

User Guide

AM768A

AM2048A MP

AM2048A CAP

AM2048A OS/M

Ascom Telecom Part Number :

1/187/500/610

Issue 8 - Dec 2001.

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Compliance Notes and Safety Instructions:



Caution – Hazardous voltage inside the equipment

Safety Instructions:

This apparatus must be installed and maintained by SERVICE PERSONNEL. Disconnect the mains plug and the NTP line connection before attempting to change the user interface plug-in module.

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.

Power Rating Information – AC plug top adapter:

Voltage Range 240V – 10% +6%

Current Range 25mA to 50mA

Frequency Range 50/60Hz

Power Rating Information – 240V AC in-line adapter:

Voltage Range 240V – 10% +6%

Current Range 25mA to 50mA

Frequency Range 50/60Hz

Power Rating Information – 110V AC in-line adapter:

Voltage Range 110V – 10% +6%

Current Range 50mA to 100mA

Frequency Range 50/60Hz

Power Rating Information – DC Source:

Voltage Range 40.5V to 58V

Current Range 70mA to 200mA

TTE – Network Statement

Safety Statements

The copper DSL line connection has a safety status of TNV-3

The Plug Top DC Power connection has a safety status of TNV-2

The X.21 Digital Network Interface Port has a safety status of SELV

The V.35 Digital Network Interface Port has a safety status of SELV

The 10/100 BaseT Port has a safety status of SELV.

For the G.703 Port Connection to Unexposed Environments:

The Alarm Port has a safety status of SELV.

The G.703 Digital Network Interface Port has a safety status of SELV

For the G.703 Port Connection to Exposed Environments:

The Alarm Port has a safety status of earthed SELV.

The G.703 Digital Network Interface Port has a safety status of TNV-1

The Protective Earth on the rear panel **MUST** be connected (see Section 4 on Installation)

Definitions:

Exposed Environment

A TELECOMMUNICATIONS NETWORK is considered to be an exposed environment if one or more conditions for an unexposed environment are not fulfilled.

Unexposed Environment

A TELECOMMUNICATIONS NETWORK is considered to be an unexposed environment if the following conditions apply to all parts of the network

- a) The possible effect of indirect lightning has been reduced by measures described in IEC 61312-1.
- b) The possibility of having different earth potentials has been reduced by connecting all equipment within the network to the same equipotential bonding system (see HD 384).
- c) The possibility of power cross/contact has been reduced (see HD 384).
- d) The possibility of induced transients and voltages has been reduced.



Caution – Laser Product

The Optical Interface is classified as a **CLASS 1 LASER PRODUCT**.



Caution – Electrostatic sensitive device

Electro-static discharge (ESD) Warning:

Antistatic precautions should be observed at all times.

If the unit is power fed from the DSL line interface then a functional earth **MUST** be connected. (See Section 4 on Installation)

EMC Statement

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.

Manufacturers Declaration*



Ascom Telecommunications Limited declares that this product is in conformity with the essential requirements of the 'R&TTE directive 1999/5/EC'.

* A copy of the Declaration of Conformity is available upon request from Ascom Telecommunications Ltd.

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1. Introduction

This manual applies to the High Speed DSL Systems, designed and manufactured by Ascom Telecommunications Ltd in the U.K..

The modems provide synchronous communications at user data rates between 64kbps and 2048kbps over up to three twisted pair cables or a single optical fibre. The equipment has modular transmission and user interfaces, which allows the equipment to be configured to meet many different installation requirements. Both rack and desktop versions of all units are available. Desktop units are AM2048A... and rackmount units are AM2048B... This manual covers the desktop units.

The AM2048A OS provides full duplex transmission at 2.048Mbps over a single single-mode optical fibre.

The AM2048A OM provides full duplex transmission at 2.048Mbps over a single multi-mode optical fibre.

The AM2048A MP provides full duplex transmission at 2.048Mbps using 3 copper pairs. It can be used in point to point or point to multipoint mode. The line code is 3B1O.

The AM2048A CAP provides full duplex transmission at 2.048Mbps using 1 or 2 copper pairs. It can be used in point to point or point to multipoint mode. The line code is CAP.

The AM768A is a reduced cost unit, available with a single transmission module. This has most of the functionality of the AM2048 but reduced payload bandwidth due to using one transmission line instead of three. It is intended mainly for use in point to multipoint mode in conjunction with the AM2048A MP or the AM2048B MP

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

Throughout the handbook, all types of unit are referred to as DSLU (Digital Subscriber Line Unit)

The DSLU can easily be configured via a dumb terminal. It is recommended to use a VT100 terminal emulation program running on a notebook or palmtop PC. Using the menu system with on-line help should reduce the need to refer to the handbook.

Once configured, the operation of the DSLU is totally automatic. In the event of line disturbances or power failure, the data link is restored without operator intervention.

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

The VT100 Management User Guide gives a full description of the menu system..

Modifications to line cords and power supply leads are available for country specific requirements. In such cases, the line cord pinout may be different. The basic model is the same, line cords and power cords are separate plug in items.

2. Constructional Details

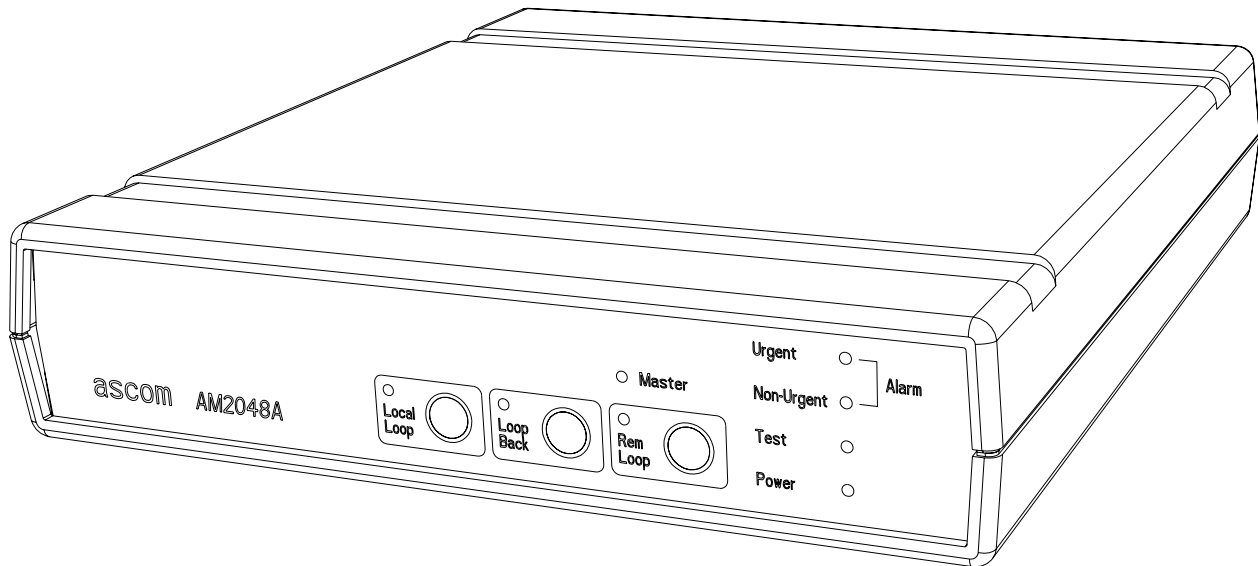


Figure 1 Desktop Unit

The desktop unit is housed in a grey non-flammable plastic case (UL94 rating V0). The membrane front panel contains 5 LED indicators and 3 push button switches with LEDs to indicate their activation.

LEDs

- Urgent Alarm
- Non Urgent Alarm
- Test
- Power
- Master

Buttons

- Local Loop
- Loop Back
- Rem Loop

On the rear panel there are the following connectors:

–48V DC supply inlet socket	3-pin mini-fit
line interface	8 way RJ45 (Copper) FC/SPC (Optical) See Appendix B for other options.
Management port interface	9 way female D-type
Alarm interface	13 way circular DIN
Data Ports (depending on module fitted)	
G.703 120Ω	8 way RJ45
G.703 75Ω	BNC
X.21	15 way D-type female
V35	34 way MRAC female

The data interface connector type will be from one of the three user specified interfaces available. They are detailed in section 5. The plastic housing contains the main PCB. The plastic case has an internal metallised layer for EMC screening purposes. The membrane front panel is attached to the main PCB with a flexible circuit connector.

Also included is a 3 metre screened, stranded, Category 5 line cord terminated in 8-way RJ45 plugs at both ends.

Optional plug-top and in-line mains adapters are available with a 1.8 metre long DC lead, terminating in a 3-pin mini-fit plug. Also available is a VT100 Management connection cable.

The overall dimensions of the unit are 274mm(L) x 251mm(W) x 55mm(H).

3. System Overview

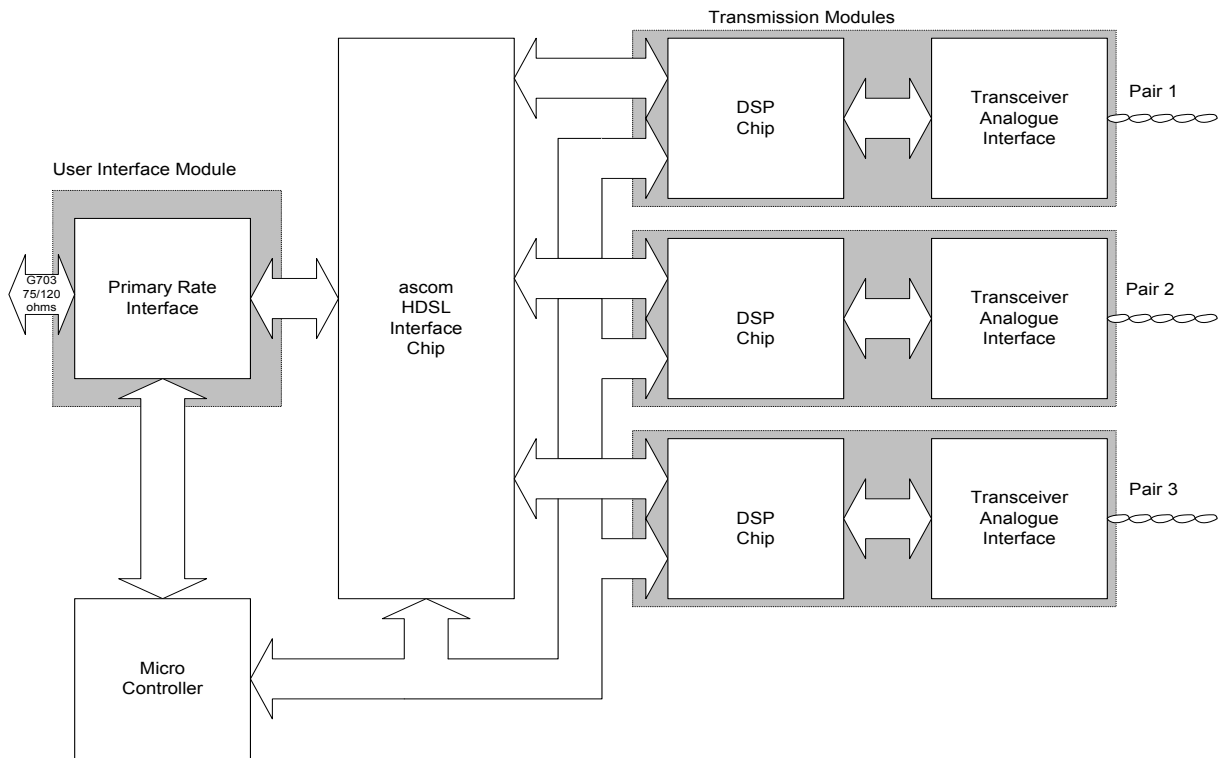


Figure 2 Copper System Block Diagram

3.1 Copper Transmission

The copper system is intended for operation on 2-wire local telephone network circuits, such as those meeting BT EPS-9 (Note: the DSLU requires between one and three such circuits). 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 rates between 64k and 2048k.

For the copper system, echo cancellation is used to eliminate the unwanted reflections of the transmitted signal from the receiver input.

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.

When more than one transmission line is in operation, each transmission system operates with the same bit rate derived from an oscillator in the master unit.

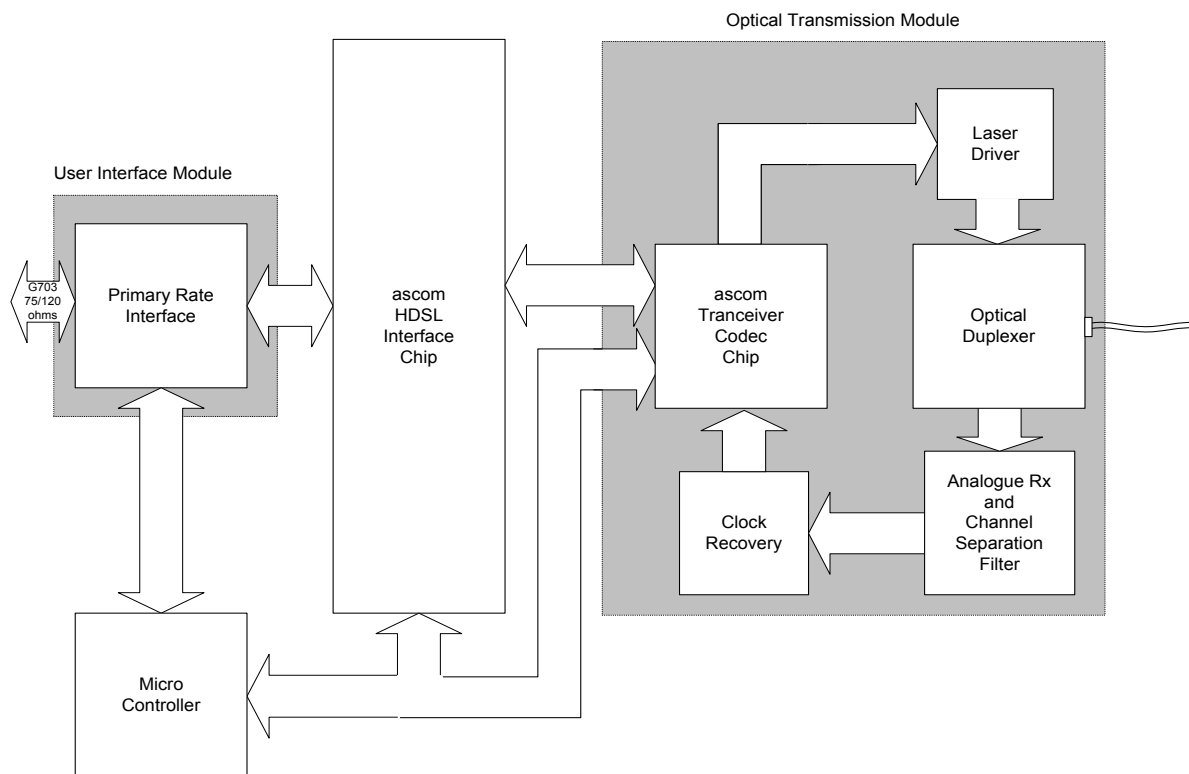


Figure 3 Optical System Block Diagram

3.2 Optical Transmission

The optical transmission interface module fits into the same envelope as three copper modules and is designed to operate over a single optical fibre. This is accomplished using an optical duplexer, which integrates a laser and a photodiode in a single package. Both directions are transmitted at the 1310nm optical window, leaving the 1550nm window free. The interface module encodes the DSL framed data using a 5B6B block code for error monitoring and spectral shaping.

Sub-carrier modulation is used to increase the separation between the upstream and downstream directions. Baseband transmission is used from ELU to NTU, whereas the other direction is modulated onto a carrier.

For transmission over single-mode fibre, order the AM2048 OS.

For transmission over multi-mode fibre, order the AM2048 OM.

The AM2048A OS and AM2048 OM are Class I products in accordance with EN60825-1 and therefore inherently safe.

3.3 DSL Transmission Frame

Both of the above transmission systems operate in a bit pump mode. The DSL frame is sent over this 'data pipe'. The DSL frame contains the following

- Sync word
- Stuff bits
- Stuff control bits
- EOC channel
- Customer data

The nominal DSL frame is always 6ms long, regardless of the transmission rate of the individual channels.

The DSL frame length is adjusted slightly by the use of stuff bits. There may be 4 stuff bits or 2 stuff bits per frame. The stuff bits are used to adjust the effective payload bandwidth of the DSL frame.

If the user rate clock is slightly quicker than the line rate clock then less stuff bits are sent. Alternatively, if the user rate clock is slightly slower than the line rate clock then more stuff bits are sent. This mechanism allows the line rate bandwidth to be adjusted to match the user rate bandwidth.

At the receive end, the rate at which the stuff bits arrive is used to recover the user clock.

The transmit and receive paths may be operated independently from one another so that when a G.703 user interface is present, the transmit and receive clocks are allowed to vary independently by ± 50 ppm. (Note. When operating with X.21 or V.35 interfaces, there is only a single clock at each user interface.)

The Embedded Operation Channel (EOC) is carried in spare overhead bits in the transmission frame. Packetised SNMP SET and GET messages are passed over the link from the ELU to the NTU, which answers with the appropriate SNMP response.

Byte timing is maintained by the transmission system and is available if required.

3.4 Control Circuit

The control circuit is based on a micro-controller and determines the operational status of the unit according to the state of the transmission system, the data interface and the configuration information received from the terminal.

Configuration data and two copies of the application are stored internally in FLASH memory. On power-up the application program is copied from FLASH to RAM from where it is executed. The main application program is backed up so that if a corruption occurs it can be corrected. This also enables the programming of a new application while the equipment is operating normally. Control is transferred to the new application after an automatic restart at the end of the download. This minimises the interruption of payload traffic. Also, if programming is interrupted, the previous version of software will remain intact. A new application program may also be downloaded from the ELU to the remote NTU over the line.

3.5 Alarm Interface

A 13 pin circular DIN connector provides access to 6 alarm inputs that are used to detect metallic contact closure. For example, they can be used to sense a cabinet door open or temperature sensors. The priority of these auxiliary alarms may be programmed through the “Alarms>Severity Level Settings” screen.

There are also relay contact outputs to indicate urgent and non-urgent alarms. This allows the system to be easily integrated into the alarm systems of other equipment.

3.6 User Interface Modules

The user interface is provided by a plug-in module of which there are six types:

- G.703, with software selectable 75ohm or 120ohm ports
- X.21
- V.35
- G.703 MK II (with 1 + 1 protection switch)
- X.21 MK II (with tail buffer)
- V.35 MK II (with tail buffer)

The existing interface module can be changed out using a pluggable replacement unit. These can be ordered separately using the part numbers detailed below. For part numbers and order codes see Appendix B.

4. Installation

This chapter describes the basic steps that are required to set up a system involving the DSL Modem.

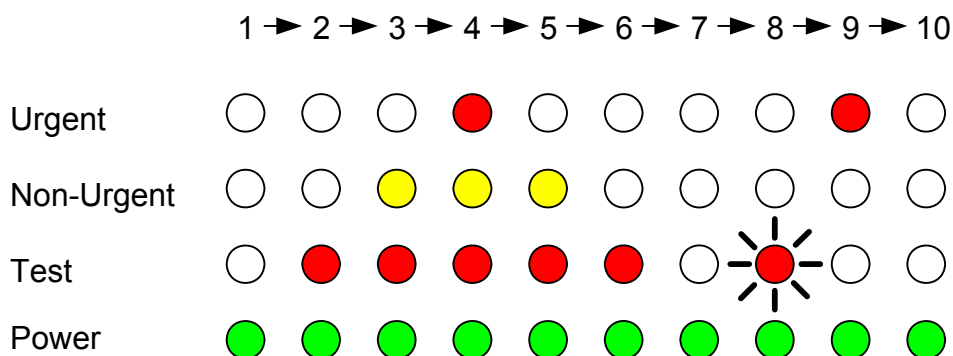
4.1 Connection of Protective Earth

If it is required to connect the G.703 port to a circuit that is defined as TNV, then a protective earth must be connected to the earth bond stud on the rear panel. See the Compliance Notes and Safety Instructions inside the front cover.

If the unit is power fed then a functional earth must be connected to the earth bond stud on the rear panel to provide a discharge path to ground for ESD protection. See the Compliance Notes and Safety Instructions inside the front cover.

4.2 Power On Sequence

With no DTE or line connected to the DSLU on power up, the following LED sequence will be displayed:



Prior to the sequence starting, a random pattern may appear momentarily.
 During sequence 1 to 7 the LEDs are illuminated in turn as an LED confidence test.
 During stage 8 the test LED flashes as the internal self-test sequence is completed. The flashing will normally last for about 4 seconds, however, if a new application has been loaded this time will be extended by about 10 seconds while a backup copy of the application is made.
 With no external connections the unit will sense the loss of external signals, raise the urgent alarm and stop at stage 9.
 When the system has been installed and is working correctly, the unit should move to stage 10.

4.3 Logging On

Connect a VT100 terminal (or PC running a VT100 emulation program) to the 9-way serial port on the rear of the unit. The log on screen should appear automatically once the DSLU detects the terminal.
 Type 'C' to select Configuration, then press 'Enter'
 Type 'ascom' the default password setting, then press 'Enter'
 The top level menu system displays the sub-menus available.
 For a full description of the menu system, refer to the 'VT100 Management User Guide'.

4.4 Setting Master/Slave mode.

For all modes of operation, one unit must be set to *master mode*, while the other unit is set to *slave mode*. The master unit is referred to as the ELU or Exchange Line Unit and the slave unit is referred to as the NTU or Network Terminating Unit. The front panel 'Master' LED indicates the mode of the unit.

The ELU is a 'master' in several senses. The master end provides the source of the bit rate timing for the transmission line(s). The ELU is also the 'master' from a network management point of view. It contains the database of configuration information for itself and all connected NTUs. The alarm and performance monitoring history is saved at the ELU. When the management terminal is connected to the ELU it can read all of the information from the remote NTU, whereas when the management terminal is connected to the NTU, only the local information is obtainable.

The factory default is for the unit to be configured as a slave (NTU).

To change the setting, using the terminal go to the "Configuration>Master/Slave" screen and select the appropriate option. (use the arrow keys or tab key to navigate and the spacebar to change the setting). The basic setup for all modes is as follows:

At the master end:

Configuration>Master/Slave

1. select Master.
2. select Point- to Point or Point to Multipoint, as appropriate.
3. enable the required number of lines

At the slave end:

The factory default setting should allow the units to get into sync, otherwise:

Configuration>Master/Slave

4. select Slave.
5. select Point- to Point or Point to Multipoint, as appropriate.
6. enable the required number of lines

The unit will automatically reboot with the new settings once the "return" key is pressed to accept the changes. You will then be invited to log back on to the system.

It is possible to set Master/Slave by using the front panel buttons if a terminal is unavailable, see section 5.8.1.

4.5 Setting the User Interface

The unit automatically detects what kind of user interface is plugged in and displays the appropriate screen in the "Configuration>User Port" screen.

For X.21 and V.35, DTE/DCE selection is carried out by moving the link header on the user interface plug-in module. The software automatically senses the link setting and sets the unit up accordingly.

To check the user interface and any link settings, using the terminal, go to the "Information>System" screen, this will display which user interface has been plugged in, and which mode it is in.

Once a unit is configured as an ELU, the expected interface at the NTU may be set, or by default, the unit will auto-discover the NTU user port configuration after the line gets into synchronisation.

4.6 Setting the Nx64K User Data Rate

For X.21 and V.35 the data rate may be set in increments of 64kbps. The default setting of N = 6. The data rate is set by entering the desired value of N. The full range of N is from 1 to 32. The screen display gives the equivalent data rate in kbps for the value of N. The software automatically restricts the value of N to match the user interface and line interface combination. e.g. for an Am768, the maximum value of N = 12.

For a G.703 to Nx64 configuration, the maximum value of N is 31 as only timeslots 1 to 31 are transported over the transmission link. N may be further restricted depending on the transmission system.

For software up to version 2.9, the value of N must be entered for each end of the link as follows:

At the master end:

Configuration>User Port

1. Set the desired value of N.
2. Press **F8**, to select the remote end
3. Set the desired value of N
4. Press Enter to activate the change.

For software versions greater than 2.9, the value of N only needs to be set once:

At the master end:

Configuration>User Port

1. Set the desired value of N.
2. Press Enter to activate the change.

4.7 Selecting the Circuit Configuration

The term 'digital section' refers to the data link between the user ports of the connected DSLUs.

In a standalone section, the DSLUs provide the complete transmission system.

In a tandem section, the DSLUs are used to extend an existing circuit or network port. To achieve synchronous data transfer, the master DSLU must derive its timing from the circuit to which it is connected.

A Point to Point link requires two DSLUs, one master and one slave.

A Point to Multipoint link can have up to four DSLUs, one master and up to three slaves.

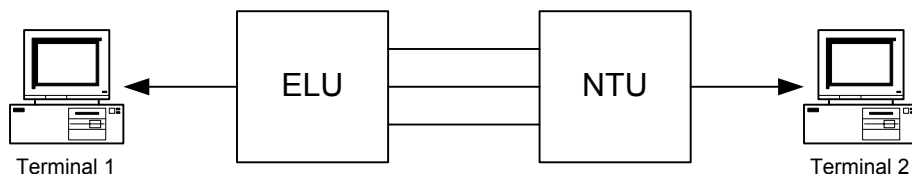
The DSLU at one end of the digital section is selected to be a Master (ELU), the remote end(s) are selected to be slave(s) (NTUs).

For a tandem section, the DSLU connected to the tandem section is configured as the master.

Please refer to the diagrams on the following pages.

4.7.1 Point to Point Link

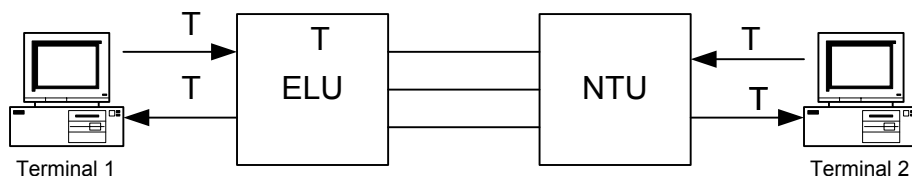
4.7.1.1 Standalone Section



The transmission channel can be a single optical fibre, one, two or three copper pairs.

4.7.1.1.1 G.703 to G.703 Internal Timing

Slave terminals are connected to the digital section at both ends, a clock inside the ELU then becomes the reference clock for the entire system.



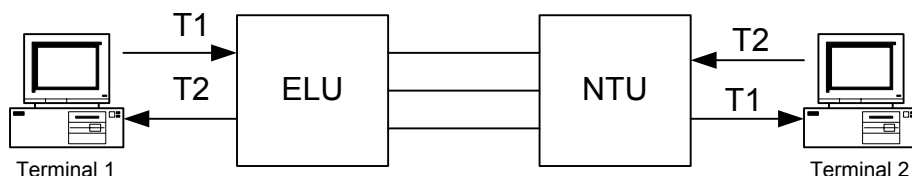
The internal clock T is generated at the ELU, both terminals lock to this clock and return the clock T to the DSL units. An elastic store in the DSLUs buffers the framed data.

Using the "Configuration > User Port" Menu:

1. At the ELU, select the 'Internal' timing option
2. Using F8, cycle to the NTU user port, select the 'Internal' timing option
3. Press 'Return' to enter the changes.

4.7.1.1.2 G.703 to G.703 Transparent Timing

One of the connected terminals acts as a master, the other is a slave. However, both terminals could operate independently or pleisiochronously.



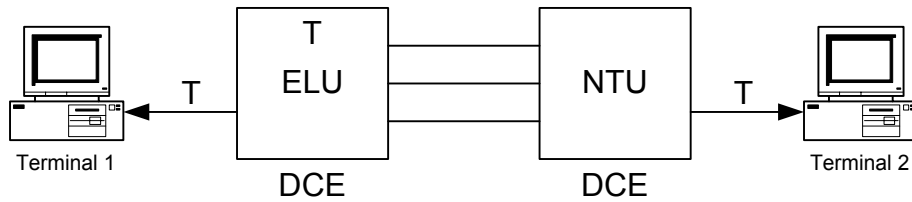
Clocks T1 and T2 are independent of one another and are transported independently through the DSL system.

Using the "Configuration > User Port" Menu:

4. At the ELU, select the 'Transparent' timing option
5. Using F8, cycle to the NTU user port, select the 'Transparent' timing option
6. Press 'Return' to enter the changes.

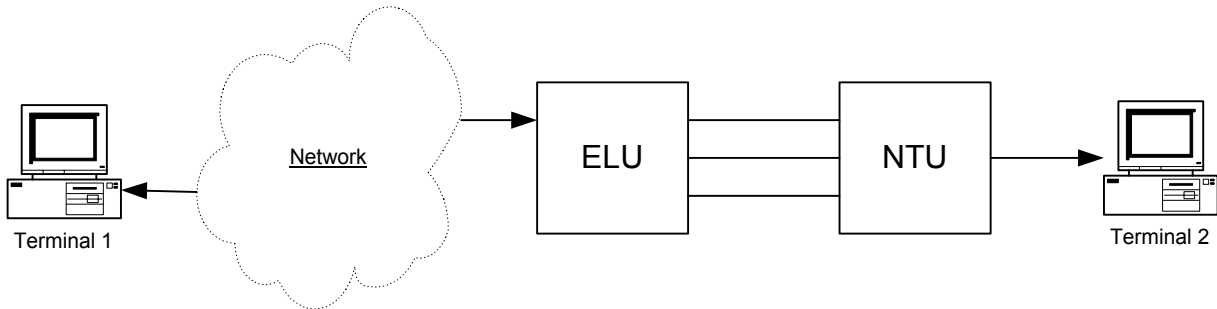
4.7.1.1.3 X.21/V.35 DCE to X.21/V.35 DCE

The terminals connected to the digital section at both ends are DTEs, a clock inside the ELU then becomes the reference clock for the entire system.



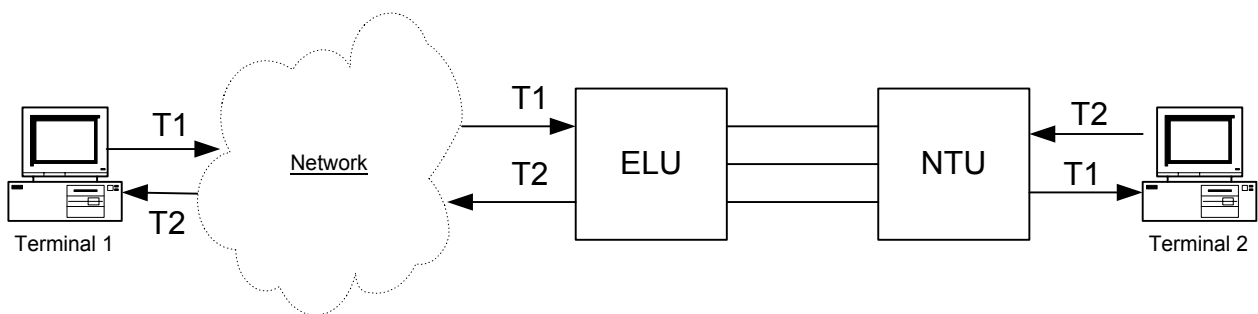
4.7.1.2 Tandem Section

For the following configurations, the DSLUs are connected in series with another transmission system or equipment



4.7.1.2.1 G.703 to G.703 Transparent Timing

The timing for each terminal is carried independently across the digital section.

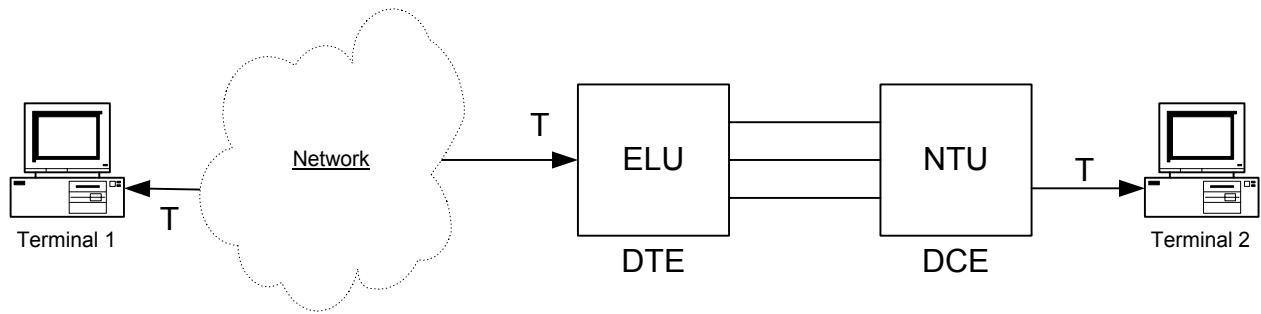


Using the "Configuration > User Port" Menu:

7. At the ELU, select the 'Transparent' timing option
8. Using F8, cycle to the NTU user port, select the 'Transparent' timing option
9. Press 'Return' to enter the changes.

4.7.1.2.2 X.21/V.35 DTE-to X.21/V.35 DCE

The plug in module at the master end of the digital section must be configured as a DTE. This allows timing to be recovered from the timing output from the tandem system.



4.7.2 Point to Multipoint Link

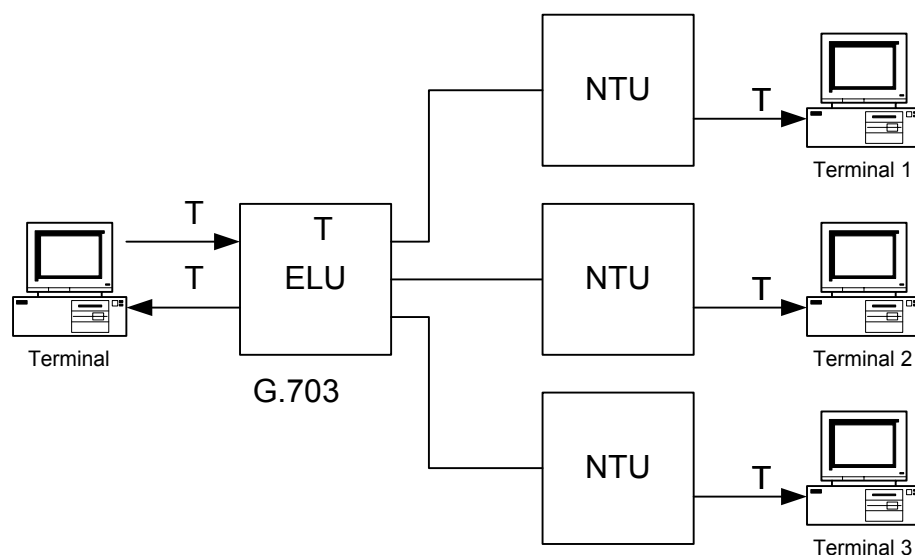
Note, when operating in Point to Multipoint, the master unit always has a G.703 user interface.

The slave units may be

EITHER all G.703

OR all Datacom (any mixture of X.21 and V.35).

4.7.2.1 Standalone Section



4.7.2.1.1 G.703 to G.703

A clock 'T' inside the master DSL unit provides the reference clock for the entire system.

Using the "Configuration > User Port" Menu:

10. At the ELU, select the 'Internal' timing option
11. Using F8, cycle through the remote user ports, selecting the 'Internal' timing option
12. Press 'Return' to enter the changes.

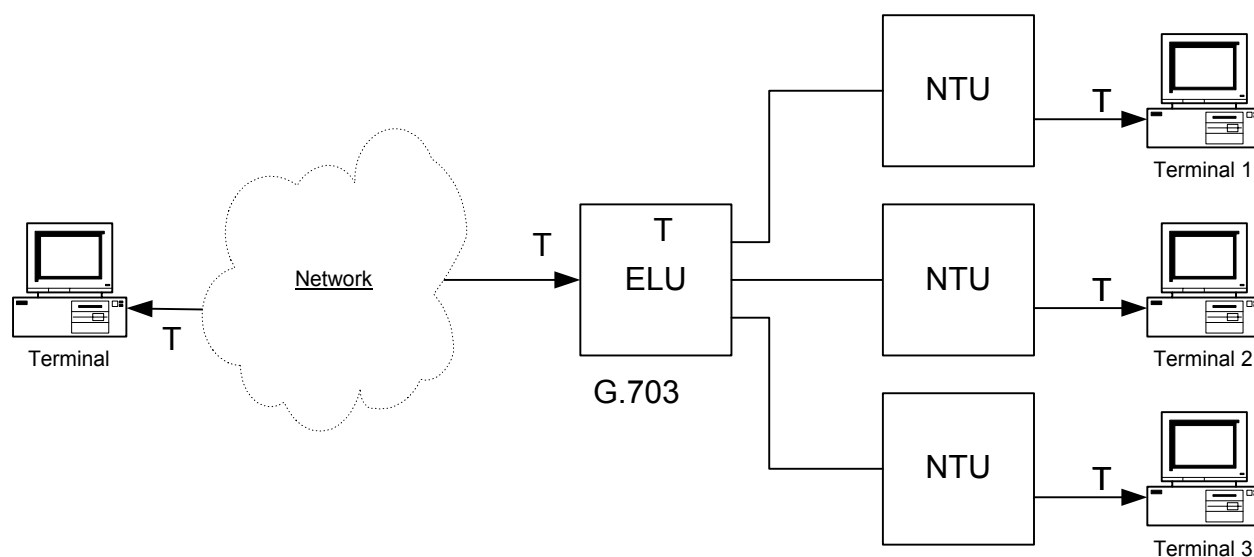
4.7.2.1.2 G.703 to X.21/V.35

A clock inside the master DSL unit provides the reference clock for the entire system.

Using the "Configuration > User Port" Menu:

1. At the ELU, select the 'Internal' timing option
2. Press 'Return' to enter the changes.

4.7.2.2 Tandem Section



4.7.2.2.1 G.703 to G.703

The master DSL unit locks on to the incoming clock 'T', this clock is passed to the remote terminals 1, 2 and 3.

Using the "Configuration > User Port" Menu:

1. At the ELU, select the 'transparent' timing option
2. Using F8, cycle through the remote user ports, selecting the 'Internal' timing option
3. Press 'Return' to enter the changes.

4.7.2.2.2 G.703 to X.21/V.35

The master DSL unit locks on to the incoming clock 'T', this clock is passed to the remote terminals 1, 2 and 3.

Using the "Configuration > User Port" Menu:

1. At the ELU, select the 'transparent' timing option
2. Press 'Return' to enter the changes.

4.8 Bringing into Service

Once the equipment is correctly installed, it may be necessary to monitor the quality of service before putting live traffic on the circuit, depending on the installation rules of the network.

The AM2048 has various features which help the user to do this with a high degree of confidence without the use of extra test equipment. A terminal plugged into the ELU gives access to the following information:

In the "Performance > m.2100" History screen, the display records errored seconds, severely errored seconds and unavailable seconds for the aggregate line system. The recording interval and the pass fail criterion of the datalog record is programmable by the user to match the tables found in m.2100.

In the "Performance > Transmission Line" screen, the display records G.826 statistics for both ends of each transmission line. In a multi pair system, if errors are recorded in the m.2100 screen, this screen will help to locate the erroring line and direction of errors.

Once the circuit is working, the "Alarm > History" screen should be checked and cleared. The alarm history should be checked after a suitable interval to ensure that no alarms are occurring.

(For more details of the menu system see the "VT100 Management User Guide for the AM2048.")

4.9 Transmission Parameters

4.9.1 Transmission Range

4.9.1.1 Copper Transmission Systems

For the copper transmission systems, the equipment is designed to meet the performance limits specified in ETR 152. This specification defines bit error rate performance for DSL systems in the presence of noise over a variety of cable loops.

Note: For the tables below, baseline performance is measured on 0.4mm Polyethylene Twin cable. Figures for other cable diameters are based the 0.4mm performance and extrapolated using typical cable characteristics.

4.9.1.1.1 AM2048 MP – 2048kbps over 3 pairs

Attenuation of 31dB at 150kHz, with noise present, gives a BER of $<1 \times 10^{-7}$.

Cable diameter (mm)	Range with noise (km)	Range, without noise (km)
0.4	2.8	3.5
0.5	3.73	4.67
0.63	5.19	6.48
0.9	8.00	10.00

4.9.1.1.2 AM2048 CAP – 2048kbps over 2 pairs

Attenuation of 31dB at 150kHz, with noise present, gives a BER of $<1 \times 10^{-7}$.

Cable diameter (mm)	Range with noise (km)	Range, without noise (km)
0.4	2.8	4.0
0.5	3.73	5.33
0.63	5.19	7.41
0.9	8.00	11.43

4.9.1.1.3 AM2048 CAP – 2048kbps over 1 pair

Attenuation of 23dB at 150kHz, with noise present, gives a BER of $<1 \times 10^{-7}$.

Cable diameter (mm)	Range with noise (km)	Range, without noise (km)
0.4	2.0	3.0
0.5	2.67	4.00
0.63	3.70	5.56
0.9	5.71	8.57

4.9.1.2 Optical Transmission

The system operates from 0dB to 25dB of optical attenuation.

For single-mode (9/125) fibre with an attenuation of 0.35dB/km this equates to a transmission distance up to 70km.

For multi-mode (50/125 or 62.5/125) fibre with an attenuation of 0.6dB/km this equates to a transmission distance up to 41km.

Attention! Care must be taken to ensure that the fibre connectors are clean.

4.9.2 End to End Delay

The transit delay from one end of the system to the other is < 700uS.

4.9.3 Jitter

For G.703 interfaces, the jitter meets the requirements of TBR12 and TBR13.

Measurement Filter Bandwidth		Output Jitter
Lower Cut Off (High Pass)	Upper Cut Off (Low Pass)	UI Peak to Peak (maximum)
40Hz	100kHz	0.11

These measurements are performed in the presence of the maximum tolerable input jitter.

4.10 G.703 Interface Options

4.10.1 Unstructured Operation

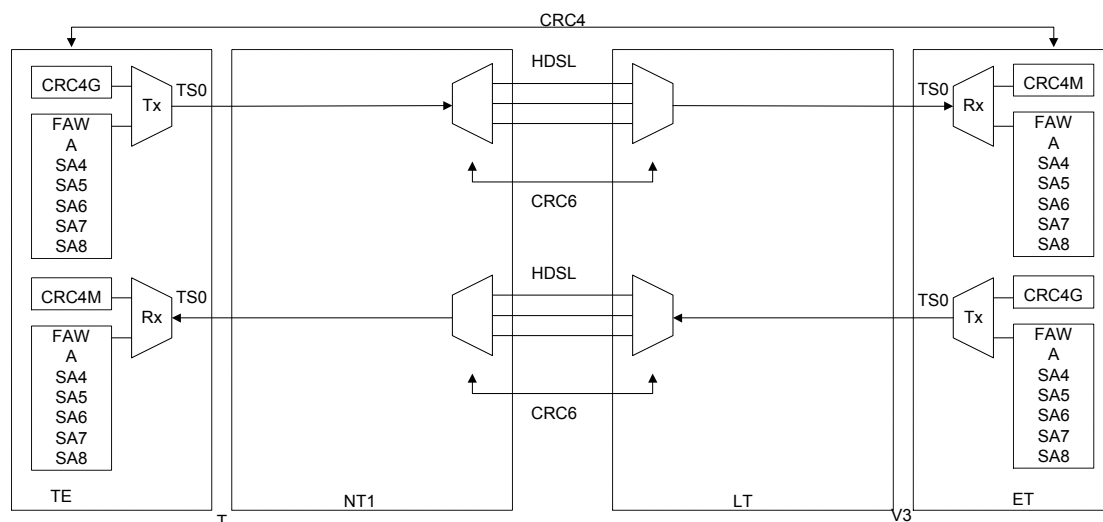


Figure 4 : Unstructured Operation

For unstructured working, Loss of Frame Alignment and AIS alarms are suppressed. The user data passes transparently through the system. An arbitrary frame position is assumed for mapping the user data in to the line pairs.

The user data may or may not have TS0, and may or may not be using CRC4, nothing is assumed about the user data.

To set up this configuration, go to the “Configuration > User Port” Menu and select

- Rx Unframed (*)
- Rx Framed ()
- Rx CRC4 []
- Tx TSO Transparent (*)
- Tx TSO Generate ()
- Tx CRC4 []

4.10.2 Structured Operation

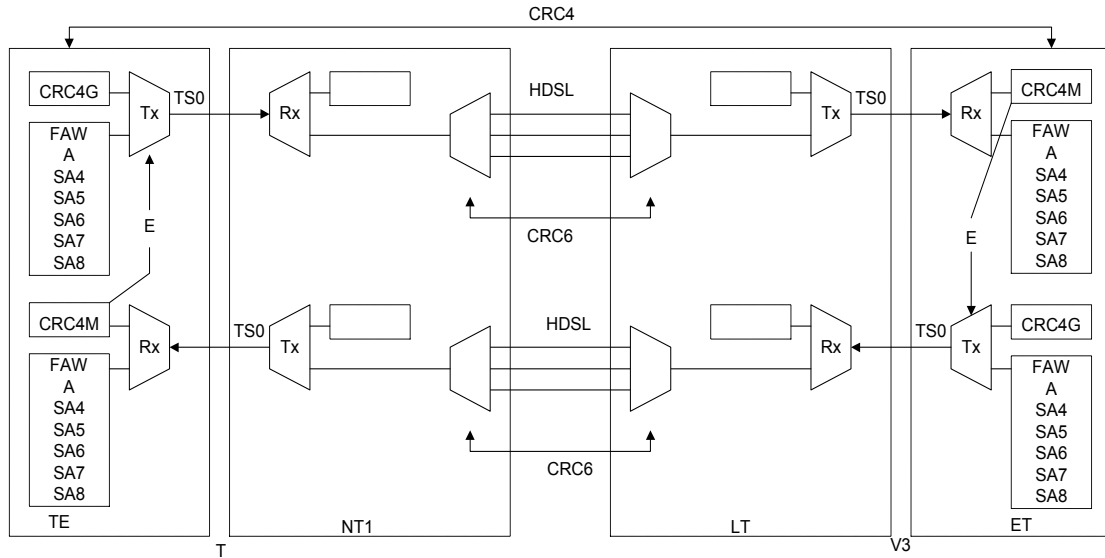


Figure 5 : Structured Working, End to End transparent CRCs

For fractional working where not all pairs are equipped, the G.704 frame is padded out with the programmable 'Idle' pattern.

To set up for structured working with transparent CRCs, go to the "Configuration > User Port" Menu and select

- Rx Unframed ()
- Rx Framed (*)
- Rx CRC4 []
- Tx TSO Transparent (*)
- Tx TSO Generate ()
- Tx CRC4 []

The incoming structured data may be monitored for CRC4 errors, however, no E bits are returned at the user interface from the transmission equipment. To do this, simply enable the Rx CRC4 checkbox.

4.10.3 Structured Working, CRCs Enabled

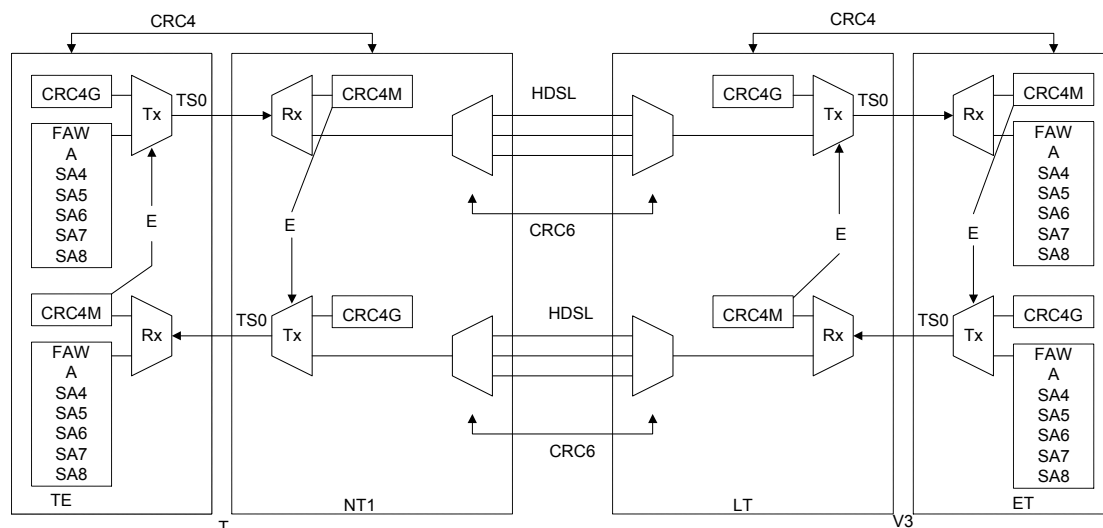


Figure 6 : Structured Working, CRCs Enabled

In this case, the CRCs are checked and errored blocks are indicated back across the user interface by use of the E bits.

This is the least ambiguous mode of operation from a performance monitoring point of view because each transmission section is covered by its own independent CRC check.

To set up this configuration, go to the "Configuration > User Port" Menu and select

- Rx Unframed ()
- Rx Framed (*)
- Rx CRC4 [X]
- Tx TSO Transparent ()
- Tx TSO Generate (*)
- Tx CRC4 [X]

In this mode of operation, the test loop activation messages defined in ETS 300 233 are passed to and from the LT over the V3 interface.

4.10.4 ETS 300 233 Loopbacks

Loop 1 and Loop2 may be activated by sending patterns using spare bits 5 and 6 in TS0.

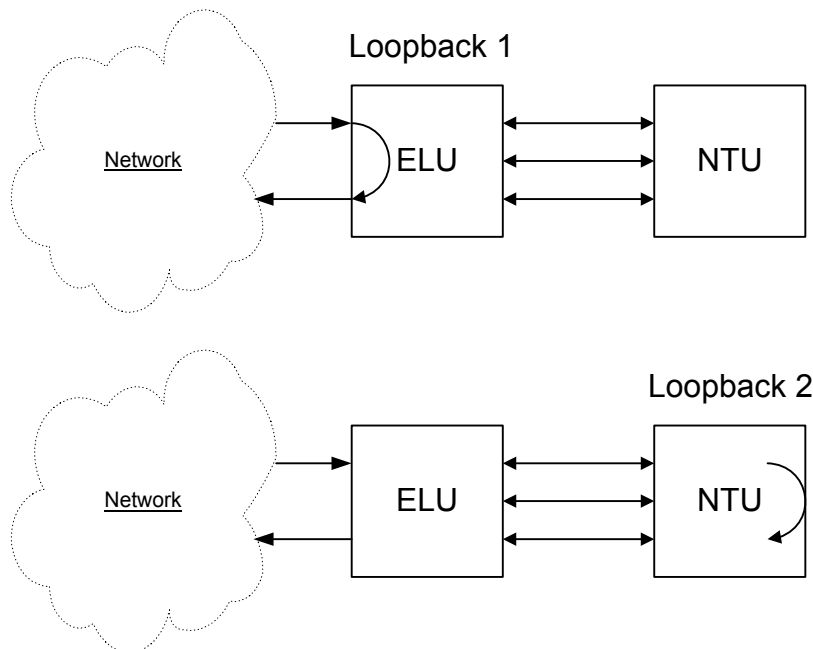


Table 1 CrC4 Multiframe Structure

	Sub-multiframe	Frame number	Bits 1 to 8 of the PCM frame (i.e. time slot 0)							
			1	2	3	4	5	6	7	8
Multi-frame	I	0	c1	0	0	1	1	0	1	1
		1	0	1	A	Sa4	Sa5	Sa61	Sa7	Sa8
		2	c2	0	0	1	1	0	1	1
		3	0	1	A	Sa4	Sa5	Sa62	Sa7	Sa8
		4	c3	0	0	1	1	0	1	1
		5	1	1	A	Sa4	Sa5	Sa63	Sa7	Sa8
		6	c4	0	0	1	1	0	1	1
	7	0	1	A	Sa4	Sa5	Sa64	Sa7	Sa8	
	II	8	c1	0	0	1	1	0	1	1
		9	1	1	A	Sa4	Sa5	Sa61	Sa7	Sa8
		10	c2	0	0	1	1	0	1	1
		11	1	1	A	Sa4	Sa5	Sa62	Sa7	Sa8
		12	c3	0	0	1	1	0	1	1
		13	E	1	A	Sa4	Sa5	Sa63	Sa7	Sa8
		14	c4	0	0	1	1	0	1	1
15		E	1	A	Sa4	Sa5	Sa64	Sa7	Sa8	

Table 2 Loopback code definitions

State	DS-ET	Sa5	Sa6
Loopback 1 command	<--	0	1111
Loopback 2 command	<--	0	1010
Loopback acknowledge	-->	0	XXXX
Loopback release command	<--	0	0000

These loop activation codes are only detected at the G.703 interface at the ELU when CRCs are enabled.

Loop 1 is the equivalent of a local loop at the ELU.
 Loop 2 is the equivalent of a remote loop set from the ELU.

Note, the specification did not anticipate point to multipoint so in this mode loop 2 is not meaningful.

5. Physical Interfaces

5.1 Mains Power Supply

If a 48V DC power supply is not available, mains to 48V converters are available.

5.1.1 240V Plug Top PSU

This unit is a basic UK plug top with two core screened cable terminated in a 3 way mini-fit connector.

Lead length 1.8m

Ascrom part number 5/500/000/037

5.1.2 240V In Line PSU

On this unit, the mains connector is a standard 3 pin IEC 320 input.

Lead length 1.8m

Ascrom part number 5/500/000/041

5.1.3 110V In-line PSU

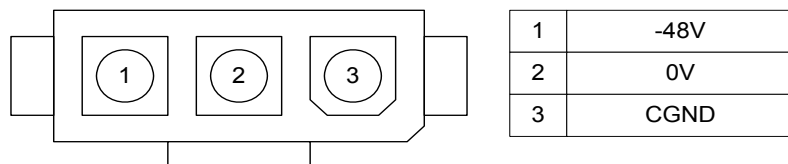
On this unit, the mains connector is a standard 3 pin IEC 320 input.

Lead length 1.8m

Ascrom part number 5/500/000/038

5.2 DC Power inlet

DC power is fed in via the three pin socket on the rear panel.



A connection from CGND to earth is required for ESD protection of the unit.

If the unit is line powered, the ground connection must be made to the earth bonding point on the rear panel. (M3 screw)

Mating connector

Molex Minifit Junior Receptacle

Molex female contact

Molex Part Number: 39-01-4031

Molex Part Number: 39-00-0039

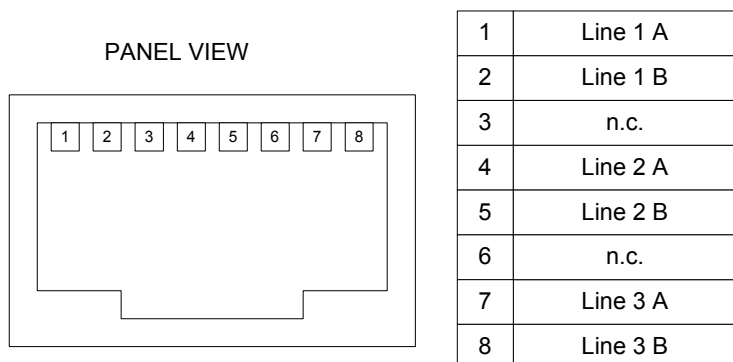
The DC Power Cable can be ordered from Ascrom, Ascrom Part Number (See Appendix B)

CABLE AM2048A DC POWER

6/910/000/423

5.3 Copper Transmission Line

The line interface connector on the unit is an 8-way RJ45 socket.



The line cable supplied is a standard 3 metre screened Category 5 cable with an 8 way RJ45 plug on each end.

Ascom part number 6/910/000/425 (See Appendix B)

5.4 Optical Transmission Line

The rear panel optical connector is either FC/SPC, ST or SC. For ordering information see Appendix B. Connectors plugged into this port should be clean and should have a return loss better than -35dB. The dust cap should be fitted when the unit is not connected to the line. The optical output from this port is -5dBm (±2dB) at 1310nm.

5.5 Serial Control

A VT100 compatible terminal can be plugged into the 9-way D-type on the rear panel. The socket is wired to allow a straight connection to a PC serial port. The serial cable must have pins 2, 3, 4, 5 and 6 connected.

For a full description of the menu system, refer to the 'VT100 Management User Guide'.

The serial port setting is 19.2Kbaud/s, 8 bit, no parity, 1 stop bit, Xon/Xoff flow control.

The RS232C interface complies with the CCITT V24/V28 standards. The maximum length of cable between communicating devices is limited to 15.2m (50ft).

Pin #	Function
1	
2	Receive cct 104
3	Transmit cct 103
4	DTR
5	Ground cct 102
6	DSR

The serial control cable can be ordered from Ascom, (See Appendix B)

Serial Cable Assembly-	Ascom Part Number
CABLE 9 WAY SERIAL	6/910/000/429

5.6 Alarm Input/Output Port

The alarm port provides 6 logic level inputs, and the contacts of two changeover relays. The pinout is shown below:

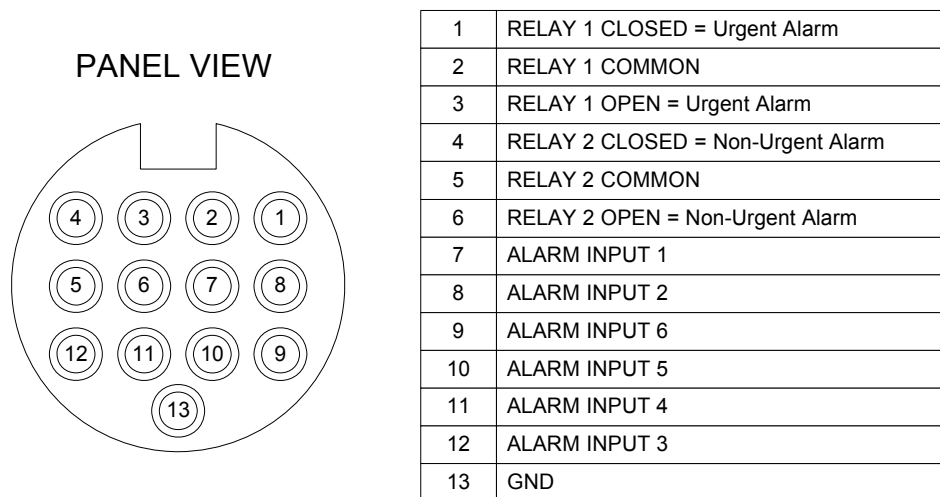


Figure 7 - Alarm Connector

In the de-energised state, the urgent alarm relay closes the contact between pins 1 and 2 (pins 2 and 3 are open) and the non-urgent alarm relay closes the contact between pins 4 and 5 (pins 5 and 6 are open).

When power is applied and all alarms are off, the urgent alarm relay opens the contact between pins 1 and 2 (pins 2 and 3 are closed), the non-urgent alarm relay opens the contact between pins 4 and 5 (pins 5 and 6 are closed).

In the ELU, the alarms relay outputs may be used to integrate the AM2048 into the exchange alarm system.

To save power in the NTU the alarm relays are disabled.

The alarm inputs are available at both the ELU and the NTU and may be used for alarm collection from other equipment, e.g, door open alarm, battery low alarm, temperature alarms etc. The alarm inputs detect a short circuit between the alarm input pin and GND (pin 13)

Mating connector -
 CONN 13 WAY PLG
 Screened Cable Assembly-
 CABLE AM2048A ALARM
 (See Appendix B)

Ascom Part Number
 6/313/000/002
 Ascom Part Number
 6/910/000/424

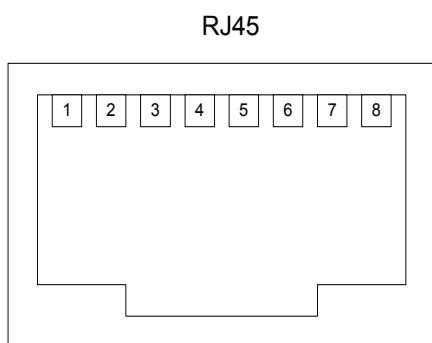
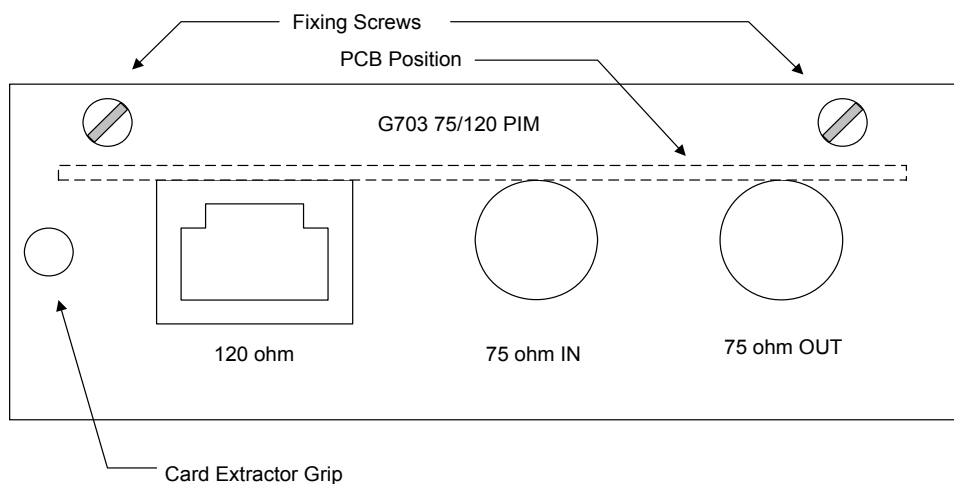
5.7 Interface Modules

5.7.1 G.703

The 75 ohm interface connectors are BNC.

The 120 ohm interface connector is RJ45.

Selection of the interface is carried out in the "Configuration > User Port" menu.



1	TxA
2	TxB
3	screen
4	RxA
5	RxB
6	screen
7	n.c.
8	n.c.

5.7.2 X.21

V11 refers to ISO 4903 for the connector pin-out.

Circuit	Interchange Circuit Name	Pins A.....B		Definition
G	Signal ground or Common Return	8		
T	Transmit	2	9	From DTE to DCE
R	Receive	4	11	From DCE to DTE
C	Control	3	10	From DTE to DCE ON during Data OFF during Control
I	Indication	5	12	From DCE to DTE ON during Data OFF during Control
S	Signal Element Timing	6	13	From DCE to DTE T and R change at OFF to ON of S
B	Byte Timing	7	14	From DCE to DTE OFF for the ON period of S During the last bit of the octet
X	DTE Signal Element Timing	7	14	MK I, not used. MK II, From DTE to DCE

The clock rate is set up using the “Configuration > User Port” Menu.

Select the required value of N for Nx64K circuits.

DTE – DCE mode, and X-B mode are selected using the hardware links on the X.21 interface module.

Note: X-B is only available on the X.21 MK II Plug In Module.

5.7.3 V.35

V.35 refers to ISO 2593 for the connector pin out.

Circuit	Interchange Circuit Name	Pins		Definition
		A	B	
102	Signal ground or Common Return		B	
103 \emptyset	Transmitted Data	P	S	From DTE to DCE
104 \emptyset	Received Data	R	T	From DCE to DTE
105	Request To Send (RTS)		C	ON transmit Data OFF transmit binary 1.
106	Ready For Sending (RFS)		D	ON DCE ready to accept data OFF DCE not ready
107	Data Set Ready (DSR)		E	ON DCE ready to operate OFF DCE not ready to operate
109	Received Signal Detector		F	ON line signal is good OFF line signal out of limits
113 \emptyset □	Terminal Signal Element Timing	U	W	103 changes at OFF to ON of 113
114 \emptyset	Transmitter Signal Element Timing	Y	AA	103 changes at OFF to ON of 114
115 \emptyset	Receiver Signal Element Timing	V	X	Centre of bit on 104 ON to OFF on 115
140	Remote Loopback		N	
141	Local Loopback		L	
142	Test Indicator		NN	

Circuits marked \emptyset are balanced V.35, unmarked circuits are to V.28

Circuit marked □ is only implemented in DTE mode.

The clock rate is set up using the "Configuration > User Port" Menu.

Select the required value of N for Nx64K circuits.

DTE – DCE mode may be selected using Links 1 and 2.

5.8 Front Panel

5.8.1 Controls

5.8.1.1 Setting Master/Slave

1. Press the local loop and loopback buttons together and hold them until both the local loop and loopback indicators are lit. Upon releasing the buttons, the Remote Loop indicator starts to flash and you have 5 seconds to select and accept the required Master /Slave mode.
2. With the remote loop indicator flashing, press the remote loop button to toggle the state of the Master/Slave LED. Select Master/Slave as desired.
3. To accept the change, press local loop and loopback buttons together until the Remote Loop indicator goes off. The unit will then automatically restart in the selected mode.
4. If the change is not accepted within 5 seconds, the Remote Loop indicator will stop flashing and the unit will leave the programming mode and return to normal operation, with its Master/Slave mode unchanged.

5.8.1.2 Resetting to Factory Default Configuration

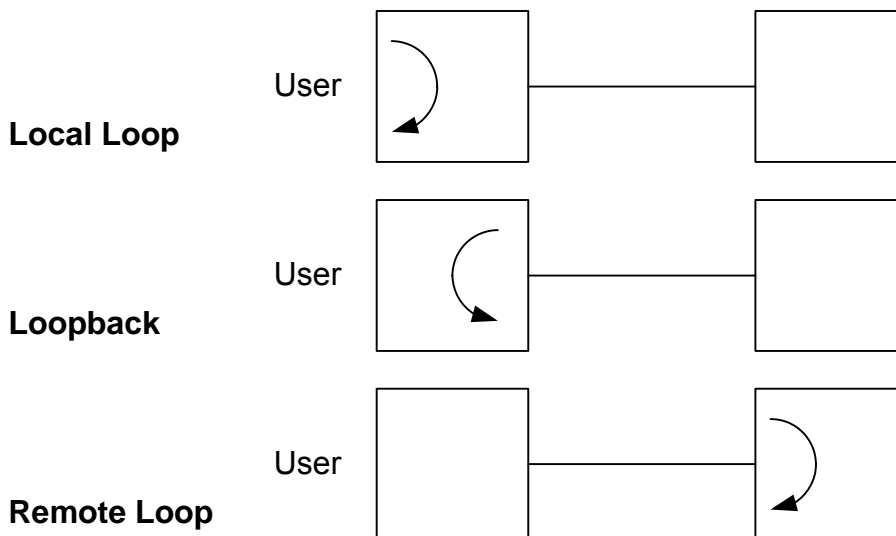
Press the Local Loop and Loopback buttons together, then with the buttons still pressed, press the remote loop button as well. The unit will automatically restart with all of its configuration data cleared. Note, when the units reboots it will be configured as a "Slave".

5.8.1.3 Setting Loops

The following test loops may be set using the front panel buttons.

- Local Loop
- Loopback
- Remote Loop

N.B. These buttons may be disabled from the 'Test > User Port' menu.



5.8.2 Indicators

Power (Green)

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

Test (Red)

This will be illuminated whenever:

- the unit has a loop locally or remotely applied.
- the unit is applying a remote loop.
- the unit is running a data test.

Non-Urgent Alarm (Yellow)

This LED will be illuminated if an alarm of fault severity 2 or 3 is present on the unit

Urgent Alarm (Red)

This LED will be illuminated if an alarm of fault severity 4 or 5 is present on the unit

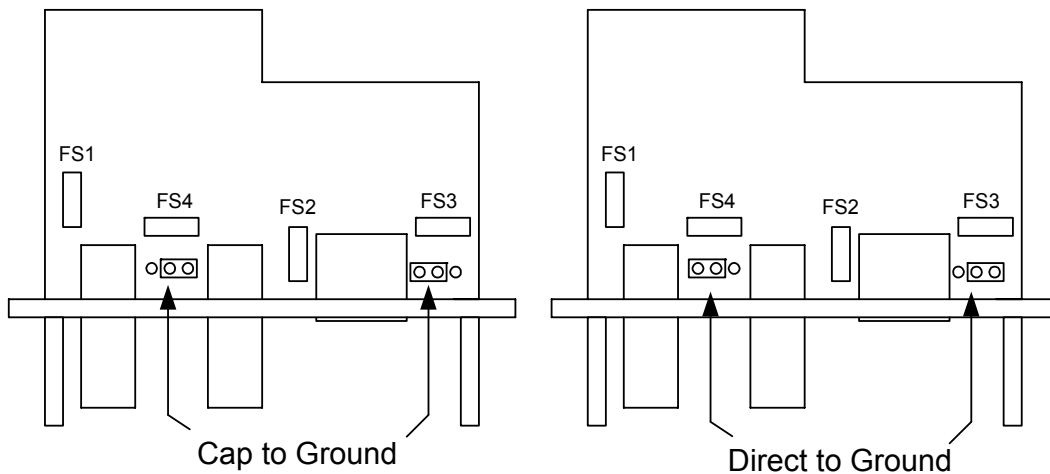
Master (Green)

When lit, this LED indicates the unit has been configured to operate as a 'master'. The default setting is for the unit to be a 'slave' in which case the LED will be off.

6. Internal Links and Fuses

6.1 G.703 Plug In Module

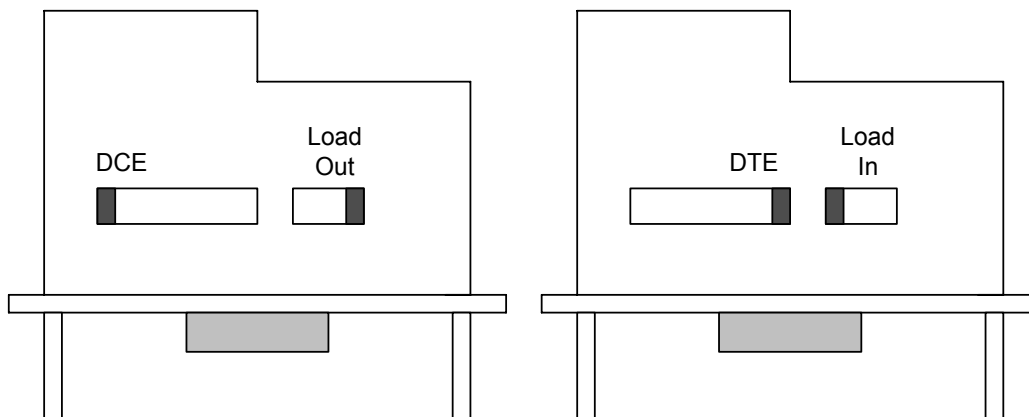
The following diagrams show the location of the internal hardware links. In all cases the factory default setting is shown on the left.



The 75ohm G.703 receiver and the 120 ohm cable screen may be optionally connected directly to ground or to ground via a capacitor. The fuses FS1 to FS4 are used to protect the circuit against the transverse application of mains.

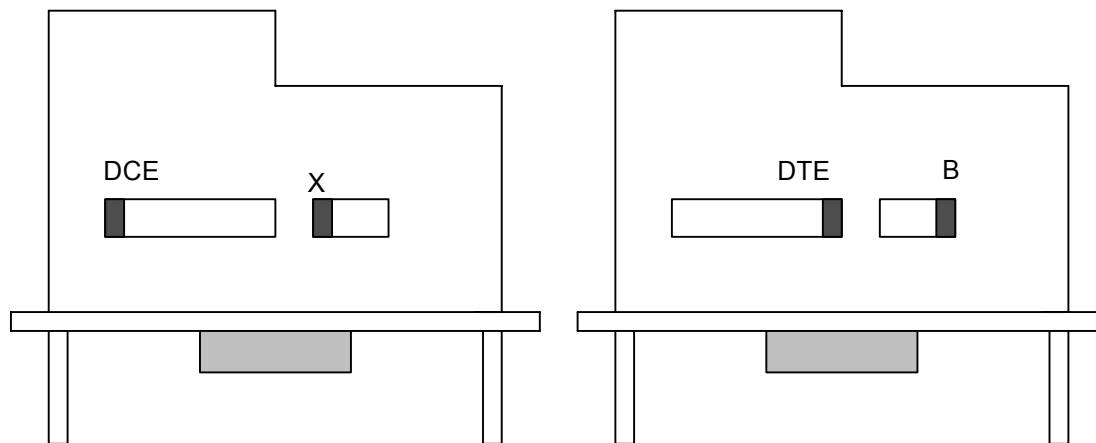
6.2 X.21 Plug In Module MK I

The X.21 module may be configured as a DCE or DTE. In both modes, the receive clock, data and byte timing circuits may be terminated in 120 ohms.



6.3 X.21 Plug In Module MK II

The X.21 module may be configured as a DCE or DTE.
The 120 termination is always in.

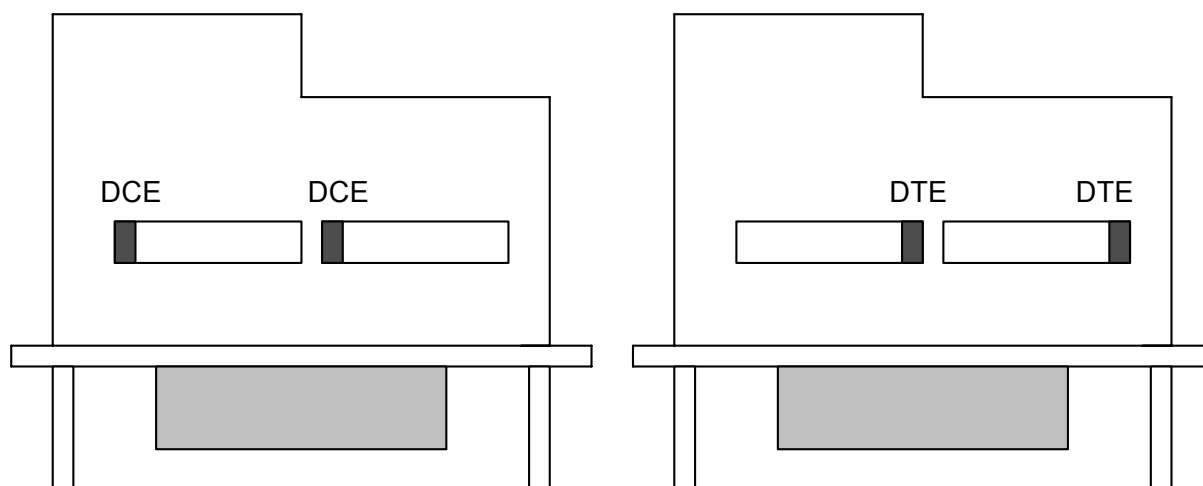


In DCE mode, the module may be configured to generate Byte Timing (B) or receive the DTE clock (X).

In DTE mode, the module may be configured to receive Byte Timing (B) or generate a DTE clock (X).

6.4 V.35 Plug In module (MK I and MK II)

The V.35 module may be configured as a DCE or DTE. Both links must be in the correct position. If the links are incorrectly set, the unit will detect the illegal setting.



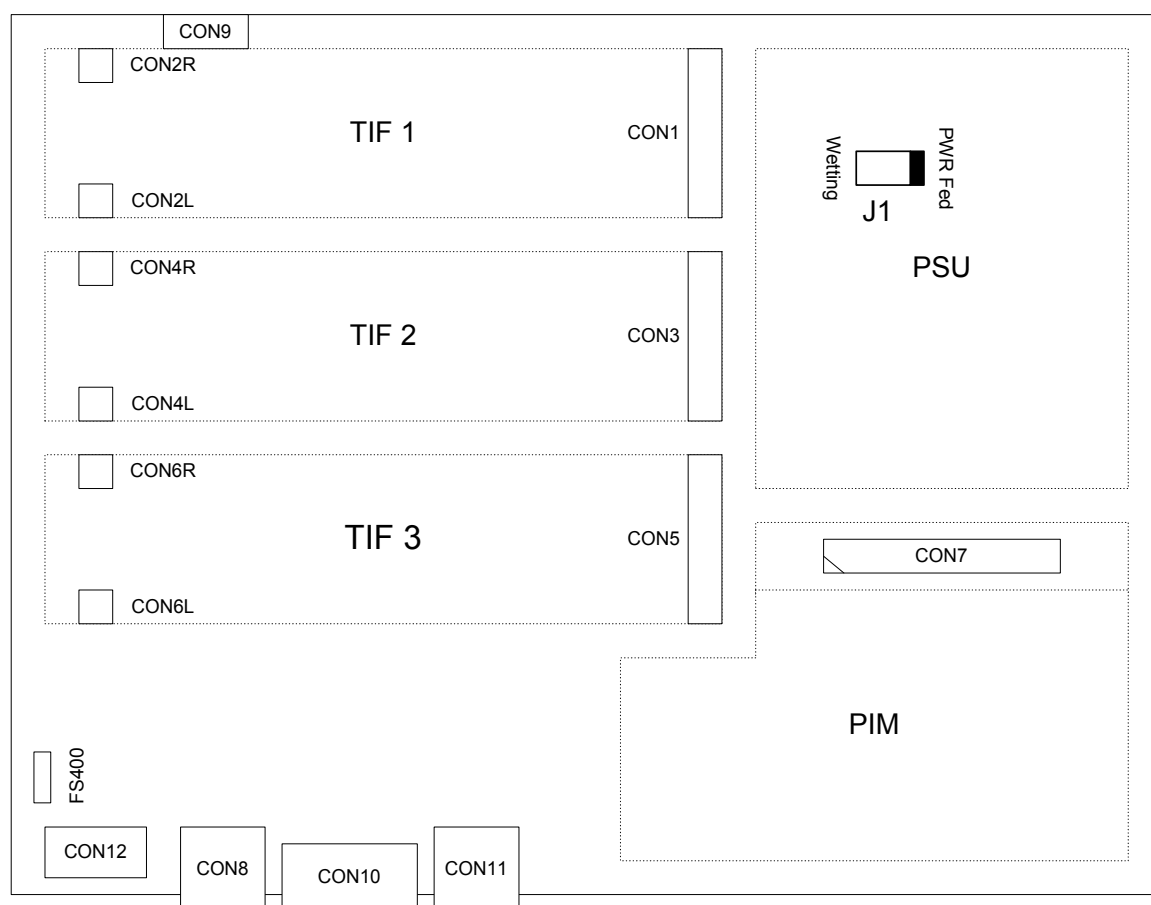
6.5 Motherboard

Link J1 is factory fitted in the 'PWR Fed' position.

This means that the unit can be powered directly from line (for copper transmission systems) or from the DC input.

The other position for the link is for future use.

The fuse FS400 is a 1A slow blow fuse to protect the DC input.



WARNING

Only authorised personnel are allowed to open the DSL System 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 the guarantee and CE compliance.

7. Compliance Notes

TTE network statements and the declaration to conformity to EC directive 1999/5/EC are provided inside the front cover of this User Guide together with safety information.

7.1 Telecommunication Standards

The equipment is in conformity with the following Common Technical Regulations and National Standards:

Common Technical Regulations

CTR2	X.21, X.21bis (V.35)
CTR12	G.703 2Mbps, 120Ω, unstructured
CTR13	G.703 2Mbps, 120Ω, structured

UK National Standards

NTR4	G.703, 75Ω
NTR14	Analogue Baseband

8. Glossary

A	Alarm bit in G.704 frame, timeslot 0
AC	Alternating Current
AIS	Alarm Indication Signal
BT	British Telecom
CAP	Carrierless Amplitude and Phase Modulation
CCITT	International Telegraph and Telephone Consultative Committee
CRC4	Cyclic Redundancy Check 4 (bits)
CRC6	Cyclic Redundancy Check 6 (bits)
CRC6G	CRC6 Generator
CRC6M	CRC6 Monitor
DC	Direct Current
DCE	Data Circuit Terminating Equipment
DS	Digital Section (Line section including ELU and NTU)
DSP	Digital Signal Processing
DSL	Digital Subscriber Line
DSLU	Digital Subscriber Line Unit. (AM768, AM2048 CAP, AM2048 OS etc.)
DTE	Data Terminating Equipment
E bit	Bits in the G.704 frame used to indicate that a CRC has been received in error.
ELU	Exchange Line Unit
EMC	Electromagnetic Compatibility
EN 41003	Particular Safety Requirements for Equipment to be connected to Telecommunications Networks
EN 60950	1992. Up to A11 (1997) Safety of Information Technology Equipment.
EOC	Embedded Operations Channel
ESD	Electro Static Discharge
ET	Exchange Termination
ETR152	ETSI Technical Report 152 (1996).Transmission and multiplexing; DSL transmission system on local lines;
ETS	European Telecommunications Standard
FAW	Frame Alignment Word
FIFO	First In First Out Buffer
FLASH	Nonvolatile read/write memory
G.703	CCITT Recommendation G.703 (1988): "Physical/electrical characteristics of hierarchical digital interfaces".
G.704	CCITT Recommendation G.704 (1988): "Synchronous frame structures user at primary and secondary hierarchical levels".
G.706	CCITT Recommendation G.706 (1988): "Frame alignment and CRC procedures relating to basic frame structures defined in G.704"
G.826	CCITT Recommendation G.826 (1996) "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate"
HD 384	Electrical Installation of Buildings (IEC 60364 series, modified)
IC	Integrated Circuit
IEC 61312-1	Protection against lightning electromagnetic impulse; Part 1 General Principles
ISO	International Standards Organisation
LED	Light Emitting Diode
LT	Line termination (Same as ELU)
LVD	Low Voltage Directive
M.2100	CCITT recommendation M.2100 (1995) Performance limits for bringing into service and maintenance of international PDH paths, sections and transmission systems.
NT	Network Termination
NTU	Network Terminating Unit
NTP	Network Termination Point

PC	Personal Computer
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
RAM	Random Access Memory
SAn	G.704 Timeslot 0 spare bit n.
SELV	Safe Extra Low Voltage
SNMP	Simple Network Management Protocol
TE	Terminal Equipment
TSn	Timeslot n
TNV	Telecommunications Network Voltage
VT100	Industry standard character based terminal.
V11	CCITT Recommendation V.11 Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications
V.35	CCITT Recommendation V.24 List of definitions for interchange circuits between DTE and DCE
X.21	CCITT Recommendation X.21 Interface between DTE and DCE for synchronous operation public data networks.
3B1O	Line code where 3 binary bits are coded into 8 (octal) discrete levels.

9. Troubleshooting

Please check the following points if problems are experienced setting up a DSL link:

1. For the copper system, ensure the modem is being used on unconditioned twisted pairs.
2. For the copper system, check the correct pin connections are being used on the RJ45 line connector.
3. For the optical system, if problems are experienced with 'Loss of Sync' check that the optical connector is clean. On a single fibre system, the transmission may be sensitive to back reflections caused by dust in the connector.
4. Check that one DSLU is set to master and the other(s) to slave.
5. Check that no test loops are active. (The front panel TEST LED should be off on all units).
6. Using the Management Terminal,
 - a) Check the "Information > System" screen for user port settings ie. DTE/DCE mode.
 - b) Check the "Alarms > Status" screen for details of any faults.
 - c) Check the "Configuration > Master/Slave" mode for general system settings.
 - d) Check the "Configuration > User Port" for user clock rate settings.
7. For G.703 interfaces. If CRCs are enabled and only one copper pair is being used for transmission, ensure that the idle pattern is set correctly in the "Configuration>User Port" Screen.
8. For nx64k check that the correct value of 'n' has been selected at BOTH ends of the link. If there is a doubt, enter the Configuration> User Port Screen and press 'Enter'.
9. For nx64k, check the DCE-DTE cable length against the charts in Appendix A.
10. If the front panel test loops fail to operate, check to see if they are enabled in the "Test > User Port" screen, also check that no conflicting tests are already activated.

For persistent problems please contact your local distributor for assistance.

Ascom Transmission technical support is available by fax on +44 29 20 500 850 in the first instance.

Appendix A - X.21/V.35 Cable lengths

There is an inherent design limitation with the X.21 and V.35 interfaces when timing information is only transmitted in one direction.

The timing is usually sent from the DCE to the DTE. Data originating from the DCE and travelling to the DTE arrives at the DTE with the same clock skew with which it originated at the DCE. However, data originating at the DTE arrives back at the DCE skewed relative to the DCE clock. This skew is equal to (2 x cable delay) + Driver delays at both ends.

Receive data is normally sampled at the half bit period position. So to guarantee correct operation, the data arriving at the DCE must avoid this half period delay.

NB. This calculation is only valid if the DTE samples receive data at the half bit position.

Example calculation:

Note: The driver delays for the DTE are only ESTIMATED values.

For N = 32

Bit period = 488ns

Half period = 244ns

Typical V11 driver delay = 30ns

Total driver delay = driver delay x 4 = 120ns

Typical logic delay = 8ns

Typical cable delay per metre = 6ns

$$\begin{aligned} \text{1st problem cable delay} &= (\text{Half Bit Period} - \text{total driver delays} - \text{logic delay})/2 \\ &= (244 - 120 - 8)/2 \\ &= 58\text{ns} \end{aligned}$$

$$\text{1st problem cable length} = 9.7\text{m}$$

$$\begin{aligned} \text{2nd problem cable length} &= (\text{one and a Half Bit Period} - \text{total driver delays} - \text{logic delay})/12 \\ &= (732 - 120 - 8)/12 \\ &= 50.3\text{m} \end{aligned}$$

$$\begin{aligned} \text{3rd problem cable length} &= (\text{two and a Half Bit Period} - \text{total driver delays} - \text{logic delay})/12 \\ &= (1220 - 120 - 8)/12 \\ &= 91\text{m} \end{aligned}$$

And so on...

So, further problem lengths occur at additional
(Bit Period)/(2 x Cable delay per metre) = 40.6m

See the next pages for the potential problem cable lengths for all values of N.

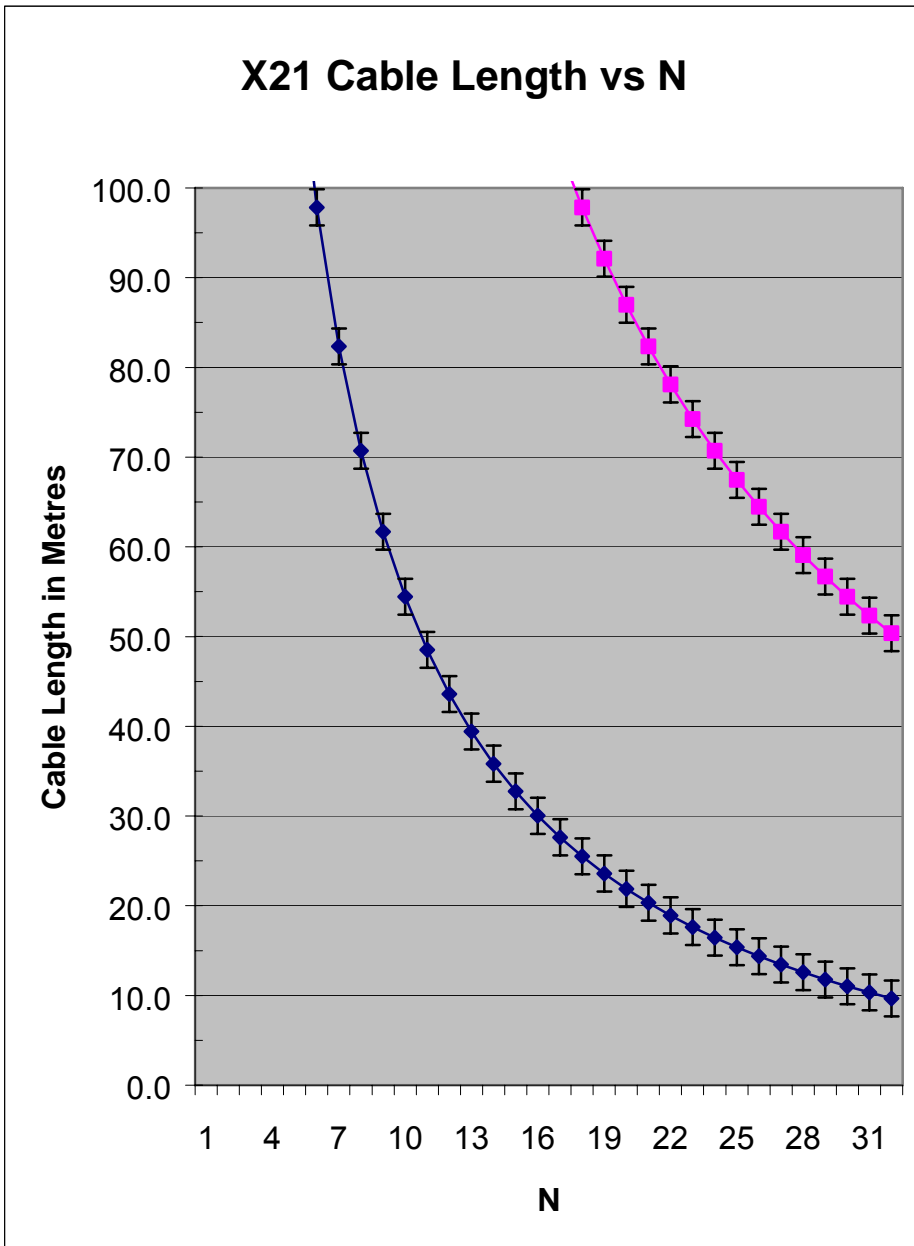
If a problem is experienced, try adding two metres to the cable length.

The latest versions of the X.21 and V.35 interface have features which help to overcome these problems.

X.21 Cables - Potential Problem Lengths

Cable Delay per metre (ns) 6
 Driver Delay (ns) 30
 Logic Delay (ns) 8

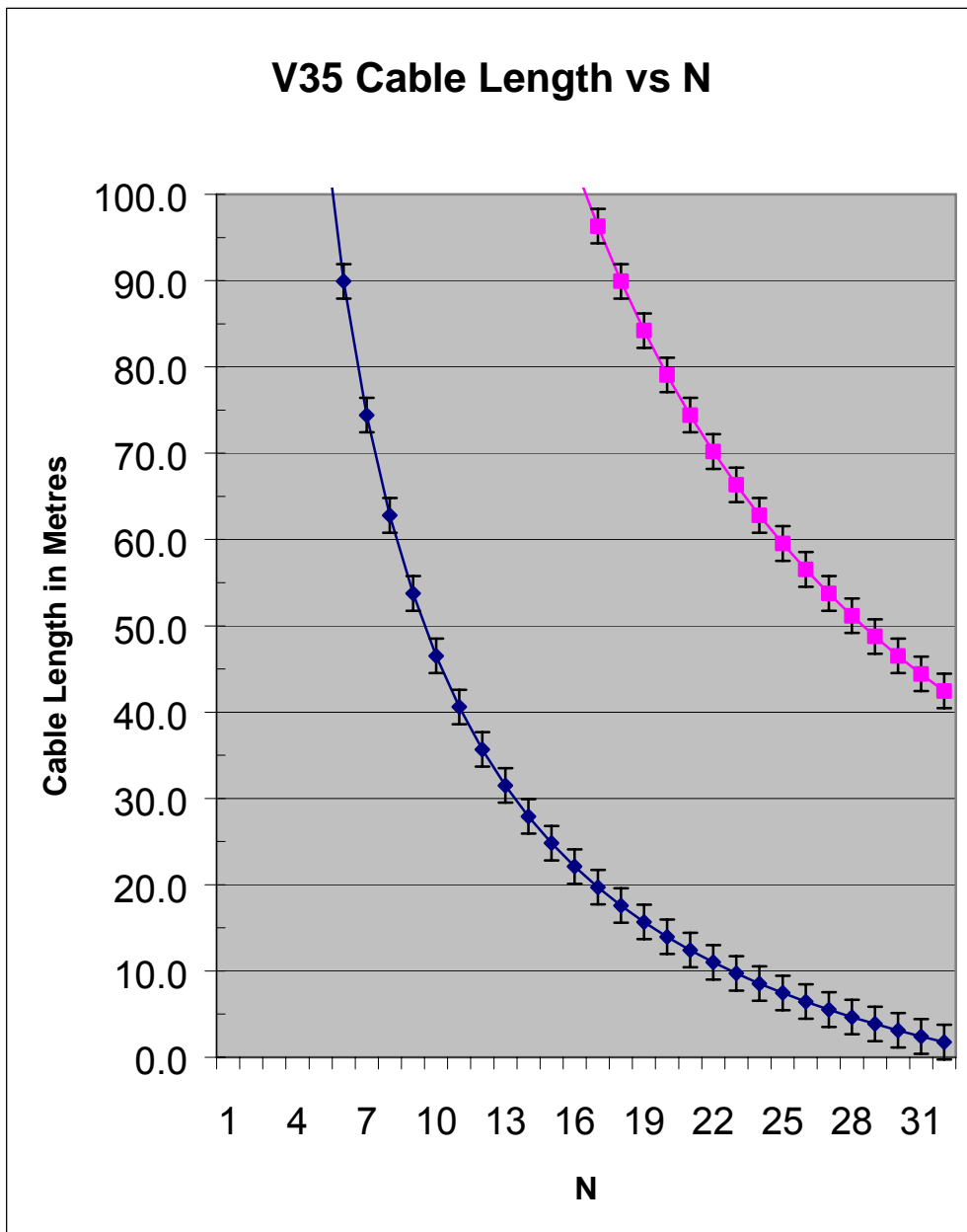
N	Data Rate	Bit Period	Max Delay	1st Length	2nd Length	
	kbps	ns	ns	m		m
1	64	15625	3842	640.4	1302.1	1942.5
2	128	7813	1889	314.9	651.0	965.9
3	192	5208	1238	206.3	434.0	640.4
4	256	3906	913	152.1	325.5	477.6
5	320	3125	717	119.5	260.4	380.0
6	384	2604	587	97.8	217.0	314.9
7	448	2232	494	82.3	186.0	268.4
8	512	1953	424	70.7	162.8	233.5
9	576	1736	370	61.7	144.7	206.3
10	640	1563	327	54.4	130.2	184.6
11	704	1420	291	48.5	118.4	166.9
12	768	1302	262	43.6	108.5	152.1
13	832	1202	236	39.4	100.2	139.6
14	896	1116	215	35.8	93.0	128.8
15	960	1042	196	32.7	86.8	119.5
16	1024	977	180	30.0	81.4	111.4
17	1088	919	166	27.6	76.6	104.2
18	1152	868	153	25.5	72.3	97.8
19	1216	822	142	23.6	68.5	92.1
20	1280	781	131	21.9	65.1	87.0
21	1344	744	122	20.3	62.0	82.3
22	1408	710	114	18.9	59.2	78.1
23	1472	679	106	17.6	56.6	74.3
24	1536	651	99	16.5	54.3	70.7
25	1600	625	92	15.4	52.1	67.5
26	1664	601	86	14.4	50.1	64.5
27	1728	579	81	13.4	48.2	61.7
28	1792	558	76	12.6	46.5	59.1
29	1856	539	71	11.8	44.9	56.7
30	1920	521	66	11.0	43.4	54.4
31	1984	504	62	10.3	42.0	52.3
32	2048	488	58	9.7	40.7	50.4



V.35 Cables - Potential Problem Lengths

Cable Delay per metre (ns) 6
 Driver Delay (ns) 50
 Logic Delay (ns) 23

N	Data Rate	Bit Period	Max Delay	1st Length	2nd Length	
	kbps	ns	ns	m		m
1	64	15625	3795	632.5	1302.1	1934.5
2	128	7813	1842	306.9	651.0	958.0
3	192	5208	1191	198.4	434.0	632.5
4	256	3906	865	144.2	325.5	469.7
5	320	3125	670	111.6	260.4	372.0
6	384	2604	540	89.9	217.0	306.9
7	448	2232	447	74.4	186.0	260.4
8	512	1953	377	62.8	162.8	225.6
9	576	1736	323	53.8	144.7	198.4
10	640	1563	279	46.5	130.2	176.7
11	704	1420	244	40.6	118.4	159.0
12	768	1302	214	35.7	108.5	144.2
13	832	1202	189	31.5	100.2	131.7
14	896	1116	168	27.9	93.0	120.9
15	960	1042	149	24.8	86.8	111.6
16	1024	977	133	22.1	81.4	103.5
17	1088	919	118	19.7	76.6	96.3
18	1152	868	106	17.6	72.3	89.9
19	1216	822	94	15.7	68.5	84.2
20	1280	781	84	14.0	65.1	79.1
21	1344	744	75	12.4	62.0	74.4
22	1408	710	66	11.0	59.2	70.2
23	1472	679	58	9.7	56.6	66.3
24	1536	651	51	8.5	54.3	62.8
25	1600	625	45	7.5	52.1	59.5
26	1664	601	39	6.5	50.1	56.5
27	1728	579	33	5.5	48.2	53.8
28	1792	558	28	4.7	46.5	51.2
29	1856	539	23	3.9	44.9	48.8
30	1920	521	19	3.1	43.4	46.5
31	1984	504	15	2.4	42.0	44.4
32	2048	488	11	1.8	40.7	42.5



Appendix B – Ordering Information

KEY

User Interfaces

G.703	X = 1
X.21	X = 2
V.35	X = 3
G.703 MK II	X = 4
X.21 MK II	X = 5
V.35 MK II	X = 6

Fibre Connectors

FC/SPC	Y = A
ST	Y = B
SC	Y = C

Optical Transmission

Single Mode Fibre	AM2048A OS
Multimode Fibre	AM2048A OM

Order Code

1/187/50X/9AY (For X and Y, see key)
1/187/53X/9AY

Copper Transmission

Three pair, 3B1O	AM2048A MP
Single Pair 3B1O	AM768A
One/Two Pair CAP 1024/2048	AM2048A CAP

Order Code

1/187/51X
1/187/52X
1/187/56X

Example order code

1/187/536/9AB	AM2048A OM V.35 ST Optical Transmission Multimode fibre ST connector User interface V.35 MKII
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Spare User Interfaces

	ascom part number	Order Code
G.703	2/187/002	1/187/002
X.21	2/187/004	1/187/004
V.35	2/187/005	1/187/005
G.703 MK II	2/187/006	1/187/006
X.21 MK II	2/187/007	1/187/007
V.35 MK II	2/187/008	1/187/008

Power Supplies

	ascom part number	Order Code
240V UK Plug top	5/500/000/037	1/187/311
240V In Line IEC	5/500/000/041	1/187/312
110V In Line IEC	5/500/000/038	1/187/313

Accessories

	ascom part number	Order Code
AM2048 DC Cable	5/500/000/037	1/187/314
AM2048 Alarm Connector	6/313/000/002	1/187/315
AM2048 Alarm Cable	6/910/000/424	1/187/316
AM2048 RJ45-RJ45 Cable	6/910/000/425	1/187/317
AM2048 RS232 Cable	6/910/000/429	1/187/320
Management Pack	n.a.	1/187/350
(Includes VTMS Handbook and RS232 cable)		

