, or a loop has been applied by this unit.

It is possible to transmit the Control signals from one unit to another or to configure the units so that they are permanently switched on. The LCD indicates the status of the modem at any given time as;

S> LTU Not Ready	Indicates Modems not in Synchronisation
S> LTU Ready	Indicates Modems in Synchronisation but, Control Signals not on either end
S> Data Transfer	Both Modems Control Signals on and in Synchronisation
S> Receive Data	Remote Modem Control Signals on
S> Send Data	Local Modem Control Signals on

If Control Signals are being used then the state of the I or 109, C or 105 lines are ;

Both ends on	-	Data Transfer,
Local end on	-	Send Data,
Remote end on	-	Receive Data,
Neither end on	-	LTU Ready,
Lost Sync	-	LTU Not Ready.

S> No Sync	This message set indicates that there is no synchronisation with the remote modem, this could be due to a disconnected line, configuration error or other fault.

S> CRC errors	CRC error indicates that there are errors detected in the incoming line data (only visible when In Service Test is running)

S> No Alarm	The BBM is operating with no alarms present.

A modem fitted with a G.703 Interface has extra alarm messages

S> G.703 sync fail

This alarm may be active on its own or in conjunction with the transmission system LOS. In order to accommodate this, the LOS alarm in the status menu has been extended. There are four possible messages displayed;

S> LOS	The transmission system has lost sync.
S> CD Fail	The G.703 interface cannot extract clock from received signals.
S> LOS / CD Fail	The transmission system has lost sync and the G.703 cannot extract the clock from received signals.

There are no displays showing interface circuits since the G.703 interface has no control lines.

7.1 Line Quality

During synch-up, there are up to 4 `*´ characters indicating progress of the transmission circuit in gaining sync. The stages of progression are as follows;

```
*     - Detected tone.
**    - Detected Frame Sync.
***   - Detected Full Sync.
****  - Detected Framer Sync.
```

Once the unit has achieved Sync, the status menu indicates a general qualitative guide to the signal quality on each pair whilst the link remains in sync.

Quality P1 = 00

Quality P2 = 00

This message set indicates the quality of the signal to noise ratio of the two line pairs which is continuously monitored and updated on the LCD.

0	=	No link established.
1	=	Low quality, low signal to noise ratio.
10	=	High quality, high signal to noise ratio.

7.2 User Interface Control Signals

7.2.1 V.28 Interface

These displays show the state of each Control Signal line AFTER any options have been taken into account. For example, with option 105 set On, the state of line 105 will always be reported as On even if the hardware signal is fluctuating up and down. Messages displayed are as follows ;

Line 105 On		Line 105 Off
Line 106 On		Line 106 Off
Line 107 On		Line 107 Off
Line 108 On	OR	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

5 █ 6 7 █ 8 9 0 1 2

The last message provides a condensed display of all the lines 105 to 142 together. A blank space to the right of the digit indicates the line is Off, a black block to the right of the digit indicates that the line is On.

7.2.2 V.11 Interface

For X.21/V.11 interface, the lines are all replaced with a single status line which shows the state of the C and I lines.

S> C off I off	S> C off I on	S> C on I off	S> C on I on

7.3 Menu Lock

To toggle the menu locking options, press the   key until; | S> Menu Xxxxxxxx | is displayed then,

Press and hold in the SELECT button

While keeping the SELECT button pressed, press and hold the   button

While keeping the SELECT and   button pressed, press the ◁ button until the desired setting is found

| S> Menu Unlocked | The user can apply all tests and change Option and Config settings

| S> Menu Limited | The user can apply all the tests but only view the Option and Config settings

| S> Menu Locked | The user can only view present settings and cannot make any changes

When the desired setting is found, release all the buttons.

8. Test Menu

The   and   keys move through the items in the menu. All actions in this menu are set automatically. The SELECT (S) key changes the state of each item.
The test menu has the following lines:

8.1   Local Loop

| T> Local Loop OFF | S | T> Local Loop ON |

This allows the local modem to apply a loop to redirect the data back to the customer interface (loop 3c). This loop can be applied in conjunction with a Loopback, but not the Remote Loop. If Local Loop is On, the Remote Loop and Data Test items will not be visible in the Test Menu.

8.2   Loopback

| T> Loopback OFF | S | T> Loopback ON |

This instructs the modem to apply a loop to redirect the data back to the remote modem, (loop 2b).   This loop can be applied in conjunction with a Local Loop but not the Remote Loop. If Loopback is On, the Remote Loop and Data Test items will not be visible in the Test Menu.

8.3   Remote Loop

| T> Rem Loop OFF | S | T> Rem Loop ON |

This instructs the modem to apply a loop at the Remote end.
If the Remote Loop is On, the Local Loop and Loopback items will not be visible in the Test Menu.

8.4   Data Test

This mode allows the user to send a PRBS (Pseudo Random Binary Sequence) pattern to the remote modem and monitor the received data stream for errors. The number of bits received in error is displayed on the LCD. The test time elapsed can also be displayed, allowing the user to calculate the effective Bit Error Rate if required. This is given by ;

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

A loop must exist somewhere in the line system for the test to be valid. This loop can be selected in two ways ;

1. Remote loop selected from the Test Menu.
2. Remote loop selected from the DTE.

Loop 1 is usually the most convenient. It must be applied before entering Data Test Mode. The loop can of course be applied directly at the far end Modem. This is done by selecting Loopback from its Test Menu. If the Data Test is On, the Local Loop and Loopback items will not be visible in the Test Menu.

Once the Test Menu is selected by scrolling down (using the   arrow), the Data Test option becomes available and the following selections are available ;

T> Data Test	S	T> Select pair n

The Modem injects a PRBS (Pseudo Random Binary Sequence) immediately the mode is entered. The Test LED should light to verify this.

The   and   keys can then be used move through the items in the menu

Errors w000000		Injecting PRBS	S	Injecting Errors

The first item shown indicates that the error detector is trying to align to the received PRBS pattern and the data test is waiting for the error type to be selected. The options of injecting errors are Injecting PRBS (Pseudo Random Binary Sequence) or Injecting Errors which is simply injecting an error every 1 second.

T wait 000000	S	T Stop 000000	or	T Abort 000000		Errors s000000

Follow the steps above to execute and finally stop the test then, view and note the errors if required.

8.5 In Service Test

This mode allows the error performance of the line to be monitored without interrupting data traffic. This operates by monitoring the CRC bits that make up part of the transmission frame structure. Figures produced cannot accurately be extrapolated to give the data error rate, but can be used as a general guide. Each CRC error indicates that 1 or more bit error has occurred in the transmission frame (frame length depends on data rate but is basically 1900 for 2B1Q and 2800 for 3B1O rates). Results are given for both receive and transmit directions. A brief outline of the steps is shown below ;

Note : This can only start the test if the link is in sync.

T> In Svc Test	S	T> Select Pair n

The test starts as soon as the pair option has been selected (if it has not been left running from a previous pass).

Rx CRC 000001		Tx CRC 000000

Note: There will be an `a' or `s' in front of the digits if the test is aborted or stopped respectively.

This mode may be left running over a long period of time, to start and stop the test press the select button and the duration of the test will be shown as follows ;

| T Time 000000 |

S | T Stop 000000 |

The error count and time will remain unchanged until the test is restarted at which point all counts for all pairs will be cleared.

| T Abort 000000 | If the line has lost sync during a test.

8.6 Lamp Test

This facility is used to check the LED's and the LCD display:

| T> Lamp Test | S | ■■■■■■■■■■■ | | □□□□□□□□□□□ |
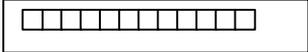
This lights all the segments on the LCD display and lights all of the front panel LED's for approximately 2 seconds then turns off all its segments on the LCD and turns off all the front panel LED's for approximately 2 seconds then returns to Lamp Test.

8.7 Self Test

The Self Test facility which is activated each time the unit is powered up does some simple checks on the EPROM, EEPROM and the Framer chips.

| T> Self Test | | Testing | | Self Test Pass | | AM64/XXXA V2.X |

This function is activated on every power up and takes approximately 6 seconds to complete. On completion of the Self test at power up the modem automatically reverts to the Status Menu as shown in section 6. However, when the Self Test is activated from the Test menu, once completed the unit returns to Self Test awaiting further user instruction. If the unit is left idle, after approximately 1 minute the program will automatically return to the Status Menu.

9. Option Menu

This menu displays the type of DTE interface currently fitted in the BBM. The BBM automatically "reads" which interface type is fitted on power up and programs certain options accordingly. The first two display options are read only. These display the following information:

O> X.21	O> X.21 bis	O> G.703

9.1   Operation

Scroll up and down through the items with the   and   keys. Set the item to the required value using the SELECT key. Program the entire set of configuration options by using the PROGRAM key.
A star appears by any item that has been changed but not programmed. The yellow program LED should be lit when there are any items in the menu that have been changed but not programmed.
The BBM will detect one of the following interface types:

O> V11 Interface	O> V28 Interface

O> V35 Interface	O> V36 Interface

The next items are control line options which can be applied to the X21bis, V.35, V.36 interface:

O> 105 Normal	S	O> 105 Set On

This line allows the circuit 105 line to be clamped on permanently if required. Note : X.21 modules have a single option to force C Normal or C set On.

O> 106 Normal	S	O> 106 Delay

This line allows the circuit 106 to follow circuit 105 after a delay of about 10 to 20ms.

O> 107 Normal	S	O> 107 = 108/1	For X.21 bis

O> 107 Set On	For V.35, V.36

This line allows the circuit 107 line to follow 108 if required.

O> 108 Normal	S	O> 108 Set On

This line allows the circuit 108 line to be clamped on permanently if required.

There is no control line 108 directly associated with V.35 / V.36, so it is held ON internally. This means that although it is not displayed, the option 108 set on is active with V.35 or V.36 interfaces fitted.

The Option and Config Menus have a bottom item `Program Items' which is only visible if any settings have been changed (PROG LED is on). This item is removed when the user goes to this item and presses SELECT button or presses the PROG button. Both actions save the new settings into the Flash memory and the PROG LED will go off. Note: If the user leaves the menu without programming the items or does not press any buttons then the display reverts back to the Status Menu and any changes made will be discarded.

10.   Configuration Menu

This menu contains the items that are used in the initial configuration of the BBM. Once set up, they are usually left unchanged for normal BBM operation. All of the configuration parameters are stored in non-volatile memory and are restored each time the BBM is powered up.

10.1 General

Scroll up and down through the items with the   and   keys. Set the item to the required value using the SELECT key. Program the entire set of configuration options by using the PROGRAM key.
A star appears by any item that has been changed but not programmed. The yellow program LED should be lit when there are any items in the menu that have been changed but not programmed.

10.2 Menu Items

10.2.1 Master / Slave working

When two BBM's are connected together to form a link, one must always be set to Master while, the other has to be set to Slave. The transmission signal is different for a Master and Slave, so line synchronisation will never be achieved if two like types (e.g. Master to Master) are connected together.
The Config Menu options are ;

| C> Slave Mode | C> Ind. Master | C> Ind. Slave | C> Master Mode |

The Master and Slave setting allows the Slave settings to be controlled by the Master, whereas, the Ind. Master and Ind. Slave settings have to be manually configured at each end of a link. i.e.: They are Independent of each other.

10.2.2 HDSL Pairs

| C> 1 Pair | S   and on AM64/768 and AM64/1024 only | C> 2 Pairs |

10.2.3 User Data Rate

This is dependent on the speed of modem purchased from 64/384K up to 64/1024K.

| C> Rate = 64K | S | C> Rate = 128K | In steps of 64k | C> Rate = XXXX K |

Note : If T/S Control Line operation is selected, the maximum data rate is not available (See 10.2.5).

10.2.4 Clock Source

When in Master mode the Config Menu display will show;

| C> Internal Clk | S | C> Ext Bit Clk | S | C> Ext Byte Clk |

1. The Internal mode sources the timing from the master unit's own oscillator.
2. When the unit is operating in master mode the timing can be supplied from an external source.
3. The External mode accepts a clock at the bit or byte frequency.
When in slave mode the display will show (Note: This cannot be changed);

| C> Line Clk |

10.2.5 Control Line Operation

| C> Controls Off | S | C> Controls EOC | S | C> Controls T/S |

The Control settings determine how the interface control lines 105 and 109 (C & I for X.21) are passed end to end across the link. There are three options as shown above, these are ;
Controls EOC   The line states are passed in reserved bits in the Embedded Operation Channel
Controls Off   The line states are not passed at all from one end to the other.

Controls T/S   The line states are passed using bits in a data Time Slot. This timeslot is no longer available for user data.

Note ; If the user has already selected the maximum data rate which the unit can support, the controls Time slot item will not appear so the user cannot select it. Conversely, if the user selects Control T/S then the user will only be able to select a data rate of up to 64kbps less than the maximum supported by the unit. For example: Using Ascoms AM64/512 Modem: If Controls are off, the max user rate may be 512kbps but, with Control T/S, the maximum user rate is 512kbps less 64kbps = 448kbps.
See section 9.1 for the control line options.
Usage Instructions: Use EOC if a slow response is acceptable.
                    Use T/S if a higher signal rate is required (sacrificing range).
                    Use Off if signalling is not required.
                    Note : Signalling / data integrity is not preserved.

10.2.6 Transmission Power

| C> Power Auto | S | C> Power 7.5dBm |

Normally, the transmission power is controlled automatically by the transmission chip itself. Changing the setting to Power 7.5dBm forces the chip to transmit at a lower power than normal. This will be required for back to back operation or possibly when using short lines.
Note: To maintain BABT Approval, for rates of 192kbps and below for a one pair system and 384kbps and below for a two pair system the transmission power option <u>MUST</u> be manually set to 7.5dBm. This will restrict the power of the unit to 7.5dBm and so reduce the modems range. For the higher rates and where BABT approval is not required the Transmission power option should be set to Power Auto.

10.2.7 Line Code

The line code cannot be selected independently from the Menu structures. The Line Code is automatically configured by the modem.
The following settings are adopted automatically by the modem per wire pair when the desired rate is selected ;

64K, 128K, 192K, 256K modem automatically sets to 2B1Q line code.
320K up to 1024K modem automatically sets to 3B1O line code.
Note: At rate of 512kbps on two pairs, the line rate is 256kbps (i.e. 2B1Q is selected).

11.   NOTES

Units fitted with previous versions of Software V1.2, V1.5, V1.6 will not operate with zero length line at any rate. A line with an attenuation of 3dB or so (approximately 400m of cable) should be adequate to resolve this problem.
Units fitted with previous versions of Software V1.2, V1.5, V1.6 will not interwork or synchronise with new version Software 2.x or higher.

GLOSSARY OF TERMS

AIS	Alarm Indication Signal.
ALT	Automatic Local Test. - Pattern sent to apply a local loop in the DCE.
ART	Automatic Remote Test. - Pattern sent to apply a loopback on the remote modem.
BBM	Base Band Modem.
BT	Byte Timing. - Synchronisation to every 8 bits.
CCITT	International Telegraph and Telephone Consultative Committee.
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. Equivalent to Base Band Modem.
RS-530	High speed 25-position interface for DTE and DCE employing serial binary data inter change; developed to serve as a complement to EIA-232-D for data rates above 20kbps.
UNR	Uncontrolled Not Ready.
V.11	CCITT specification. Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications.
V.24	CCITT specification. List of definitions for interchange circuits between DTE and DCE.
V.28	CCITT specification. Electrical characteristics for unbalanced double-current interchange circuits (V.28 Interchange circuits defined in V.24).
V.35	CCITT specification. Data transmission at 48kbit/s using 60-108kHz group band circuits.
V.36	CCITT specification. Modems for synchronous data transmission using 60-108kHz group band circuits.
X.21	CCITT specification. Interface between DTE and DCE for synchronous operation on public data networks.
X.21 bis	CCITT specification. Use on public data networks of DTE which is designed for interfacing to synchronous 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).
2B1Q	Line code for 2 binary bits to one Quaternary (4 level) symbol.
3B10	Line code for 3 binary bits to one Octal (8 level) symbol.

General Specifications

The Transmission system uses DSP techniques involving echo cancellation and adaptive decision feedback equalisation. The system is intended for use on 2/4-wire unconditioned copper wire.

Power output - When the power is set to Auto in the Config Menu (reference section 10.2.6), the power output of the unit is 13.5dBm which will automatically reduce to 12dBm on short lines. If the power is set to 7.5dBm in the Config Menu then, the power is held at 7.5dBm.

Line codes are 2B1Q and 3B1O.
Line rates are from 64kbps to 1024kbps.

Synchronous working at all user rates.

Most options and features software configurable.

User interfaces:	X.21 V.11
	X.21 bis V.28
	X.21 bis V.35
	X.21 bis V.36
	X.21 bis RS-530
	G.703 (64Kbps 120Ω) Codirectional

Test facilities:	3c (local loop), 2b (loopback), Remote Loop, Self Test, Lamp Test, Data Test, In SVC Test.

Enviromental conditions:	Temperature range	-10 to + 55 deg C
	Humidity range	5 % to 95 % relative humidity - non-condensing.
	Air pressure range	70 to 106 kPa

Power supply	110 - 260V, 50/60 Hz
Supply requirements	10W Max
Dimensions	275mm (L) x 250mm (W) x 55mm (H)
Weight	2.1 kg (excluding leads)

All models comply with the following European directives :

EMC	-	89/336/EC
LVD	-	73/23/EC
TTE	-	98/13/EC

and will carry the CE mark as an indication of this compliance.

APPENDIX A - Interface Pin Connections

25 Way D-type X.21 bis (V.24/V.28) Connector pin allocation

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

15 Way D-type X.21 (V.11) Connector pin allocation

Pin			Circuit	Description	Type SITS 89/43
A-wire	B-wire	Unbal			
		8	G	Signal Ground / Common Return	Common
15	1		S EXT	External Signal Element Timing	Generator
2	9		T	Transmit	Load
4	11		R	Receive	Generator
3	10		C	Control	Load
5	12		I	Indication	Generator
6	13		S	Signal Element Timing	Generator
7	14		B	Byte Timing	Generator

V.35   (MRAC) Connector Pin Allocation

Pin Unbal	Pin A Wire	Pin B wire	Circuit	Description	Type SITS 89/43
B			102	Common Return	Common
	P	S	103	Transmitted Data	Load
	R	T	104	Received Data	Generator
C			105	Request to Send	Load
D			106	Ready for Sending	Generator
E			107	Data Set Ready	Generator
F			109	Data Channel Received	Generator
	U	W	113	External Transmitter Signal Element Timing	Load
	Y	AA*	114	Transmitter Signal Element Timing	Generator
	V	X	115	Receiver Signal Element Timing	Generator
N			140	Remote Loopback	Load
L			141	Local Loopback	Load
NN*			142	Test Indicator	Generator

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

37 Way D-type V.36 Connector pin allocation

Pin Unbal	Pin A Wire	Pin B wire	Circuit	Description	Type SITS 89/43
19, 20, 27, 29, 31			102	Common Return	Common
	4	22	103	Transmitted Data	Load
	6	24	104	Received Data	Generator
	7	25	105*	Request to Send	Load
9	(9)	(27)	106*	Ready for Sending	Generator
11	(11)	(29)	107*	Data Set Ready	Generator
13	(13)	(31)	109*	Data Channel Received	Generator
	17	35	113	External Transmitter Signal Element Timing	Load
	5	23	114	Transmitter Signal Element Timing	Generator
	8	26	115	Receiver Signal Element Timing	Generator
14			140	Remote Loopback	Load
10			141	Local Loopback	Load
18			142	Test Indicator	Generator

* Standards indicate that the control circuits 105, 106, 107, 109 may be implemented as balanced circuits (using both A and B wires) or unbalanced single ended circuits. In the case of the control circuits the A wire is to be used and the B wire is to be joined to GND (circuit 102) at the receiver end of the circuit.

25 Way D-type RS-530 Connector pin allocation

Pin			Circuit	Description	Type SITS
Unbal	A Wire	B wire			89/43
1				Earth/Shield	Common
7, 22, 10, 13			102(AB)	Common Return	Common
	2	14	103(BA)	Transmitted Data	Load
	3	16	104(BB)	Received Data	Generator
	4	19	105*(CA)	Request to Send	Load
5	(5)	(13)	106*(CB)	Ready for Sending	Generator
6	(6)	(22)	107*(CC)	Data Set Ready	Generator
8	(8)	(10)	109*(CF)	Data Channel Received	Generator
	24	11	113(DA)	External Transmitter Signal Element Timing	Load
	15	12	114(DB)	Transmitter Signal Element Timing	Generator
	17	9	115(DD)	Receiver Signal Element Timing	Generator
21			140(RL)	Remote Loopback	Load
18			141(LL)	Local Loopback	Load
25			142(TM)	Test Indicator	Generator

* Standards dictate that the control circuit 107 may be implemented as a balanced circuit (using both A and B wires) or as an unbalanced single ended circuit.
To allow interworking between balanced and unbalanced circuits, the A wire is to be used and the B wire is to be joined to GND (circuit 102) at the receiver end of the circuit.

9 Way D-type (64kbps, 120 Ω) G.703 Codirectional connector pin allocation

Pin		Description	Type SITS
A-wire	B-wire		89/43
1	5	G.703 Out	Generator
6	9	G.703 In	Load

LINE CONNECTOR

The modem comes packed with an 8 way - 8 loaded Rj45 to Rj45 line cord as standard. There is also an RJ45 to bare ended wires available.

The line connections are as follows ;   Pair 1 - pins 7 and 8
                                                 Pair 2 - pins 4 and 5

APPENDIX B – Internal Link Settings

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

Interface Module

LK200

Mains

Transformer

PL4

LK2   LK3

LK203   LK201

LK102

LK1

LK101

IC1

IC100

PL7

PL8

Jumper Detail

Pin Numbering Format ———————— 2   1   3

Gold Pins

PCB Silk Print

Bar marked on PCB   Removable Link
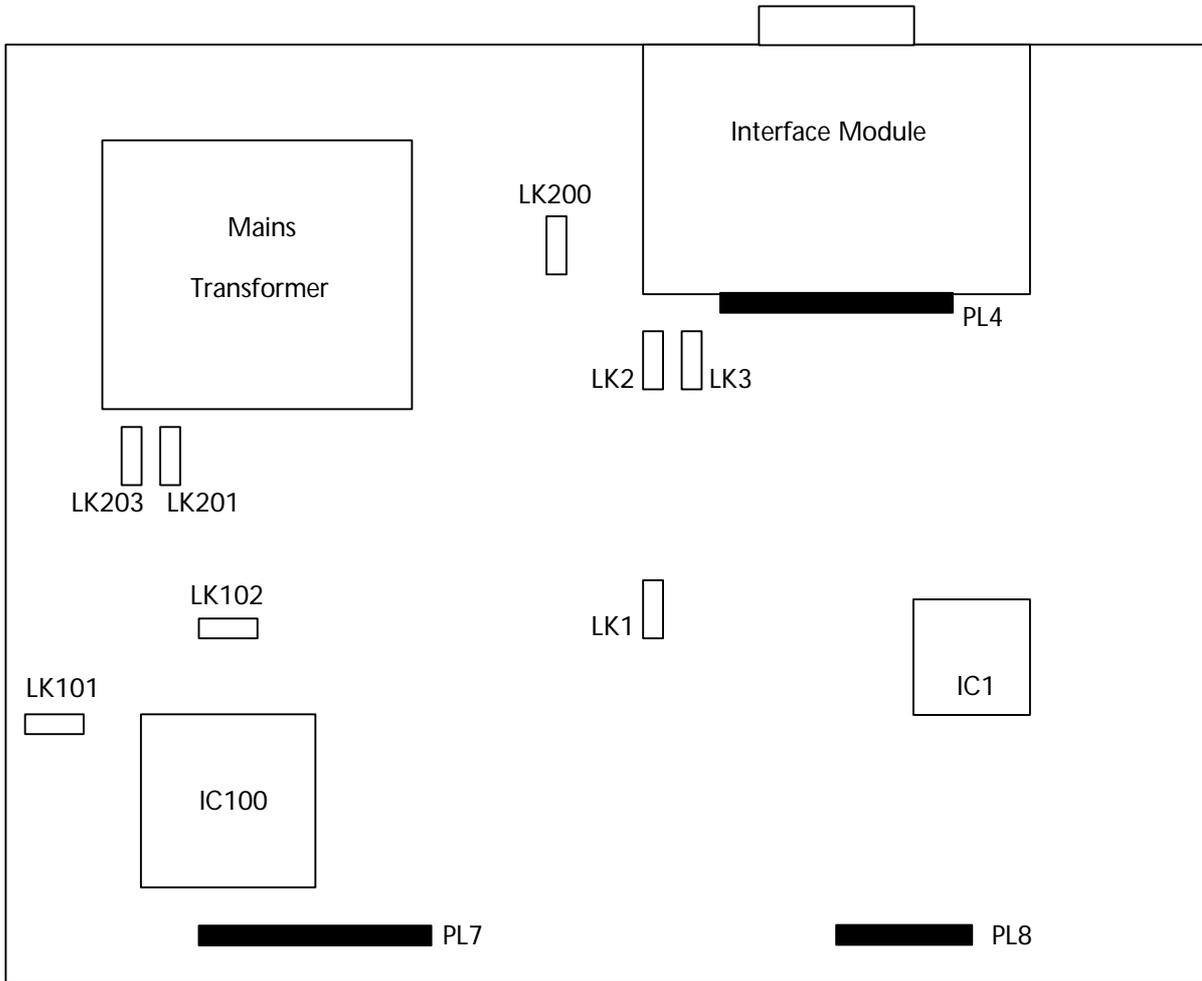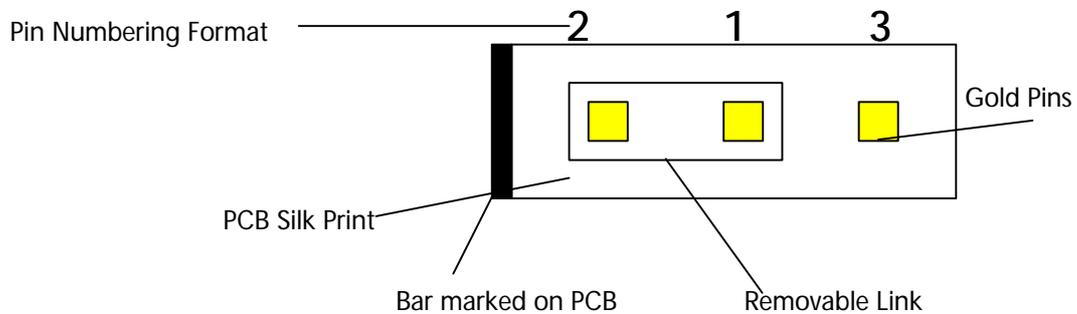
All of the links have 3 pins, the bar end indicating pin 2.

The function of the links is as follows ;

The following links should NOT be altered from the factory settings. Changing any of the links below will invalidate both the guarantee, CE and BABT approvals.

LK1   External PLL for Ext timing   This link is always left in position 1-3

LK2,3   Monitor Port Selection   These links are always left in position 1-3

LK101   RAM size selector 32K / 8K   This link is always left in position 1-3

LK102   Flash Program Disable / Enable   This link is always left in position 1-3

LK200 Connects supply earth to the circuit ground   The link is floating in position 1-3

LK201   Watchdog Disable / Enable   This link is always left in position 1-3

LK203   Vbat to GND   This link is always left in position 1-3

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.

a

APPENDIX C - Approvals

LVD - Safety Statements :

Power Rating Information - AC Source :

1.   Voltage Range   110V- 260V Wide ranging Switch Mode P.S.U.
2.   Current Range   23mA at 230V and 48mA at 110V.
3.   Frequency Range   50/60Hz.

Safety Instructions :

1.   This apparatus must be installed and maintained by SERVICE PERSONNEL.
2.   Disconnect the mains plug and the NTP line connection before attempting to change the Digital Network Interface card.

Disconnect device statement :

The mains plug on the equipment serves as the disconnect device, therefore a socket outlet shall be installed near the equipment and shall be easily accessible.

EN 41003 - Safety statements :

The NTP connection has a safety status of TNV, the Digital Network Interface port (D-type) connection has a safety status of SELV and the mains connection has an EXCESSIVE VOLTAGE status.

EMC - Statements :

Radiated Emissions Warning :

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

EMC Test conditions :

During EMC testing, the digital port cable used was of a screened type. To ensure compliance, it is recommended that a screened cable is used on this port when in use.
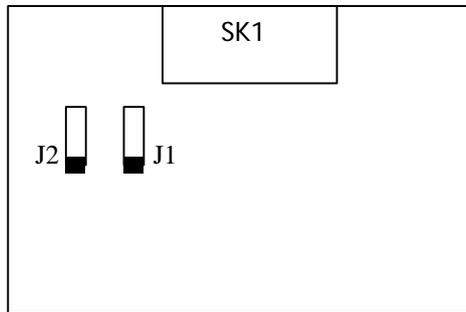
Electro-static discharge (ESD) Warning :

DURING INSTALLATION DO NOT DISCARD ANY CONNECTOR COVERS OR DUMMY PLUGS.

To ensure compliance with ESD criteria, ensure any port or connector that is not in use is protected by the cover or dummy plug supplied.

Interface Modules

X.21 Interface Module :

```
┌─────────────────────────────────┐
│        ┌──────────────┐         │
│        │     SK1      │         │
│        └──────────────┘         │
│                                 │
│      ┌─┐    ┌─┐                 │
│   J2 │ │    │ │ J1              │
│      └─┘    └─┘                 │
│                                 │
│                                 │
└─────────────────────────────────┘
```
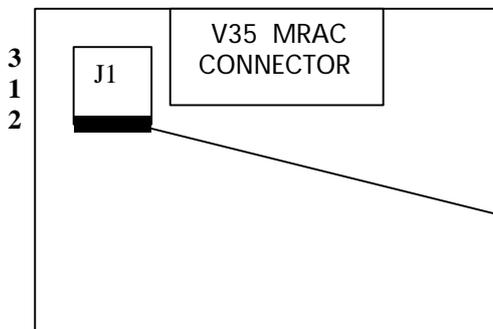
J1 - T - Circuit

J2 - Circuit S Ext Termination.

 J1 - X.21 T (Transmit data) Circuit Termination – This link connects a 120 ohm load resistor across the T circuit position 1-3. This helps maintain signal rise times and minimises reflections at rates greater than 9.6 kbps over long lines. At lower rates and over short lines the termination resistor may be omitted, (link set position 1-2).

 J2 – X.21 SEXT (External Signal Element Timing) Circuit Termination – This link connects a 120 ohm load resistor across the SEXT circuit in position 1-3. This helps maintain signal rise times and minimises reflections at rates greater than 9.6 kbps over long lines. At lower rates and over short lines the termination resistor may be omitted, (link set position 1-2).
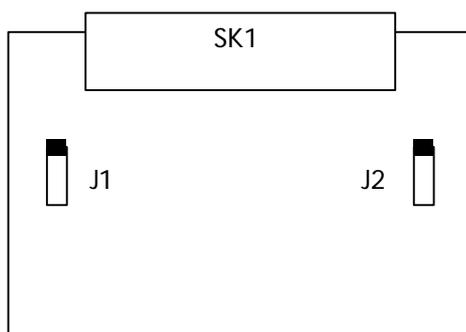
V.35 Interface Module :

```
┌─────────────────────────────────┐
│          ┌──────────────┐       │
│ 3   ┌──┐ │  V35  MRAC   │       │
│ 1   │J1│ │  CONNECTOR   │       │
│ 2   └──┘ └──────────────┘       │
│                                 │
│                                 │
└─────────────────────────────────┘
```

Removable link shown joining pins 1-2, to reverse connection of A and B wires to Circuit 113 move link to position 1-3.

J1 – V35 Circuit 113 (External Signal Element Timing) Input Polarity Selection – This aspect of the V35 interface may be implemented differently by different manufacturers. This link allows the authorised personnel to swap the polarity of the A and B wires of this differential input circuit. The factory default setting for this position 1-2.

V.36 Interface Module :

```
┌─────────────────────────────────┐
│      ┌──────────────────┐       │
│      │       SK1        │       │
│      └──────────────────┘       │
│                                 │
│    ┌─┐                  ┌─┐     │
│    │ │ J1            J2 │ │     │
│    └─┘                  └─┘     │
│                                 │
└─────────────────────────────────┘
```
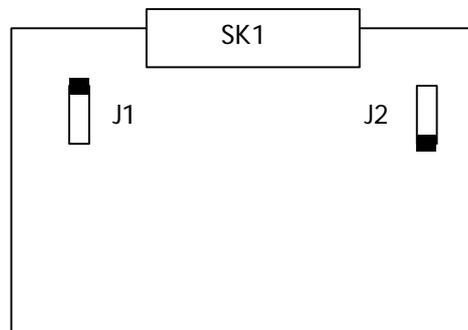
J1 - T - Circuit

J2 - Circuit S Ext Termination.

Interface Modules :

RS530 Interface Module :

J1 - T Circuit.

J2 - Circuit S ExT Termination.

J1 – V36 and RS530 Circuit 103 (Transmit data) Circuit Termination – This link connects a 120 ohm load resistor across the 103 circuit in position 1-3. This helps maintain signal rise times and minimises reflections at greater than 9.6 kbps over long lines. At lower rates and over short lines the termination resistor may be omitted, (link set position 1-2).

J2 – V36 and RS530 Circuit 113 (External Signal Element Timing) Circuit Termination – This link connects a 120 ohm resistor across the 113 circuit in position 1-3. This helps maintain signal rise times and minimises reflections at rates greater than 9.6 kbps over long lines. At lower rates and over short lines the termination resistor may be omitted, (link set position 1-2).

X.21bis Interface Module ;

There are no links on the X.21BIS Interface module

G.703 Interface Module ;

There are no links on the G.703 interface module.

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 CE and BABT approval.

TTE - Network Statements :

Networks for which the apparatus has connection approval :

a)   Analogue Baseband connection upto a rate of 1024kbps.

b)   Digital X.21 connection up to a maximum rate of 1024kbps.

c)   Digital V.35 connection up to a maximum rate of 1024kbps.

d)   Digital X.21bis (V.24) connection up to a maximum rate of 19.2kbps.

e)   Digital V.36 connection up to a maximum rate of 1024kbps.

The apparatus may be directly connected to a 2 or 4 wire baseband circuit or connected to a relevant branch system for 2 or 4 wire baseband circuits.

If any other apparatus, including cable or wiring, is to be connected between the apparatus and the point of connection to any baseband circuit, then all that other apparatus shall comply with the following :

(1)   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 baseband circuit;

(2)   All that other apparatus shall comprise only

> (a)   apparatus approved for the purpose of connection between the apparatus and a baseband circuit; and

> (b)   cable or wiring complying with a code of practice for the installation of equipment, or such other requirements as may be applicable.

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

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

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

INTERNATIONAL MODELS

Modifications to line cords and power supply leads are available for country specific requirements. In such cases, line cord pin outs may be different.

APPENDIX D - Use on X.21/X.21bis digital circuits

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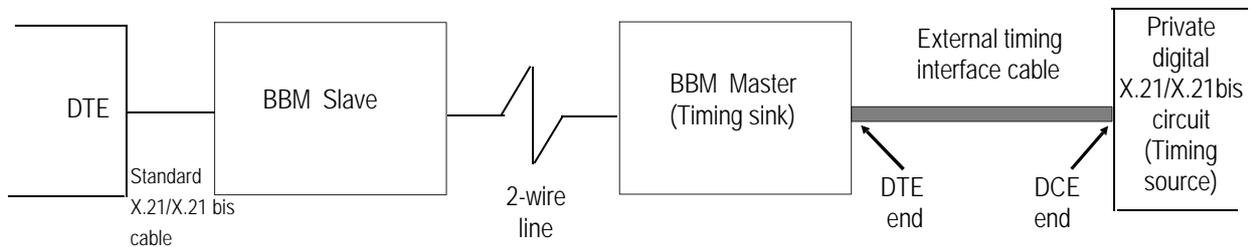

Figure E.1

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. The bit timing mode is available for every interface type and user rate, but the byte timing mode is only available for X.21 at 64kbit/s.

Please see table below showing expected system performance on various wire gauges :

Wire Gauge mm	Transmission Distance in km	
	64K Line Rate	High Speed 512k Line Rate
0.32	5.8	3.4
0.40	6.5	3.6
0.51	8.6	5.0
0.64	10.8	6.4
0.90	17.5	8.9

It is important that the cables are connected correctly, (see diagram). The cable details are given below:

1. **X.21 bit timing cable - (15 way to 15 way D type plugs).**

CCITT circuit	Timing Source (DCE)	Timing Sink (DTE)	CCITT circuit
T-A	2	4	R-A
T-B	9	11	R-B
R-A	4	2	T-A
R-B	11	9	T-B
S-A	13	1	SEXT-A
S-B	6	15	SEXT-B
I-A	5	3	C-A
I-B	12	10	C-B
C-A	3	5	I-A
C-B	10	12	I-B
GND	8	8	GND

2.   **X.21 byte timing cable - (15 way to 15 way D type plugs).**

CCITT circuit	Timing Source (DCE)	Timing Sink (DTE)	CCITT circuit
T-A	2	4	R-A
T-B	9	11	R-B
R-A	4	2	T-A
R-B	11	9	T-B
B-A	14	1	SEXT-A
B-B	7	15	SEXT-B
I-A	5	3	C-A
I-B	12	10	C-B
C-A	3	5	I-A
C-B	10	12	I-B
GND	8	8	GND

3.   **V.24 / V.28 bit timing cable - (25 way to 25 way D type plugs).**

CCITT circuit	Timing Source (DCE)	Timing Sink (DTE)	CCITT circuit
103	2	3	104
104	3	2	103
105	4	8	109
102	7	7	102
109	8	4	105
115	17	24	113

4.   **V.35 bit timing cable - (34 way to 34 way MRAC plugs).**

CCITT circuit	Timing Source (DCE)	Timing Sink (DTE)	CCITT circuit
103-A	P	R	104-A
103-B	S	T	104-B
104-A	R	P	103-A
104-B	T	S	103-B
105	C	F	109
109	F	C	105
115-A	V	U	113-A
115-B	X	W	113-B
GND	B	B	GND

5. X.21 bis V.36 bit timing cable - (37 way to 37 way D type plugs).

CCITT circuit	Timing Source (DCE)	Timing Sink (DTE)	CCITT circuit
103-A	4	6	104-A
103-B	22	24	104-B
104-A	6	4	103-A
104-B	24	22	103-B
105-A	7	13	109-A
105-B	25	31	109-B
109-A	13	7	105-A
109-B	31	25	105-B
115-A	8	17	113-A
115-B	26	35	113-B
102-A	19	19	102-A
102-B	20	20	102-B

* In some cases it may be necessary to connect this line to GND (102) at the receiver end of the link dependant upon the implementation of the interface control lines - balanced or unbalanced.

6. RS530 bit timing cable (25 way to 25 way D type plugs).

CCITT circuit	Timing Source (DCE)	Timing Sink (DTE)	CCITT circuit
103-A	2	3	104-A
103-B	14	16	104-B
104-A	3	2	103-A
104-B	16	14	103-B
105-A	4	8	109-A
105-B	19*	10*	109-B
109-A	8	4	105-A
109-B	10*	19*	105-B
115-A	17	24	113-A
115-B	9	11	113-B
102	7	7	102

* In some cases it may be necessary to connect this line to GND (102) at the receiver end of the link dependant upon the implementation of the interface control lines - balanced or unbalanced.

Appendix E - Troubleshooting

Please check the following points if problems are experienced setting up a BBM link.

1. Ensure the Power LED is ON.

2. Ensure the modem is being used on unconditioned copper twisted pair wire.

3. Check one modem is set to Master, one is set to Slave

4. Check line rate is set the same on both Master and Slave if working independently.

5. Check correct pin connections on telephone line connector.

6. If the link will not set up at the higher rate, use 64K rate setting to check whether the line loss is within range. If the link works at 64K rate , but not at the higher rates, then the line noise or impedance is too large for the higher line Rate and a lower Data Rate will have to be chosen.

7. Check that no test loops are active in the modem or being set by the DTE.

8. Check the interface cable pin out requirements as described in the DTE manuals and Appendix A for the BBM. A special cable may need to be made for external timing applications, as per Appendix E.

A sample set up procedure follows for a pair of BBMs.
Using the front panel push buttons and LCD display, set one unit as follows.
In the Configuration Menu (* Config Menu *) set :

C> Mode : * Master * then press SELECT

C> Pairs : 1   then press SELECT

C> Rate : 64K   then press SELECT

C> Clk : Internal Clk

Then Press PROG key

In the second BBM, using the * config menu * set as follows ;

C> Mode : Slave   then press SELECT then press Prog

C> Pairs :   1   [Automatically set by Master]

C> Rate : 64K   [Automatically set by Master]

C> Clk : Line Clk   [Automatically set by Master]

Connecting the two units back to back should now create a link and the units should be in sync.
Note : If back to back, the power may need setting to 7.5dBm (see section10.2.6).

If further problems are encountered, please contact your local distributor initially or ask for ascom Telecommunications Transmission division Technical Support on - + 44 1222 500 700.