DCX 870
Reference Manual

STATUTORY NOTICES

WARNINGS

The DCX 870 incorporates a panel in front of the plug-in modules. This panel may only be removed by suitably qualified personnel for installation or maintenance purposes, and must be replaced afterwards. Removal under any other circumstance would invalidate the RFI (Radio Frequency Interference) and Safety Type Approvals.

Interconnection directly or by way of other apparatus, of ports marked 'WARNING CONNECT ONLY APPARATUS COMPLYING WITH BS6301 TO THIS PORT', with ports not so marked may produce hazardous conditions on the BT network. Advice should be obtained from a competent engineer before attempting such a connection.

The rating of the fuse used in the fuse disconnection barrier is 60 mA, 250V (part number A312-030160).

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions in the manual, may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

In all cases where the mains cord is the disconnect device, the socket outlet must be installed close to the equipment and should be easily accessible.

CE

Case Technology Ltd declare that this product conforms with the protection requirements of Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic protection.

This equipment has been tested using shielded cables supplied by Case Technology Ltd. These cables, or equivalents, must be used to ensure compliance with this declaration.

Case Technology Ltd declare that this product conforms with the requirements of Council Directive 73/23/EEC on the harmonisation of the laws of the member states relating to electrical equipment designed for use within certain voltage limits.

All PCB assemblies contain Electrostatic Sensitive Devices (ESDs) which may be permanently damaged if incorrectly handled. This equipment must be handled in accordance with BS5783 code of practice for the handling of electrostatic sensitive devices.

Published by Case Technology Technical Publications Department

Preface

This manual firstly gives a description of the DCX 870 multiplexer. It then provides pre-installation information for DCX sites, and instructions for suitably qualified personnel to install DCX equipment. It goes on to provide information for network managers (supervisors) to operate, configure and test the DCX 870 multiplexer. It forms part of the DCX Systems Documentation, and refers to other manuals in the series. It assumes that you will already have some knowledge of the DCX system, obtained either from the System Documentation or from a Case training course.

The manual applies to equipment originating in the Case UK factory. Although it contains information specifically related to British Telecom and its regulations, its application to PTTs in other countries is generally similar. If in doubt, contact your local Case representative for advice.

For an explanation of terms used in this manual, see the Pocket Books of Telecommunications and Computer Communications.

STATUTORY NOTICES (contd)

LITHIUM BATTERY

The lithium used in the battery of this unit will react violently with water and most gases. Discharged batteries must not be crushed, incinerated or disposed of in the normal waste. Used batteries should be collected and disposed of in an approved land fill. The manufacturer and your local waste authority will provide more detailed information about their disposal.

Accidental charging and short circuiting of the battery may cause overheating and possible rupture.

Replace only with the same or equivalent type recommended by the equipment supplier.

CZECH REPUBLIC SAFETY STATEMENT

Prístroj musí byt umístěn v blízkosti síť ové zásuvky.
K odpojení přístroje od sítě slouží vidlice síť ového přívodu.

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1 Introduction

1.1 The DCX 870

The DCX 870 is a Network Processor with Frame Relay, X.25 and conventional DCX ARQ interfaces. It is a member of the DCX Series of networking multiplexers, compatible with all other members of the DCX family.

The DCX 870 Network Processor is soft-configurable, either locally or from a remote device.

The DCX 870 is modular in construction, allowing a variety of DCX module cards to be incorporated as shown in Figure 1-1.

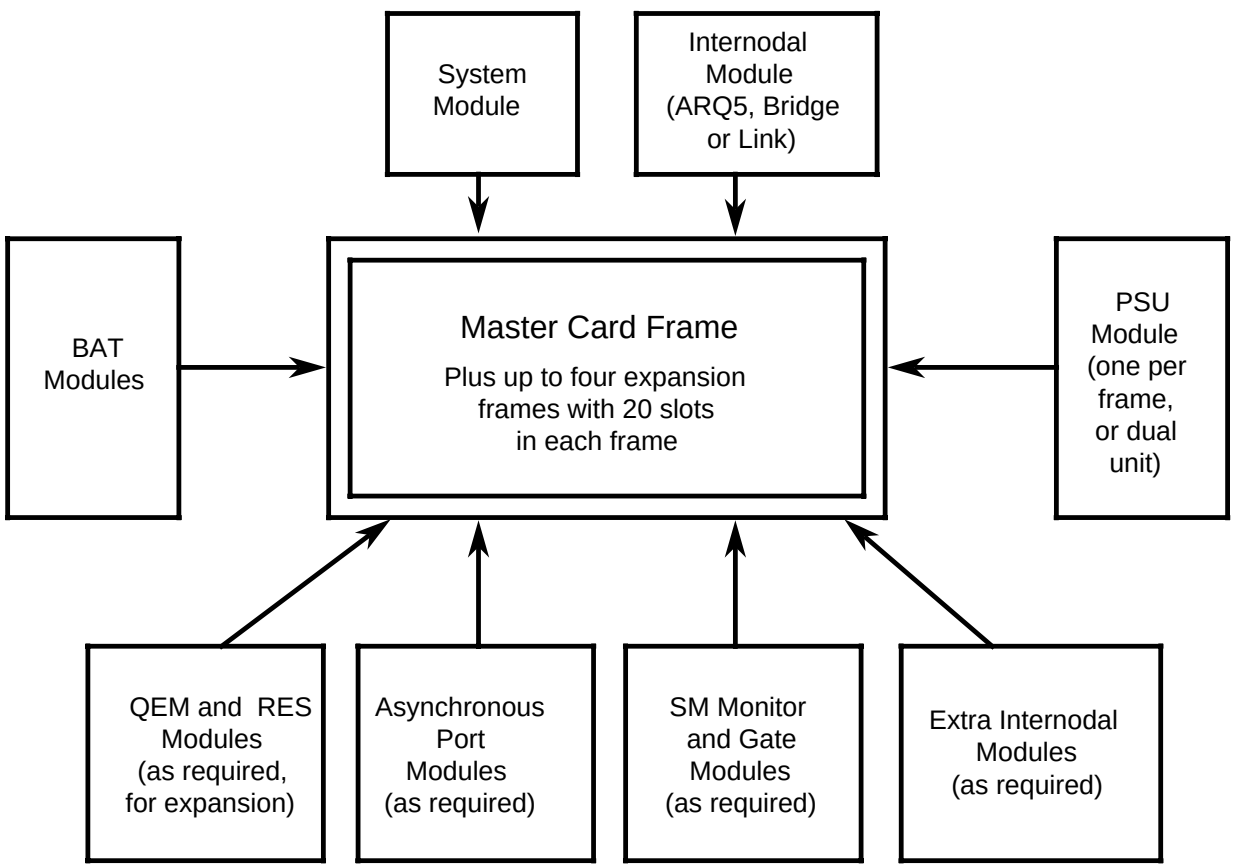


Figure 1-1 Modular Construction of DCX 870

This modular construction enables the creation of the exact multiplexer configuration for your network. The *minimum* complement of modules required for a DCX 870 to operate is:

- **Two BAT (Buffer And Timing) Modules** – To provide resilient buffer memory and system timing for the 870.
- **One System Module** – The System Module is the prime operating interface for configuration and monitoring of the DCX 870 in the DCX network. It exercises control over the DCX 870 by means of configuration maps held in memory, which provide the routing facility for multiplexer networking. The System Module also contains the configuration of the User Switching Option, allowing users to select destinations as required. Extensive test facilities are also available for individual port or channel testing, and to aid network fault diagnosis and location. A second System Module can be added for resilience.
- **One SC Module** – To provide asynchronous ports.
- **One ARQ5, Bridge or Link Module** – To provide an internodal synchronous composite link.

Each of the modules has its own Reference Manual providing full details of its operation. In particular, it is recommended that you become familiar with the contents of the System Module Reference Manual to gain an understanding of how to access the DCX 870 facilities.

The DCX 870 has many features and facilities, as summarised below.

- It can handle up to 256 asynchronous ports on each multiplexer.
- It can interface to synchronous or asynchronous devices.
- It can handle practically any combination of channel data rates and codes from 50 to 19200 bps.
- Data rates up to 9600 bps can be established automatically by the terminal.
- Dual resilient Buffer And Timing (BAT) modules.
- Each multiplexer can provide up to 15 composite links.
- Each composite link may operate at up to 79.2 kbps.
- Automatic retransmission of frames provides extensive error correction facilities.

- The internal routing of channels can be configured to your network requirements with configuration maps stored in memory.
- Two separate configuration maps are available, to provide for alternative configurations.
- While one configuration map is Active (in use), you can edit or reconfigure the other one. Either map may be inspected at any time.
- Test facilities are available for fault tracing and diagnosis.
- Machine readable files of configuration maps can be downloaded (dumped) to an external storage medium or uploaded from an external medium.
- Remotely sited DCX 870s can be controlled from the Network Management Centre (NMC) or a VT100 terminal via System Modules.
- Events and statistics can be logged by the System Modules.
- Modular construction makes configuration and maintenance a simple task.
- Extensive monitoring facilities are available for network management and diagnostics.

A brief operational description follows in Section 1.2, and the physical configuration of the DCX 870 is covered in detail in Chapter 3.

1.2 DCX 870 Operation

The principles of DCX operation are explained in the Introduction to DCX Documentation guide. The operation of the DCX 870 is illustrated by the block diagram in Figure 1-2 and summarised below.

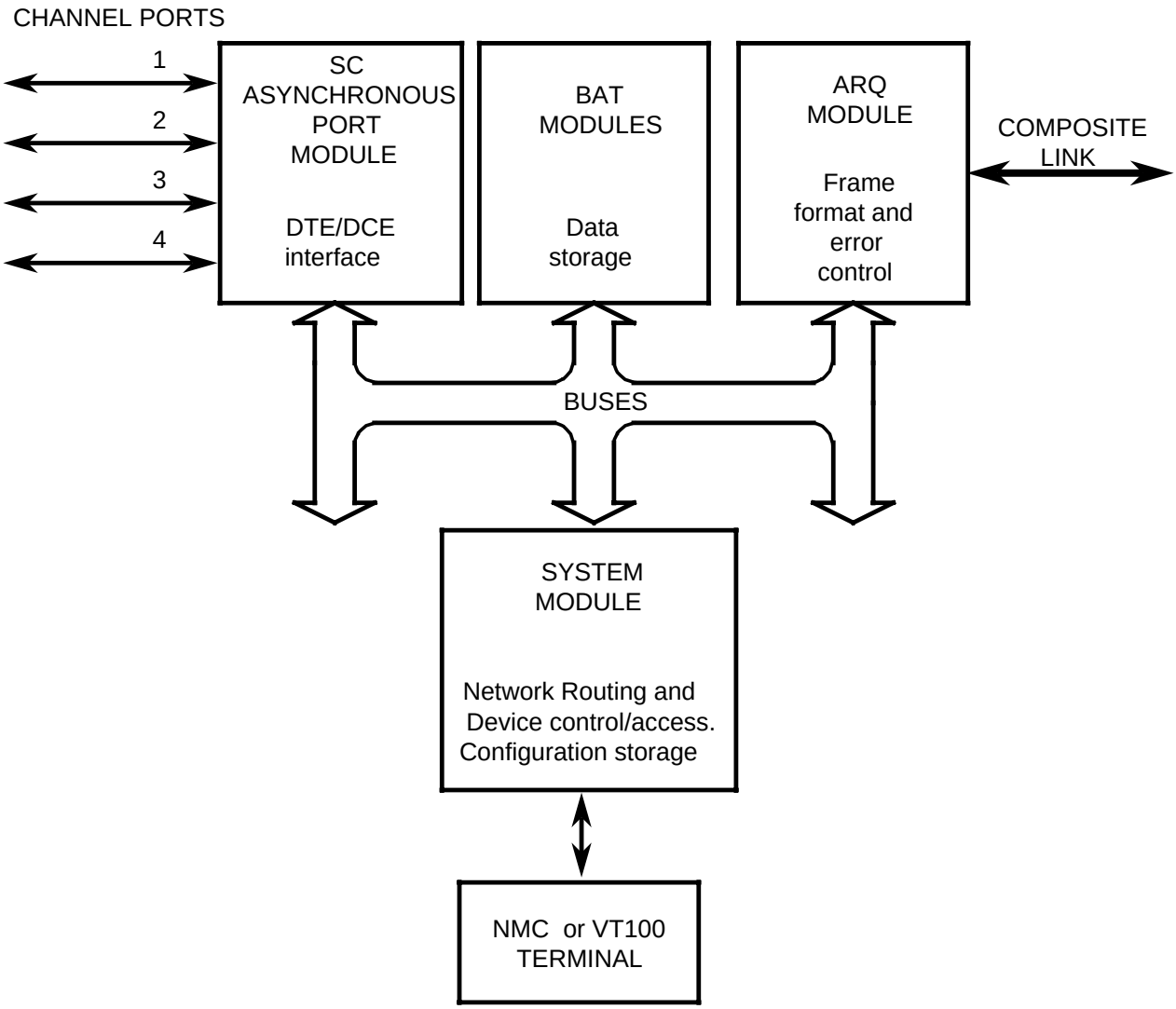


Figure 1-2 DCX 870 Operational Block Diagram (Simplified)

- Asynchronous data (from the terminal equipment) at the channel ports is interfaced to the multiplexer by the SC modules.
- The data is then sent to the Buffer And Timing (BAT) modules for temporary storage in buffer memory.
- An ARQ (Automatic Repeat reQuest), XBridge or FBridge module takes data from the buffer and formats it into multiplexed data frames,

together with the communications protocol data. It then transmits this composite data on the high speed link. It also re-transmits any frames requested by the other end of the link. If there is more than one ARQ, XBridge or FBridge module within the node, it would be possible to switch between alternative routes out of the node.

- Alternatively, asynchronous data may be taken from the buffer and routed locally to another asynchronous channel within the same node.
- The ARQ module accepts composite link data, checks the frames for errors, and requests the retransmission of any error frames. It then demultiplexes the data and places it in the buffer memory.
- The SC modules accept the (ARQ) data from the buffer and interface it to the channel ports for output.
- Alternatively, the (ARQ) data from the buffer can be retransmitted, via an additional local ARQ module, to another DCX node.
- The System Module controls the operation of the multiplexer and routes the data channels according to maps held in memory, or user destination selection. It allows you to configure, control, monitor and test the devices in the multiplexer. Remotely sited multiplexers may also be accessed and controlled from the local System Module.
- Communication and control between the various modules is achieved by means of the buses on the backplane of the card frame.
- Additional device modules can be plugged into the card frame, accessing the backplane buses as required.
- For large systems that require more modules than can be accepted in a single frame, expansion frames are used. These are connected to the backplane buses of the master frame by the QEM and optical fibre cables.

All modules that can be incorporated into the DCX 870 have separate manuals describing their operation in detail.

2 Physical Description

2.1 Overview

The DCX 870 is a system of modules assembled within a card frame to form a networking multiplexer. The type and number of modules incorporated is dependent upon the network requirement. When the number of low-speed modules required exceeds the capacity of the 'master' frame, expansion frames are used. Expansion frames are connected to the master frame by optical fibre cables, which means that they may be sited up to 1 km from the master frame.

A DCX 870 card frame can be housed in any standard 19-inch (482 mm) rack cabinet, in which it requires 7 U of space. Up to four card frames can be installed in the standard-height cabinet available from Case, and up to two in the short cabinet. Air deflector plates (which are always supplied), taking up 1 U of space, must be installed between the card frames when they are fitted in rack cabinets.

2.2 The DCX 870 Card Frame

DCX 870 card frames are 7 U high, and are designed to fit into 19-inch wide racks. Each frame has a front panel, attached to the unit by four screw fasteners. At the rear, there is a hinged panel, attached by two screws, which holds the interface connectors. These panels allow access to the various parts of the assembly as illustrated in Figure 2-1 (see the warning on Page 0-2).

The frame has 20 slots for plug-in module cards, and two further slots for plug-in power supplies. It provides a backplane with buses which interconnect the modules and supply power to each card. The rear panel has provision for mounting the DCE or DTE connectors allocated to each card slot, as shown in Figure 2-2. The card frame has an integral fan tray, fitted beneath the slots, for cooling purposes.

On the outside of the frame, below the rear panel, there are two fuses and a mains connector. There is no mains switch: the unit powers up via the switch(es) on the power supply unit(s).

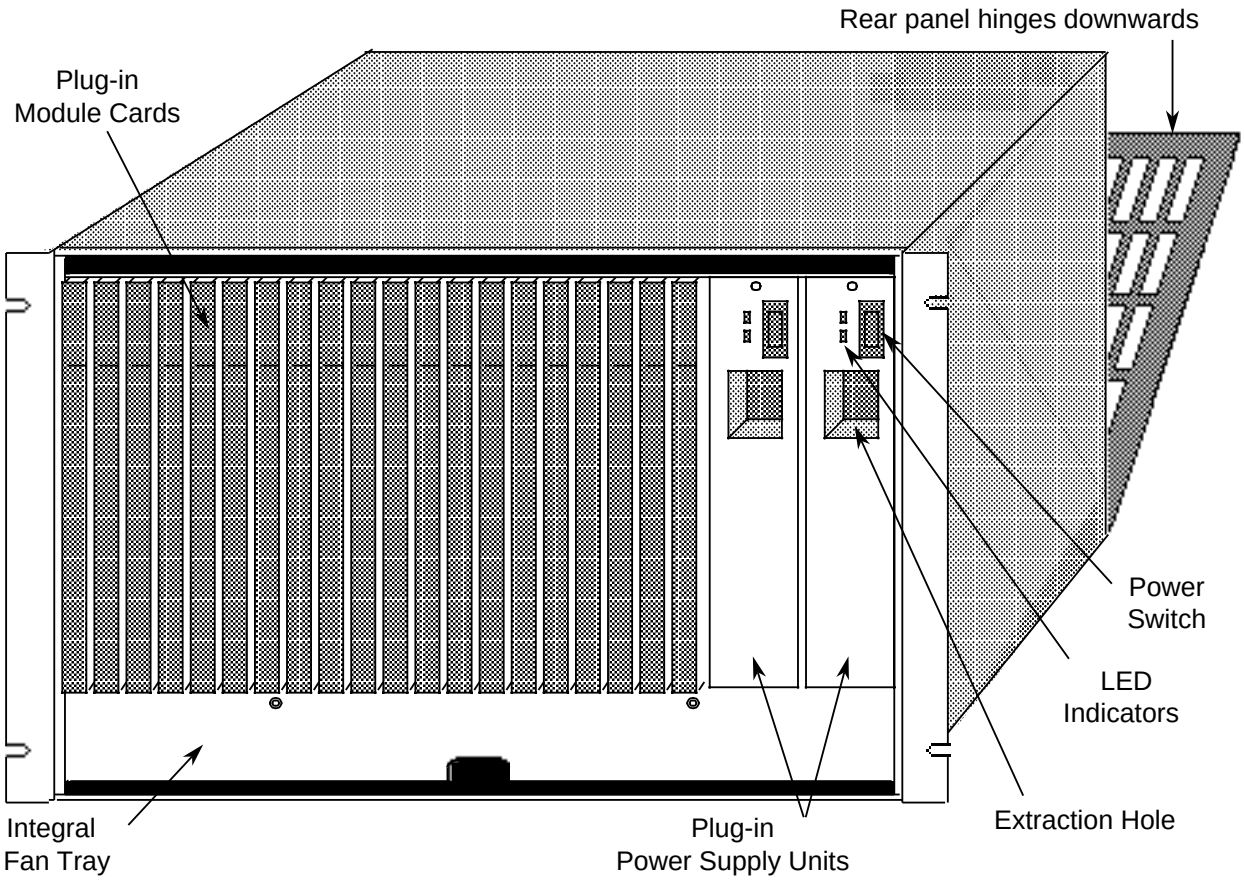


Figure 2-1 A DCX 870 Frame (Front Panel Removed)

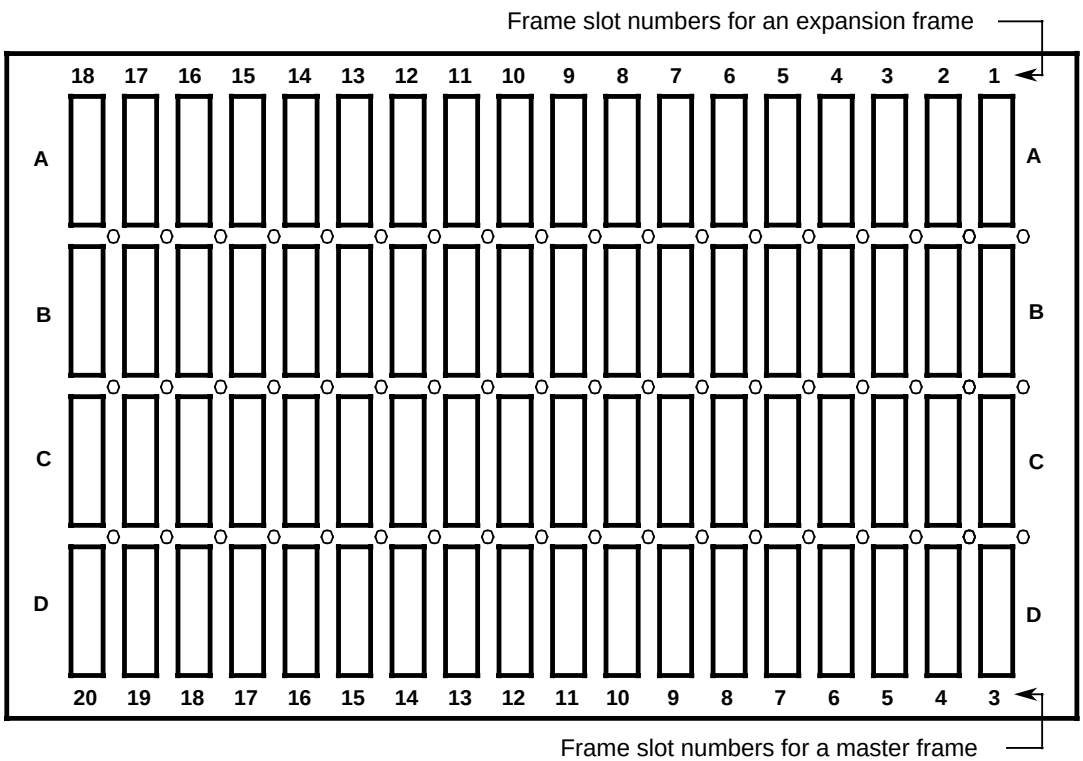


Figure 2-2 View of Rear Panel

2.2.1 Modules

The modules used in the DCX 870 are plug-in printed circuit cards inserted into the card frame(s). The position of each card in the frame is determined by its type, the configuration of the multiplexer, and the quantity of cards required. Each card occupies one slot in the frame.

The following cards are automatically supplied to provide the basic DCX 870 configuration:

A System Module
Two BAT modules

In addition, a number of SC1 or SC2 cards will be required to provide asynchronous ports.

Several other cards are also available, providing internodal links, protocol conversion, monitoring facilities and expansion facilities.

Each module is provided with a manual describing its use, operation and physical parameters.

The characteristics of the main cards are summarised in the following paragraphs for quick reference.

- **System Module (SM)**

  This module controls the routing of the low speed channels and the composite links to produce the node configuration. It provides user switching capabilities, configuration map manipulation and access to, and control of, other devices installed in the DCX 870.

  When only one SM card is installed, it will be located in slot 20 of the master frame.

  When two SM cards are installed, they must occupy slots 19 and 20 in the master frame. The two SM cards are connected together by means of a cable which plugs into a Port Access Module (PAM) at the rear of each card.

- **BAT Card**

  This card provides temporary storage for all data in transit, and also supplies the system timing. The BAT card can support a total of 512 full-duplex channels, or 1024 individual channel buffer queues.

Two BAT cards are installed in the DCX 870 for resilience. BAT cards may only occupy slots 1 and 2 in the master frame.

- **QEM Card**

  This card is used for expansion frames. It interfaces the DCX bus of the master frame to an optical fibre cable. The QEM should be installed in slot 3 of a master frame.

- **RES Card**

  This card is used in expansion frames. It interfaces the optical fibre cable from the master frame to the DCX bus of an expansion frame. The RES card is installed in slot 20 of an expansion frame.

- **Asynchronous Port Card (SC)**

  The version of card usually fitted in the DCX 870 is the SC2. This card accepts data from four asynchronous user ports (DTE channels) and interfaces them to the internal multiplexer bus. Each channel has dynamic memory allocated to it by the BAT card(s). SC cards may be installed in any slot (up to slot 16) not occupied by any other card.

- **ARQ Card**

  This card (specifically, the ARQ5) formats data, provides error control, and provides a synchronous composite link interface to a single destination. As ARQ cards are high-speed devices, they must only be installed in the master frame.

- **SM Monitor Card**

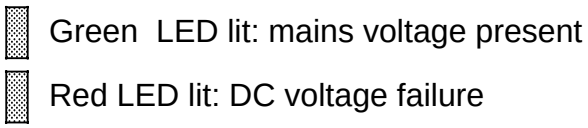
  This card allows channels to be monitored, and the information routed to a low-speed channel port or a remote port via an ARQ or bridge channel.

2.2.2 Power Supply Units

Each card frame has at least one plug-in power supply unit (PSU) situated at the right hand end of the frame; the second PSU, if fitted, is for resilience.

The PSU has two LED indicators – one green and one red – situated next to the power switch (above the square extraction hole). When the unit is operating correctly, with mains power present, the green LED is

continuously lit, and the red LED is off. The red LED would be illuminated should any of the three DC rail voltages fail.



If a card frame has two PSUs installed, it is possible, on failure of one of them, to remove the failed unit without powering the frame down.

2.3 Cabinet-related Hardware

You can use any standard 19-inch cabinet for enclosing DCX 870 frames. Specifications of the two types of cabinet supplied by Case are given below.

2.3.1 Case Standard-height Cabinet

The standard-height cabinet provides 36 U capacity.

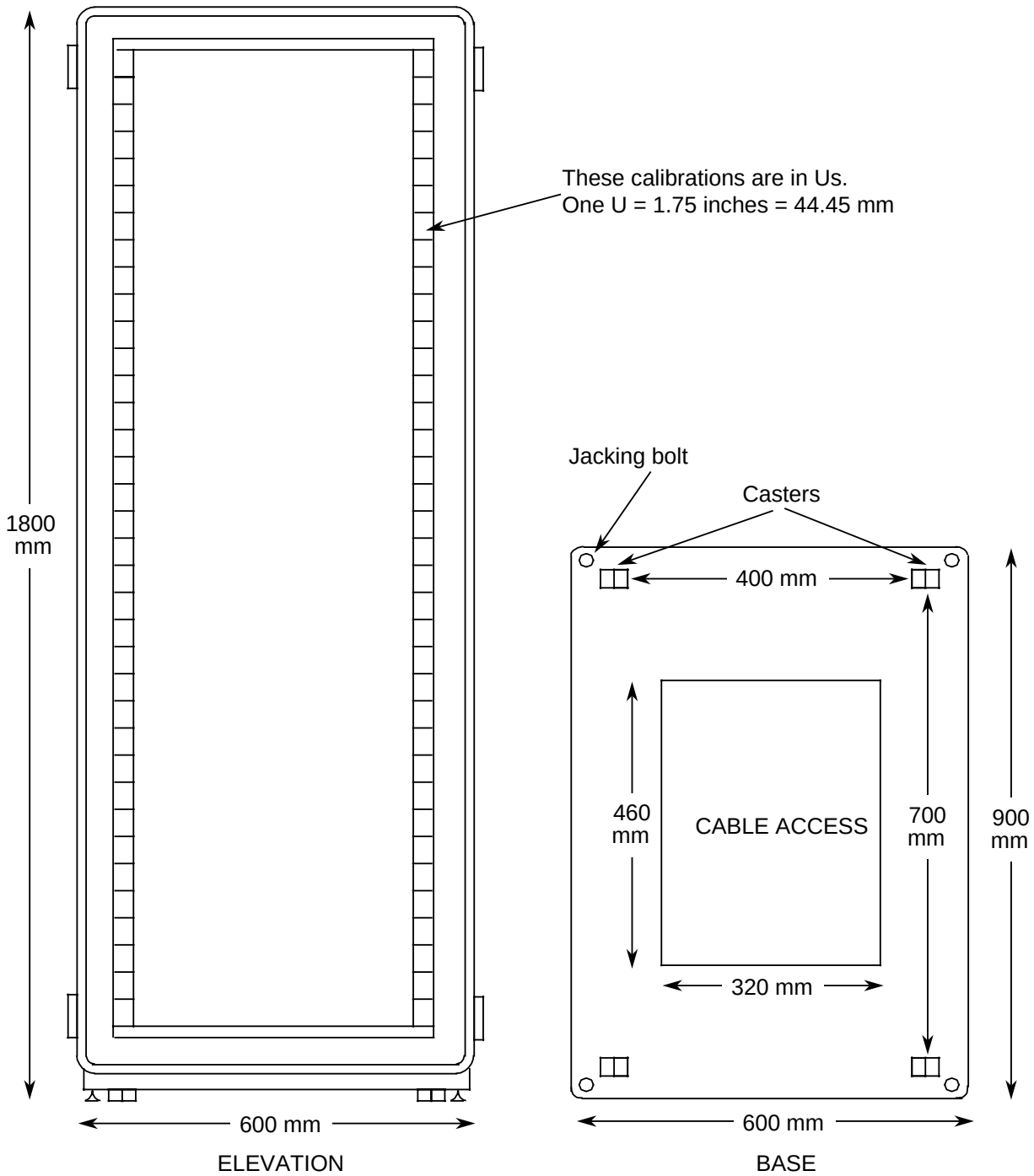


Figure 2-3 Case Standard-height Cabinet Details

Weight:	120 kg (excluding contents)
Mains Cable:	3 metres, 15A Hubbell connector (cabinet end), 13A plug
Power Sockets:	10 outlets, 13 A sockets (these must not draw a total current more than the rating of any single connector in the circuit)

2.3.2 Case Short Cabinet

The short cabinet provides 22 U capacity.

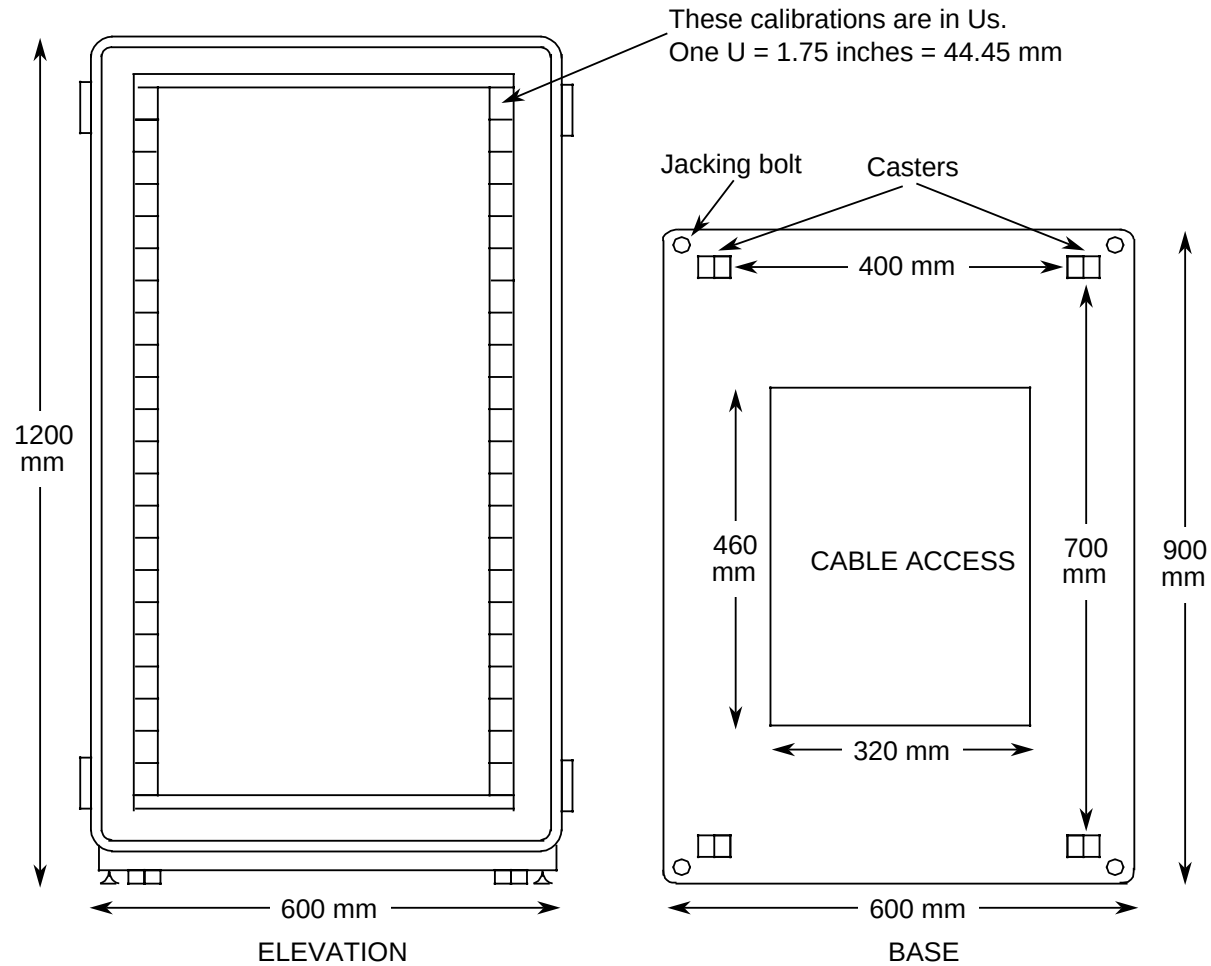


Figure 2-4 Case Short Cabinet Details

Weight:	75 kg (excluding contents)
Mains Cable:	3 metres, 15 A Hubbell connector (cabinet end), 13 A plug

Power Sockets:	6 outlets, 13 A sockets (these must not draw a total current more than the rating of any single connector in the circuit)

2.3.3 Ventilation Accessories

A particular type of fan unit is used in the Case standard-height and short cabinets. Also, air deflector plates must be used in *all* cabinets, and a ventilator panel should be used in certain circumstances. These items and their usage are described below.

The combined effect of these ventilation accessories on the airflow is illustrated in Figures 3-2 and 3-3.

Fan Panel Units

One fan panel unit is supplied with each Case cabinet. The unit is fitted in the bottom 3 U of the cabinet. The fans draw in air through vents in the front door and direct it upwards into the space between the door and the card frames. From there, the air passes through the deflector plates, and hence into each card frame.

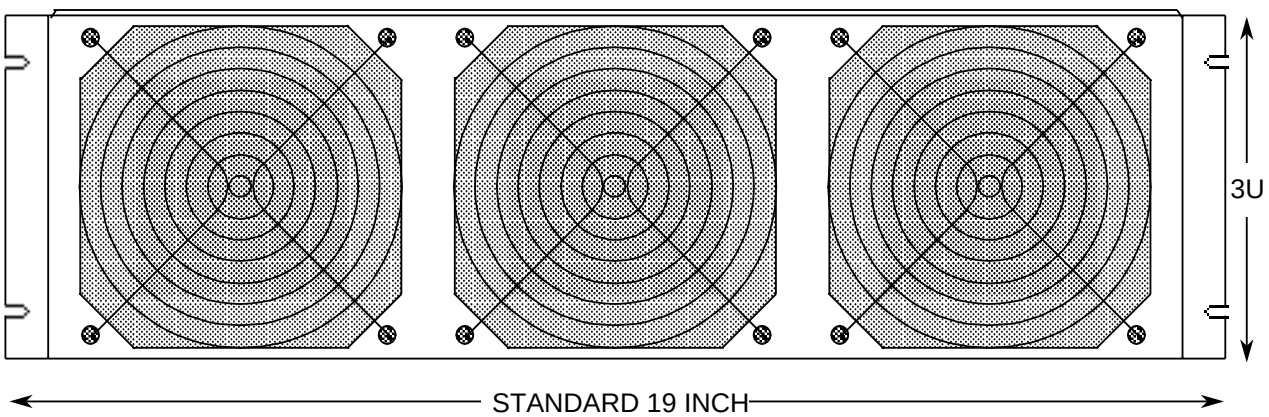


Figure 2-5 Fan Panel Unit

Weight:	2.5 kg
Mains Cable:	2 metres (with 13 A plug in UK)
Mains Requirement:	230 VAC, 50-60 Hz
Typical Heat Output:	27 watts

Air Deflector Plates

Air deflector plates suitably direct the airflow within a cabinet. Two of these are supplied with the master frame, and one with each expansion frame. They must be fitted above and below each frame in a multiple-frame or mixed installation, except for the top frame in a cabinet (usually the master), which must have a deflector plate below it and, depending on the airflow scheme, either a ventilator panel (see below) or a blanking panel above it. Allow 1 U for each deflector plate.

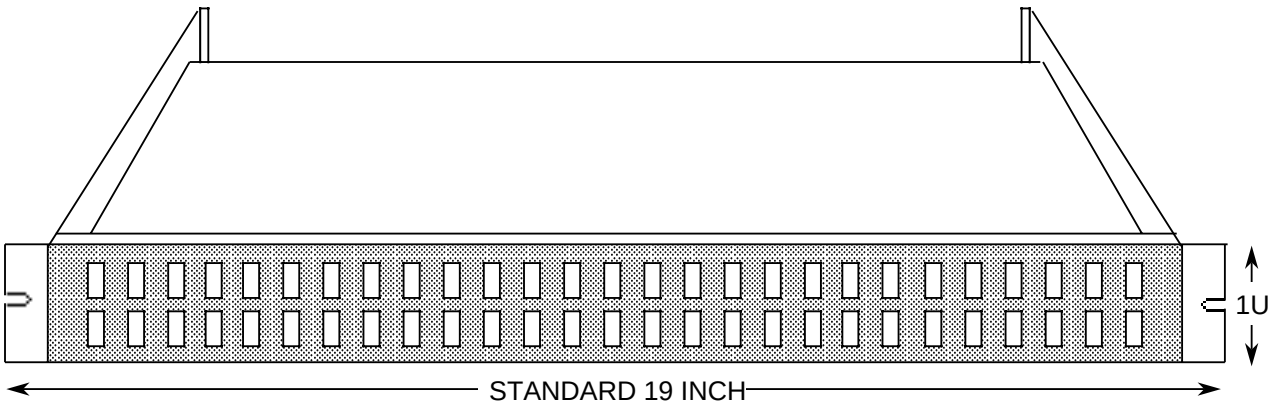


Figure 2-6 Air Deflector Plate

Weight: 1.8 kg

Ventilator Panels

If the airflow scheme in a cabinet is such that air is drawn in from the rear, a ventilator panel of some kind must be fitted above the topmost DCX 870 frame in that cabinet. The ventilator panels available from Case are each 1 U high. However, they are not required in Case cabinets, where a blanking panel (also 1 U) would be used instead.

Figure 2-7 Ventilator Panel

Weight: 0.15 kg

3 Pre-installation Planning and Preparation

Planning and making preparations for a DCX installation can be a relatively major undertaking if the intended installation is large. For a small installation, however, these tasks can be fairly minimal, especially if much of the requisite on-site infrastructure already exists.

The guidance given in this chapter is quite comprehensive and, as such, applies mainly to large installations; parts of it may be ignored for small installations. In the case of *very* small installations (perhaps where there is only one DCX frame), it may even be preferable to apply the planning essentials during the installation itself. The most essential information, which will be relevant to *all* types of installation, is to be found in the sections on Physical Configuration and Port Connector Plans.

When installing large DCX systems at your site(s), it is advisable to produce plans and tables detailing all the necessary installation information. For this purpose, blank tables and plan forms are given in Appendix C. They can be copied for your own use. You are referred to the individual tables and plans in the appropriate sections of this chapter.

If the actual installation is to be carried out by Case, or by an authorised DCX supplier, the pre-installation planning will also be conducted by them. In this case, customer responsibility will be limited mainly to preparation of the site (see Section 3.8). For an indication of the likely installation schedule, see Section 3.9.

3.1 General Site Requirements

The following general requirements apply to all DCX installations:

- **Space.** Sufficient space must be allowed for front and rear access to all units.
- **Environment.** The location must be free from dust, fumes, vibration etc.
- **Temperature and humidity.** The environmental limits within which the equipment must be operated, and the approximate heat dissipated from each unit in normal operation, are given in the DCX 870 specification (see Appendix A). Large installations may require assistance from air conditioning to maintain a suitable ambient temperature.
- **Ventilation.** DCX 870 units use integral fans and various accessories to provide adequate airflow. Care must be taken not to obstruct the passage of air through the cabinet vents. For most types of cabinet, both of the cabinet doors (front and rear) must be closed for the cooling to function correctly.
- **Power.** A sufficient source of 'clean' AC power at the correct voltage must be available (see Appendix A).
- **Cable runs.** The routing of cables from the equipment associated with the network to the multiplexer should be pre-planned. A decision on whether the cables are to be laid across the floor or under a raised floor must be made. It is unwise to run data cables alongside or across mains cables.
- **Weight.** The weight of the equipment should be taken into consideration when installing the system (see Appendix A). When mounting rack cabinets on raised flooring, adequate support must be provided.
- **Telecommunications installation requirements**. The statutory requirements for connection of data communications equipment to telecommunications transmission equipment must be strictly observed.

3.2 Site Configuration Plan

Your intended DCX network configuration determines what equipment is to be located at each site (note that a site may contain more than one DCX node). You should be able to specify the following information:

- The type and size of each DCX, and the number of cabinets required.
- The equipment to be attached by cable to each DCX (DTEs, modems, printers, etc).
- The precise location of each DCX at the site, and of each piece of attached equipment (both local and remote).
- Any telecommunication requirements or restrictions to installation.

To record this information, a Site Configuration Planning form is provided in Appendix C. A copy of this form should be completed for each site as shown in the example in Figure 3-1.

Network Name: DCX Admin Net Site Name: WATFORD OFFICE
Location: Level 1 Computer Room
Multiplexer Type(s): DCX 870 Enclosure Type: Standard Cabinet
Telecom Requirements/Restrictions:
1. PAM requirement on Kilostream connections
2.

Composite Link(s):

LINK No	EQUIPMENT TYPE	LOCATION AND NOTES
1	Modem - Quattro	Cabinet (to London office)
2	Modem - Quattro	Cabinet (to Denmark office)
⋮	⋮	⋮

Attached Equipment:

DTE/DCE	QTY	EQUIPMENT TYPE	LOCATION AND NOTES
DTE	9	VDU - VT100	Sales Office
DTE	2	Printer - OKI	Despatch
DCE	1	Modem - Syncro	Cabinet (to Sales Manager)
⋮	⋮	⋮	⋮

Figure 3-1 Example Site Configuration Planning Form

3.3 Floor Plan

To determine how your DCX physically merges with the existing facility, it is advisable to produce a floor plan of the proposed site. This shows the position of the DCX multiplexer in relation to surrounding equipment. It may also show the cable routing to the equipment and the supply of AC power for the DCX. To aid you in producing a floor plan a scale diagram of a cabinet base is given in Appendix C together with a floor grid. The following considerations should be observed when planning the equipment location:

- Rear access to cabinets for installation and maintenance is required. Space behind the cabinets should be at least 600 mm to allow the rear door to be opened and the cables to be fitted.
- Front access to cabinets for installation, operation and maintenance is required. Space in front of cabinets should be at least 600 mm to allow the front door or front panels to be opened, so that the indicators may be seen, and cards may be installed and removed.
- Free access of air to the cabinet rear door and from the cabinet top must be allowed.
- When installing standard Case cabinets, floor-to-ceiling height of at least 1.83 m should be allowed.
- When installing cabinets on raised floors, adequate support must be provided.
- A Baying Kit is available to join two standard cabinets side-by-side.
- A supply of mains AC power must be provided within three metres of each piece of equipment.
- The position of leased or dialled line or NTU connections must be considered. (Possibly within rear of cabinet, e.g. BT LTF 2B 19-inch rack or blanking panel fixing in rear of cabinet.)
- The maximum recommended length of 16 metres for signal cables should be observed (see Sub-section 3.7.2).

Example floor plans (with cable runs) are shown in Figures 3-15 and 3-16.

3.4 Cabinets

3.4.1 Cabinet Ventilation

The exact method of ventilating a cabinet depends on your own preference and the type of cabinet to be used: proprietary or supplied by Case.

All methods employ up to three types of fan:

- Integral fans in each DCX 870 frame. These fans draw air from the front or rear of the cabinet, past the air deflector plates, and force it through each unit, and finally out through the roof of the cabinet.
- Roof fans. One is fitted at the top of most cabinets, expelling hot air through the perforated cabinet roof.
- Fan panel units. One is fitted in the bottom of each cabinet supplied by Case, immediately behind the front door. It draws air from the ventilation slots in the front door, forcing it upwards through the units. Many proprietary cabinet designs do not employ such a fan.

Two basic airflow schemes are possible: they are shown in Figures 3-2 and 3-3. The main difference between the two is the location of the air intake (front or back of the cabinet), and hence the relative orientation (upside-down or otherwise) of the air deflector plates. The second scheme is the one that is used in cabinets supplied by Case, for which the fan panel unit at the bottom is mandatory.

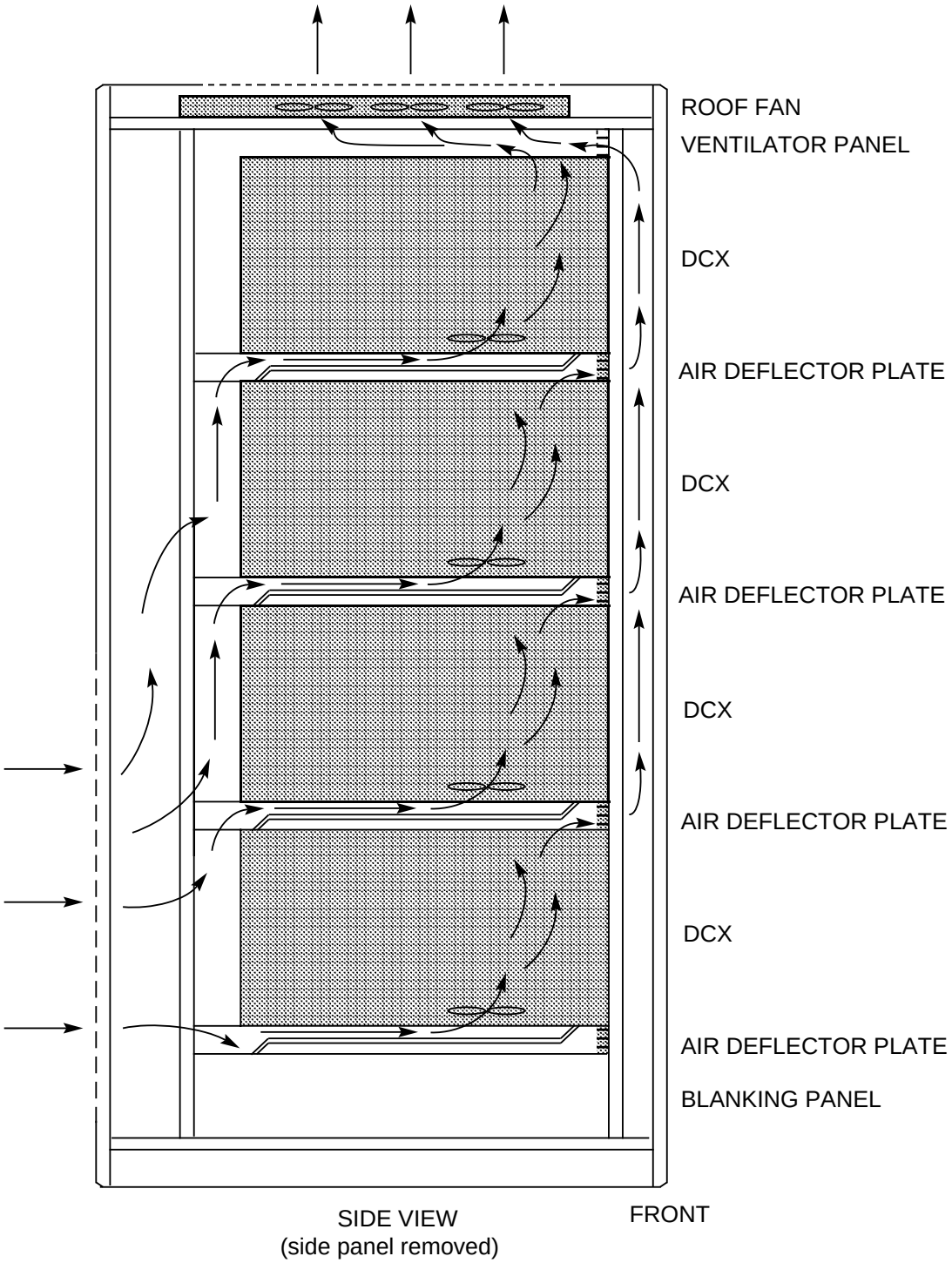


Figure 3-2 Typical Airflow through a Cabinet

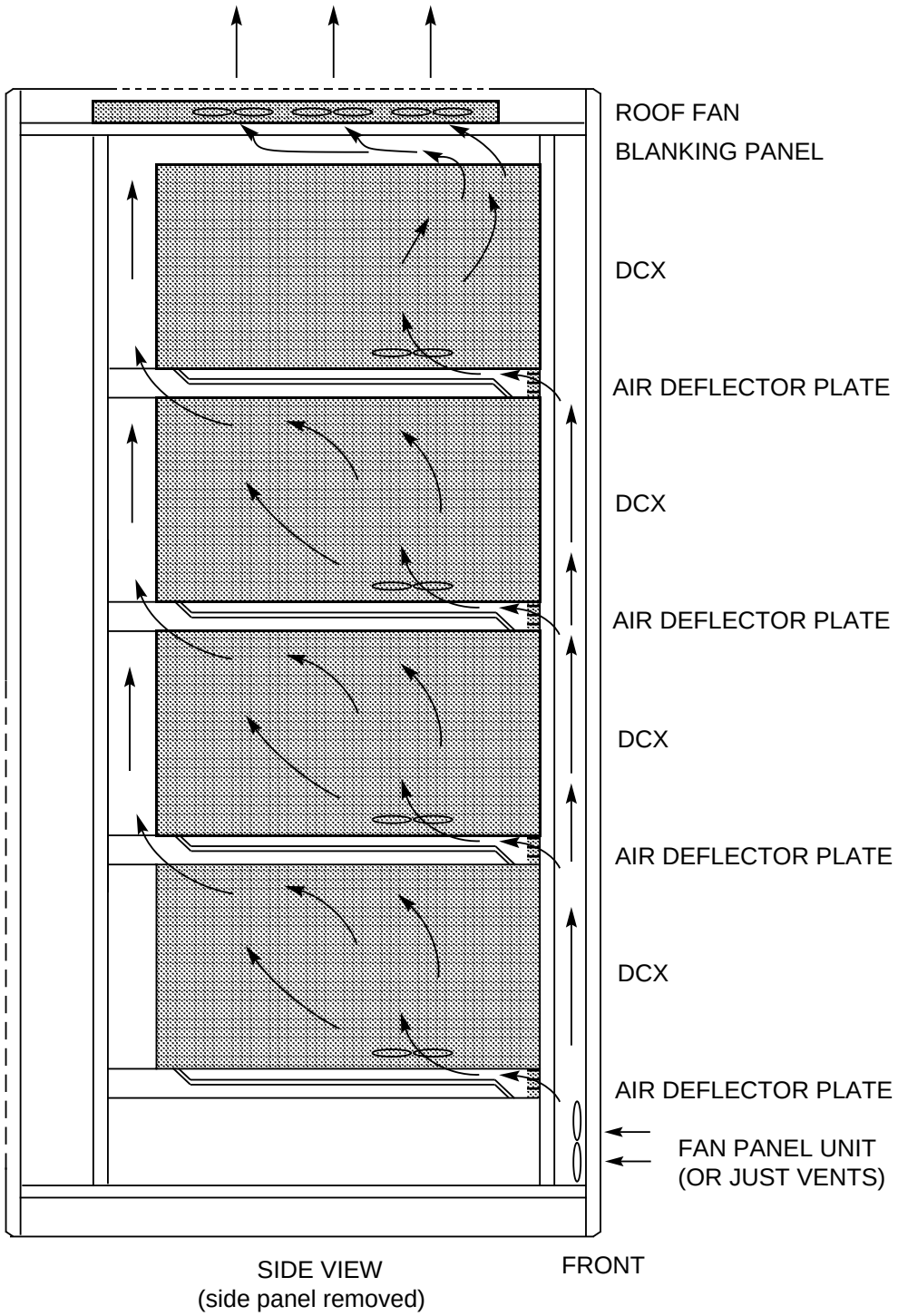


Figure 3-3 Alternative Airflow Scheme

3.4.2 Cabinet Assembly Plan

The multiplexer type and configuration for each site will have been determined at the network planning stage using the unit reference manuals. This determines the quantity of modules and frames installed, and consequently the size of enclosure required. Large multiplexers requiring two or more card frames are usually mounted in the taller type of cabinet.

You should now construct cabinet assembly layout plans to show:

- The position of card frames within the cabinet.
- The position of other equipment within the cabinet.

They are used to determine:

- The positions and run lengths of cables within the cabinet.
- The positions of the expansion cables connecting card frames.

In planning, do not assign excessively heavy units to the top of the cabinet unless the cabinet is properly braced. Other equipment considerations are:

- Operating convenience.
- Ease of installation and removal.
- Cabinet stability.
- Floor loading.
- Heat dissipation.
- If more frames are required than can be fitted in one cabinet, a Baying Kit may be used to simplify cabling by joining two cabinets side-by-side.

An example of a cabinet layout plan is shown in Figure 3-4. Blank diagrams suitable for planning cabinet assembly layouts are given in Appendix C.

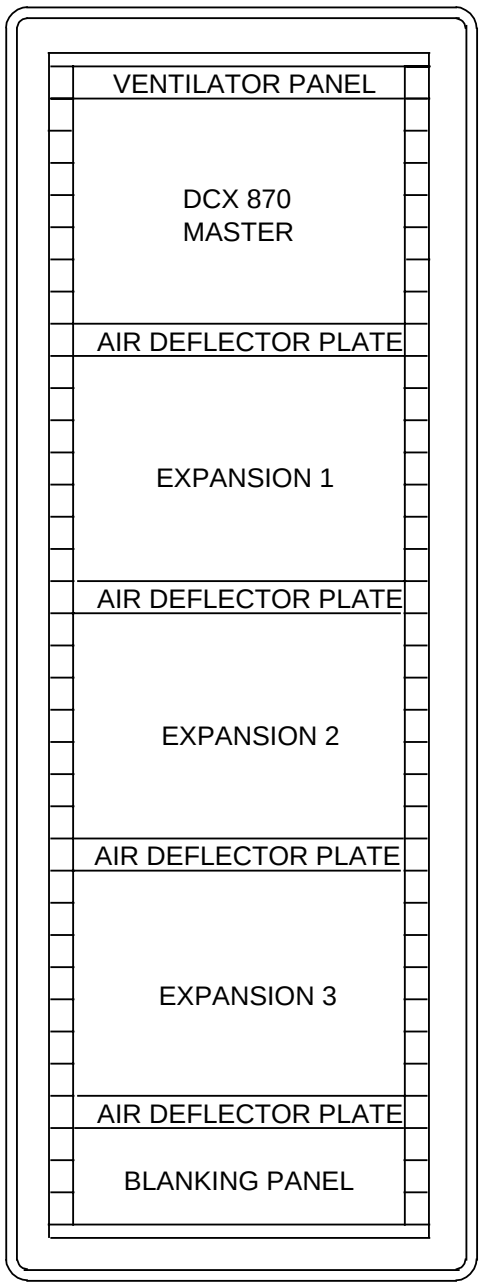


Figure 3-4 Example DCX 870 Cabinet Assembly Layout Plan

3.5 Physical Configuration

The 'physical configuration' of the DCX 870 refers to the number and location of cards within the frame(s). It depends on several parameters:

– The number of asynchronous ports required.

– The number of links to remote locations required.

– The number of ARQs, Bridges, Gates, Links and Monitors required.

– The number of expansion frames required (if any).

– The DCX bus architecture.

These parameters are determined from the network requirements.

The DCX bus architecture determines that the SM must always occupy slot 20 (with the standby SM, if any, occupying slot 19), and that the high-speed devices (ARQs, etc) must be installed in the master frame from slot 19 'downwards' (or from slot 18 downwards if a second SM is installed).

The following rules and diagrams are given to help you to determine the configuration of your DCX 870. A blank Physical Configuration Plan is given in Appendix C for your use.

3.5.1 Single Frame Configuration

A DCX 870 consisting of only a master frame is configured in the manner indicated in this sub-section (see Figure 3-5).

The population requirements are as follows:

- Number of mandatory cards

SM	1
BATs	2

- Number of optional cards

Second SM	max 1	up to an aggregate maximum of 17 cards
SCs	max 14	
Other modules	max 15	

The configuration rules are as follows:

- The SM card is inserted in slot 20.
- A second SM card, if required, must be inserted in slot 19.

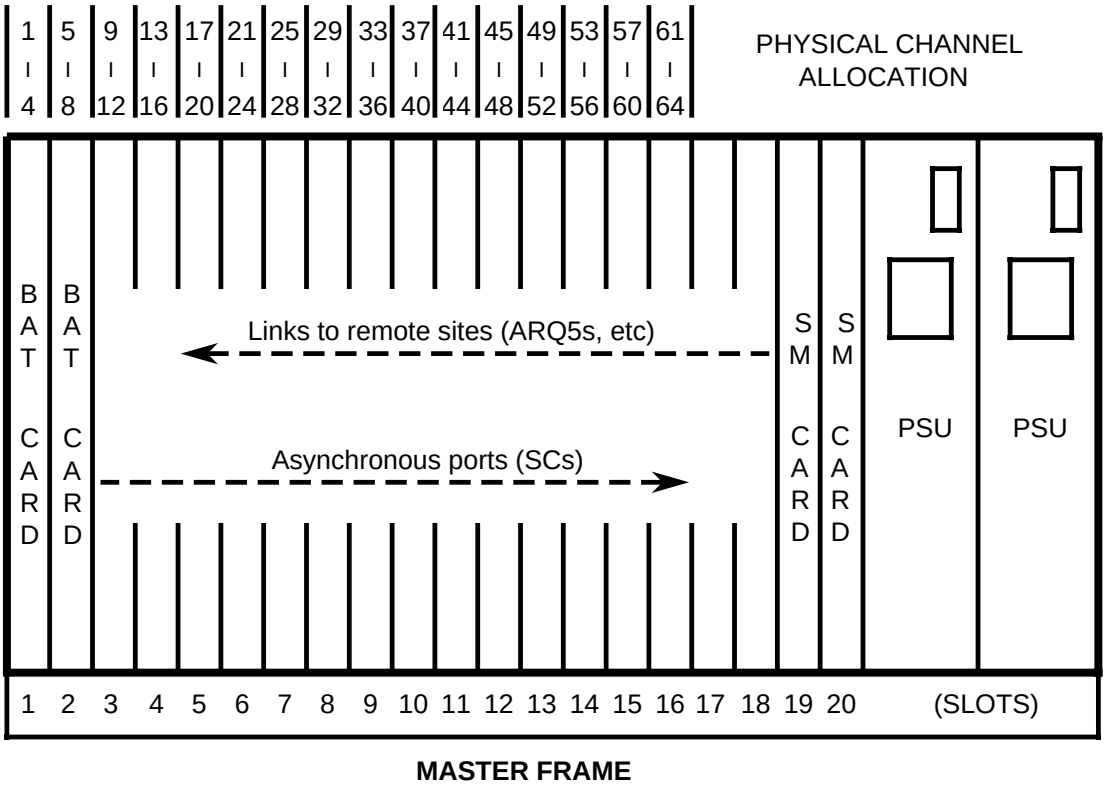


Figure 3-5 Single Frame Configuration

- Internodal cards (ARQ5, XBridge, FBridge, etc) are inserted from slot 19 (or 18) 'downwards'. Slots 1 to 4 are prohibited for such cards.
- BAT cards are inserted in slots 1 and 2.
- SC cards are inserted from the BAT cards 'upwards', up to slot 16.
- Internodal cards must not be inserted between the SC cards.
- QEM and RES modules are not used.
- The asynchronous channel numbers are fixed and allocated by the position of the SC cards within the frame. They start from 1 and can go to 64.

3.5.2 Dual Frame Configurations

Standard Dual Frame Configuration

A DCX 870 consisting of a master frame and one expansion frame is usually configured in the manner indicated in this sub-section (see Figure 3-6).

The population requirements are as follows:

- Number of mandatory cards

SM	1	Master Frame
BATs	2	
QEM	1	
RES	1	Expansion Frame

- Number of optional cards

Second SM	max 1	Master Frame
Other modules	max 15	
SCs	max 16	Expansion Frame

The configuration rules are as follows:

- The SM card is inserted in slot 20 of the master frame.
- A second SM card, if required, must be inserted in slot 19 of the master frame.
- Internodal cards (ARQ5, etc) must be inserted from slot 19 (or 18) 'downwards' in the master frame only. Slots 1 to 4 are prohibited for such cards.
- The QEM must be inserted in slot 3 of the master frame.
- The RES must be inserted in slot 20 of the expansion frame.
- For a standard dual-frame configuration, SC cards would not be allowed in the master frame. They are inserted from slot 1 up to slot 16 in the expansion frame.
- The asynchronous channel numbers start from 1 and can go to 64 in the expansion frame.

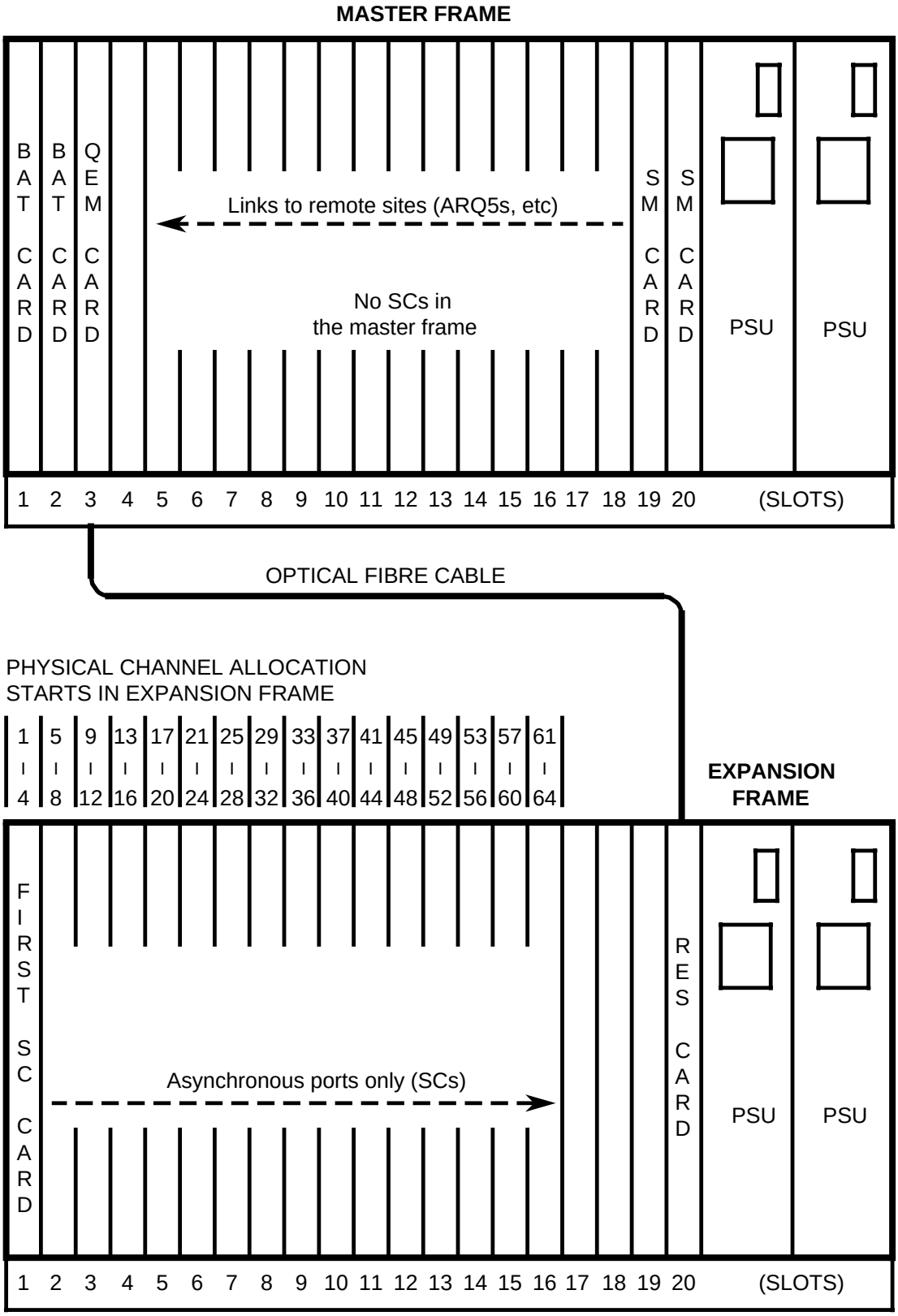


Figure 3-6 Standard Dual Frame Configuration

Alternative Dual Frame Configuration

A dual-frame DCX 870 requiring SC cards in the master frame (to avoid having an extra expansion frame) is usually configured in the manner indicated in this sub-section (see Figure 3-7).

The population requirements are as follows:

- Number of mandatory cards

SM	1	Master Frame
BATs	2	
QEM	1	
RES	1	Expansion Frame

- Number of optional cards

Second SM	max 1	Master Frame (max total of 16 cards)
SCs	max 13	
Other modules	max 15	
SCs	max 16	Expansion Frame

The configuration rules are as follows:

- The SM card is inserted in slot 20 of the master frame.
- A second SM card, if required, is inserted in slot 19 of the master frame.
- Internodal cards are inserted from slot 19 (or 18) 'downwards' in the master frame only. Slots 1 to 4 are prohibited for such cards.
- The QEM card must be inserted in slot 3 of the master frame.
- The RES card must be inserted in slot 20 of the expansion frame.
- SC cards are inserted from slot 4 in the master frame 'upwards' to slot 16, and from slot 1 in the expansion frame 'upwards' to slot 16.
- Available channel numbers start from 13 (slot 4) in the master frame up to the ARQ slot allocation. Channel numbers then recommence from channel 65 (slot 1) in the expansion frame up to 128.

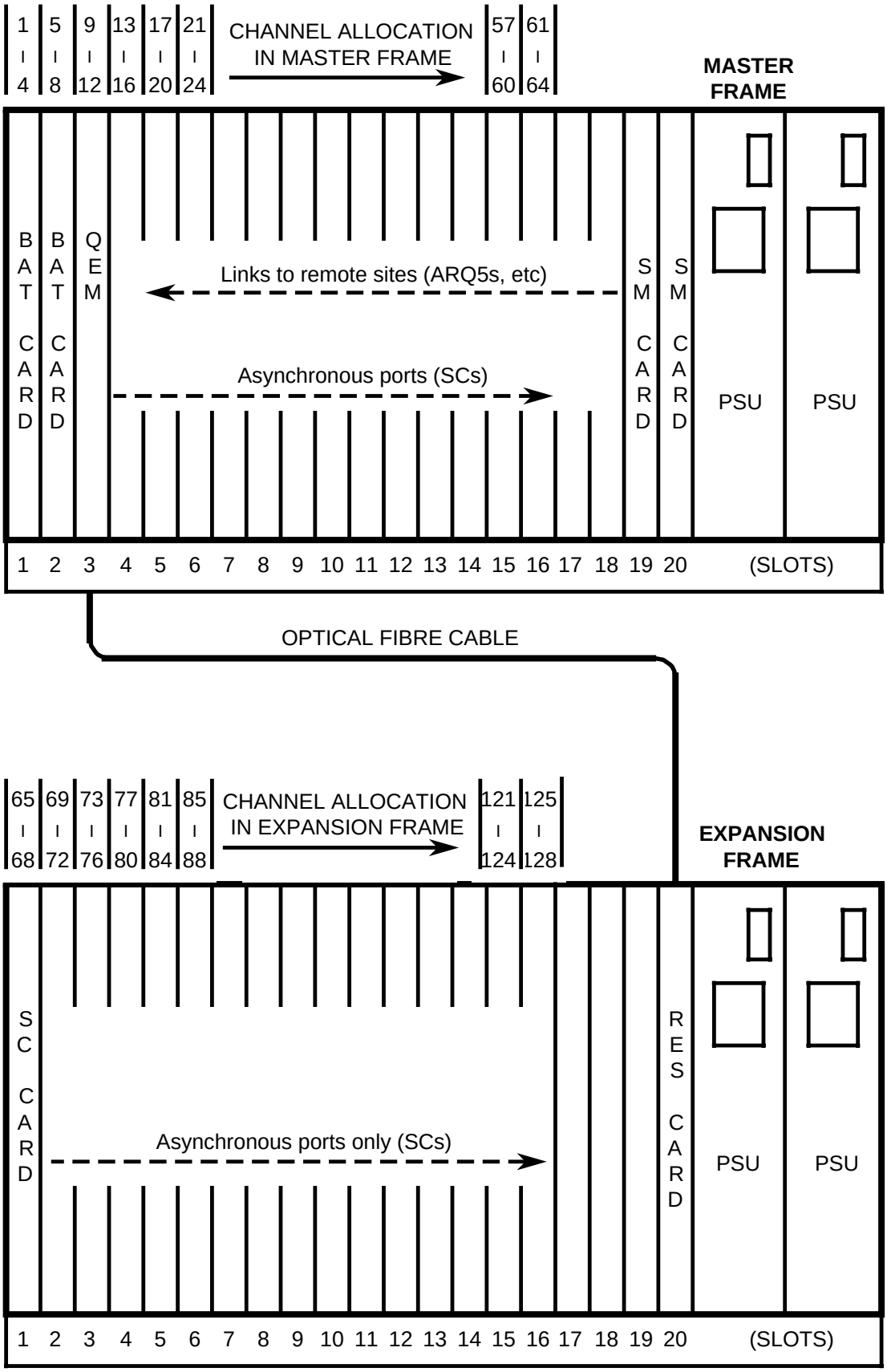


Figure 3-7 Alternative Dual Frame Configuration

3.5.3 Multiple Frame Configurations

A DCX 870 consisting of a master frame and two or more expansion frames is usually configured in the manner indicated in this sub-section (see Figure 3-8).

The population requirements are as follows:

- Number of mandatory cards

SM	1	Master Frame
BATs	2	
QEM	1	
RES	1	Each Expansion Frame

- Number of optional cards

Standby SM	max 1	Master Frame
Other modules	max 15	
SCs	max 16	Each Expansion Frame

The configuration rules are as follows:

- The SM must normally occupy slot 20 of the master frame.
- The second SM, if required, must occupy slot 19 of the master frame.
- Internodal cards are inserted from slot 19 (or 18) 'downwards' in the master frame only. Slots 1 to 4 are prohibited for such cards.
- The QEM card must occupy slot 3 of the master frame.
- A RES card must occupy slot 20 of each expansion frame.
- For a multiple-frame configuration, SC cards would not be allowed in the master frame. They are inserted from slot 1 up to slot 16 in each expansion frame.
- Asynchronous channel numbers are allocated from 1 in expansion frame 1, up to 256 in expansion frame 4.

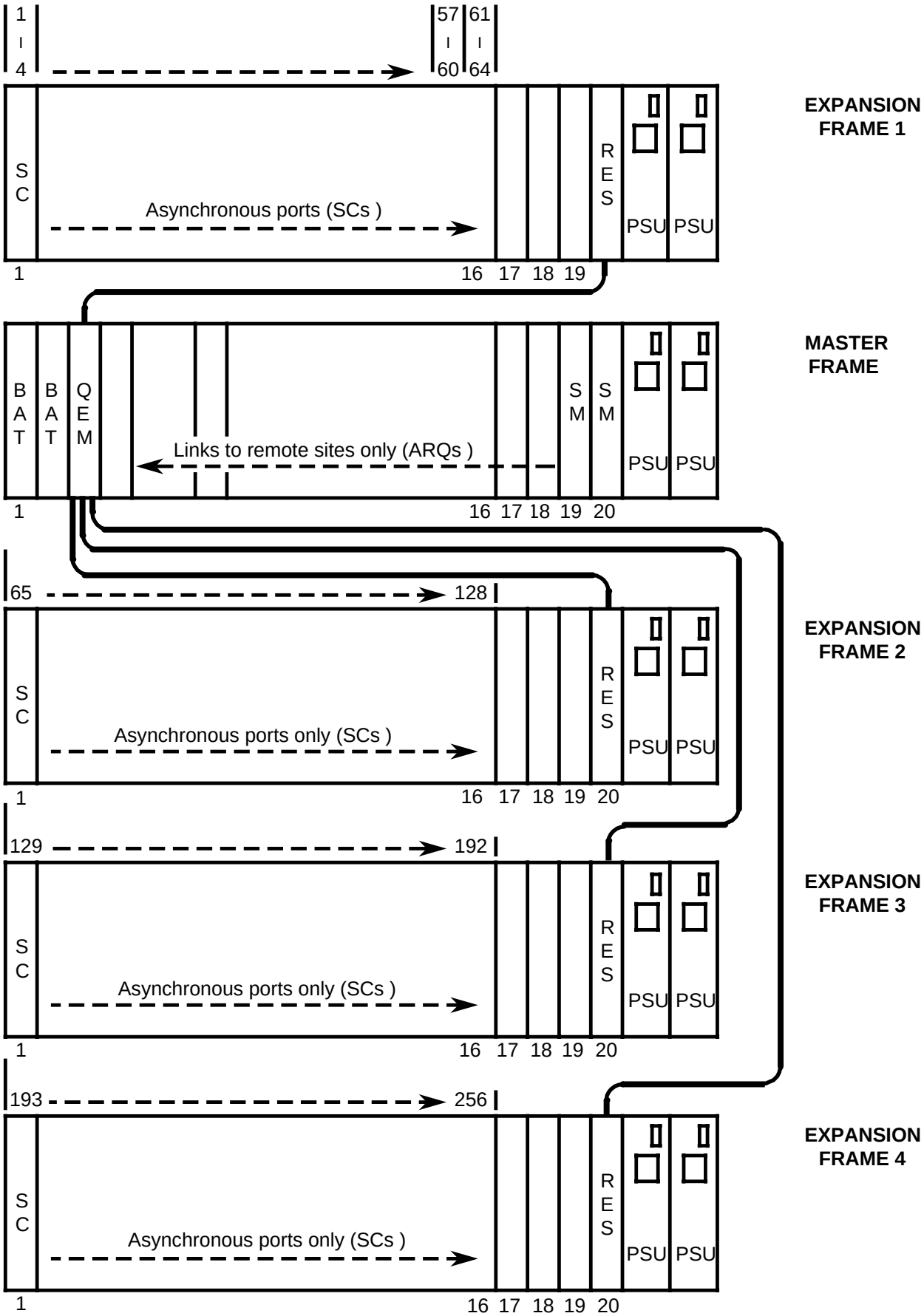


Figure 3-8 Multiple Frame Configuration

3.6 Port Connector Plans

The allocation of modules to frame slots, and consequently the numbering of channels, will have been determined at the network planning stage. It is now advisable to record the allocation of frame rear panel port connectors to high-speed devices and low-speed channels, to ensure the correct connection of cables from modems and terminals. To assist in this, blank port connector plans are provided in Appendix C.

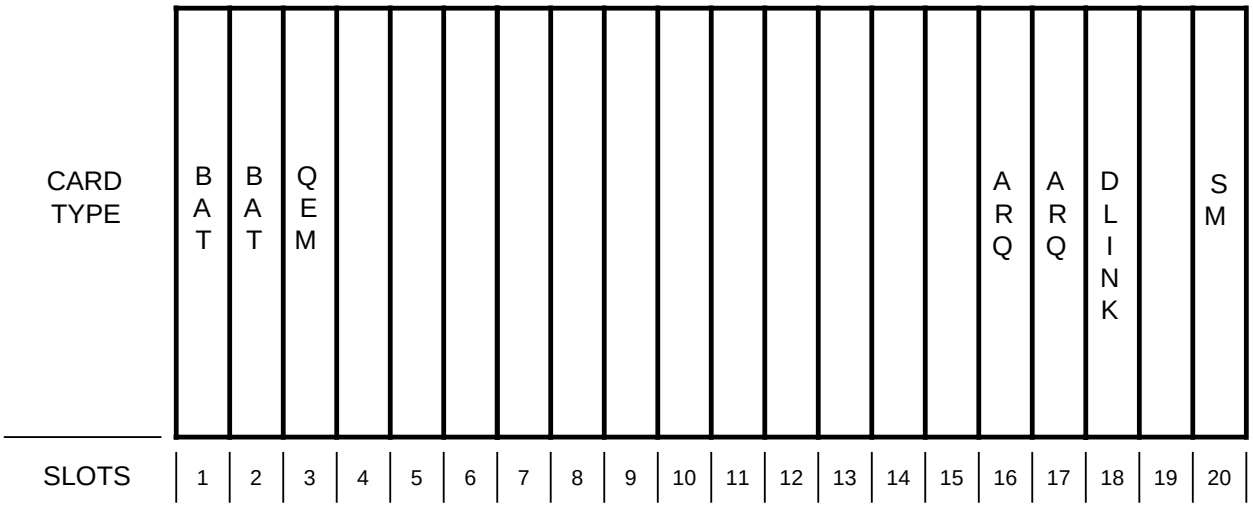
Every card slots into one or two connectors on the backplane. The lower of these (where there are two) is linked, via a short installable cable, to a PAM (also installable) fitted at an appropriate position on the frame rear panel. On each PAM (and hence, for each associated slot), there are four port connectors labelled A, B, C and D. High-speed modules use one or two ports (D, or C and D), and SC modules (SC1 and SC2) use all four ports.

There are only 18 possible PAM positions for 20 slots, since BAT cards do not have external connections, and there is also a limit on the number of SC cards that can reside in a frame.

The PAM position numbers on the rear panel should correspond with the respective slot numbers (except for the RES – see below). However, the same rear panel is used on both master and expansion frames; hence, there is one set of numbers (labelled 1 to 18), and an indication EXP FRAME, along the rear panel top that apply to expansion frames, and another set of numbers (labelled 3 to 20), with an indication MASTER FRAME, along the bottom that apply to master (and single) frames.

On the port connector plans included in Appendix C, you should put information such as low-speed channel numbers and link numbers for the ports at each of the relevant slot/PAM positions. Examples are given in Figures 3-9 to 3-12. Each example has a front view of the frame at the top, to show card-to-slot allocations, and a suitably filled-in plan below to represent the rear view, showing the port connectors. Observe that the SM Management Port is located in position 20A on the master, or single, frame. The RES card is unusual in that, despite residing in slot 20 of each expansion frame, its PAM position is labelled 18; thus, its twin optical port is located in position 18A. The four QEM twin ports are located in positions 3A, 3B, 3C and 3D on the master frame.

Cross-references between slot numbers, ports and channel numbers are given in Table 3-1, which assumes a normal distribution setting on the QEM (see the QEM and RES Modules Reference Manual).



LOCATION: CITY **NODE:** 1

FRAME: MASTER

	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A	SM																	OO	**A**
B																		OO	**B**
C																		OO	**C**
D			L1	L2	L3													OO	**D**
	20	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	

MASTER FRAME

Figure 3-9 Example of DCX 870 Master Frame Connector Plan (Three Link Modules Used)

PHYSICAL CHANNEL ALLOCATION	1 – 4	5 – 8	9 – 12	13 – 16	17 – 20	21 – 24	25 – 28	29 – 32	33 – 36	37 – 40	41 – 44	45 – 48	49 – 52	53 – 56	57 – 60	61 – 64				
CARD TYPE	SC2	SC2	SC2	SC2																RES
SLOTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

LOCATION: CITY **NODE:** 1

FRAME: EXPANSION 1

EXP FRAME

	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A	OO														C13	C9	C5	C1	A
B															C14	C10	C6	C2	B
C															C15	C11	C7	C3	C
D															C16	C12	C8	C4	D
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	

Figure 3-10 Example of DCX 870 Expansion Frame 1 Connector Plan (Channels – Normal Distribution)

PHYSICAL CHANNEL ALLOCATION	65 | 68	69 | 72	73 | 76	77 | 80	81 | 84	85 | 88	89 | 92	93 | 96	97 | 100	101 | 104	105 | 108	109 | 112	113 | 116	117 | 120	121 | 124	125 | 128
CARD TYPE	SC2	SC2	SC2	SC2												RES
SLOTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

LOCATION: CITY **NODE:** 1

FRAME: EXPANSION 2

EXP FRAME

	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A	OO														C 77	C 73	C 69	C 65	**A**
B															C 78	C 74	C 70	C 66	**B**
C															C 79	C 75	C 71	C 67	**C**
D															C 80	C 76	C 72	C 68	**D**
	20	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	

Figure 3-11 Example of DCX 870 Expansion Frame 2 Connector Plan (Channels – Normal Distribution)

PHYSICAL CHANNEL ALLOCATION	1 I 4	5 I 8	9 I 12	13 I 16	17 I 20	21 I 24	25 I 28	29 I 32	33 I 36	37 I 40	41 I 44	45 I 48	49 I 52	53 I 56	57 I 60	61 I 64				
CARD TYPE	BAT	BAT	SC2	SC2	SC2	SC2	SC2	SC2	SC2	SC2	SC2	SC2	SC2	SC2	SC2	SC2		ARQ# 2	ARQ# 1	SM	SM
SLOTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	

LOCATION: CITY **NODE:** 2

FRAME: SINGLE

	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A	SM	SM				C57	C53	C49	C45	C41	C37	C33	C29	C25	C21	C17	C13	C9	A
B						C58	C54	C50	C46	C42	C38	C34	C30	C26	C22	C18	C14	C10	B
C						C59	C55	C51	C47	C43	C39	C35	C31	C27	C23	C19	C15	C11	C
D			L1	L2		C60	C56	C52	C48	C44	C40	C36	C32	C28	C24	C20	C16	C12	D
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	

MASTER FRAME

Figure 3-12 Example of DCX 870 Single Frame Connector Plan (Two Link Modules and 13 Channel Modules Used)

Slot	Port	Single-frame Channel Numbers	Multi-frame Channel Numbers [Brackets denote alternative configuration]			
			Exp1 [Master]	Exp2 [Exp1]	Exp3 [Exp2]	Exp4 [Exp3]
1	A B C D	Not used due to BAT card in slot	1* 2* 3* 4*	65 66 67 68	129 130 131 132	193 194 195 196
2	A B C D	Not used due to BAT card in slot	5* 6* 7* 8*	69 70 71 72	129 130 131 132	197 198 199 200
3	A B C D	9 10 11 12	9† 10† 11† 12†	73 74 75 76	133 134 135 136	201 202 203 204
4	A B C D	13 14 15 16	13 14 15 16	77 78 79 80	137 138 139 140	205 206 207 208
5	A B C D	17 18 19 20	17 18 19 20	81 82 83 84	141 142 143 144	209 210 211 212
6	A B C D	21 22 23 24	21 22 23 24	85 86 87 88	145 146 147 148	213 214 215 216
7	A B C D	25 26 27 28	25 26 27 28	89 90 91 92	149 150 151 152	217 218 219 220
8	A B C D	29 30 31 32	29 30 31 32	93 94 95 96	153 154 155 156	221 222 223 224
9	A B C D	33 34 35 36	33 34 35 36	97 98 99 100	157 158 159 160	225 226 227 228
10	A B C D	37 38 39 40	37 38 39 40	101 102 103 104	161 162 163 164	229 230 231 232

Table 3-1 (Part 1 of 2) Channel Numbering (Assuming Normal Distribution for Multiple Frames)

Slot	Port	Single-frame Channel Numbers	Multi-frame Channel Numbers [Brackets denote alternative configuration]			
			Exp1 [Master]	Exp2 [Exp1]	Exp3 [Exp2]	Exp4 [Exp3]
11	A B C D	41 42 43 44	41 42 43 44	105 106 107 108	169 170 171 172	233 234 235 236
12	A B C D	45 46 47 48	45 46 47 48	109 110 111 112	173 174 175 176	237 238 239 240
13	A B C D	49 50 51 52	49 50 51 52	113 114 115 116	177 178 179 180	241 242 243 244
14	A B C D	53 54 55 56	53 54 55 56	117 118 119 120	181 182 183 184	245 246 247 248
15	A B C D	57 58 59 60	57 58 59 60	121 122 123 124	185 186 187 188	249 250 251 252
16	A B C D	61 62 63 64	61 62 63 64	125 126 127 128	189 190 191 192	253 254 255 256

* Not used in alternative configuration due to BAT card in slot.

† Not used in alternative configuration due to QEM card in slot.

Table 3-1 (Part 2 of 2) Channel Numbering (Assuming Normal Distribution for Multiple Frames)

3.7 Data Cables

To connect the associated equipment to the DCX, a cable of the correct type and length must be provided for each device. To ensure that all applicable equipment is installed correctly to the DCX it is advisable to produce an Equipment/Cable List for each site. A blank form is provided in Appendix C for this purpose, to be filled out as in the example shown in Figure 3-13. The following subsections provide further information.

DCX Site: WATFORD DCX Type: 870

Location: COMMS ROOM

EQUIPMENT	LINK/ CHANNEL	TAG CODES	CABLE TYPE	CABLE PART NO.	CABLE LENGTH
LINKS					
Modem (Q)	L1	M/19D	DTE-DCE	X840-400911	3m
FEP	L2	M/18D	DTE-DCE	X840-400911	6m*
NMC port 0	N1	M/6C	DTE-DCE	X840-407511	3m
NMC port 1	N2	M/6D	DTE-DCE	X840-401511	3m†
CHANNELS					
VDU #1	C1	E1/1A	DCE-DTE	with terminal	–
VDU #2	C2	E1/1B	DCE-DTE	with terminal	–
VDU #3	C3	E1/1C	DCE-DTE	with terminal	–
Exec 440	C4	E1/1D	DCE-DCE	X840-400611	3m
Comp port #1	C5	E1/1E	DCE-DTE	X840-400711	6m*
Comp port #2	C6	E1/1F	DCE-DTE	X840-400711	6m*
Comp port #3	C7	E1/1G	DCE-DTE	X840-400711	6m*

* Available in this length to order. Standard length is 3 metres.
† Standard length is 15 metres.

Figure 3-13 Example Equipment/Cable List

3.7.1 Data Cable Types

DCX interfaces are provided with the following standard physical configuration:

- SC ports are configured as DCE.
- ARQ ports are configured as DTE.
- SM management port is configured as DTE.
- Link and Gate ports are configured as DTE.
- Terminals and computer ports are configured as DTE.
- Modems, modem eliminators and line drivers are configured as DCE.

Standard straight-through cables (connecting pin 1 to pin 1, pin 2 to pin 2, etc) are used for interconnecting a DCE to a DTE.

To interconnect DCE to DCE, or DTE to DTE, a crossover cable is required.

Both straight-through and crossover cables are available from Case in various types and lengths. Standard cables are 3 metres long. Details of cables are given in the manuals of the units or modules with which they are used.

3.7.2 Data Cable Runs

Equipment location may be restricted by the RS-232/V.28 maximum 16 metres cable length recommended (greater distances require the use of suitable line drivers or modems). This length must include the DCX cabinet run, the sub-floor runs and equipment rack runs. See Figure 3-14.

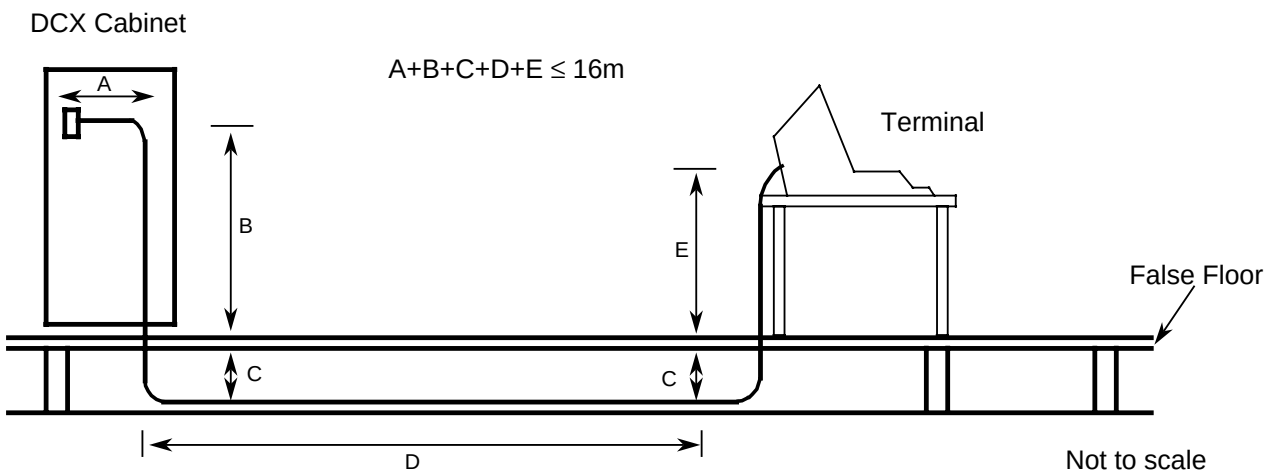


Figure 3-14 Run Length Diagram

Note that dimension 'A' should include 250 mm of slack cable to allow removal of the rear panel.

Cable access to cabinets is generally through the base, as shown in Figures 2-3 and 2-4 for cabinets supplied by Case.

Figures 3-15 and 3-16 show example cable runs for different circumstances.

3.7.3 Data Cable Tag Codes

A simple tagging code can be derived from the Port Connector Plans (Section 3.6) to identify the DCX end of each cable. This code could, for example, consist of the frame number/connector number, as illustrated below:

M1/16A			(DCX 870 Master Frame)
E1/1A	E1/1B	E1/1C	(DCX 870 Expansion Frame 1)

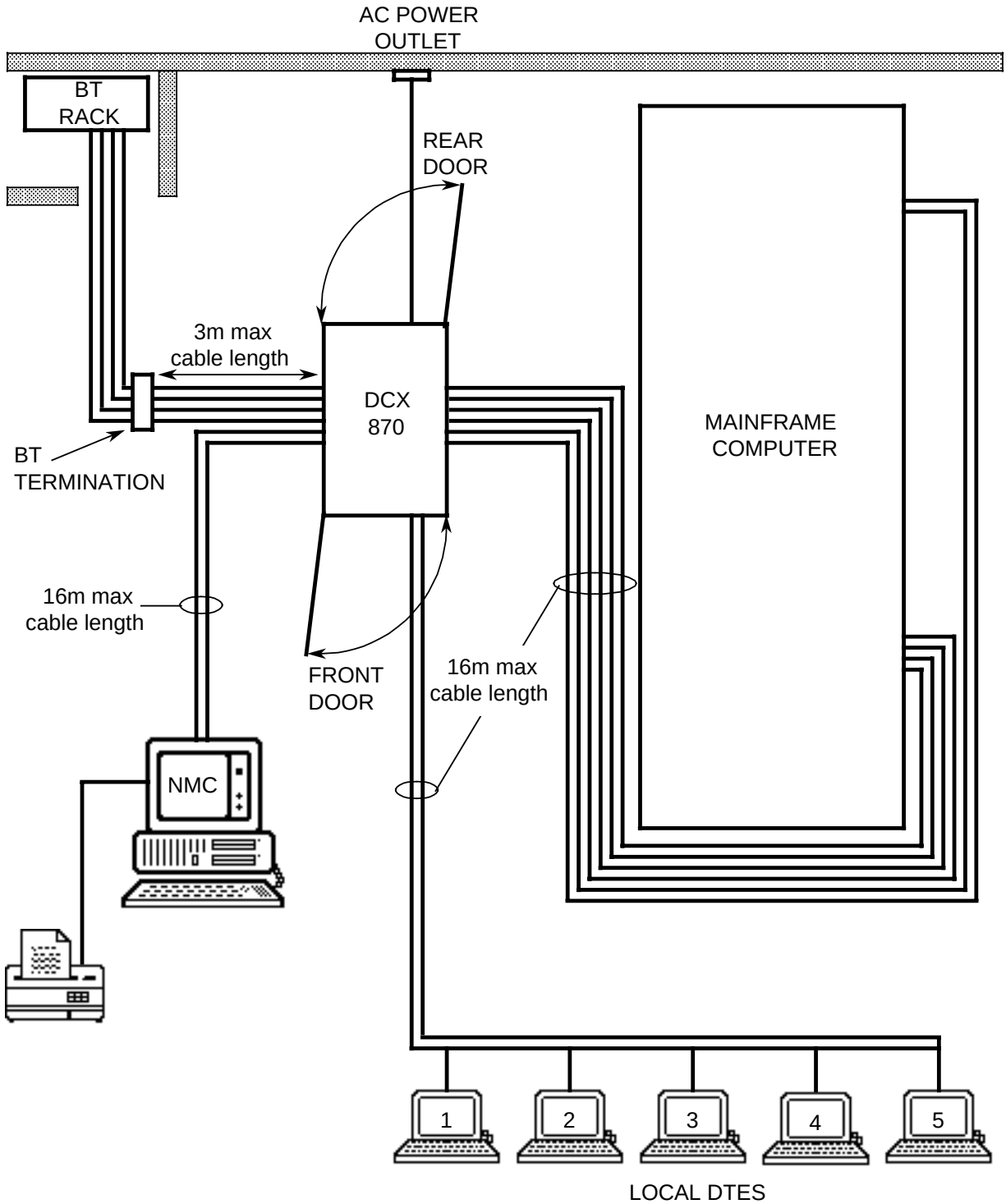


Figure 3-15 Example Floor Plan of a DCX 870 Installation with Ducted Cables

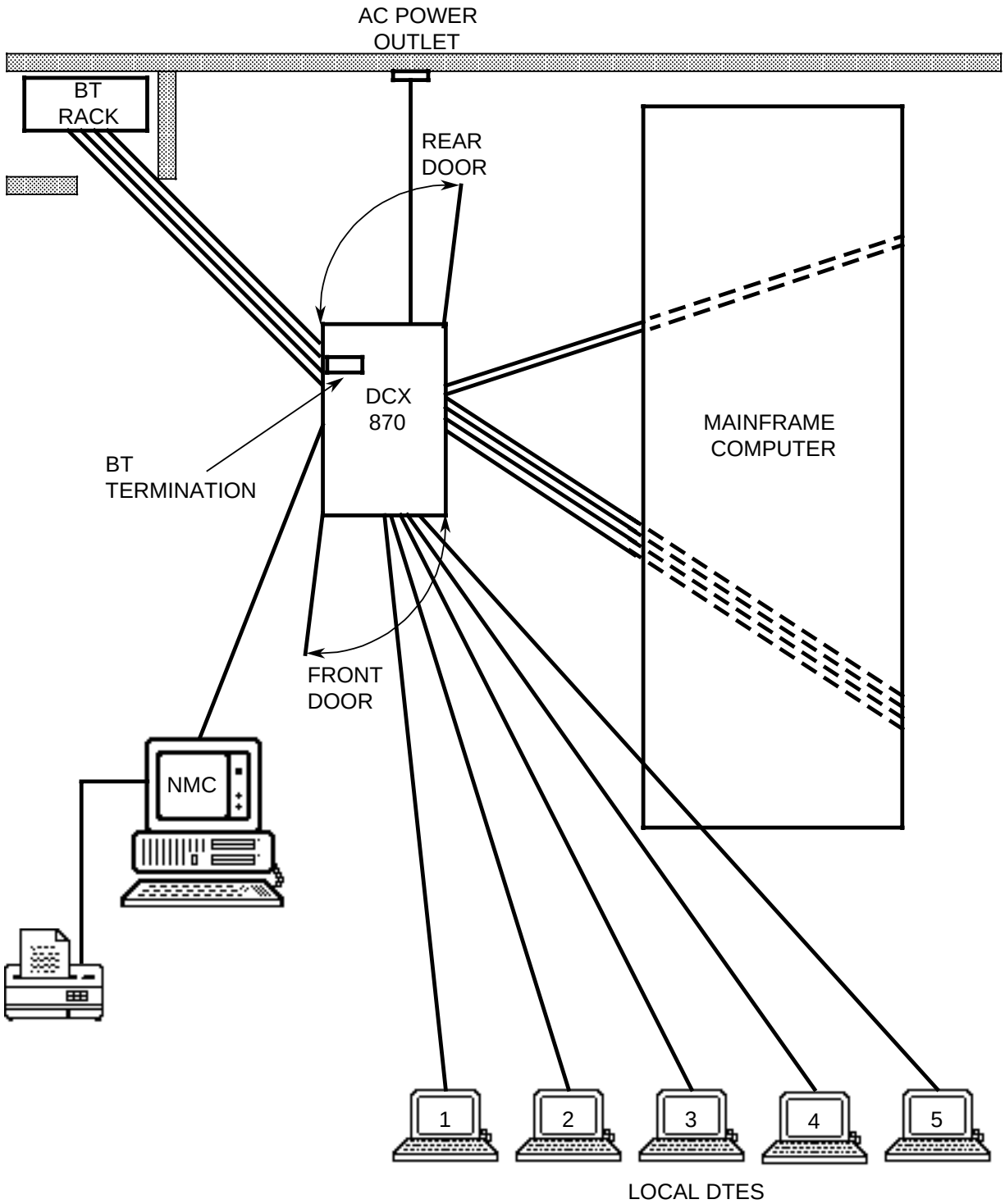


Figure 3-16 Example Floor Plan of a DCX 870 Installation with Sub-floor Cables

3.8 Site Preparation

Before the installation team arrives, or before you start your own installation:

- Clear the location site and the surrounding area as far as possible to aid installation.
- Ensure that adequate mains sockets are provided in the correct locations.
- Prepare the flooring for cabinet installation. For raised floors it may be necessary to brace the flooring immediately under the cabinet base and to make a floor hole for cable access.
- Prepare any cable conduit required and any cable access apertures to allow cable pulling to the equipment.
- Ensure that all necessary telecommunication lines and termination equipment are available.

3.9 Case Installation Schedule Summary

If a DCX installation is scheduled by Case (or its agents), an installation task sequence is usually followed, which includes both user and Case responsibilities. The normal sequence is shown in Table 3-2. The tasks are listed in logical order so that needed facilities are available on time and few if any installation delays will be incurred. Variations are allowed if mutually agreed upon.

TASK No	RESPONSIBILITY	DESCRIPTION
1	Case	Conduct site surveys.
2	Case	Prepare site-by-site configuration package.
3	User	Order leased and dial-up telephone lines.
4	User	Prepare physical environment, including power, cooling, floorspace and cable conduits.
5	Case	Installation group arrives and reviews configuration documentation with site coordinator.
6	Case	Unpack and check equipment and installation materials.
7	User	Verify that interfaces on DCX are compatible with DTE cable connectors.
8	User and Case	Run and label all cables from terminals, CPU ports and onward-linked modems.
9	Case	Mount frames and air deflector plates in cabinet (if not already mounted).

Table 3-2 DCX Installation Task List (Part 1 of 2)

TASK No	RESPONSIBILITY	DESCRIPTION
10	Case	Install PAMs, and connect up any expansion cables.
11	Case	Dress and connect up data cables and internal power leads.
12	User (or Case)	Set all option switches and straps on all modules, including spares, and insert modules into slots.
13	Case	Log on to System Module and configure DCX. Re-arrange SC cables if necessary.
14	Case	Conduct DCX checkout tests of all frames and modules, including spares.
15	Case	Supervise cut-over to on-line operation.
16	Case	Pass equipment keys to site coordinator.
17	Case	Revise system plans to reflect actual installation and turn over package to site coordinator.
18	Case	Obtain installation sign-off from authorised customer representative.
19	Case	Distribute copies of service reports and the configuration package to the appropriate Case service departments.

Table 3-2 DCX Installation Task List (Part 2 of 2)

4 Installation Procedures

It is advisable to follow the procedures in this chapter, where they apply, in the order given.

4.1 Cabinet Preparation

Prepare each cabinet as follows:

1. Place the cabinet on its location at the site and lower the jacking bolts.
2. Dismantle the cabinet for access to the interior.
   – The front and rear doors of most cabinets can be lifted off.
   – The sides of most cabinets can be lifted off after removing interior shipping screws.

Cabinet preparation is now complete. Do *not* connect power to the cabinets yet.

4.2 Installation of the Data Cables

4.2.1 Cable Preparation

This procedure is particularly important for large installations.

1. Lay out all cables in straight lines (where space permits) with the DCX ends of the cables together.
2. Tag each cable, according to the Equipment/Cable List (see Section 3.7), with the appropriate tagging code. Tags should be attached within a few inches of the connector.
3. Segregate the cables into bundles for the master and each expansion frame.
4. Each cable bundle can be loosely tied together for convenience during cable pulling.

4.2.2 Laying Cables

This procedure applies particularly where cables are to be laid or pulled beneath a false floor or in a conduit.

1. Determine the best direction for cables to be laid or pulled, preferably through the largest cut-out to the smallest.
2. Select the cable bundle for the lowest frame in the cabinet and pull it first.
3. Dress the cables inside the cabinet side and tie them temporarily in their approximate final positions.

   It is important to note that you should not tighten up any cable ties until all cable runs are complete.
4. Repeat steps 2 and 3 to pull the cable bundle for the next frame up into the cabinet.
5. Repeat the process until all cable bundles have been pulled.
6. Check that each cable connector is clean and undamaged.

4.3 Hardware Installation

This section gives the recommended procedure for actually installing and cabling up the DCX hardware within the cabinet(s). Any illustrative examples given here assume a configuration of a master frame and three expansion frames being installed into a standard cabinet.

Normally, DCX 870 frames will be delivered from the factory with some of the modules already plugged in, and their associated PAM assemblies and interconnect cables fitted.

If cabinets are being supplied by Case, these will generally be delivered with the frames and bottom fan panel units pre-installed. In this case, you should ignore those parts of the procedure given below that relate to installing frames.

1. Ensure that the DCX cable runs are complete, and that all power to the cabinets is off.
2. If adjacent cabinets are to be joined by a Baying Kit, remove the side panels and install the kit.
3. For each cabinet, follow the cabinet assembly plan, installing from the bottom up. Mount each DCX frame (and other equipment, if any) on the front rails and install the rear mounting brackets.
4. Examine your physical configuration plan and port connector plan for each of the card frames to determine the intended slot positions of the cards and how they should be connected. Also see Figures 4-1 and 4-2 for example installations.
5. Remove the screws retaining the DCX rear panels.
6. For each card to be installed in a card-frame slot, attach the appropriate end of the PAM interconnect cable supplied with the card to the relevant slot on the frame's backplane using the two screws provided. Refer to the cables already installed for guidance.
7. For each card to be installed, fit the PAM assembly supplied with the card to the corresponding position on the rear panel using the retaining screws provided. Refer to the PAMs already installed for guidance on orientation. The QEM and RES PAMs are illustrated (the correct way up) in Figure 4-3.
8. Plug the free end of each PAM interconnect cable into the socket of its associated PAM.

9. Replace the DCX rear panels.

10. Connect the optical fibre cable between the QEM and RES PAM bayonet fixtures, ensuring that the transmitter at one end is connected to the receiver of the other, that is, a QEM TX connector goes to a RES RX connector, and vice versa (see Figure 4-3 for PAM connector layouts).

    Note that if the full complement of expansion bays is not used, any unused transmitters and receivers on the QEM PAM should retain the rubber covers to prevent pick-up from the surrounding environment.

11. If required, install horizontal support bars across the back rails below each DCX frame. Leave enough space above and below the bars to permit tying the cable bundles to the bars.

12. Plug one end of each frame power cable into the socket at the bottom left of the frame (as viewed from the rear), and the other end into an outlet in the AC strip at a level near the bottom of that frame to prevent the cord and plug from interfering with connector panels when hinged down. Tape off any other outlets level with the frames to prevent inadvertent use. (Do not connect the cabinet to the mains yet.)

13. Connect the data cables to their assigned frames, dressing the cables down and securing them to their horizontal support bars (if fitted) below the frames. Cut away any temporary strain relief ties as each frame is completed.

    Test each rear panel in turn to ensure that it hinges down properly without obstruction or pulling the data cables tight. Dress the cable runs as required.

    Example diagrams of standard cabinet cabling are given in Figures 4-1 and 4-2.

14. When all cable dressing is complete, you can re-assemble the cabinet sides and doors.

15. Set the configuration straps and switches on all the individual cards, and install the cards into the frames. Refer to the relevant module manuals for details.

The equipment should now be ready for applying power as described in Chapter 5.

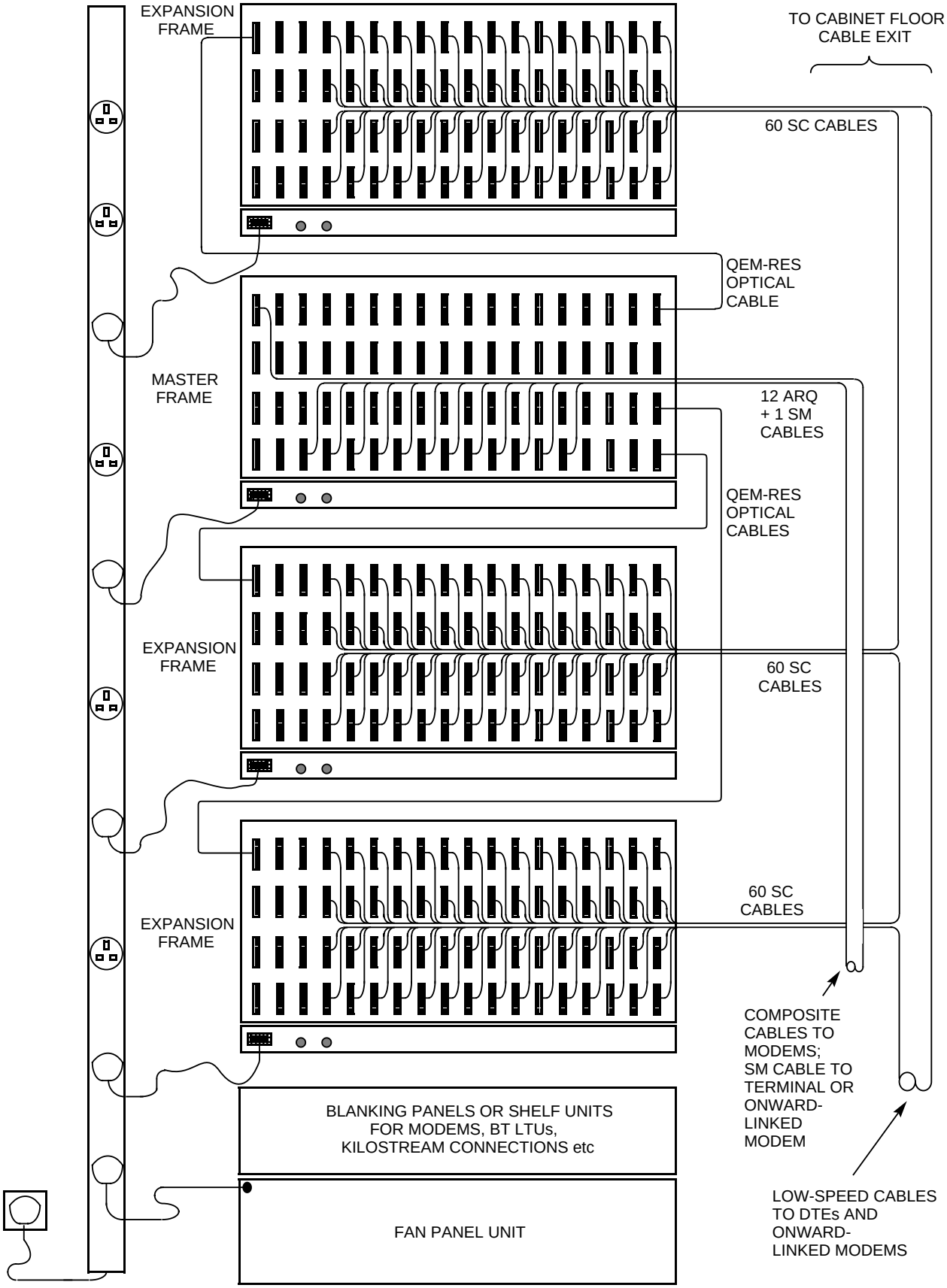


Figure 4-1 Example Multi-frame DCX 870 Cabling (Schematic – Rear View)

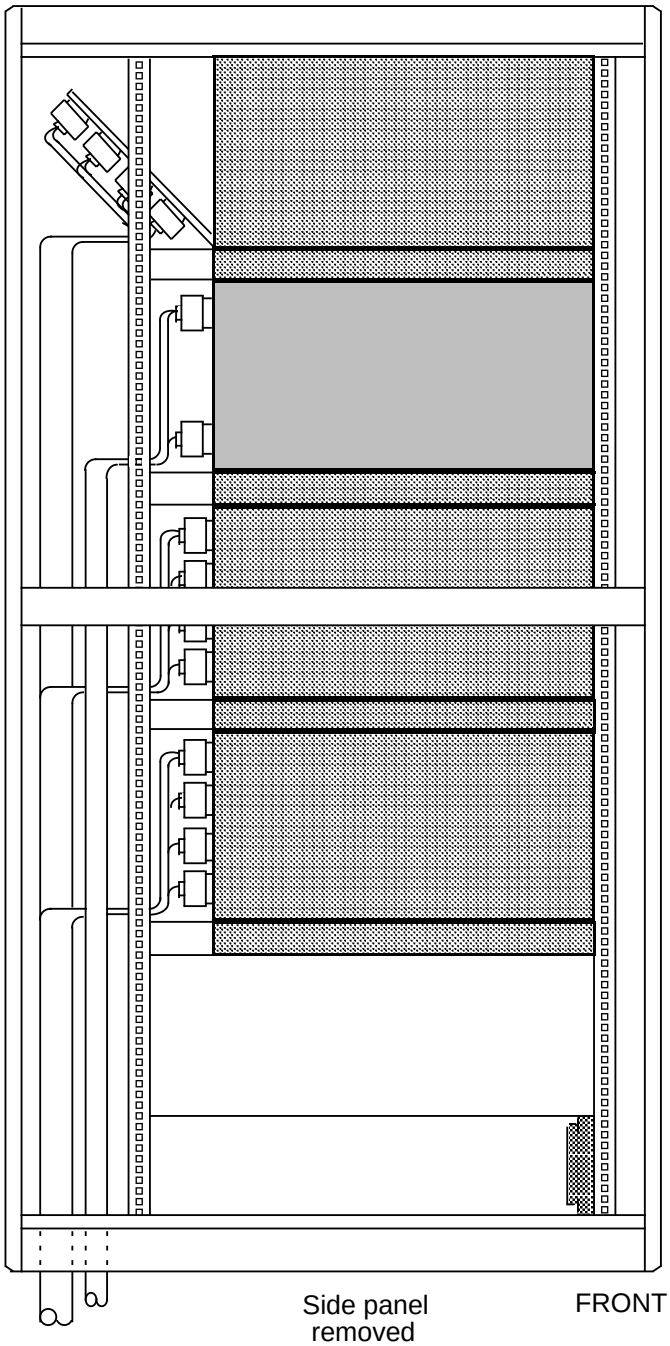


Figure 4-2 Example Multi-frame DCX 870 Cabling (Side View)

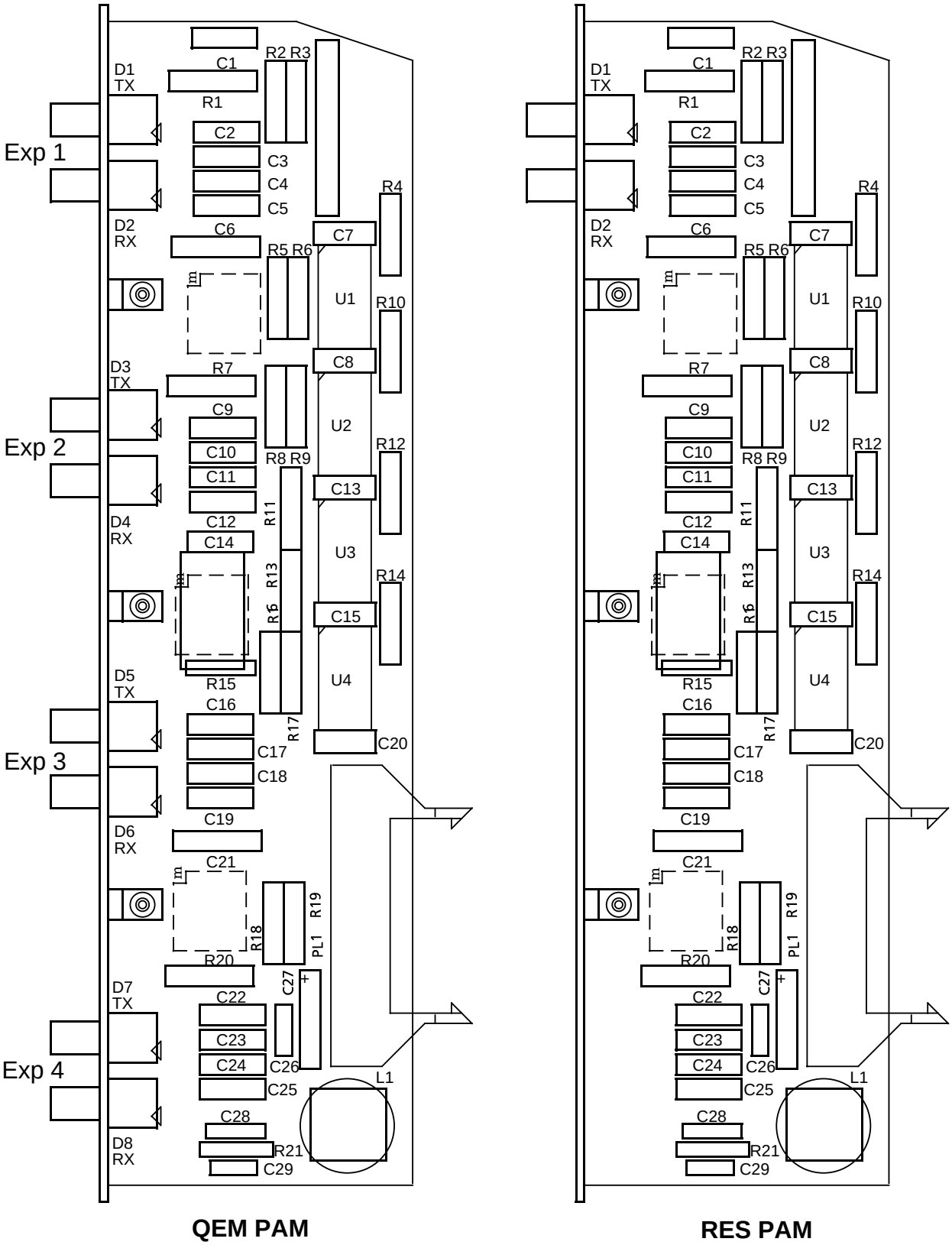


Figure 4-3 QEM and RES PAM Layouts

5 Powering Up and Logging On

WARNING

DCX equipment contains hazardous mains voltage when powered up. Do not apply mains power to any DCX equipment until all installation operations have been completed.

5.1 Powering Up

After installation, connect all operational equipment and ensure that all switches are in correct positions (cards not in loopback). Connect power. Observe that the green LED indicator on each power supply unit illuminates.

Should the red voltage-failure LED on either of the PSUs illuminate on power-up or during operation, and there is a second (working) PSU installed in the same frame, you can remove the failed unit for repair without having to power down (see Section 8.2).

5.1.1 DCX Initialisation

Initialisation is the process by which the DCX 870 organises itself after power is applied. The following sequence occurs:

(a) The System Module attempts to find a good map: first checking the map that was previously Active, then (if that is unsuccessful) the alternative map. If they are absent or irretrievably corrupted, a basic 'default map' state is set up (see the System Module Reference Manual).

(b) The map is turned on.

(c) Any centrally stored speeds are sent to SC cards.

(d) Control updates are sent to all channels to re-initialise them.

(e) The buffer section is re-initialised.

(f) The system is ready and the SM displays an invitation to log on at the NMC (or VT100-compatible terminal).

5.1.2 After the First Power-up

When the DCX 870 is powered up for the first time (a cold start), the modules within the multiplexer assume certain default conditions.

- The System Module contains a working default configuration map, thus the buffer queues are assigned to particular device channels.
- The SC modules assume a default channel configuration for each channel.

Note that the SC cards and System Modules each contain a battery back-up system which maintains their configuration information when powered down. Therefore, the status of these modules on subsequent power-up may be different from cold-start conditions.

In order to operate the DCX 870 it is necessary to access and configure the various modules via the System Module. This requires logging on to the SM as described in Section 5.2.

5.2 Logging On

The DCX 870 is accessed through the SM module by completing a logon sequence. This logon sequence is enacted from the NMC (or VT100-compatible terminal) via the SM user interface. Refer to the System Module manual for further details of these procedures.

After completion of the logon sequence you may proceed with configuring and operating the DCX 870 (see Chapter 6).

Default Log-on Requests and Passwords

On initial power-up of the DCX 870 the following modules have default access requests and passwords set as shown:

SM:	↵	(Return key)
SC:	Ctrl A	(to log on)
	LOGON	(supervisor password)

The relevant password has to be entered into the SM when initial access to a device is required (except for the SC device).

5.3 Logging Off

When you have completed the supervisory procedures, you should log off from the DCX 870.

The log-off procedure for each device type is detailed in the relevant module manual. This should be followed when the SM is connected transparently to the device.

Log-off from the SM is described in the System Module manual.

6 Managing and Using the DCX 870

6.1 Introduction

The DCX 870 can be used in essentially two different operating environments: the network manager's and the end user's. All management operations on the DCX 870 are achieved through the System Module; therefore, it is important for the network manager to be familiar with the System Module's operation by reading the relevant manual.

In order that the DCX 870 system can operate according to the network plan (with the required data paths defined and appropriate user access given), the manager must suitably configure the DCX 870. Functional configuration of devices and network maps is achieved through the System Module. Entry of the network configuration information into the SC modules of each multiplexer is also made via the System Module. When all the multiplexers in the network have been configured, normal operation can begin.

Once the network is up and running, it is possible for end-users, too, to influence certain parameters of the network configuration (e.g. to switch destinations or select local echo) via the SC module and System Module. Refer to the relevant manuals for details.

With the network running, its operation can be monitored by using the relevant System Module facilities. Should faults occur, this module offers test facilities to aid fault diagnosis (see Chapter 8).

At this point, any cabinet assembly plans and Equipment/Cable lists previously drawn up for the installation should be reviewed. Corrections should be made to reflect any changes made during installation. This aids any future troubleshooting and system-alteration planning.

6.2 Management Operating Environment

The diagram given in Figure 6-1 summarises the management operating environment.

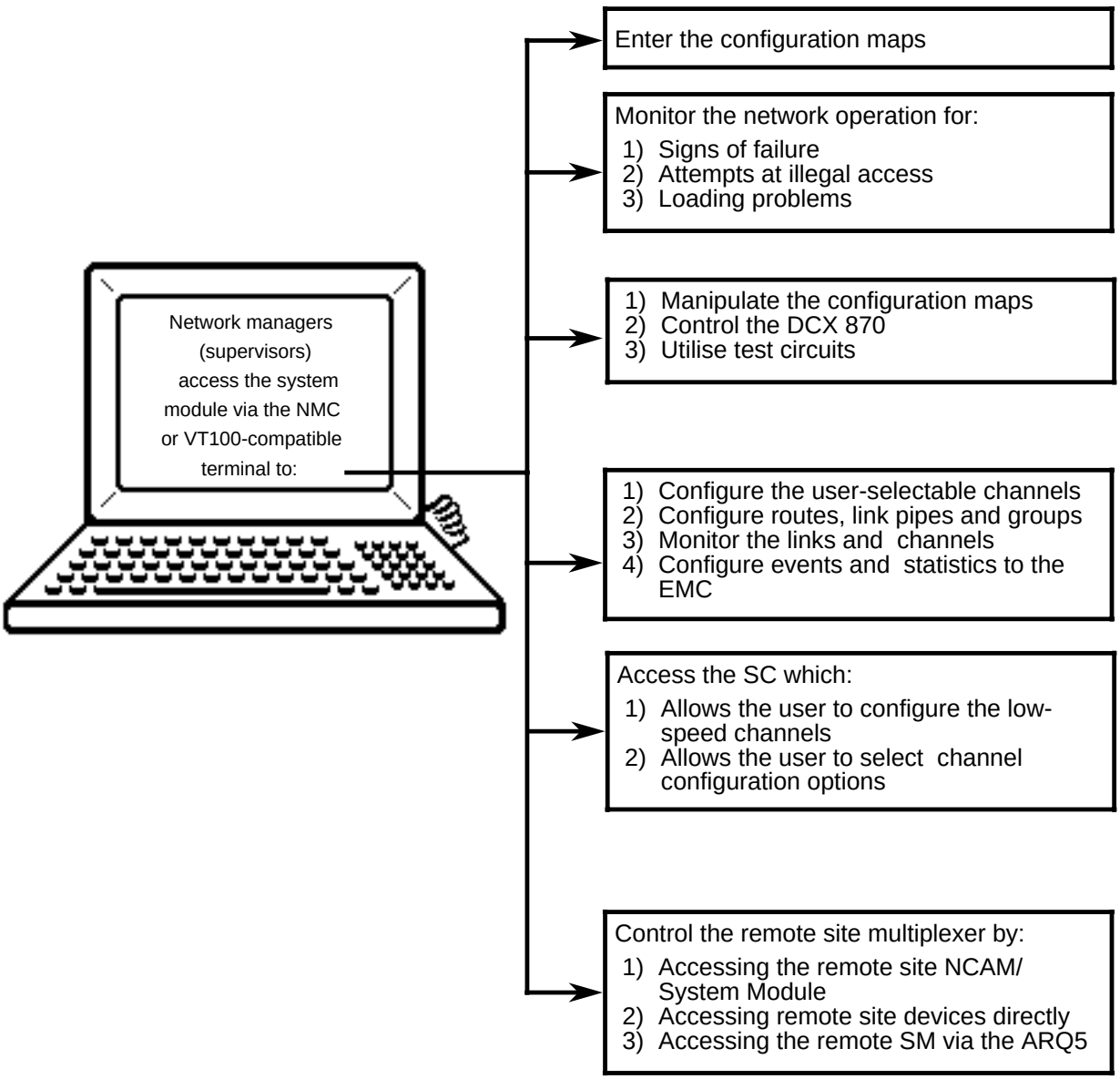


Figure 6-1 Management Operating Environment

6.3 Users' Operating Environment

The diagram given in Figure 6-2 summarises the users' operating environment.

(The users' operating instructions depend largely on the parameters established by the supervisor.)

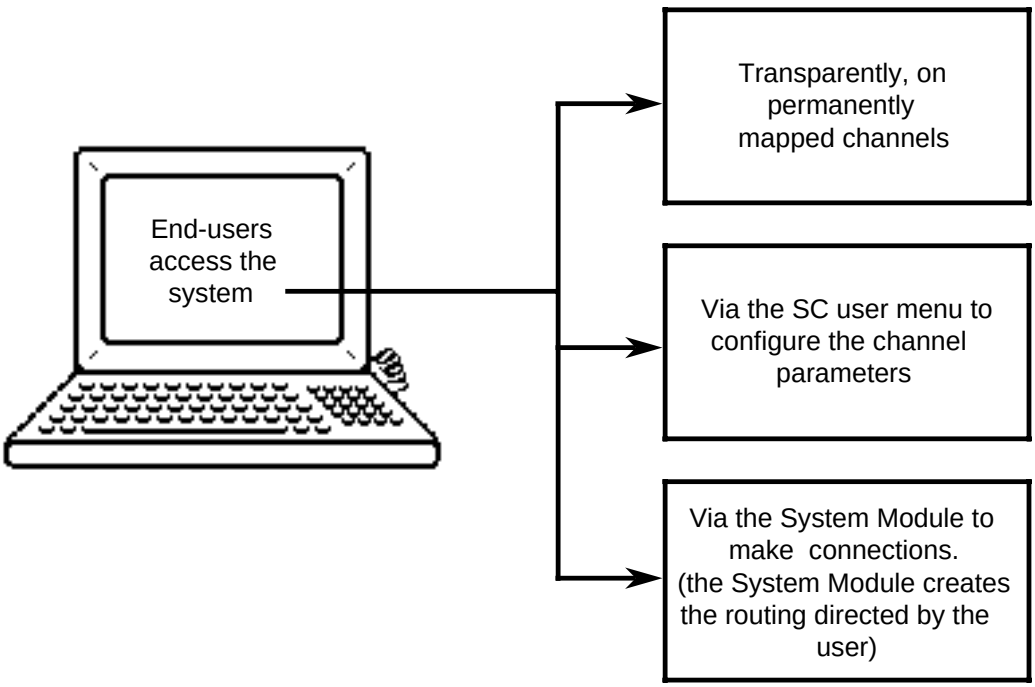


Figure 6-2 Users' Operating Environment

7 Device and Channel Numbers

This chapter specifies the precise allocation of device and channel numbers to the slots in a DCX 870 frame. The information given should be useful during the functional configuration of the DCX 870.

7.1 Device Number Allocation

The DCX 870 allocates device numbers to the card slots of the master frame as shown in Table 7-1.

Device No	Master Frame Slot No
*0	–
†1	19
2	18
3	17
4	16
5	15
6	14
7	13
8	12
9	11
10	10
11	9
12	8
13	7
14	6
15	5

* Device 0 refers to all low-speed channels
† Device 1 is not used if slot 19 has an SM

Table 7-1 Device Numbering

A slot containing an SC card will always be allocated device number 0 (for mapping purposes).

An ARQ5, Bridge, Link or Gate module will always assume the device number of the slot in which it is installed. So, too, will an SM Monitor module, except in instances where it has been set up to have a fixed device number (14), when it will keep this irrespective of slot position. In such an instance, it should be noted that the slot corresponding to this device number cannot then be used by any other module (except for an SC module). Figure 7-1 illustrates this concept.

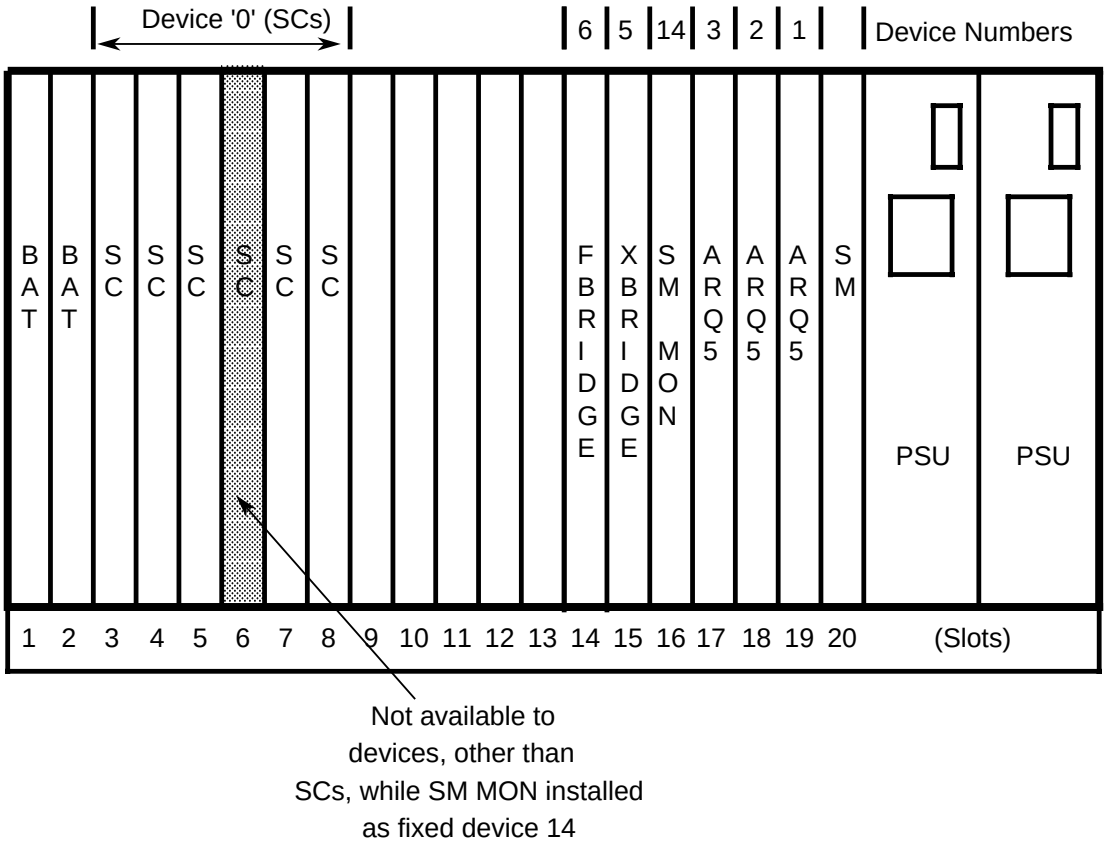


Figure 7-1 Example of Device Number Allocation

A System Module, BAT or QEM card will not have a device number for mapping purposes, since such a card has no channels to be mapped.

7.2 Channel Number Allocation

The absolute channel allocation of the buffer queues matches the physical channel allocation of the DCX 870. However, the allocation of the physical channels within a DCX 870 depends upon the multiplexer's physical configuration, as described in Section 3.5. The physical channel allocations for the three possible types of frame configuration are shown in detail in Table 3-1 within that section. A summary is given below:

- Single Frame Configurations. The physical channel allocation starts from channel 9 at slot 3, and ends at channel 64 at slot 16.
- Standard Multiple Frame Configurations. The physical channels are allocated from channel 1 at slot 1 in expansion frame 1, up to channel 256 at slot 16 in expansion frame 4.
- Alternative Multiple Frame Configurations. Certain multiple-frame configurations may have SCs in the master frame, in which case the channel allocation starts from channel 13 at slot 4 in the master frame, and ends at channel 256 at slot 16 in expansion frame 3.

The physical channel numbers are taken by the low-speed channels installed in the DCX 870, and become the low-speed channel allocation for that multiplexer.

Note that, for multiple-frame configurations, both the above summary and Table 3-1 assume that the QEM card has been set to give the normal distribution of channels. See the QEM and RES Modules Reference Manual for details of how the channel number allocation changes with different distributions.

8 Fault-finding and Test Procedures

8.1 Introduction

If there is a problem which has been isolated to a DCX 870, the diagnostics presented in this chapter should help you locate its cause. Most of the diagnostic procedures involve using the test functions of the System Module.

Note that the SC and ARQ modules also have their own tests and procedures as detailed in their manuals. The controls for operating these tests are on the individual cards, behind the DCX 870 front panel – see the warning on Page 0-2. In addition, an SC module can be controlled from a terminal connected to one of its channels.

8.2 Power Supply Problems

Should the entire DCX 870 appear inoperative, the power supply LED indicators should be examined. The green indicator must be illuminated while the DCX 870 is powered up, and the red indicator should be off.

The red indicator on a PSU illuminating during normal operation must be taken as a fault in that PSU, and you should remove the PSU immediately. If the relevant frame has only one PSU (or, in the case of two PSUs, both are showing a fault), you should disconnect the power at the mains before removing the unit(s).

If there are two PSUs in the frame, and only one of them has failed, DCX 870 operation would most likely be unaffected. You could then remove the faulty unit without having to disconnect the power to the frame. You only need to switch the failed unit itself off, using the power switch at the front of the unit, before you actually remove it.

You physically remove a PSU by releasing the screw at the top of the module, and then inserting your finger into the extraction hole and sharply (but carefully) pulling, so as to unplug the entire unit. Note that this should only be carried out by suitably qualified personnel.

8.3 DCX 870 Diagnosis

Diagnosis of the DCX 870 may be accomplished by a process of elimination, as summarised in Figure 8-1. The direction this process takes depends upon whether the problem is apparent on the local channel side or on the incoming data side, as shown. This indicates the order in which various loop tests can be used to diagnose the fault.

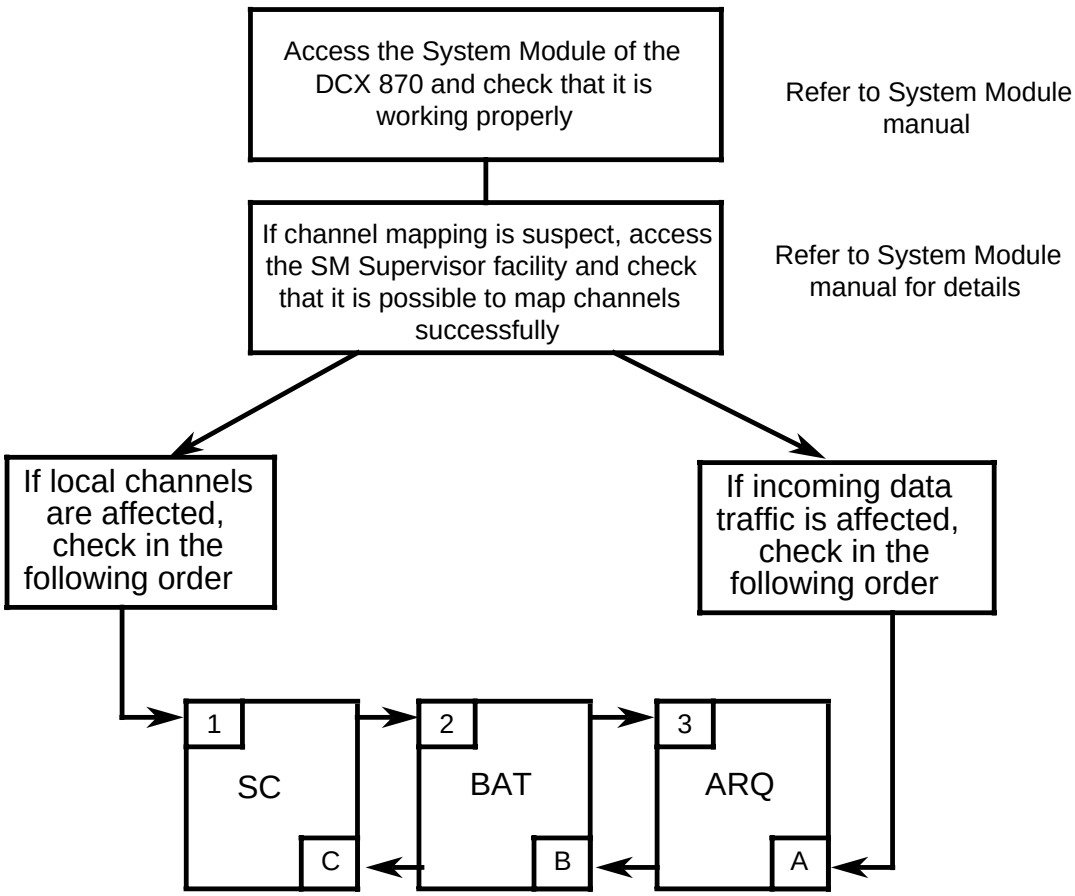
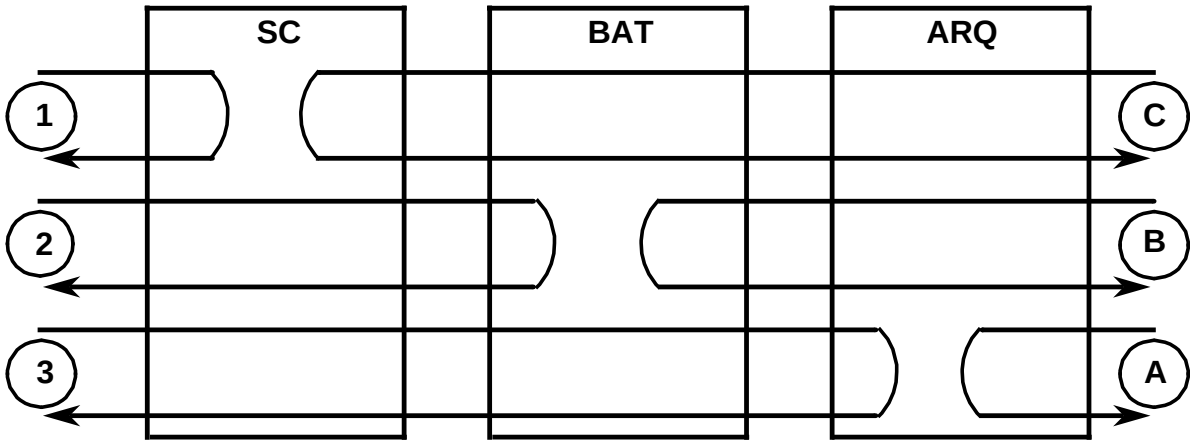


Figure 8-1 Diagnosis Flow Chart

The loop tests are illustrated in the following block diagram, and are then summarised.



Loop tests 1, 2 and 3 are to be monitored locally. The tests are:

1 SC checks – Use local loopback (Section 8.4), or Test Mode tests (Section 8.5) where a terminal is not available.

2 BAT checks – Either use the Test Mode tests (Section 8.5), or self-map the affected channel (forced loopback, Section 8.6).

3 ARQ checks - To check the virtual channel side of the device, use Test Mode tests (Section 8.5). To check the complete ARQ module, put local loopback on associated modem or line driver (Section 8.7).

Loop tests A, B and C are to be monitored from the remote site multiplexer. The tests are:

A ARQ checks – Use local loopback (Sub-section 8.4.1), which puts on a remote loop to the remote multiplexer.

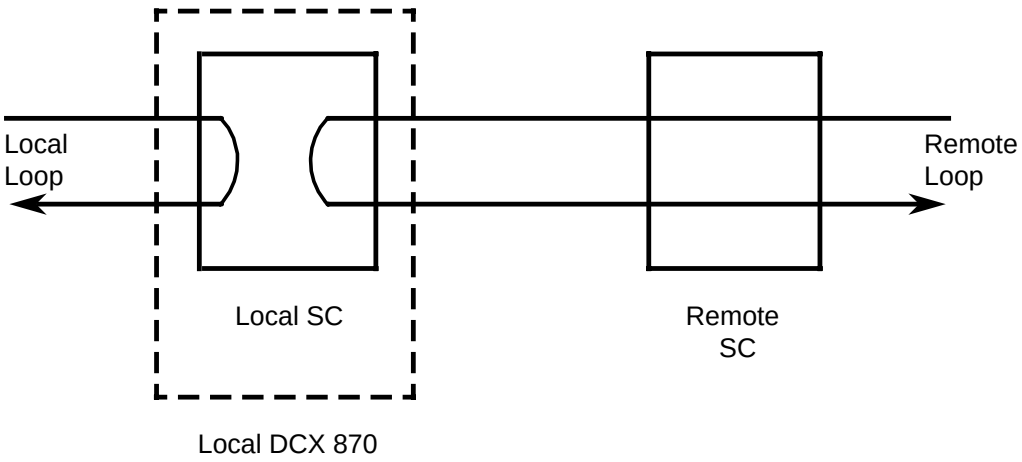
B BAT checks – Either use the Test Mode tests (Section 8.5), or self-map the virtual channel of the ARQ device (forced loopback, Section 8.6).

C SC checks – Set a local loopback test (Sub-section 8.4.1), or a remote loopback test on the remote multiplexer (Sub-section 8.4.2).

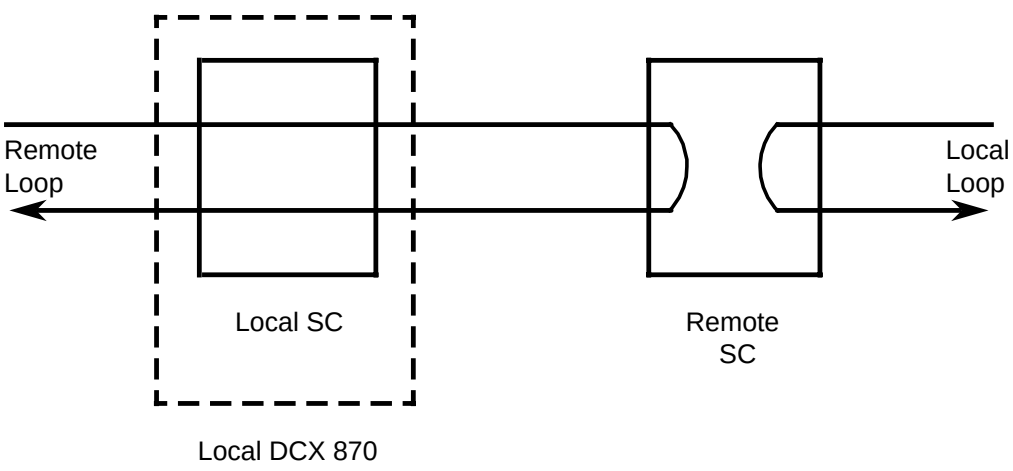
The tests referred to are described in detail in the following sections, and should be implemented in the order indicated above. The Test Mode tests refer to the test facilities available at the System Module using the Channel Test Facilities form or the BAT Test form. The test procedures are operated via the network manager's terminal. Refer to the System Module Reference Manual for details.

8.4 Loopback Tests

These refer to the local and remote loopback tests available from the SM's ACTCHAN Information form. Changing the Loopback Status field to ON initiates a loopback on a selected channel. The Local field places a local loop on a local channel. The Remote field places a remote loopback on the selected channel and sets the remote channel to local loopback. Refer to the diagrams below.



Local Loop set on the local DCX 870



Remote Loop set on the local DCX 870

8.4.1 Local Loop Test Procedure

1. From the Super Mode of the SM, select Active Channel Mapping (ACTCHAN ↵).
2. Move the cursor down to the selected local channel and press the PF2 key.
3. Alternatively, type: ACTCHAN o:n ↵ where n is the channel number, and press the PF2 key.
4. New columns will appear on the right-hand side of the form displaying local and remote channel numbers, absolute addresses, card types, reported speed, V.24 states and state of local and remote loopbacks.

   If the channel is self-mapped it will be displayed as 'Self' in the remote column 'Type' field and will only allow the setting and removing of local loopbacks.

   If the channel is an SM designated port which is open, it will be displayed as 'Locked' in the 'Type' field and will not allow loopbacks to be set unless that port is first closed.
5. Toggle the LLB (local loopback) field to ON using the < > keys.
6. Submit the form using Ctrl G to invoke the local loop on the selected channel.
7. Observe that the Local Loopback Status field changes to ON.
8. Enter data at the local terminal connected to the selected channel.
9. Observe that the data entered is returned correctly to the terminal.
10. To remove the loopback, toggle the LLB field to OFF and submit the form with Ctrl G.
11. Observe that the Local Loopback Status field returns to OFF.

8.4.2 Remote Loop Test Procedure

Follow the procedure in Sub-section 8.4.1 above, but use the RLB (remote loopback) field instead of the LLB field.

8.5 Test Mode Tests

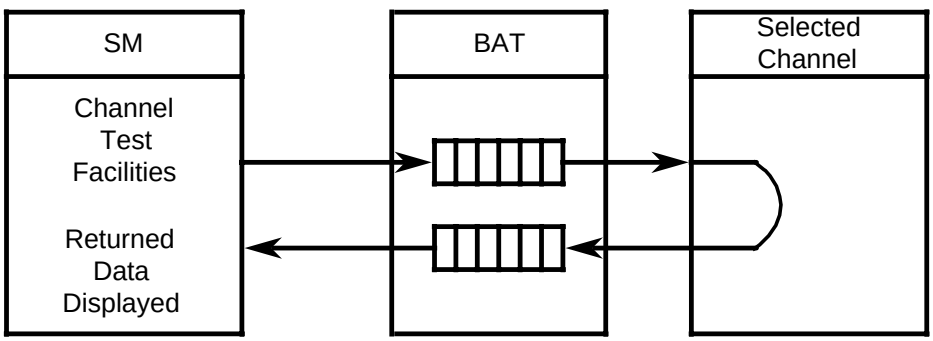
These are tests obtained from the Super Level of the SM as described in the System Module manual. There are two types of test facility available, allowing you to diagnose suspect channels and BATs individually:

- Channel Test Facilities Form
- BAT Test Form

8.5.1 Channel Test Facilities

Test facilities are provided by the SM directly and allow you to perform extensive diagnosis on specific channels. The tests utilise the buffer memory associated with the channel, allowing BAT operation to be validated, as indicated in the next diagram.

This test facility can send either a single character or a predefined test string of characters to the channel selected. The character string is specified in ASCII, EBCDIC or BAUDOT. The functions of the Channel Test Facilities form are described in the System Module manual, and a simple test procedure is given below.



Test Procedure

1. Access the SM Super level mode of operation.
2. Invoke the Channel Test Facilities form (TEST C ↵).
3. Enter the suspect channel number (device:channel number) in the channel field.
4. Ensure that the Local Loopback field is set to ON by toggling the Change LLB field using the < > keys.
5. Leave the default test string as shown in the Test Data field (Quick brown fox message).

6. Enter a viable parity and code for the channel under test.
7. Ensure the Mode Display is set to stop on error.
8. Toggle the Command field set to send continuously.
9. Press Ctrl G to initiate the test.
10. Observe the Sent, Received and Errors fields for correct indications (i.e. no errors and matching character strings).
11. Toggle the Command field to HALT and the Change LLB to YES.
12. Press Ctrl G to halt the test and return the channel to normal working.
13. Press Ctrl C to exit the test facility, or select another channel as required.

8.5.2 BAT Test

The SM provides test functions for BAT modules. A BAT test can be used when the buffer section assigned to a faulty channel is suspect, to help verify its operation.

Absolute channels are assigned to BAT buffer sections in the following manner:

absolute channels	1	–	64	on first buffer section
absolute channels	65	–	128	on second buffer section
absolute channels	129	–	192	on third buffer section
absolute channels	193	–	256	on fourth buffer section
absolute channels	257	–	320	on first buffer section
absolute channels	321	–	384	on second buffer section
absolute channels	385	–	448	on third buffer section
absolute channels	449	–	512	on fourth buffer section
absolute channels	513	–	576	on fifth buffer section
absolute channels	577	–	640	on sixth buffer section
absolute channels	641	–	704	on seventh buffer section
absolute channels	705	–	768	on eighth buffer section
absolute channels	769	–	832	on fifth buffer section
absolute channels	833	–	896	on sixth buffer section
absolute channels	897	–	960	on seventh buffer section
absolute channels	961	–	1024	on eighth buffer section

The test selects a buffer section and sends characters to a channel on that section until buffer overload occurs. It then reads back the data and

compares the two sets for mismatch. Any errors are reported on the display form.

Test Procedure

1. Select BAT Test (TEST B ↵).
2. Enter the number of the BAT buffer section you wish to check (0 to 7). Toggle the command field to RUN using the < > keys and invoke the test by pressing Ctrl G. The SM selects the first available self-mapped channel on that buffer and commences the test.

   This test may take several minutes to complete.

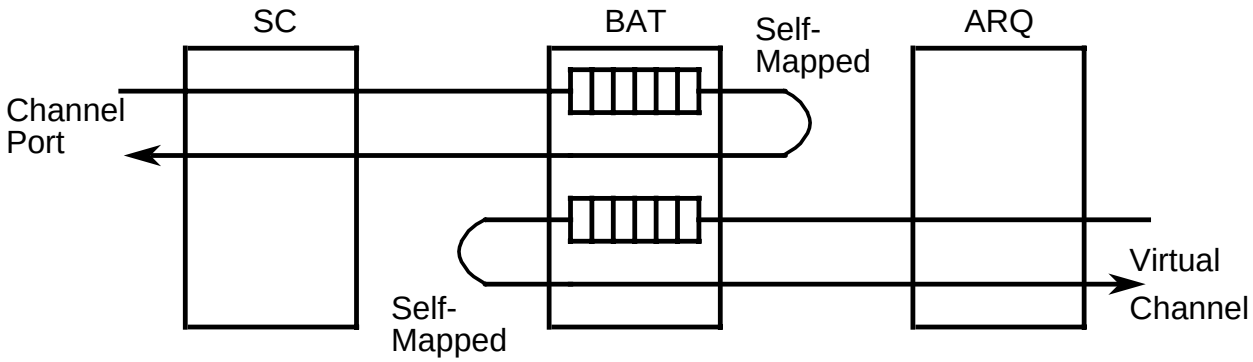
   On completion the test results are displayed on the form.

   Note that entering 1 selects the first buffer section.
3. Press Ctrl C to exit the test facility.

8.6 Self-map Tests

By self-mapping a channel, a form of forced loopback can be achieved which allows the buffer to be included in the loop test.

Self-mapping can be done to both the low speed channels and the high speed virtual channels, as shown below.



Example

Low Speed Channel 17 – 0.17 to 0.17

Device 4 Channel 6 – 4.6 to 4.6

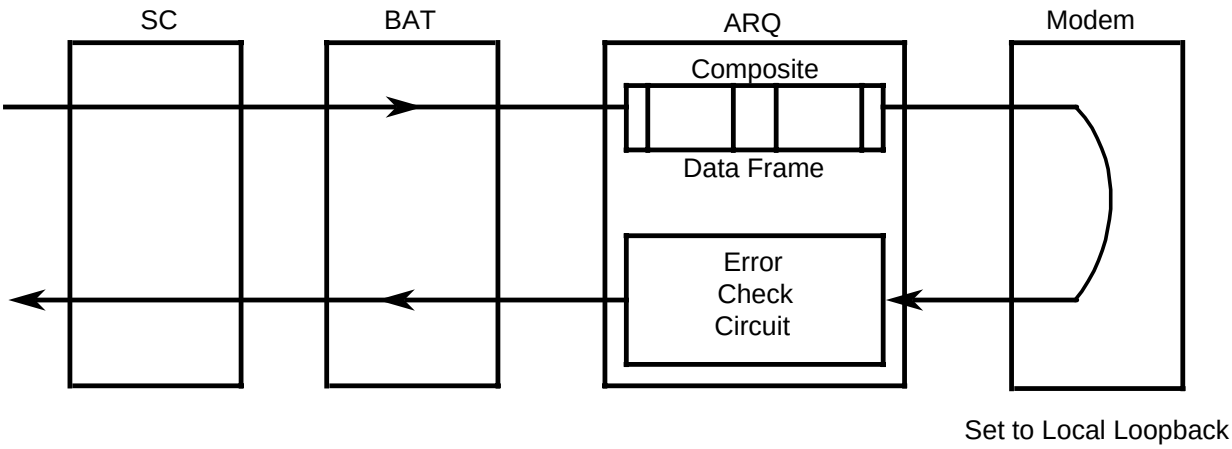
Data entered into a channel is passed into the BAT module and then routed back through the BAT module to the same channel. Data sent to a virtual channel via a link from a remote node may be delayed slightly by the network.

Test Procedure

1. Select Active Channel Mapping (ACTCHAN dd:nnn ↵) where dd is the device number and nnn is the channel number.
2. Enter the channel to be self-mapped by its device:channel number in the Mapped To field.
3. Submit the form (↵) to self-map the channel.
4. Enter data at the channel port of the selected channel and observe that it is returned in an identical format.
5. Return the mapping to the original configuration after this test by using the Active Channel Mapping form.

8.7 Modem Loopback Tests

In order to test the composite link side of an ARQ module locally, a loopback at the attached modem (or line driver) can be used, if the equipment has that facility. By placing a local loop on the modem the data sent from the ARQ is returned and checked by the ARQ's error correction circuits, as shown below.



The procedure for initiating a local loop on your modem depends upon the model you are using. Therefore, refer to the modem's documentation for details of this facility.

8.8 SM Monitoring Facilities

Diagnosis of channel and link failure can be made by monitoring the performance of the suspect part of the DCX system via the SM. Operation of the SM is detailed in the System Module manual.

Appendix A Specification Summary

Basic Unit

Multiplexing Technique	Character-interleaved, time-division, statistical
Maximum Channels	512 full-duplex
Maximum Channel Aggregate Input	4915 kbps
Maximum Composite Links	15
Power Requirements	230 VAC ±10%, 50-60 Hz (optionally 115 VAC ±10%)
Maximum Input Current	3 A at 230 VAC 6 A at 115 VAC
Maximum Heat Output	500 Watts per full frame
Unit Dimensions per frame:	
Height	310.3 mm (12.25 inches)
Width	482.6 mm (19 inches)
Depth	530 mm (21 inches)
Weight	40 kg (with full set of cards and PSUs)
Air Deflector Plate	1 U high (additional to frame height)
Environment	
Ambient Temperature	Operating: 5° to 40°C Storage: -25° to 55°C
Relative Humidity	Up to 95% non-condensing at 40°C

Modules

Asynchronous	SC1, SC2: see individual manuals
BAT	BAT II: see manual
QEM, RES	See QEM and RES manual

ARQ	ARQ5: see manual
Links, Gates, Bridges	See individual manuals
System Module	System Module 2: see manual
SM Monitor	See manual

Appendix B ASCII/Binary/Hex Conversion

Binary Value		b_7	0	0	0	0	1	1	1	1
		b_6	0	0	1	1	0	0	1	1
		b_5	0	1	0	1	0	1	0	1
b_4 b_3 b_2 b_1	**Hex Value**		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
0 0 0 0	**0**		NUL	DLE	SP	0	@	P	`	p
0 0 0 1	**1**		SOH	DC1	!	1	A	Q	a	q
0 0 1 0	**2**		STX	DC2	"	2	B	R	b	r
0 0 1 1	**3**		ETX	DC3	# (£)	3	C	S	c	s
0 1 0 0	**4**		EOT	DC4	$	4	D	T	d	t
0 1 0 1	**5**		ENQ	NAK	%	5	E	U	e	u
0 1 1 0	**6**		ACK	SYN	&	6	F	V	f	v
0 1 1 1	**7**		BEL	ETB	'	7	G	W	g	w
1 0 0 0	**8**		BS	CAN	(	8	H	X	h	x
1 0 0 1	**9**		HT	EOM	)	9	I	Y	i	y
1 0 1 0	**A**		LF	SUB	*	:	J	Z	j	z
1 0 1 1	**B**		VT	ESC	+	;	K	[	k	{
1 1 0 0	**C**		FF	FS	,	<	L	\	l	¦
1 1 0 1	**D**		CR	GS	–	=	M	]	m	}
1 1 1 0	**E**		SO	RS	.	>	N	^	n	~
1 1 1 1	**F**		SI	US	/	?	O	_	o	DEL

ASCII/Binary/Hex Conversion Table

Appendix C Blank Forms and Diagrams

The forms and diagrams in this appendix may be removed and copied for use on your installation.

SITE CONFIGURATION PLANNING FORM

Network Name: Site Name:

Location:

Multiplexer Types: Enclosure Type:

Telecom Requirements/Restrictions:

1.

2.

Composite link(s):

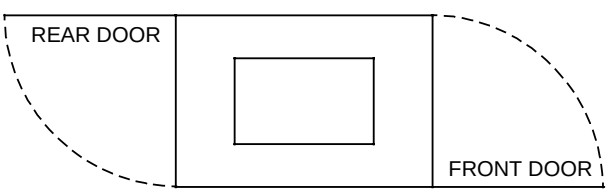
LINK No	EQUIPMENT TYPE	LOCATION AND NOTES

Attached Equipment:

DTE/DCE	QTY	EQUIPMENT TYPE	LOCATION AND NOTES

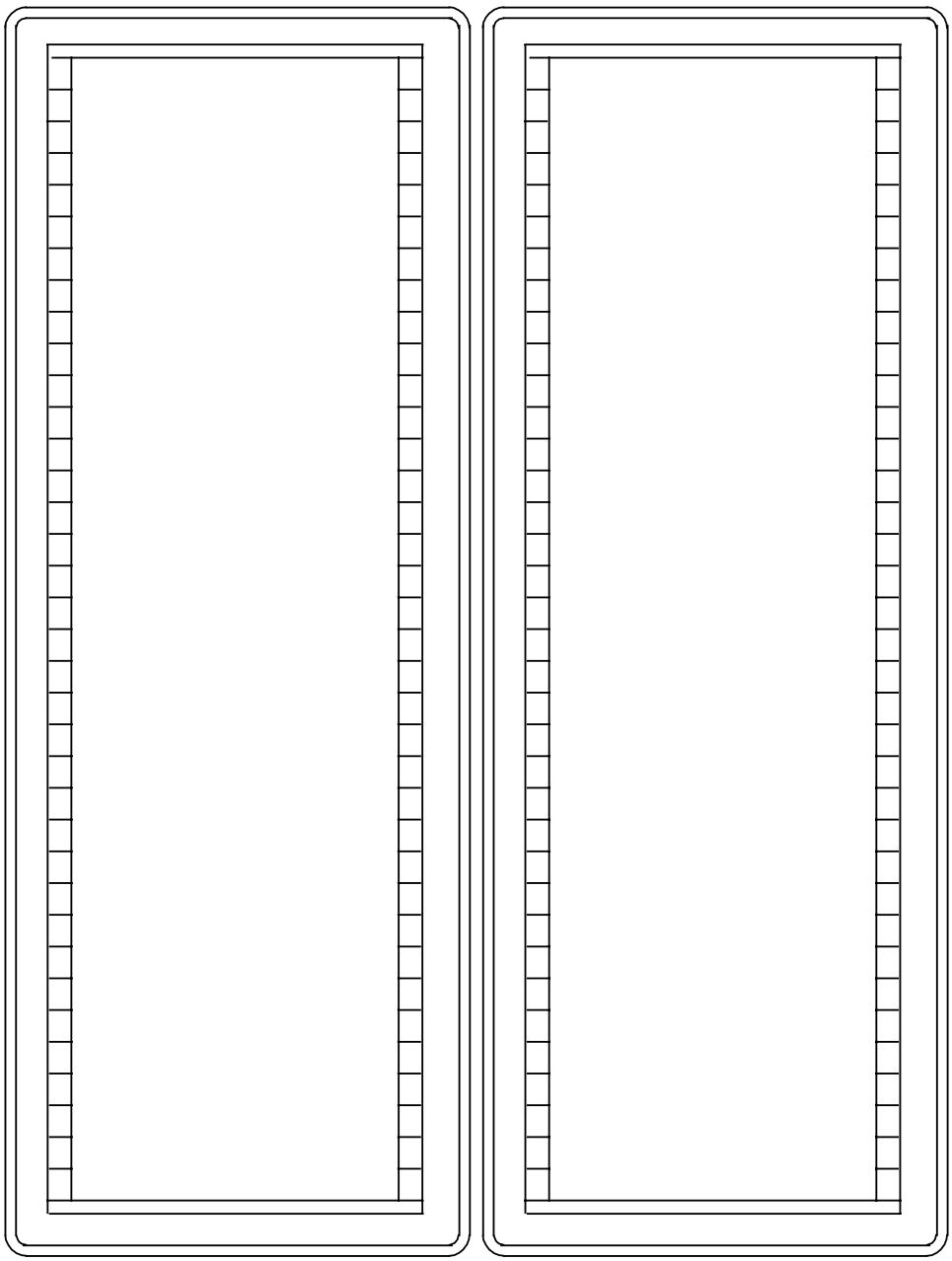
FLOOR PLAN

Scale : = 300 mm
= 1 ft

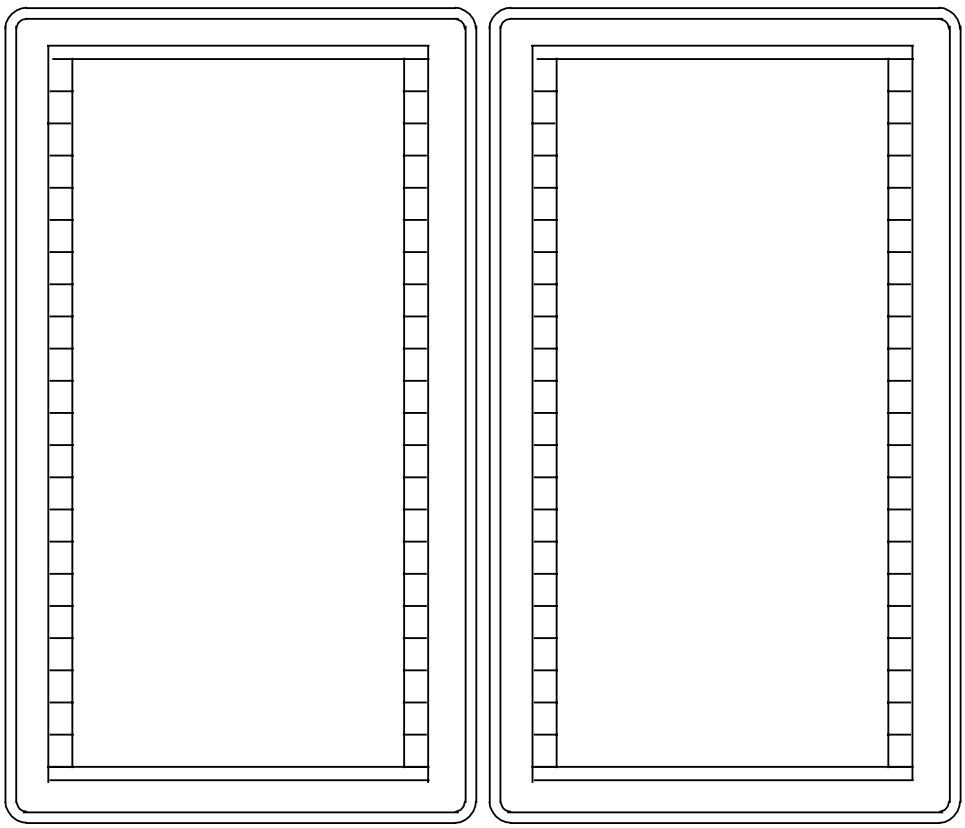


DCX Cabinet Plan

STANDARD CABINET ASSEMBLY LAYOUT

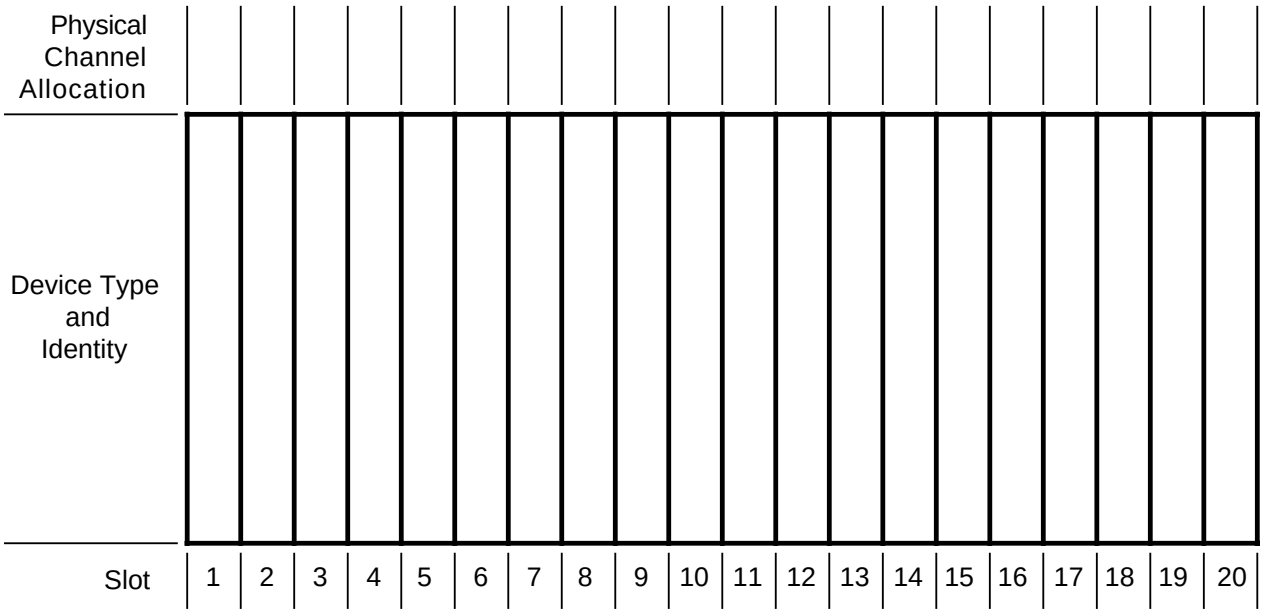


SHORT CABINET ASSEMBLY LAYOUT



PHYSICAL CONFIGURATION PLAN

Frame:



PORT CONNECTOR PLANS FOR 20-SLOT FRAMES (DCX 870)

LOCATION: **NODE:**

FRAME:

	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A																			A
B																			B
C																			C
D																			D
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	

EXP FRAME

MASTER FRAME

FRAME:

	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
A																			A
B																			B
C																			C
D																			D
	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	

EXP FRAME

MASTER FRAME

EQUIPMENT/CABLE LIST

DCX Site: DCX Type:

Location:

EQUIPMENT	LINK/ CHANNEL	TAG CODES	CABLE TYPE	CABLE PART No	CABLE LENGTH