Digital ISDN Switching Platform ECS-FD

System Description ECS-FD224

Digital Trunk Switching System ECS-FD224

BlueCom Ltd.

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1 Principle Technical Characteristics

1.1 Introduction

The ECS-FD224, from now on generally referred to as PBX, is a 4th generation ISPBX hybrid telephone exchange compliant with the EURO-ISDN standards and able to offer a complete range of voice and data services.

With the high performance the PBX is able to more than satisfy the needs of modern medium and large size organizations.

The exchange employ a wide range of large scale integration components in HCMOS technology that are widely available on the market. These components offer velocity, low power consumption and have a high level of reliability.

A personal computer loaded with sophisticated software packages (administration terminal "TEGEST") allow the execution of diagnostic, maintenance and updating operations both locally and from a remote site using a modem built-in to the ECS-FD exchange.

The ECS-FD224 as well as the ECS-FD96 systems are "homogeneous" in their architecture and functional structure, offering the same level of services and using the same component modules. The only practical difference is the maximum number of ports or the number of internal and external lines that can be managed (capacity).

The ECS-FD224 exchange has the capacity for up to 224 ports. With a rack extension a capacity of 528 (ECS-FD500) or 1088 ports (ECS-FD1000) can be achieved.

The ECS-FD224 exchange can handle the voice/data ports in an extremely modular way, hence making it simple to plan the necessary components upon initial equipment installation and any successive expansion up to the maximum capacity of card slots possible for each type of ECS-FD exchange.

- all of the essential centralized functions are situated on the Traffic management card (GT) and the Service Unit (US) card;
- There are no restrictions in positioning the peripheral boards in the rack
- an eventual system expansion is possible with the ECS-FD exchange in operation.

The ECS-FD exchanges conform to the European Community recommendations EMC 89/336/EEC, 73/23/EEC and the European standards EN 50082-1, EN 55022, EN 60950 for electromagnetic compatibility and electrical safety. To guarantee that the equipment continues to satisfy these recommendations, the installation must be commissioned and operated by specialized personnel, following the recommendations in force and the instructions contained in this document.

1.2 Architecture of Distributed Control

The architecture of the ECS-FD is defined on two control levels organized in a hierarchical manner (Fig. 1-1):

- peripheral control level
- central control level to which the peripheral level is enslaved

Each peripheral level processor (peripheral controller) controls a certain number of interface circuits on the system (terminations) and in particular controls in real time, the signalling associated with the lines connected to the extensions.

Each peripheral controller is directly connected to the internal communication bus (S/C bus), that is managed by a central level processor (bus controller) whose function is to activate, in a cyclic mode, communication sessions with the various peripheral controllers.

The messages coming from the peripherals during a scan cycle are recorded in the receive memory of the bus controller and from here are read by the system central command (CPU) to be processed.

In the opposite direction, messages to be transmitted to the single peripheral controllers are output from the central CPU and recorded in the transmit memory of the bus controller.

The central CPU is assigned all the main processing functions, which includes in particular the supervision of telephone traffic and data being sent on the various lines, the systematic development of diagnostic procedures and the management of communication sessions with service terminals.

To sum up we can say that the ECS-FD architecture provides:

- central processing unit (GT) and peripheral units with microprocessors.
- main system program recorded on FLASH memory (non-volatile memory with contents electrically modifiable).
- customer data recorded in battery backed RAM memory; a long life lithium battery is used.
- PCM A-law ITU-T G.711 voice coding.
- PCM/ TDM central switch matrix; channel switching at 64 Kbit/s organized in frames of 32 channels.
- signalling messages to GT and command messages from GT on a full-duplex asynchronous serial communication channel at 375 Kbit/s.
- emergency service.
- extensive use of HCMOS technology components and surface mount.
- all boards are standard eurocard size, with multi-layer structure. Each inserted within a socket in the back-plane.
- redundancy of centralized units

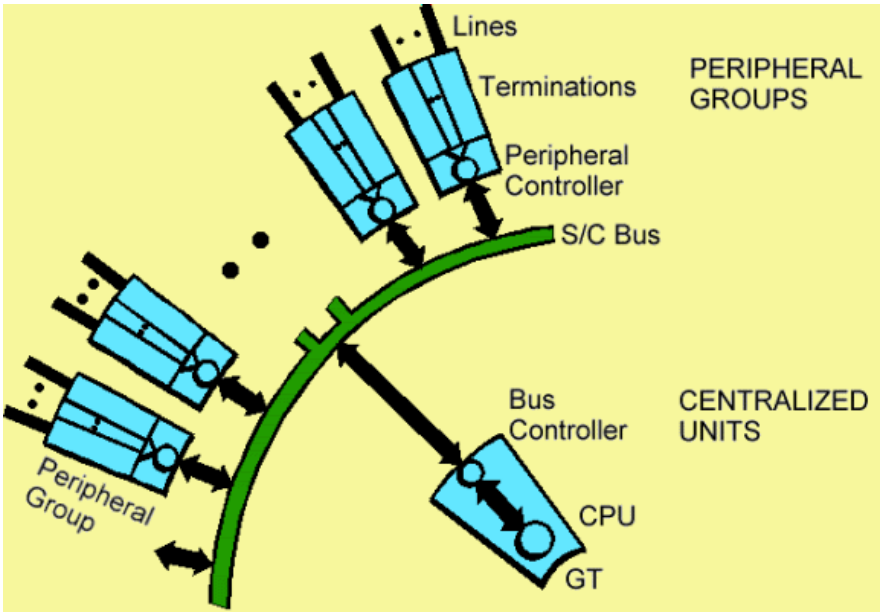


Fig. 1-1
The distributed control

1.3 Functional Units forming the System

In direct relation to the distribution of the various processors, the system is made up of peripheral and centralized units.

The peripheral units are comprised of a certain number of terminations (interface circuits) of the same type as the local peripheral controller whose program is specialized for that type of termination; the number of terminations per unit is a function of the circuit complexity of each single termination on the system and varies from 4 to 8 to 16 to 32.

With regards to termination grouping, the peripheral units are generally called Peripheral Groups (PG).

Among the units with centralized functions, the GT unit is fundamental, which as well as including the central CPU and the bus controller processor, also includes other functional blocks essential to system functioning among which are:

- the system timing synchronism with signals coming from the external digital network
- the total access PCM switching matrix and the conference circuits
- the digital generator of internal tones
- the serial communication channels.

Together with the GT, the Service Unit (US) is normally present, this contains the DTMF transceivers, the service relays, the serial ports and the modem which permits the ECS-FD to communicate with a distant Administration terminal (TEGEST), situated in a remote management centre.

Each unit is of the standard euro-card dimensions and fitted with 2 plug-in connectors on its rear edge.

1.4 Cabinets and Internal Mechanical Structure

The various peripheral groups (PG) and centralized modules are inserted in a rack (subframe), having a width of 19" (48.3cm) and a height of 6U (1U = 1.75"= 4.45cm). Each subframe is fixed to a vertical support inserted within the cabinet.

The ECS-FD224 system cabinet contains a single subframe attached to rotatable support, which allows access to connectors at the rear of the subframe. The subframe contains the system power supply that receives a primary voltage of -48Vdc on its input from an external battery back_up power station and generates the secondary voltages for the centalized and peripheral units.

The ECS-FD500 system cabinet contains two subframes (of the type described above) and a third subframe positioned above these of height 3U, containing the system power supply (ALIM). This power supply receives a primary voltage of -48Vdc on its input from an external battery back_up power station and generates the secondary voltages.

The ECS-FD1000 system cabinet contains four subframes and uses the same subframe as the ECS-FD500 for the power supply. (ALIM)

The ECS-FD224 subframe is designed with pre-defined card slots for two Trafffic Management (GT) units (one of which is the reserve GT), two power converter units and a parallel converter card (inserted in reduandant system only); the card slot on the immediate left of the GTs is normally assigned to the US unit and the other 14 card slots are available for the insertion of peripheral groups.

Within the ECS-FD500 and ECS-FD1000 systems, one of the subframes (base subframe) is designed for the insertion of two GT units in two pre-defined card slots (one of which is the reserve GT); the card slot on the immediate left of the GTs is normally assigned to the US unit and the other 17 card slots are available for the insertion of peripheral groups.

The other subframes within the ECS-FD500 and ECS-FD1000 systems (extension subframes) are dedicated to peripheral groups only.

For the ECS-FD500 and ECS-FD1000 systems, the cables and wiring between the subframes are situated on the right inside face of the cabinet, whereas at the back of the cabinet there is access to the upper connectors of the installed PGs, which are connected to the main distribution frame by the insertion of a cabled female sockets.

The main distribution frame is external to the cabinet and is supplied upon request.

Fig. 1-2
ECS-FD224 rack

1.5 Redundancy

All of the system centralized units which can effect the operation of the whole system should a failure occur, have a secondary back_up.

Within all the systems it is possible to have a redundant GT and also the power supply can be duplicated. Within the ECS-FD500 and ECS-FD1000 systems, there can be a redundant power supply unit ALIM, whereas within the ECS-FD224 system a redundant DC/DC power supply converter is possible.

A "Master-slave" type of redundancy architecture is used in the case of the GT, with the "slave" GT always in hot stand_by.

An information channel between the two GTs allows real time updates regarding information relative to traffic_in_progress, which is dynamically recorded in the same area of memory in both of the GTs. The same channel is used for customer data updates and for the systematic exchange of messages regarding the actual functional state of the system.
Upon the "slave" GT being informed of errors within the "master" GT or in an extreme case no longer receives any messages from the "master" GT, it will activate a changeover, assuming the state of the "master" GT.

The activation of the changeover does not effect any connections already made within the matrix.

1.6 Modularity

The system is structured in such a way that the planning of the necessary parts of a system is very easy; the initial installation phase and variations are straight forward, as are the introduction of new applications while the system is in operation.

There are many factors contributing to this "simplicity" among which are the following:

- all essential centralized functions and the central control of the system are integrated in a single unit (GT), supported by the Service Unit (US).
- the centralized control can be duplicated in the initialization phase or during the system operating life by the insertion of a second GT in a pre-defined position within the base subframe. A second internal S/C bus within the system is always present.
- within the ECS-FD224 system, the back-up power supply converter (DC/DC) can be inserted within the space available next to the active power supply converter. If a redundant power supply is used an aditional board the paralel converter unit has to be inserted.
- within the ECS-FD500 and ECS-FD1000 systems, the back-up power supply unit (ALIM) can be inserted within the space available next to the on line power supply unit.
- every PG, independent of the type and the number of ports that it requires, can be inserted in any card slot defined for a peripheral group.
- the mix between the various types of ports is not dependent upon specific conditions and the increase in the number of ports within the system can be performed when the system is in operation. Increasing the number of ports involves the physical insertion of new PGs in the subframe, insertion of the connector from the PG to the main distribution frame and the activation of a specific procedure using the Administration terminal (TEGEST).

The high system modularity of the ECS-FD is completed by the possibility to easily add services to an existing system by only activating new services using the maintenance software TEGEST.

1.7 Traffic Management Capacity

The system architecture employed distributes the control functions and more demanding processing to the various peripheral groups (PG).

The information sent from the peripheral groups to the system CPU is high level processed data as is the data processed by the system CPU destined for the PGs.

The immediate consequence of this structure is that the system CPU normally has ample margin to satisfy the periods of more intense traffic.

The high traffic carrying capacity of the ECS-FD exchange is contributed by the non-blocking central PCM matrix and the possibility to add centralized resources (e.g. number of DTMF transmitters/ receivers or a modem) as required.

1.8 Standard Conformity

The ECS-FD exchanges conform to the standards enforced in Italy relative to the internal installations (CEI 103-1) and to the telephone set standard (CEI 103-5).

The ECS-FD exchanges conform to the International ITU-T Recommendations and the European ETSI standards for connection to the EURO-ISDN public networks:

- with respect to the EURO-ISDN trunk interfaces, communication is performed via peripheral groups with the "T" interface for either the multiple Basic access connection (each access 2B+D) with a overall bit rate of 192 kbit/s or Primary Rate access (30B+D) at 2 Mbit/s
- with respect to the EURO-ISDN internal network, communication is performed via peripheral groups with the "S0" interface with single/multi-number connection at the Basic access (2B+D) with an overall bit rate of 192 kbit/s

1.9 Voice Services

All the conventional telephone services related to the use of standard analogue telephones (with pulse or DTMF dialling) are available.
Also numerous supplementary voice services are available to which access is gained by the use of SAEfon T/ B/ TK/LE digital telephones.

For detailed descriptions of all available services refer to the various user manuals, however a brief description of some of the many services are listed below:

- abbreviated dialling (speed dialling) to internal and external destinations (up to 2000 telephone numbers selected by an abbreviated code are possible)
- dedicated function keys for direct calls to internal and external destinations
- announcement signals in the form of pre-recorded messages relating to particular situations
- classifiable services for the so-called telephone groups (i.e. manager/ secretary services, intercommunicating services assigned to internal extension groups etc.)
- waiting message led indication
- hands-free communication service; the presentation on the telephone display of the name and telephone number of the caller, the current time, the reason why a correspondent is unable to answer a call (absent user message), the number of call meter units (advice of charge).

1.10 Proprietary Data Services

Numerous data communication services are offered between the users equipped with standard data terminals and between users and host.

The communication environment can be local or may be extended to include external switching networks through the use of a modem.

Data communication is normally activated by means of a data terminal which is at the position of a voice/data user. (Fig. 1-5) The connection is established by directly connecting the terminal to a SAEfon digital telephone. This is connected to the system by a normal twisted pair on which two 64 kBit/s channels (B), a 16 kBit/s signalling channel (D) and a 16 kBit/s synchronization channel (D) (in 2B + 2D format) are transmitted.

Therefore the data communication may be implemented completely independent of any voice communication.

The data destination (another PC, host or printer port) is dialled on the SAEfon keypad or output on the serial path of the data terminal.

The data destination can be to a data terminal that is completely independent of a voice conversation in progress being performed by its associated partner.

It is possible from a user voice / data point to set-up data traffic by the appropriate configuration of the CAUn group termination associated with that position.

A special card called the "Terminal Adapter" (AT), that is connected on one side to the an analog subscriber port of the CAUn board and on the other side allows the connection of two terminals or ports for host. See Fig. 1-5.

Four of these AT cards can be placed in a box, (external to the exchange) and mounted on a wall.

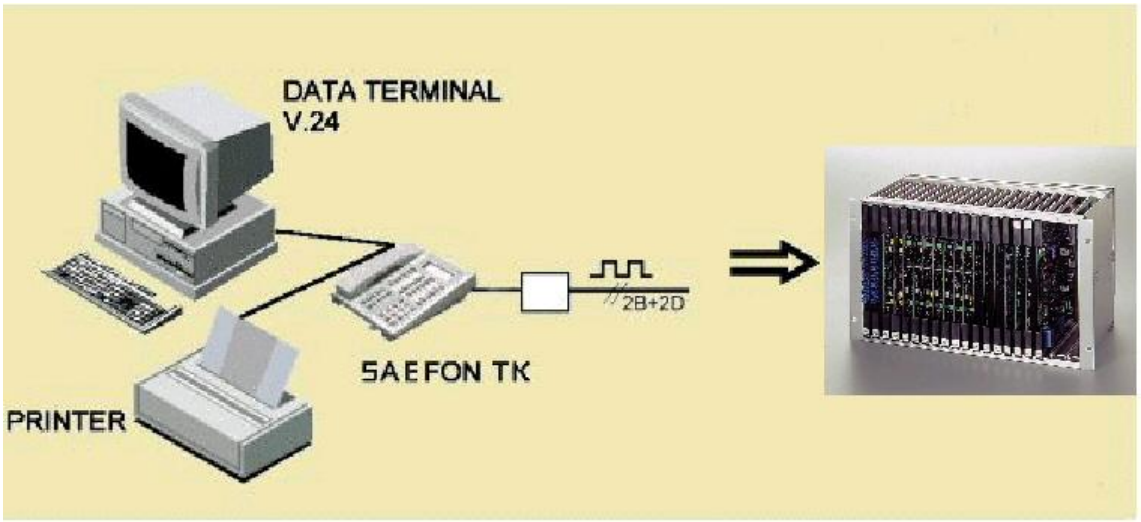


Fig. 1-5
Voice/data user point / Data terminal adapter

1.11 ISDN Data Services

ISDN services are available which fully comply to the European standards EURO-ISDN.

The communication environment can be local (i.e. both extensions on the same "S0" bus or within the same ECS-FD exchange) or it can be widened through the "T0" and "T2" interfaces with the trunk network to include externally switched or dedicated networks.

The data communication is normally activated from a terminal with the S0 interface (G4 Fax, P.C., Videophone, etc.) connected directly to or through a terminal adapter (AT) to the "S0" bus.

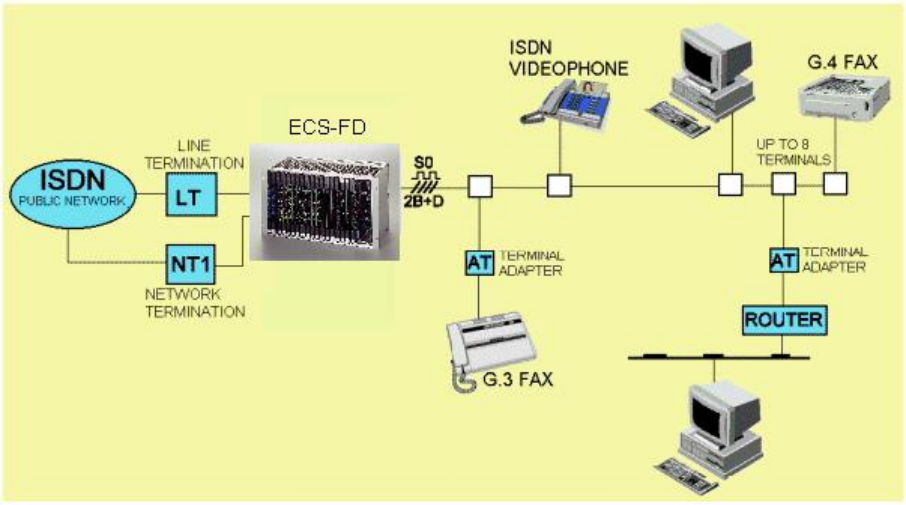


Fig. 1-6
S0 interface connections

The communication can use one or both B channels according to the request of the terminal connected to the "S0" bus.

1.12 Access to Public Networks

The ECS-FD exchange interfaces with the public PSTN by means of:

- incoming and/or outgoing low frequency analogue trunks, with pulse or DTMF dialling
- incoming analogue trunks with direct inward dialling (national standard)
- 2 Mbit/s digital trunks with associated signalling, conforming to PT Ministry technical standard nr 701.
- EURO-ISDN digital trunks

It is also possible to access the X25 public data network (nominated ITAPAC in Italy) and the Telex / Teletex network for commercial electronic mail, by connecting the system's V24 interfaces to PAD and SERVER units respectively.

LEAST COST ROUTING

This service allows you to connect the PABX to various public network operators, utilizing the most economic trunk line, dependent by date, hour and number of the selection.

1.13 Private Networks with E&M Signalling

The ECS-FD may operate as a terminating exchange or as a transit exchange in a private network of multiple exchanges.

Multiple possibilities and functions are possible largely dependent on the availability of adequate transmission channels between the nodes.

The tie-line connections employ E&M type signalling which gives the user access to basic teephony services. Special network features such as section dialling, break in and forced release can be programmed so that the ECS-FD is an ideal PABX in utility networks.

A variety of digital tie line connections are available. Refer to the specific documentation.

1.14 Private / Multi-Vendor Networks with Q-SIG Signalling

It is possible to handle connections with private networks whether they are analogue, digital, multi-vendor digital, virtual digital or virtual digital via the PSTN. The digital standardized Q-Signalling protocol makes it possible to integrate the ECS-FD in multivendor digital private networks.

This signalling is defined by the ECMA/ETSI bodies for the private networks and allows the management of networking services which includes voice calls, data calls and video calls within the private network, direct and alternate routes for calls in the Q_SIG private network , direct dialling calls, public network calls, transport of the name/number of a calling extension/ of the connected extension, the type of call in progress, call transfer within the network with a check by the Exchange of the extension implementing the call transfer, advice of charge generation at a Gateway node (an Exchange in which there is a transition between the private Q_SIG and the public networks), display of the call meter units (Advice of charge) in real time, 3-way conferences within the network, supervision of calls on distant tie lines.

The handling of the private/multi-vendor networks is practically transparent to the user, who must ensure only that the routings (paths) and the numbering of the network users is correctly customized and then access the network through this data.

The following figure shows the type of private network connections of ECS-FD exchanges in a multivendor network.

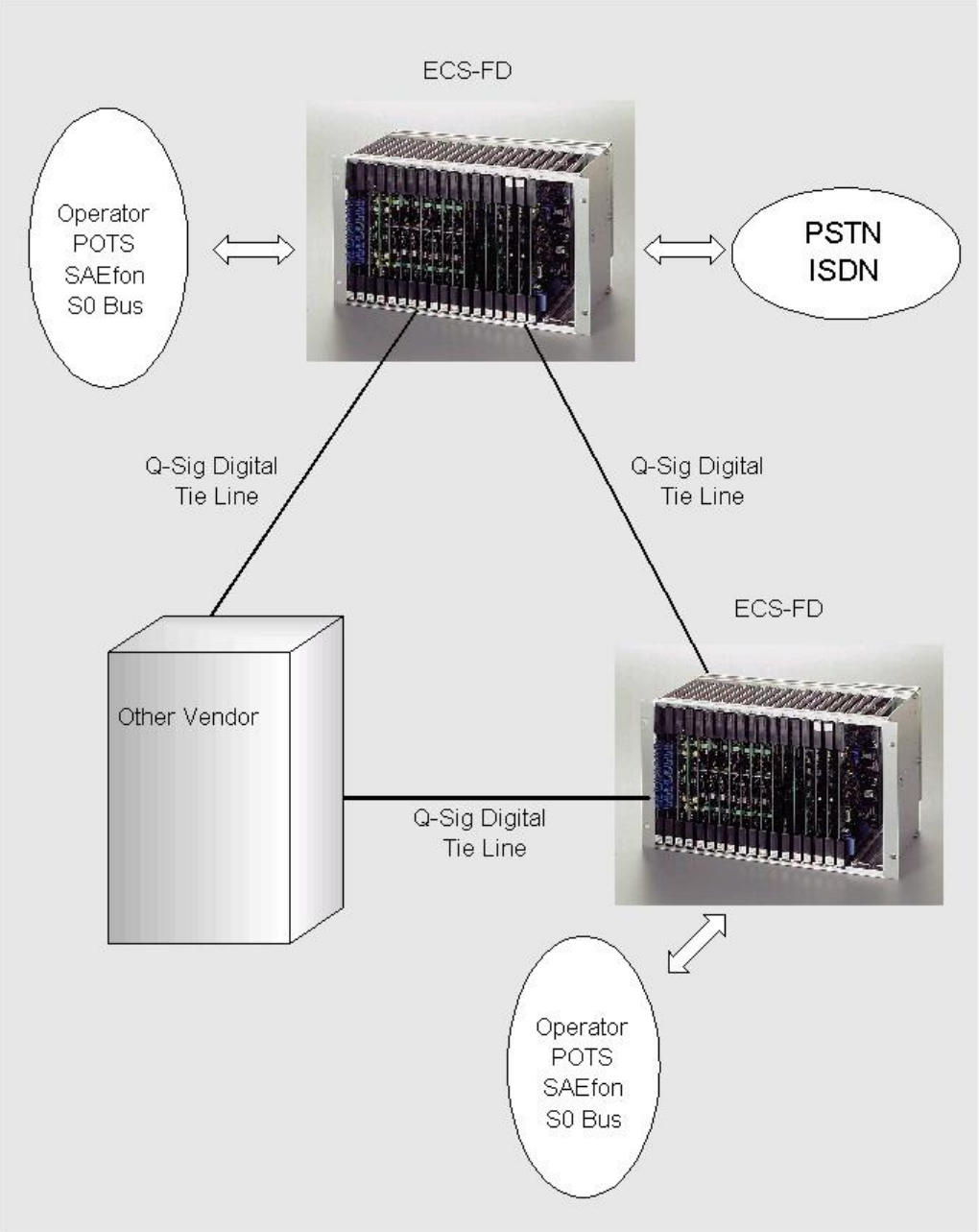


Fig. 1-7
Private Network Example

1.15 Customer Data and Diagnostics

The customer data management services, the alarm management and the start of diagnostic programs etc. are possible both in local or remote locations by means of the administration terminal (TEGEST); these services involve the direct communication between the local (or remote) terminal and the central control unit GT.

In the case of remote administration the communication with the ECS-FD exchange is acomplished using either the public telephone network (PSTN, ISDN, etc) or the internal analogue lines connected to the ECS-FD exchange. The administration Terminal is connected to a MODEM from which a session with the CPU board GT can be established.

1.16 Traffic Statistics

The ECS-FD exchange is able to implement telephone traffic measurements, so as to quantify the employment of the various components within the exchange. These measurements allow the ECS-FD exchange to be correctly dimensioned in order to cope with both the peak internal and external traffic.

The administration terminal TEGEST using the SPESER maintenance program is used to initially set-up the traffic statistics and to display the results; the TEGEST terminal can be connected to the ECS-FD exchange both locally and remotely via a modem.

Traffic measurements can be implemented for the following:

- trunk line bundles
- direct dialling routes (tie-lines) (non Q_SIG)
- hunt groups
- attendant consoles and trunk night service for each multiproperty block
- extension groups for traffic measurements (RMT)
- DTMF transmitter/receiver circuits (or tone recognition)
- parameters related to the configuration of the whole exchange

In particular it is possible to implement the following from TEGEST (loaded with the SPESER application program):

- set-up traffic statistics
- request the ECS-FD for the collected data upon completion of a day of statistical measurements
- store the set-up statistical data in a file (this file is unique for each ECS-FD exchange subjected to statistical measurements)
- store the instantaneous and measured statistical data in a file (this file must be identified by the day of the measurements and the actual ECS-FD exchange that underwent the statistical measurements)
- display, print of the stored data
- request the ECS-FD to display, print the partial data while measuring

During the statistical data measurements set-up the following must be defined:

- the start date of the statistical data measurements
- the timing grid that defines which days, starting from the start date for which the statistical measurements must be implemented
- the two data measurement intervals T1 and T2 during the course of a day
- the relevant trunk line bundles
- the relevant direct dialling routes (tie-lines)
- the groupings for traffic measurement
- whether data should be measured relevant to the Attendant Console (PO) and the Night Service (NS)
- whether data should be measured relevant to the DTMF circuits
- whether data should be measured relevant to the equipment configuration parameters

1.17 Hotel Applications

Special application programs allow the ECS-FD exchange to fully satisfy the service needs of Hotels or in more general terms those environments that must demonstrate a particular hospitable relationship with their clients (clinics, tourist centres etc.).

The following provides some examples of the hotel services available:

- handling of the communication with one of the major hotel management software packages, developed by FIDELIO
- telephone numbering plans that use the hotel room numbers
- automatic wake-up call with wake-up message in client's language
- room alarm management
- telephone set alarm management
- auxiliary assistance call, external alarm management
- pre-paid billing
- automatic debit of bar service charges
- room ready
- watchman
- room check-in / check-out
- detailed billing
- public telephone kiosk

1.18 Voice Mail / Automatic Attendant

A voice mail server such as the MVX2000s can be integrated to the ECS-FD. Voice mail services as well as an automated operator may be implemented.

The following provides some examples of the services available:

- Internal or external calls directed or forwarded to a voice message handler
- management and control of messages
- informative vocal help for automatic routing of incoming calls to desired destinations
- attendant automatic recall

For further details about the MVX2000s system refer to the specific documentation

1.19 DECT Service

The ECS-FD exchange may be equipped with a cordless communication system which conforms to the DECT (Digital European Cordless Telecommunications) standard. Each system allows:

- 8/16 radio base stations
- 32/40 portable DECT telephones
- coverage within a distance of up to 1000 metres

For further details about this system refer to the specific documentation

1.20 External Equipment and Services

The Fig.1-8 illustrates what type of terminal equipment can be connected to the ECS-FD exchange through the internal network and the type of external connection that can be made with the ECS-FD system.

All of the internal and external connections from the main distribution frame are connected to the ECS-FD exchange via standard cables going to the upper connector of the respective peripheral boards within a subframe.

Normally the main distribution frame is contained in a cabinet similar to that used for the ECS-FD exchange; the two cabinets are placed close together in order to reduce the length of the interconnecting cables. It is also possible to integrate the MDF in the same cabinet as the ECS-FD to make a more compact system.

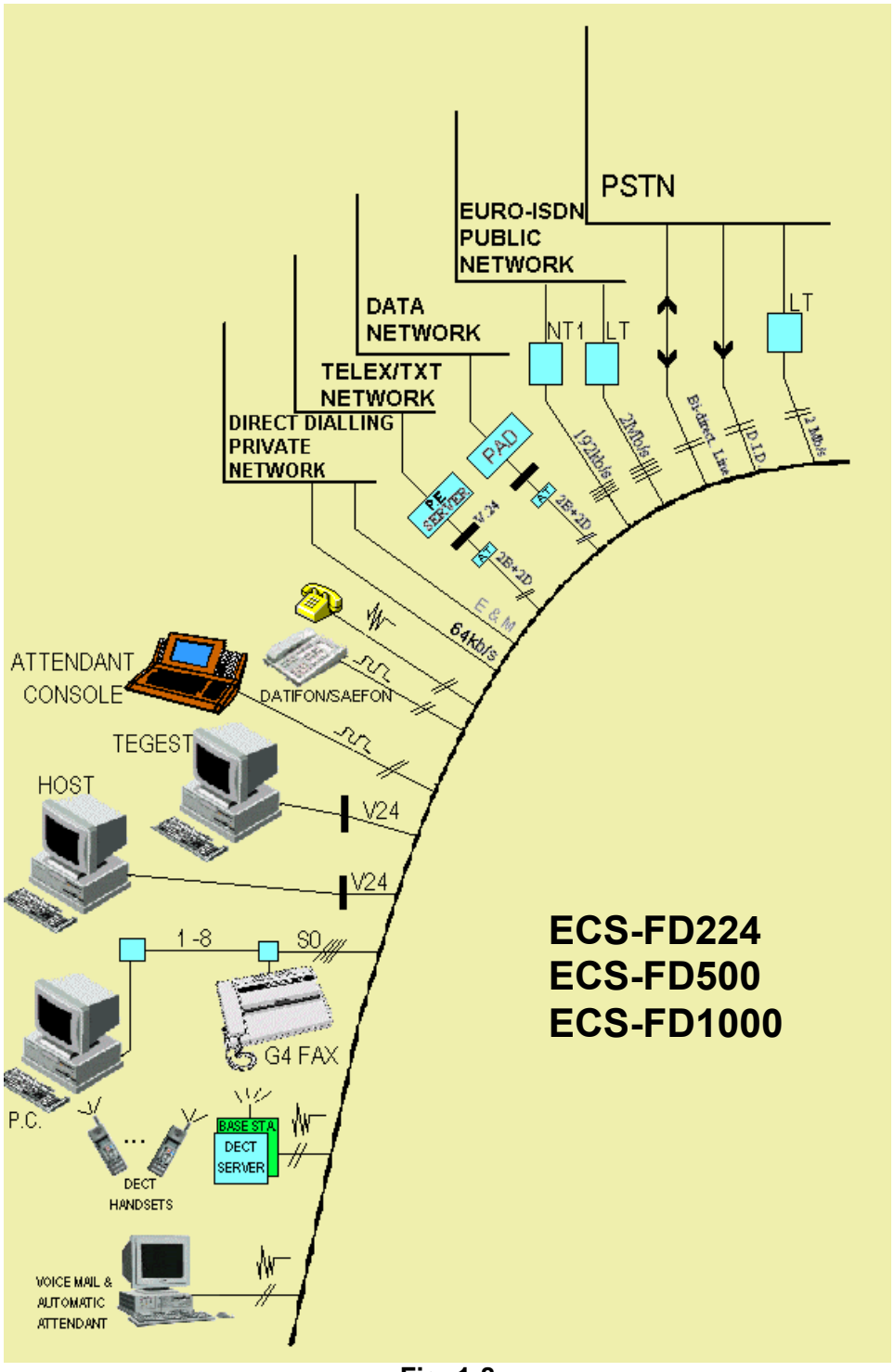


Fig. 1-8

Equipment and lines managed by the ECS-FD exchanges

2 Functional Organization

2.1 Introduction

Fig. 2-1 illustrates the general structure of the ECS-FD exchange previously outlined.

It is divided into two principle subsystems:

- the peripheral subsystem (PSS) which is comprised of the various peripheral groups (PG) which interface the system with the internal and external lines
- the central subsystem (CSS) which is comprised of the GT, the centralized devices and functions in general.

The power subsystem (SSA) is described separately in chapter 4; the application subsystems, that can be optionally used (server for "Detailed Billing" data, server for voice messages, server for electronic mail) are described in separate documents.

The two subsystems PSS and CSS interact by means of:

- a bus structure (S/C Bus) which is used for signalling message transfer from the PSS to the CSS and in the opposite direction for command messages
- a star structure formed by PCM buses that are controlled by the central PCM switching matrix.

Further information about the two types of connection follows.

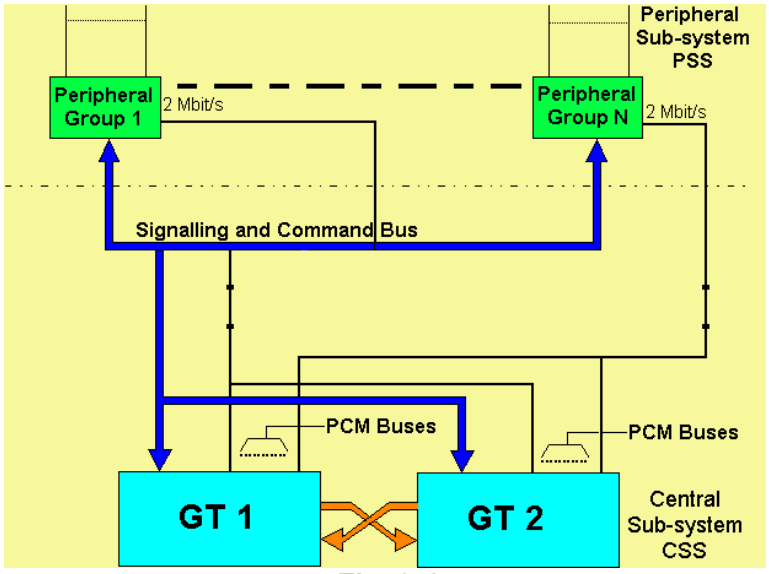


Fig. 2-1
General structure of the system

2.2 Signalling and Command Bus

The S/C bus is physically comprised of:

- a pair of wires situated on the subframe's backplane representing a wire for each transmission direction
- peripheral processors on the installed peripheral groups (PG)
- the bus controller on the GT board.

The bus transmission is full-duplex, asynchronous with a transmission speed of 375 kbit/s.

Bus communication always involves the bus controller, which is assigned the function of "master" in all communication sessions.

Normally a communication involves a single peripheral controller; a broadcasting communication from the bus controller to all peripheral controllers is also possible.

The messages transmitted on the bus are comprised of characters each made up of eleven bits, where the first bit is the start bit and the last bit is the stop bit.

Of the remaining nine bits, eight are assigned to the data that is to be transmitted and one bit (that previous to the stop bit) is used to define the meaning of the byte (8 bits) that precedes it.

When this bit has logic level "1" it implies that the preceding byte is an address, whereas a logic level "0" indicates that the preceding byte is data.

Fig. 2-2 illustrates the general format of a character, the address and data characters.

The message transmitted is made up of a number of characters (maximum number 59).

In order to understand the way in which the bus controller activates the communication session with a particular peripheral controller, it must be considered that the address assigned to each peripheral group (PG) is directly related to its physical position within the system to which it belongs.

To open the communication session the bus controller transmits the character containing the requested PG address on the bus. Only for that particular PG is the position address and requested address found to be equal, therefore only that particular PG is defined to receive the message and to output in parallel the pre-defined message from its transmission memory.

The total length of the message that follows is defined by the first character of the message ; the last character is always a control character that allows the unit receiving the message to detect transmission errors and to request retransmission (by returning a NACK message).

For all correctly received messages, a corresponding acknowledgement message (ACK message) is transmitted back to the sender.

From the above it is apparent that the length of each single communication session is variable as is the time interval between two successive interrogations of the same peripheral controller.

The time necessary for a complete interrogation cycle may also vary from 75 ms to 300 ms for a fully equipped system, with an average value in the case of normal traffic conditions close to the minimum value indicated

In order to avoid an interrogation interval of the same controller being so brief as to have no meaning in relation to timing and line signalling duration, the minimum interval of a cycle is set to 65 ms.

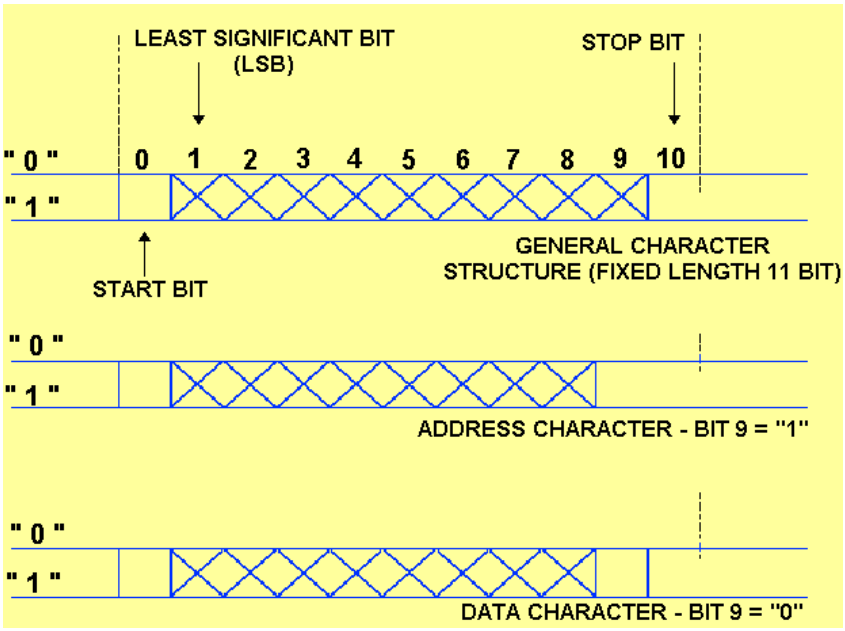


Fig. 2-2
Format of character on the S/C bus

2.3 Internal PCM Buses

The internal PCM buses are dedicated to the transport of information (voice or data) within the system relative to the various terminations.

In the case of an internal connection between two extensions with analogue type telephones, it is necessary that the information on the line relative to the voice is previously digitized. The analogue to digital conversion operation for an incoming signal and the digital to analogue conversion operation for an outgoing signal, are implemented by PCM (COMBO) co/ decoder circuits for each of the individual terminations.

With regards to data information, this may arrive at the system ports in analogue form (if it is coming from a modem); in this case the data information is treated as a normal phonic signal and therefore undergoes the same conversion as that of a voice signal at the termination.

Generally however, data information arrives at the system's digital ports and is already compatible for transfer into the system. The transfer is completely transparent, with the job of conversion or transfer control given to the data equipment on the end of the connection.

The PCM buses are comprised of wire pairs on which successive frames of 125 ms (8 kHz) duration, subdivided into 32 time slots are organized. Each time slot has 8 bits; each time slot therefore has a 64 kBit/s (8 bits x 8 kHz) transport capacity.

The wire pairs relative to the various buses are distributed in star form starting from the central switching matrix on the GT towards the peripheral groups.

Each subframe, through its back-plane wiring, provides the distribution of a certain number of PCM buses. Within the ECS-FD500 and ECS-FD1000, the assignment of a certain number of PCM buses to a subframe is implemented by a special service card (interconnection card) positioned on the inner right face of the subframe.

The terminations of a PG (or in general each functional block which deals with voice or data information) can only employ the time slots available on those PCM bus wires that are actually present at the position where the PG is inserted within the subframe.

There is no predetermined relationship between termination and PCM bus time slot allocated to a termination; in fact, as a termination has need of a time slot, the central command individualizes and assigns an available time slot of the relative PCM buses to it.

In this way it is possible to have more than 32 terminations having access to 32 time slots, concentrated on a single PCM bus, due to these terminations being allocated a time slot relative to traffic intensity.

2.4 Base Groups

The base groups are:

- Traffic management (GT)
- Service Unit (US)
- Voice Announcements (AV)
- Courtesy Announcement (AC), for the ECS-FD500 and ECS-FD1000 only

2.4.1 Traffic Management GT

The GT board performs the fundamental tasks regarding the control of the ECS-FD exchange.
The following lists some of these functions.

- depending upon the requests coming from the terminations, the GT activates and deactivates the connections in the PCM switching matrix and guarantees the development of the requested services
- operates systematic supervision on individual circuit functions and activates isolation procedures of any defective parts and outputs relative alarm signals
- generates acoustic tones
- can communicate in an interactive manner with the person assigned to the management of the ECS-FD exchange during the development of the customer data or during the maintenance program operation
- manages traffic statistics and gathers "advice of charge" (i.e. billing) data

The GT card is comprised of the following functional blocks (Fig. 2-3):

- Central Processing Unit (CPU)
- PCM and Conference Matrixes
- Tone Generator
- System Timing Generator
- Serial Channel between GTs
- Changeover circuit
- Channel access to Local or Remote Administration Terminals
- Signalling and Command (S/C) Bus Interface

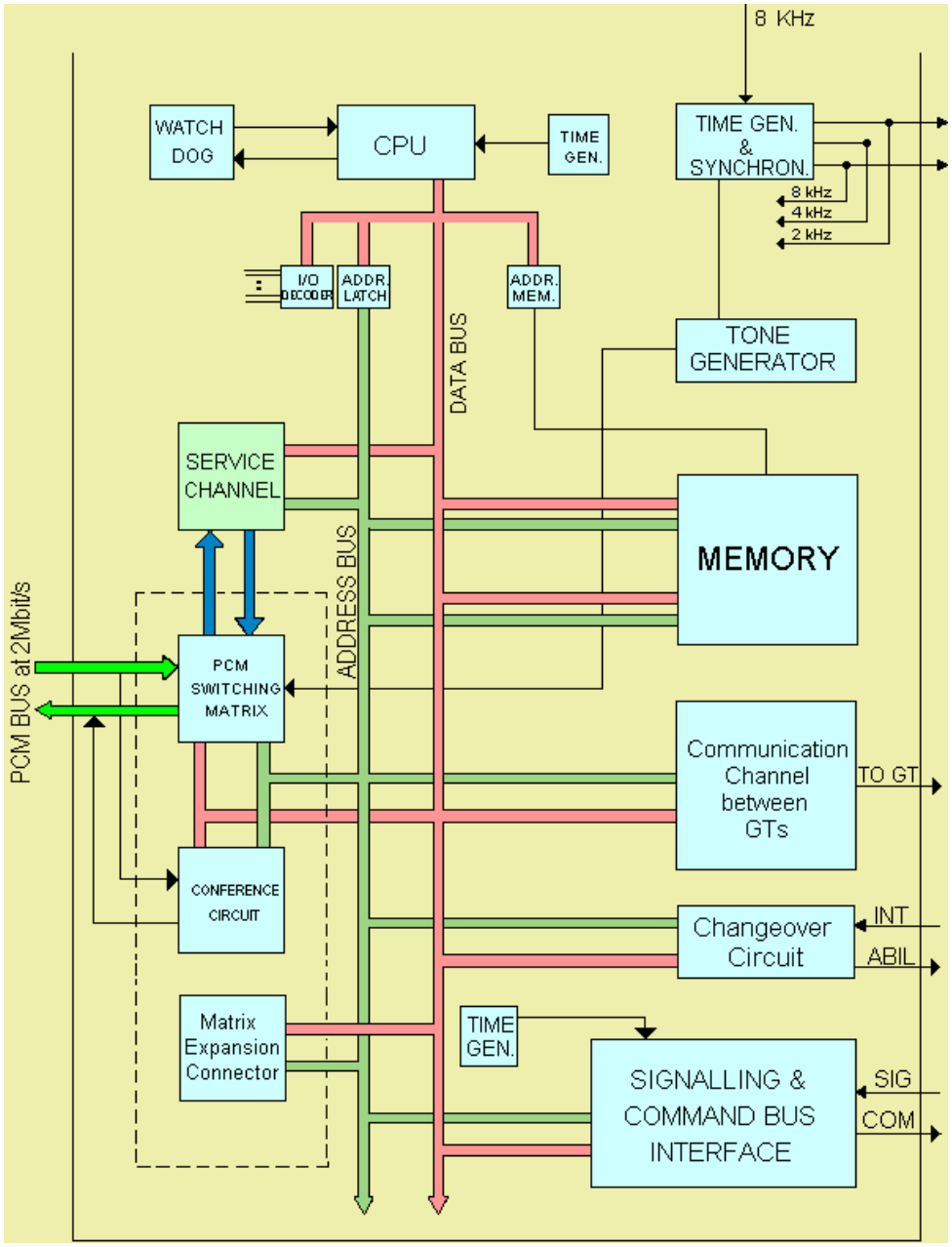


Fig. 2-3
GT block diagram

2.4.1.1 Central Processing Unit CPU

The CPU is based on multiprocessor principle using INTEL/ MOTOROLA.

The operating frequency is 8 MHz.

The memory is totally addressable and is divided between:

- memory reserved for ECS-FD program (non volatile FLASH memory, which is both electrically erasable and directly re-programmable)
- RAM memory for recording dynamic data relative to system traffic
- NOVRAM memory for the customer data with an external battery for maintaining the data. The memory is reprogrammable exclusively by implementing a particular procedure via the Administration Terminal (TEGEST).

The CPU is equipped with several auxiliary circuits which include:

- the reset circuit which is triggered upon insertion of the GT card within the subframe and is also used to monitor the +5 V voltage level. This circuit is able to intervene by blocking the CPU if the voltage level drops below a pre-set level
- the "Watch-dog" circuit is based on a counter that in the correct CPU operating conditions is periodically reset by the CPU to its initial state and therefore never develops into an alarm state. In a single GT system, an alarm state will lead to a forced CPU reset. In the case of the redundant system (i.e reserve GT in hot stand_by), the GT in alarm is placed in the "out of service" condition, and the redundant GT will take over as master.

2.4.1.2 PCM Matrix and Conference

The matrix utilizes 16 input PCM wires and 16 output PCM wires connected as shown in Fig. 2-4 for a total of 512 time-slots, which are available both for the peripheral terminations and for centralized functions e.g tones, conference and courtesy announcements etc.

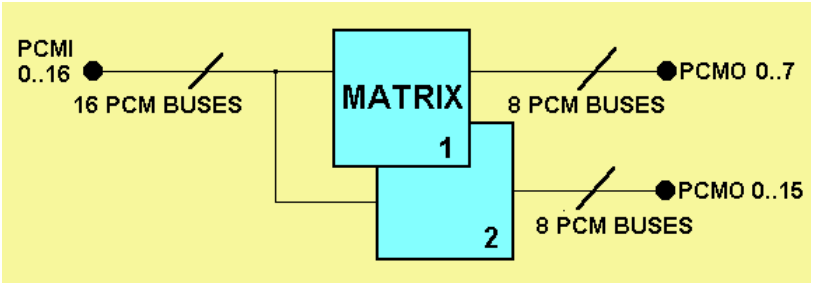


Fig. 2-4
512 slot total access PCM matrix

Each GT group, in its base configuration is equipped with a 512 time-slot total access matrix.

For the ECS-FD1000, an expansion of the matrix is possible, allowing a total capacity of 1024 time-slots (Fig. 2-5) by the addition of a "Matrix Expansion" daughter card (ESPMAT) which is inserted within a connector on the GT card.

Hence the maximum matrix size supplied with the ECS-FD1000 exchange has 32 PCM buses equivalent to 32 matrix input lines and 32 matrix output lines.

These 32 twisted pairs are distributed through the system subframe wiring and are nominated PCM0.... PC31. Each individual wire transporting incoming/ outgoing time-slots to/from the matrix are nominated PCI/X and PCO/X respectively.

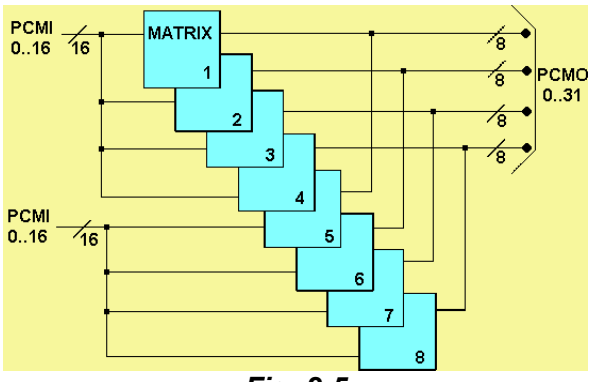


Fig. 2-5
1024 slot total access PCM matrix

The connection of two terminations through the PCM matrix is controlled by the CPU; the connection employs a bus time-slot associated with one termination and a bus time-slot associated with the other.

The "Conference" service is integrated within the same matrix and allows management of conferences using 64 time slots.

It is possible to operate a conference between groups of up to 8 users, "Users" meaning any source of phonic signal and therefore even tones or PCM coded musical signals assigned to PCM bus slots.

In this way the conference tone superimposed on a call in progress corresponds to a conference between the two users and the conference tone generator.

Some of the 64 slots are reserved in order to guarantee the attendant intrusion service.

During a conference, the voice level of the correspondents is not attenuated.

2.4.1.3 Tone Generator

The signalling tones heard on the internal extensions or output on the external lines are digitally generated directly in PCM code by the "Tone Generator" functional block.

The method used for tone generation employs the cascading of two suitably programmed EPROM memories:

- the first performs tone generation (in digital form) with a maximum of eight signals that are different from each another by at least one frequency or level parameter. PCM samples have been memorized for each signal and these are read in succession every 125m s.In particular, one of these signals corresponds to PCM "silence" characterized by the byte 01010101.

The signals generated are continuous.

- The output of the first memory is the input of the second which has the task of converting the various continuous signals in rhythms which are compliant with the required timing standards.

Up to 16 different telephonic tones are available on the output of the block which employ the slots from 16 to 31 of the PCM wire 0.

The above mentioned memories can be re-programmed, hence allowing the tones to be changed in order to be compliant with any recommendation.

2.4.1.4 System Timing Generator

Three timing signal generator blocks are provided on the GT card:

- the first comprises of a quartz oscillator which generates the CPU operating frequency
- the second comprises of a 12 MHz quartz oscillator used to clock the signalling and command bus controller (S/C bus).
- the third comprises of a quartz oscillator followed by a chain of synchronous dividers for use by the PCM matrix and conference circuits.

Within the GT the three blocks are independent.

In the case of a redundant configuration, when a redundant GT is in standby, the timing from the third block is used to provide the synchronization (in frequency and phase) with the reserve GT; this guarantees that information transmitted on the internal PCM buses is not lost when there is a GT changeover.

The frequencies of each block must be locked on to a frequency coming from an external digital trunk (e.g. 2 Mbit/s digital trunks with associated signalling or with EURO-ISDN Primary Rate or Basic access). In the case of the presence of several digital connections, a priority chain for the assignment of the function "synchronization master" is defined.

When the priority chain expires, the ECS-FD exchange functions with its own internal clock.

The GT timing generator outputs clock frequencies of 8 kHz, 2 MHz, 4 MHz, which are distributed within the system.

When there is a redundant GT the three previously described timing generator blocks also have a back-up on the redundant GT.

In the case of ECS-FD500 and ECS-FD1000, each timing frequency is distributed through a bus driver positioned on the GT which supplies further drivers positioned on the interconnection card of each subframe (Fig.2-6); the output of each of these drivers supplies a bus that is wired on its respective subframe's backplane and used for frequency.

In the case of ECS-FD224 each timing frequency is distributed through a bus driver on the GT wich supplies further drivers, positioned in each peripherical group, in the only subframe. This solution isolates each subframe when there is a bus failure that could effect other subframes; note that the electrical parameters relative to the distribution system are not influenced by varying the number of subframes.

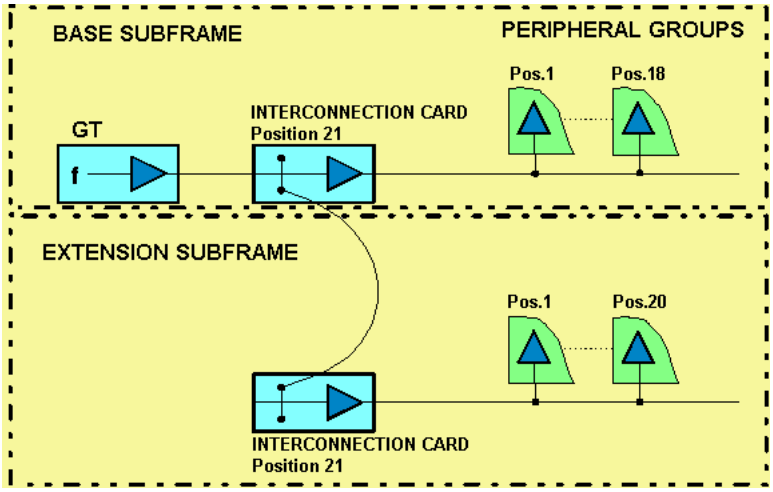


Fig. 2-6
Distribution of timing signals

2.4.1.5 Serial Channel between GTs

This channel is used when there is a redundant GT within the ECS-FD exchange.

This allows:

- asynchronous data transfers to the redundant GT (at 9600 bits/s) of the latest data regarding operation and changes within the peripheral groups
- updating of the redundant GT with customer data (using synchronous DMA data transfer at 512 Kbit/s to the CPU)

In particular cases it is possible to insert a second GT (without customer data) to be used as the reserve GT: the channel will be used for customer data transfer from master GT to redundant GT with the loading operation completed within a few seconds.

The channel that connects the GTs is driven from both ends by a "Serial Communication Controller" (Fig. 2-7).

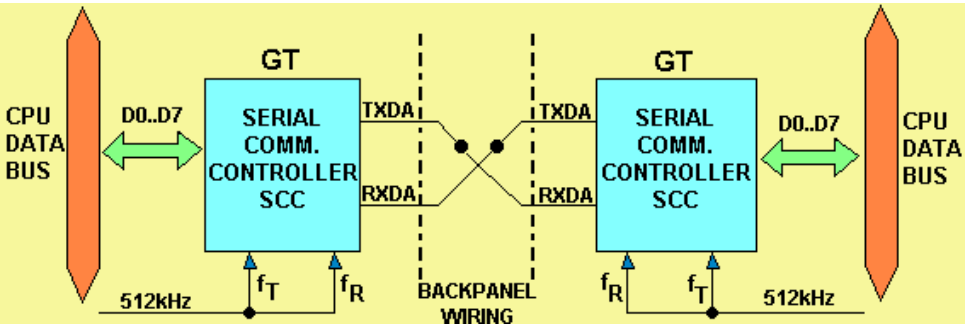


Fig. 2-7
Serial channel between GTs

2.4.1.6 Changeover Circuit

The changeover circuit between the two GTs is based on a simple Set/ Reset flip-flop. Each GT controls one of the two flip_flop circuits within the component; both of the circuits within the component are connected to the backplane (Fig. 2-8).

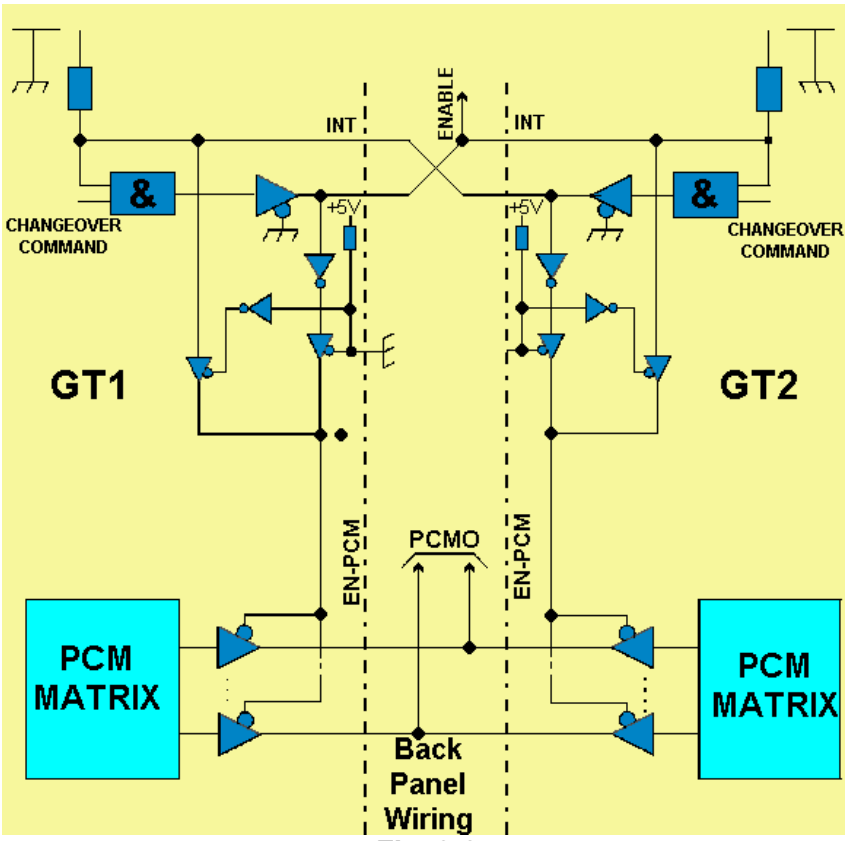


Fig. 2-8
GT changeover circuit

The circuit manages at a central level, which of the two GTs is in the master state; also this circuit enables the group of switching matrix output wires PCO/X from the master (while the matrix outputs from the slave (reserve) GT are disabled).

The data regarding which GT is master is then distributed to all of the peripheral groups (PG), in order to enable them to use only the timing generated by the master GT and to use the S/C bus relative to the master GT.

The changeover command is activated by the redundant (slave) GT based upon data received via the serial data channel from the master or otherwise the changeover command can be activated directly by service personnel using the TEGEST maintenance program.

The GT operating state is indicated by a led positioned on the front edge of the card.

GT state	**Signal**
Master	flashing green light
slave without alarms	green light on
slave with alarms	green light off

2.4.1.7 Local and Remote Administration Terminals

With a PC connected to the serial port of the US board it is possible to configure various functions:

- initial loading, checking and modification of customer data
- checking and modification the GT state
- start of diagnostic procedures or request for traffic statistics
- up-dating of software version

These functions are accessible by means of a data terminal (normally a personal computer) with V.24 standard asynchronous interface, loaded with necessary programs and named "Administration terminal" (TEGEST).

In order to connect this terminal to the ECS-FD exchange a data channel is provided on the Service Unit (US) group which is accessed via a RJ45 8 pin connector situated on the front of the board or alternatively the PC can be connected via the main distribution frame to the Service Unit (US) board.

The transmission speed is programmable up to a maximum of 19200 bit/s.

A data channel to connect a remote personal computer (PC) via the public network or direct dialling private network is also provided on the US group. It is also possible to connect the modem to an analogue termination (e.g. CAU). This data channel is integrated with a V 23/V 22/V22bis modem on the US group having a transmission speed of 600, 1200 or 2400 baud.

The connection between the GT data channel and the US local or remote channels is achieved through the PCM switching matrix.

The slots 1 and 2 of the PCM wire 0 are the slots assigned to this service

Fig. 2-9 shows the relevant circuits used for connecting the administration terminal "TEGEST" with the CPU data bus.

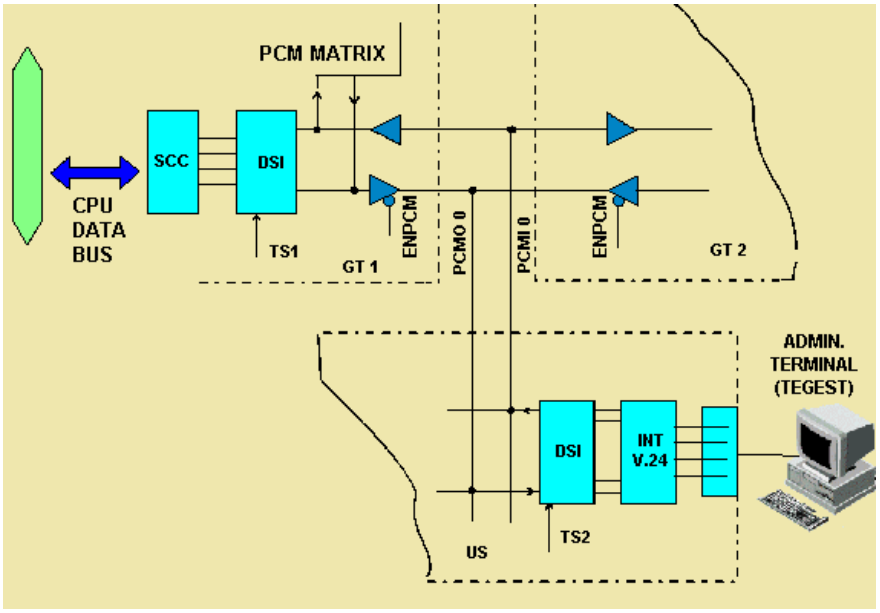


Fig. 2-9
CPU access from a local administration terminal

In particular, the Data set interface (DSI) component allows insertion of an asynchronous data stream within a PCM time-slot.

With the exception of initial customer data loading, all management functions which can be locally activated, can also be activated from a remote site connected via the public switching telephone network (PSTN). In this case the V23/V22/V22bis modem situated on the US group is employed.

The internal circuits relevant to a remote connection with an administration terminal (TEGEST) connected via a trunk is illustrated in Fig. 2-10.

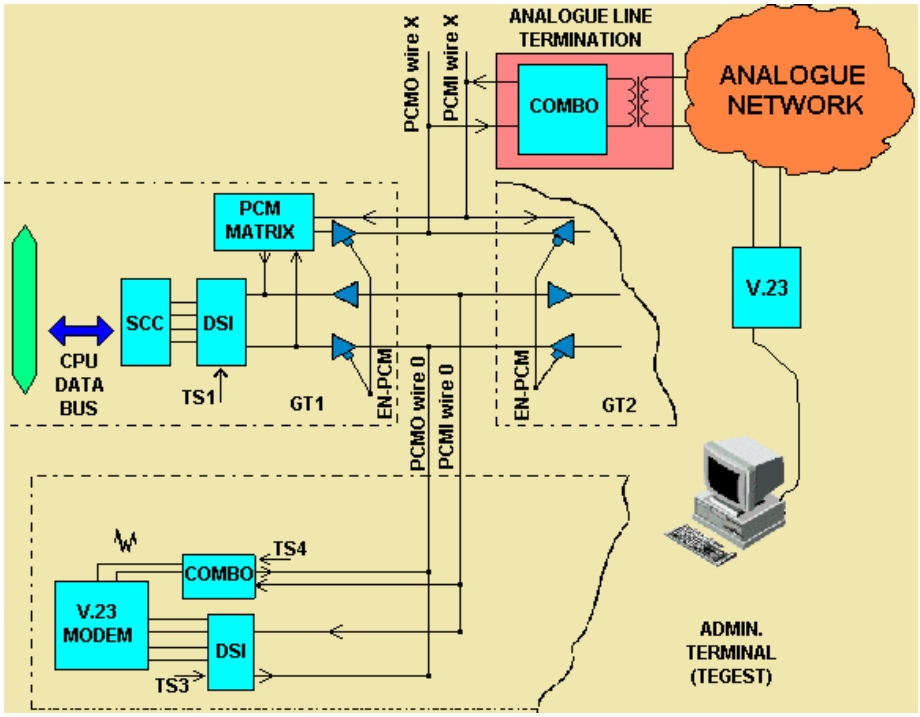


Fig. 2-10
CPU access from a remote administration terminal

It is to be noted that the two GT groups receive messages from the administration terminal (TEGEST) in parallel, but only the master GT is enabled to transmit to the administration terminal.

The administration terminal can receive information relative to the slave GT via the serial communication channel between the GT slave and master.

2.4.1.8 Interface with the Signalling and Command Bus

The GT controls the peripheral groups (PG) by means of a bus controller which performs the cyclic addressing of the PGs installed and the communication with each (Fig. 2-11).

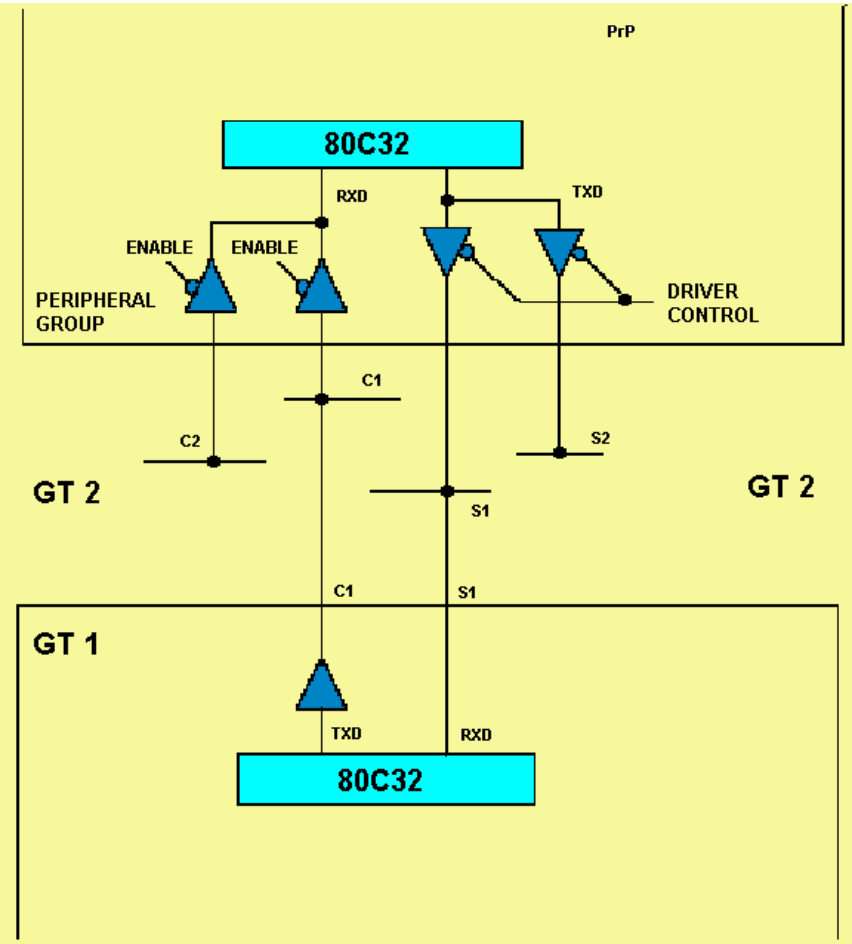


Fig. 2-11
S/C bus

Once the addressing cycle and communication with the various peripheral groups are terminated, and before reactivating a new cycle, the bus controller activates two processes in succession:

- signals to the CPU its availability for reception of the block of commands that are to be switched into the successive interrogation cycle of the PGs. The CPU, by means of its own internal DMA circuits and transfer registers, (see Fig.2-12), transmits the block of commands requested
- transmits to the CPU the block of signalling received in the previously completed scan cycle which is stored within its output memory

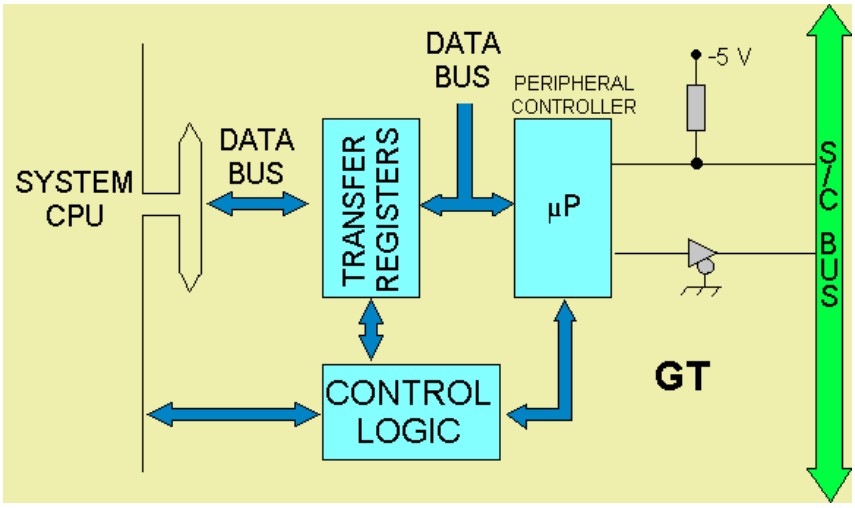


Fig. 2-12
S/C Interface bus

2.4.2 Service Unit US

Even though the US group is connected to the GT like any other peripheral group, it is however apart of the central subsystem because it contains circuit blocks that implement centralized operations within the system.

The block diagram of this group is shown in Fig. 2-13.

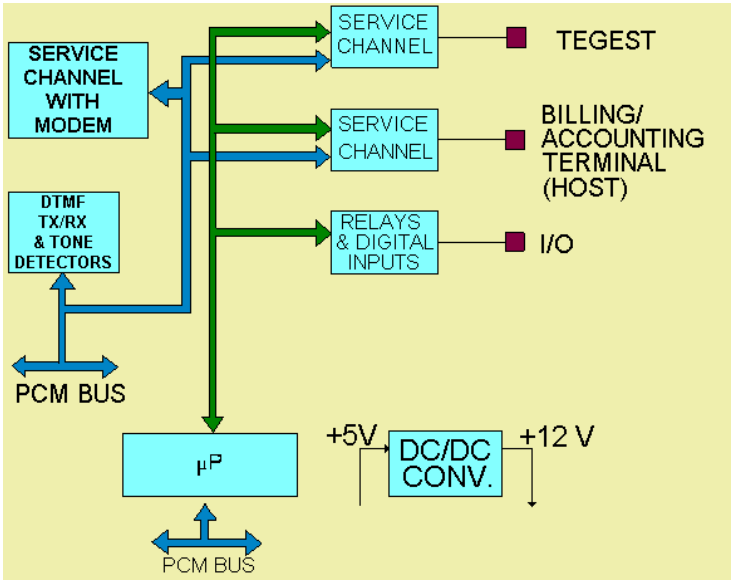


Fig. 2-13
US block diagram

The following specialized blocks are present:

- modem block and auxiliary circuits which allow access to the GT data bus from remote terminals
- block comprising of DTMF receivers, DTMF transmitters and tone detectors (trunk) at 425 Hz. The receivers allow the ECS-FD exchange to use telephones or incoming lines with multi-frequency DTMF dialling and the transmitters allow outgoing DTMF dialling on trunks. The parameters associated with DTMF dialling conform to the ITU-T Q23 recommendation
- relay block for auxiliary services with polarity free contacts

- detector block for digital signals coming from outside the ECS-FD exchange
- I/O block. This is comprised of two V 24 serial ports which have connectors available for the connection of local terminals (TEGEST and HOST) on the front edge of the US group; the same signals are also available on the ECS-FD main distribution frame corresponding to the position containing the US group; within the group the two serial ports have separate access to specific bus time-slots in PCM wire 0; in the GT the two slots are converted for access to the data bus of the ECS-FD exchange's CPU
- +12V voltage generator block; this voltage is necessary during GT flash memory programming during which the main system program is recorded
- block which generates the general "emergency" signal in the case that the GT is out of service; the emergency signal is taken to the back plane and is distributed to the bus in order to be utilized by the emergency group, (to be described later)

All the connections to the US group relative to inputs from outside the ECS-FD exchange or outputs from the ECS-FD exchange are protected from dangerous static impulses.

The US group contains some functions that are directly related with the GT operation and therefore it is necessary to insert the US card in position 18 of the base subframe. If there is the necessity for the US to have a higher number of circuits performing a particular function, not directly relevant to the GT (e.g. further Rx/Tx DTMF circuits), then it is possible to insert further US groups in any position within the base subframe (the only subframe in the case of ECS-FD224).

2.4.3 Voice Announcements AV

The AV group is a centralized module which communicates with the GT by means of the S/C bus and accesses the internal PCM buses.

The block diagram of this group is illustrated in Fig. 2-14.

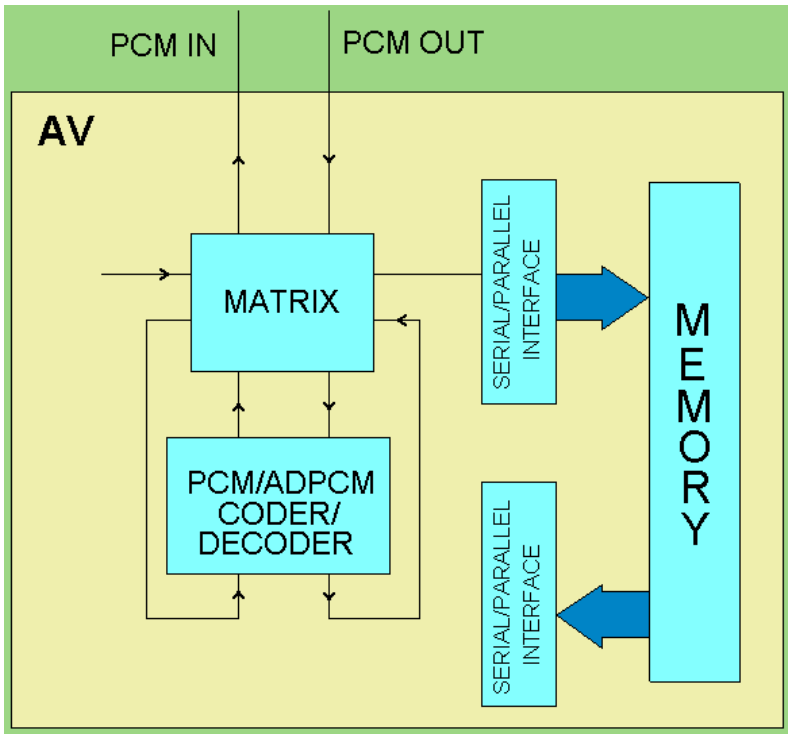


Fig. 2-14
AV block diagram

The AV group provides a certain number of voice slots in which to record courtesy announcements (e.g. announcements that substitute some exchange tones) or system announcements (e.g. announcements that answer a trunk call that politely signals the particular reasons why the service is unavailable...) or brief messages generated by enabled users (e.g. in order to indicate reasons for their own absence or to supply information regarding their whereabouts).

While the recording, playback or corrections of the announcement are activated by means of a particular procedure from telephones enabled for the service, the output of the announcement is automatic; e.g. the call to a user who has prepared an announcement undergoes automatic forwarding to the relevant voice slot containing the left message.

The specific blocks on the AV group are:

- the local CPU with the relative program for the management function of voice slot structuring, recording, playback and cancellation
- the block that comprises the co-decoder ADPCM circuits for the PCM voice signal and the switching matrix which allows dynamic allocation on the internal channels of a time-slot from the PCM bus wire relative to the group
- the RAM memory block for voice announcement recording has a 512 kByte capacity (the capacity may be increased by a further 2 MByte by inserting the memory expansion (ESPMEM) daughter card).

Message recording can be with 32 kBit/s ADPCM coding. The recording time may be doubled by programming the ADPCM sampling for a frequency of 16 kBit/s which still corresponds to the emission of a high quality phonic signal.

Circuits for a connection with an external phonic source are also available. They allow the possibility to mix the announcement with a signal coming from this source (that may for example be a music source), in order to supply a more reassuring "hold service" in the case of announcements that are played at regular intervals.

The AV group recording capacity is summarized in the following table:

MEMORY	**BASE GROUP 512 Kbyte**			**BASE+EXPANSION 2,5 Mbyte**		
Total Time Duration	**at 16 kbit/s**	**about**	**4 min.**	**at 16 kbit/s**	**about**	**22 min.**
	at 32 kbit/s	**about**	**2 min.**	**at 32 kbit/s**	**about**	**11 min.**
Number of 8 second Voice Slots	**at 16 kbit/s**	**32**	**Slots**	**at 16 kbit/s**	**160**	**slots**
	at 32 kbit/s	**16**	**Slots**	**at 32 kbit/s**	**80**	**slots**

2.4.4 Courtesy Announcements AC

This is a centralized unit, that provides the GT with 4 pre-recorded announcements with PCM coding upon a EPROM static memory

This daughter card is inserted directly into connectors situated on the GT.

Each announcement has a duration of 16 seconds and occupies one of the ECS-FD exchange's time-slots reserved for this function, from 12 to 15 of the PCM wire 0.

When preparing the customer Data for the ECS-FD, it is possible to specify the use of these announcements: it is possible to use an announcement in place of the hold tone for example.

Note that the courtesy announcement card can not be inserted in a GT card fitted with the switching matrix expansion card (ECS-FD1000 only).

2.5 Peripheral Groups (PG)

All the PGs provided have an internal structure comprising of two sections (Fig. 2-15):

- All PGs have a peripheral controller, the timing and access circuits to the internal PCM buses. The function of the periperal controller is to interface with the Central subsystem by means of the S/C bus and to control and perform diagnostics on the group terminations
- Each peripheral board has an interface section between the internal circuits of the ECS-FD and the external connections. Each peripheral group is generally comprised of many identical blocks, each of which are associated with a line termination. In more complex groups this second section has a processor with the function of processing the line signalling; this processor communicates with the peripheral controller that maintains its function of communicator towards the Central Subsystem.

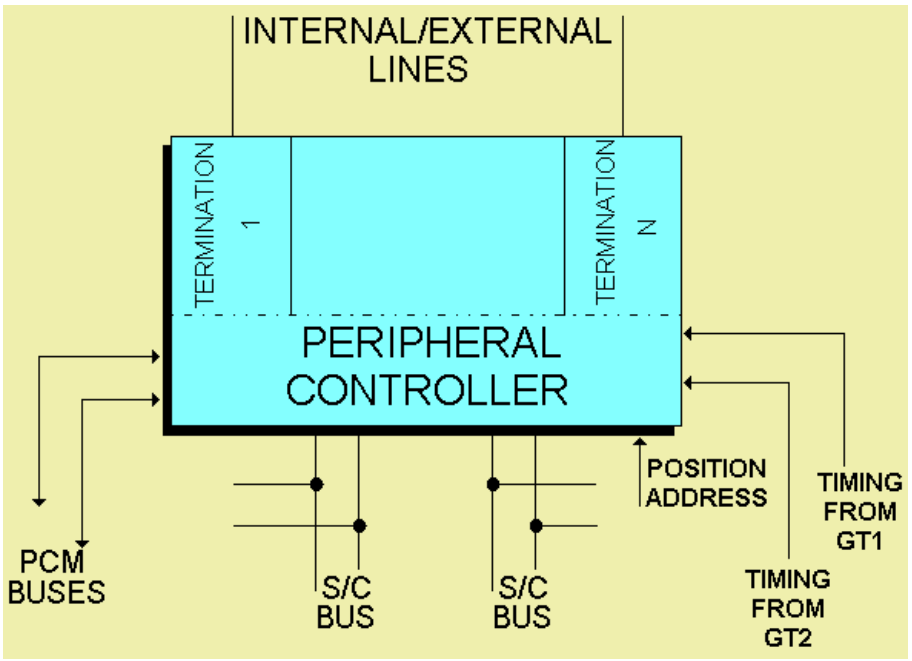


Fig. 2-15
General structure of a peripheral group

The type of interface associated with analogue and digital terminations are different, hence there are also different peripheral groups.

The following lists the peripheral groups (PG) available for the ECS-FD exchange indicating for each its acronym and the function that it executes.

Analogue extension interface to the internal network

8 CAU	8 analogue extension interface circuits
16 CAU	16 analogue extension interface circuits

These groups allow the use of analogue type telephones with pulse and/ or multi-frequency type dialling.

Analogue trunk interface to the public network

4ALUbEM	4 bi-directional analogue trunk interface circuits with emergency
4 ALUbid	4 bi-directional analogue trunk interface circuits
8 ALUbid	8 bi-directional analogue trunk interface circuits

These groups allow the connection of bi-directional analogue trunks which employ pulse and/ or multi-frequency dialling.

8 ALUsp	8 direct-inward-dialling trunk interface circuits

This group allows the connection of Direct-Inward-dialling analogue trunks and uses a protocol compliant with P.T. ministry technical recommendation number 696.

4/8 CLG	4/8 tie-line interface circuits with 4 or 2 wires

This group allows the connection of tie-lines to the direct-dialling private network; the voice circuit can use 2 or 4 wires, while the signalling occurs on separate wires with the E&M protocol.

The analogue trunk interface groups allow the insertion of plug-in daughter cards for call metering used to determine the "Advice of Charge". Each call metering card contains four independent call metering circuits that can be used to count call meter impulses on 4 trunks. The following card has this function:

TAX 12:	4 call metering circuits for 12 KHz/ 16 kHz impulse detection

Digital extension interface to the internal network

8 CAUn	8 digital extension interface circuits
16 CAUn	16 digital extension interface circuits

These groups allow the connection of the digital SAEfon telephones, attendant consoles (OP2) and terminal adapters (TA).

Digital interface to the public network

ALUna	2MBit/s digital trunk interface with channel associated signalling

This group allows connection to the public exchange through a 2 Mbit/s digital link having 30 channels at its disposition. It has a channel associated signalling protocol (2 kbit/s per channel) and requires two channels per trunk communication (i.e output & input).

EURO-ISDN Basic Access S0 interface

4CAUnS0	4 EURO-ISDN Basic access "S0" interface circuits

This group allows the connection of digital terminals with the standard EURO-ISDN Basic access (2B+D) interface to the internal S0 bus.

EURO-ISDN Primary Rate Access to the public network

ALUnc	1 EURO-ISDN Primary Rate access trunk interface

This group allows the connection of a EURO-ISDN Primary Rate access (30B+D) to the EURO-ISDN network at 2MBit/s

4ALUnb	4 EURO-ISDN Basic access "T" interface circuits
2ALUnb	2 EURO-ISDN Basic access "T" interface circuits

These groups allow the connection of EURO-ISDN basic accesses (2B+D) to the EURO-ISDN network at 144kbit/s and are fitted with 1 (2ALUnb) or 2 (4ALUnb) emergency circuits for ISDN terminals.

EURO-ISDN Basic Access T0 and S0 interface

3T01S0	3 EURO_ISDN Digital trunk Basic access T0 interface circuits and 1 EURO_ISDN Digital Extension Basic access S0 interface circuit

This group allows the connection of up to 3 EURO-ISDN T0 Basic Access (2B+D) digital trunks at the rate of 144kb/sec and it also allows the connection of a digital terminal with the standard EURO-ISDN Basic access (2B+D) interface to the internal S0 bus.

Digital, Analogue Interface Q-SIG signalling

4/8CGQSIGA	4/8 analogue tie-line circuits with Q-SIG signalling

This group allows the connection of analogue tie-lines (4/8B+D) to the Private/Corporate (Multi-vendor) networks with Q_SIG signalling.

CGQSIGN	1 digital tie-line circuits with Q-SIG signalling

This group allows the connection of a digital tie-line (30B+D) to the Private/Corporate (Multi-vendor) networks with Q-SIG signalling.

VPN digital interface towards GT

CGVPN	1 VPN digital tie-line circuit

This group allows Virtual Private Network (VPN) service to public EURO-ISDN network, keeping available the Q-SIG services.

Analogue trunk with emergency

Groups necessary to supply the emergency service are also considered as peripheral groups. These group connects some of the analogue trunks directly to standard analogue type telephones if the ECS-FD exchange is out of service.
These groups are:

4EM	4 EMergency circuits
8 EM	8 EMergency circuits

The basic functional block that implements the connection has 4 or 8 identical circuits within the group.

The "emergency" signal generated within the US group is distributed on the subframe back plane; therefore the 4EM and 8EM groups can be inserted in any position within the subframe and in a quantity sufficient to satisfy service needs. Note however that card slots 19 and 20 within the ECS-FD500 extension subframe can have only the 4EM and 8EM emergency groups inserted.

A feature of this block is that on return to a normal operating conditions, a call in progress is not interrupted and can be terminated in a regular manner.

In the case of the 4ALUbEM group, the emergency service is implemented directly on the group.

PG signal conversion

In all analogue type PGs, the basic component is the "Combo" device which has the fundamental operation of implementing the conversion of analogue line signals to a PCM coded digital signals.

The ECS-FD exchange utilizes a second generation Combo which also allows the programming of receive gain, transmission gain and hybrid circuit balancing.

The device has internal registers enabling it to be programmed directly via the serial channel by the group peripheral controller.

This same serial channel allows the Combo to periodically transfer the line signal states to the peripheral controller in order that the controller may reconstruct the line signals; in the opposite direction the controller periodically supplies the logic signals depending on which Combo is to generate the line signals.

For test purposes the Combo can be set to "loop back" mode, when the PCM signal output is connected directly to the input. The PCM bit sequence on the input slot must correspond to the bit sequence on the output slot.

PG connection

Each PG is fitted with two identical 64 pole connectors M1 and M2.

The lower connector M2 must be inserted in its corresponding backplane socket on the internal of the subframe. Besides being powered through this connector, the PG also receives timing signals associated with the PCM buses and communicates with the S/C bus.

The upper connector M1 is connected to the standard telephone cable connector which connects the peripheral boards to the main distribution frame.

In all PGs the PCB area near the M2 connector is occupied by circuits that implement the secondary level or intrinsic protection, compliant with part 12 of the CEI 103-1 standard.

The protection circuitry is with reference to a protective ground GNDP isolated from the electric ground GND, to which other circuits of the group are referred; this is in order to avoid static discharge voltages from the lines damaging the internal components of the group or jeopardizing its regular operation.

Figure 2-16 shows the various peripheral groups, illustrating their application characteristics.

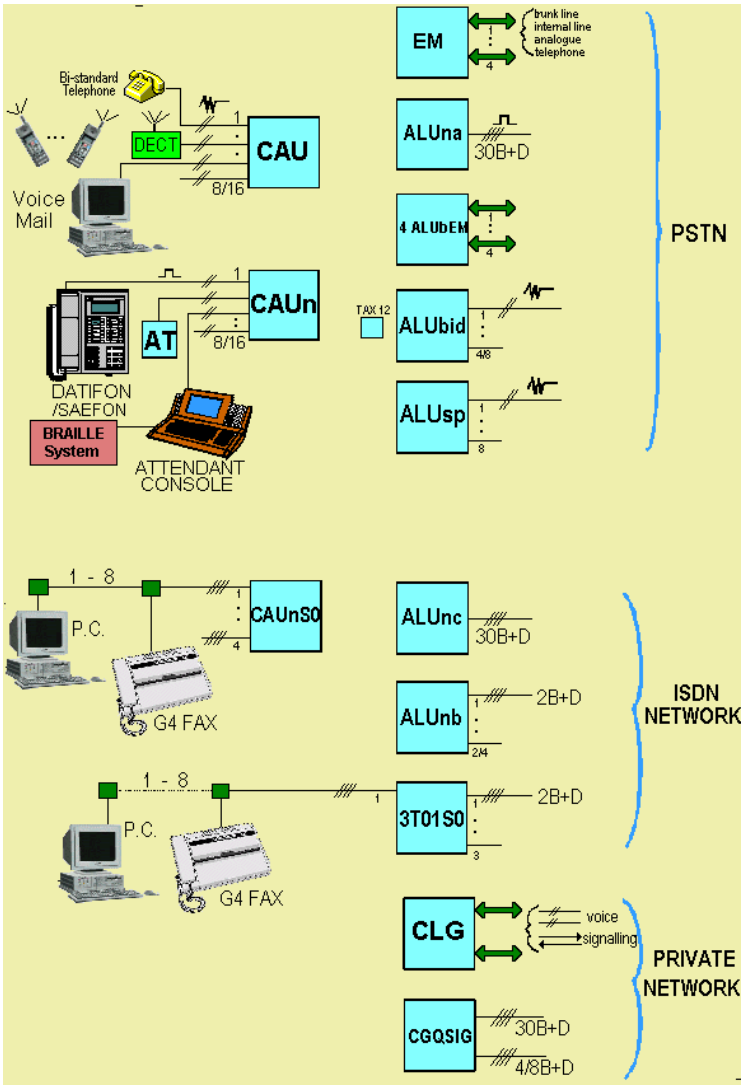


Fig. 2-16
Peripheral groups

3 Terminal Equipment

3.1 Telephone Sets

The analogue telephone sets are connected to the PBX by a twisted pair attached to one of the terminations on the CAU group (analogue extension interface card).

It is possible to use pulse dialling and DTMF dialling complying with the ITU Recommendation Q.23.

It is also possible to use telephones with ground keys or flash keys for register recall.

The following is a list of digital termination equipment specified for the PBX:

- SAEfon T
- SAEfon B
- SAEfon TK
- SAEfon LE
- Attendant Console OP2

All of the telephones listed above can be connected to the PBX through a normal telephone twisted pair attached to one of the terminations on a CAUn group (digital extension interface card); which hence identifies the way in which line signals are transmitted.

The power for all the above mentioned digital SAEfon Sets is supplied directly by the digital extension interface card.

For more detailed specific information refer to the relative user manuals.

3.1.1 SAEfon T

The SAEfon T is a multi-function digital telephone with advanced voice services.

Features:

- dialling pad (keys from 0 to 9, # and * keys)
- 16 user programmable function keys
- 2 volume adjustment keys
- 3 help menu keys
- 24 character x 2 row display
- handset
- hands free

Fig. 3-1
SAEfon T

3.1.2 SAEfon B

The SAEfon B is a multi-function digital telephone with advanced voice services.

The SAEfon B does not have a LCD Display but otherwise it is the same as the SAEfon T

Features:

- dialling pad (keys from 0 to 9, # and * keys)
- 16 user programmable function keys
- 2 volume adjustment keys
- 3 help menu keys
- group listening facility
- handset
- hands free

3.1.3 SAEfon TK

The SAEfon TK is a multi-function digital telephone with advanced voice services.

The addition of a "K module" connected directly to the telephone allows 2 pages of 24 supervision keys to be managed, which can be programmed to indicate the idle/engaged states of trunk lines and/or internal extensions.

Features

- dialling pad (keys from 0 to 9, # and * keys)
- 16 user programmable function keys
- 2 volume adjustment keys
- 3 help menu keys
- 24 character x 2 row display

- handset
- hands free
- 24 supervision keys (K module)
- supervision page selection key (K module)
- asynchronous V24 (RS 232) serial interface

Fig. 3-3
SAEfon TK

3.1.4 SAEfon LE

The SAEfon LE is a digital telephone for voice only.

Features:

- dialling pad (keys from 0 to 9, # and * keys)
- 4 user programmable function keys (shift off) or fixed function keys (shift on)
- 2 volume adjustment keys
- 2 keys for recall and shift services
- 16 character x 2 row display (first row: number of the connected party - second row: 8 icons)
- handset
- loudpeaker
- hands free

Fig. 3-4
SAEfon LE

3.1.5 Attendant Console OP2

Traffic management can also be implemented by the Attendant console OP2 (Fig. 3-5) which is able to use all attendant services offered by the PBX. It is connected to the ECS-FD digital extension board CAUn by a single twisted pair having a maximum length of 600 m and wire diameter of 0.6 mm.

Each PBX can have up to 8 attendant consoles.

The attendant console OP2 is comprised of a keyboard and an inclined tilt adjustable liquid crystal display.

The keyboard is comprised of the following keys:

- 12 telephone service keys.
- 26 programmable function keys.
- 8 soft keys (ESCAPE, F1...F6, SCROLL).

- 15 keys associated with dialling (keys 0...9, "*", "#" key, "R" key, "P" key and "RP" key).
- an internal user state panel displays the free or engaged state of the internal extensions.

Fig. 3-5
Attendant console OP2

3.2 ISDN Terminals

To handle data from the EURO-ISDN S0 interface, it is possible to use ISDN telephones or terminals in order to make maximum use of both the standard and supplementary services offered by the EURO-ISDN network.

Typical terminals include the Group 4 fax (able to transmit/ receive a page every 4/5 seconds), videophone terminals that allow communication with remote parties no longer limited to voice only communication but also allowing the possibility to transmit/receive images or to share multimedia functions, and finally backup devices (i.e. router per LAN) to improve the reliability of other dedicated network connections.

3.3 Administration Terminal TEGEST

This is comprised of an IBM compatible PC which is loaded with the software application packages allowing PBX customer data configuration, maintenance and system diagnostics.

The Administration Terminal may operate locally with a direct physical connection to the GT group; when equipped with a modem it may operate from a remote point by means of the switching network.

The minimum requirements for the personal computer configuration must be as follows:

- 1024 Kbytes RAM memory, 20 Mbytes Hard Disk, 3 1/2" floppy drive
- serial port and parallel port, monochrome VDU

The personal computer must be loaded with DOS version 5.0 operating system or a successive version.

The installation method of the software application packages and their use is described in the "Configuration and Maintenance manual (TEGEST)".

4 Mechanical Characteristics

4.1 Printed Circuit Boards

All peripheral groups and centralized groups use a printed circuit board (PCB) of standard dimensions (Fig. 5-1):

depth 236 mm
height 252 mm

The front of the board is fitted with two small levers to help with the insertion and extraction from the subframe; on the lower lever there is the unit identity plate with the relative internal code and the abbreviated PCB name (GT, CAU, AV etc).

The rear of the board is fitted with two IDC insertion connectors (the lower M2 and the upper M1); these connectors are identical, 64 pin male plugs (DIN standard 41612).

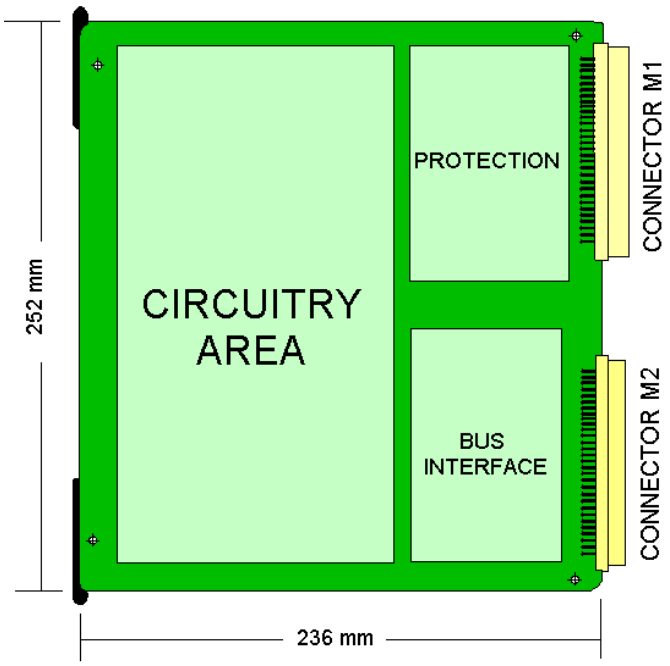


Fig. 5-1
Printed circuit board

The lower connector M2 is inserted within the corresponding backplane socket; the pin layout of this connector is the same for all groups within the system.

The upper connector (M1) has a different use which depends upon whether it is a peripheral group or a Traffic Management (GT) unit:

- for a peripheral group, the connector pins are used for incoming and outgoing signals relative to the internal, external system network. Once this group is inserted within the subframe, this connector is positioned in a free area vertically above the connector M2 (which is inserted in the lower backplane); note that the backplane is only in the lower part of the subframe; for each of the positions that contains a group, a 64 pole leaded female connector is inserted in the corresponding M1 upper connector of the group which connects the group with the main distribution frame. This leaded connector has fixing screws on its casing enabling it to be fastened in position to the subframe casing.
- for the Traffic Management (GT) unit the upper connector pins are used for logic level signals relative to peripheral timing, signalling/ command bus and internal PCM buses.

Due to all the groups being connected to the Sig and Com bus, the Traffic Management (GT) unit identifies each peripheral group by a unique hardwired "Peripheral Group" address that is derived from a combination of the subframe address (assigned by the interconnection card) and the group address (assigned by the lower backplane wiring), according to the following table:

TABLE 5-1
PERIPHERAL GROUP ADDRESSES

SUBFRAME ADDRESS	GROUP ADDRESS	"PG" ADDRESS
Base 0	0……17	1……..18
Extension 1	0……19	19……..38
Extension 2	0……19	39……..58
Extension 3	0……19	59……..78

TABLE 5-2
PERIPHERAL GROUP ADDRESSES

SUBFRAME	SUBFRAME ADDRESS	SUBFRAME ADDRESS CODE				CONNECTOR M2:			
		I7	I6	I5	ERP	a24	c25	a25	c24
Base	0	0	0	0	0	GND	GND	GND	GND
Extension 1	1	0	0	1	1	GND	GND	+5V	+5V
Extension 2	2	0	1	0	1	GND	+5V	GND	+5V
Extension 3	3	0	1	1	0	GND	+5V	+5V	GND

TABLE 5-3
PERIPHERAL GROUP ADDRESSES

CARD SLOT	GROUP ADDRESS	GROUP ADDRESS CODE						CONNECTOR M2:					
		I4	I3	I2	I1	I0	ERP	a26	c27	a27	c28	a28	c26
01	00	0	0	0	0	0	0	GND	GND	GND	GND	GND	GND
02	01	0	0	0	0	1	1	GND	GND	GND	GND	+5V	+5V
03	02	0	0	0	1	0	1	GND	GND	GND	+5V	GND	+5V
04	03	0	0	0	1	1	0	GND	GND	GND	+5V	+5V	GND
/	/	/						/					
17	16	1	0	0	0	0	1	+5V	GND	GND	GND	GND	+5V
18	17	1	0	0	0	1	0	+5V	GND	GND	GND	+5V	GND
19	18	1	0	0	1	0	0	+5V	GND	GND	+5V	GND	GND
20	19	1	0	0	1	1	1	+5V	GND	GND	+5V	+5V	+5V

Note that the subframe addresses and group addresses are verified through the use of an even parity (ERP: even rack parity; ERP: even board parity).

4.2 ECS-FD224 Subframe

The ECS-FD224 cabinet (Fig. 5-2, 5-3, 5-4) is comprised of a single subframe fixed to a hinged structure allowing the subframe to be withdrawn from the cabinet, hence allowing the connectors which are attached to cables going to the main distribution frame to be easily inserted. The main distribution frame cables and power supply cables enter the system through a window positioned on the rear of the cabinet.

The centralized units and the various peripheral groups are inserted into sockets situated on the back plane of the subframe which connects the various groups to the main system bus.

Above the back plane of the subframe containing the system bus there is space for entry of the leaded female connectors which connect the groups with the field via the main distribution frame.

The subframe can house up to 14 peripheral groups and is designed with possible redundancy for the -48 Vdc voltage converter, GT units and US groups.

The connections between the printed circuit boards, power distribution, timing signalling and all logic level signals in general are achieved through connections on the back plane PCB.

The signals are generally distributed by means of a bus; the wires and PCB tracks have diameters proportional to the maximum current values which they could carry.

A unique position address is assigned to each of the fourteen peripheral groups in the subframe by means of hardwiring on the back plane card.

Each address is assigned automatically to each peripheral group, allowing it to interface correctly with the communication bus.

In order to provide the correct connection of the screened cables (16 and 32 pair, with 2 metre length) from the main distribution frame to the external lines, the installer of the ECS-FD exchange must proceed as follows:

- remove all the the fixing screws from the cable clamp block (shown in Fig. 5-4)
- wire the screened cables to main distribution frame, inserting them in the appropriate guides of the cable clamp blocks, maintaining a tidy cable form which is distant from the subframe's backplane
- replace all the fixing screws in the cable clamp block, making sure that the screened casing makes electrical contact with cable clamp block and maintains the mechanical polarity of the blocks.

5 Services

Listed below are some of the services available; for more information refer to the ECS-FD224 SERVICE DESCRIPTION manual.

SYSTEM SERVICES

- Abbreviated (Speed) Dialling
- Abbreviated Dialling Callback
- Abbreviated Number Variation
- Add-On Conference Call
- Attendant Automatic Recall
- Attendant Call Distribution
- Automatic Callback
- Automatic Hold
- Automatic Line Blocking
- Automatic Serial Trunk Calls
- Automatic Supervision Of Connections
- Both Parties Release
- Callback On No Reply
- Call For Assistance
- Call Transfer To Ring
- Call Waiting (Camp-On)
- Centralized Answering & Recording Equipment
- Class of Service Change from Extension for Others
- Direct Incoming Call
- Direct Inward Dialling (D.I.D.)
- Direct Outgoing Trunk
- Distinctive Ringing
- Do-Not-Disturb
- Extension/Attendant Class of Service
- Extension Temporary Class of Service Change
- External Communication
- Flexible Numbering Plan
- Forwarding
- Hold
- Hot Line Call (Direct Call)
- Hunt Groups
- Immediate Call
- Internal Communication
- Intrusion
- Last Number Redial
- Line Bundles
- Multiproperty Blocks and Area Sub-Division
- Message Wait Indication

DIGITAL TELEPHONE SERVICES

- Advice of Call Duration
- Advice of Charge at End of Call
- Automatic Answering
- Caller Name and Number Display
- Class of Service Display
- Continuous Class Of Service Display
- Dialled Number Display Dialling From an External Terminal
- Distinctive Ringing
- Functions Key/Services Local Programming
- Hands-Free
- Intercom Call
- Intercommunicating User Groups
- Line/Extension Status Leds
- Loudspeaker
- Manager/Secretary
- Message From Absent User
- Multi-Line Telephone
- Mute
- On-Hook Dialling
- Park
- Personal Directory
- Printer Connection
- Priority Calls
- Priority Trunks
- Single Line Telephone
- Telephone Diagnostics
- Time Display

VOICE ANNOUNCEMENT & MESSAGE SERVICES

- Courtesy announcements
- Incomplete call personal announcement
- Incomplete call system announcement
- Music on hold

DATA SERVICES

- Automatic Answering
- Automatic Callback
- Automatic Line Blocking
- Connection Test
- Data Terminal Classification
- Dialling From Telephone and From Terminal/ Host
- Direct Internal Call
- Disable Dialling
- Flexible Data Numbering Plan
- Forwarding
- Homogeneous Voice and Data Terminal Groups
- Hunt Groups
- Internal Connection
- Line Exclusion
- Protection
- Reciprocal Release
- Sub-Division Of Areas

SPECIAL SERVICES

- Assistance Call Alarm
- Automatic Wake-Up Call/Appointment Reminder
- Auxiliary Alarms
- Bar Service Charges
- Call Meter Overflow Alarm
- Check-In/ Check-Out
- Credit Calls
- Detailed Billing
- Emergency
- Equipment Diagnostics
- External Alarms
- Local/Remote Supervision
- Major and Minor Alarm Signals
- Printer Out Of Service
- Program Loading
- Public Telephone Kiosk
- Remote Configuration
- Remote Maintenance
- Remote Ordering
- Room Ready

- Night Service Variation From Telephone
- Priority to Attendant
- Paging
- Park
- Pick-Up
- Post-Dialling on Public Exchange
- Pulse / DTMF Trunk Line Dialling
- Restricted Number Check
- "S0" Data Interface Handling
- Store and Redial of External Number
- Switching Between Pulse/ DTMF Dialling on Trunk Line
- Three-Way Conference
- Toggle
- Transfer
- Trunk Dialling Tone Detection
- Trunk Pre-Selection
- Voice Mail Connection

ATTENDANT SERVICES

- Automatic Recall
- Callback with Automatic Call Park
- Caller/ Correspondent Identity
- Camp-On Signal
- Clock
- Console Diagnostics
- Exclusion From Calls
- Extension Status Indicators
- Inclusion
- Loudspeaker
- Malicious Call Identification
- Nominative Call
- Overflow
- Park
- Print of the Customer Data from Console
- Priority Calls
- Programmable Keys
- Public Network Directory
- Queue Indicator
- Serial Call
- Transfer
- Transit Connection Supervision
- Trunk Line Reservation
- Trunk Status Indicators

NETWORK SERVICES

Private Network Services With E&M Signalling

- Abbreviated Speed Dialling
- Dialling Conversion
- Direct Dialling Night Service (DDNS)
- Direct Dialling Traffic
- DTMF Dialling
- Forced Release
- General Alarm Call
- Network Inclusion
- Routings
- Store And Redial Of Tie-Line Numbers
- Switching Between Pulse/DTMF Dialling
- Tie-Lines
- Tie-Line State Indicators

Multi-Vendor Services With Q-SIG Signalling

- Basic Call
- Calling/Connected Line Identification Restriction
- Calling Line Identification Presentation
- Calling Name Identification Presentation
- Centralized or Distributed Incoming/Outgoing Trunk Traffic
- Conference
- Connected Line Identification Presentation
- Detailed Billing
- Direct Dialling Night Service
- Direct Inward Dialling
- Extension Class of Service
- Flexible Numbering Plan
- Hold
- Pulse/DTMF Dialling Transportation
- Q-Sig Channel Groups
- Toggle
- Transfer
- Transit
- Trunk Night Service
- Set System Date And Time From Host
- Telephone Set Alarm
- Traffic Statistics
- Wake-Up/ Appointment Reminder Alarm
- Watchman

EURO_ISDN PUBLIC NETWORK SERVICES

- Access To Intelligent Network Services
- Advice Of Charge During Call
- Calling/ Connected Line Identification Restriction (CLIR & COLR)
- Calling Line Identification Presentation (CLIP)
- Connected Line Identity Presentation (COLP)
- Direct Dialling In (DDI)
- Direct Dialling In To ISDN Data Terminal
- Handling of Incomplete Calls
- Homogeneous Groups of ISDN Data Terminals with Programmable Accesses
- Incoming Call Forwarding
- ISDN Data Protection
- ISDN Data Terminals Class of Service
- ISDN Data Terminal Dialling Disable
- ISDN Hot Line Data Call
- ISDN Internal Data Communication
- Level Attenuation
- Malicious Call Identification
- Multiple Subscriber Number
- Reading of Meters
- Single Subscriber Number
- Sub-Addressing (Sub)
- Sub-Division of ISDN Data Areas
- User to User Signalling (UUS)

6 System Configuration

6.1 Introduction

Each ot the ECS-FD exchange have to be configured according the needs of the customer. In more general terms it involves the conversion of the initial customer data into a form that is compatible with the ECS-FD exchange's data format, in everything from the variation of the physical position of the equipment and its resources to the modification in the assignment of services.

By using a standard PC loaded with the TEGEST software the configuration of an ECS-FD is very easy.

The TEGEST software allow to make the following tasks:

- the off-line preparation of customer data
- loading the customer data into the ECS-FD exchange.

6.2 Off-Line Preparation of Customer Data

On the basis of the initial requirements of the client, it is necessary to enter data in a series of tables which define the various parameters of the ECS-FD exchange.

This data entry is implemented directly on the personal computer which displays the relative pages for each table on the monitor and offers an auxiliary guide (help on line) for the correct entry of customer data, in each table.

The program performs automatic cross-checks on the data entered and may produce a list of errors found in order to help with the correction.

The tables are then stored on the hard disk and/or on a floppy disk and may be printed.

It is naturally always possible to recall the various tables for necessary modifications.

6.3 Loading of Customer Data

The customer data must be recorded in a dedicated memory area within the central memory of the Traffic Management card (GT).

For this memory area a RAM is used with a battery back-up which allows the stored data to remain intact in the case of a fall in the +5 V voltage (which powers the traffic management card GT), or in the case of the temporary extraction of the card.

The customer data entry can occur:

- locally, through a V 24 serial connection from the Administration terminal (TEGEST) to the GT card
- remotely, through a V 23 / V 22 / V 22bis modem connected to the distant Administration terminal (TEGEST) and which has the same characteristics as the remote modem situated on the GT card

The relevant internal circuitry block diagram for the local and remote administration access is shown in Fig. 2-9 and Fig.2-10.

For the local connection the baud rate may be programmed as 9600 or 19200 bit/s (baud), while the remote connection can have baud rates of either 600 or 1200 bit/s.

Entry to the TEGEST customer data configuration program and the request for data transmission to the ECS-FD exchange can only be achieved by entering a password.

The data transmission protocol between the Administration terminal and the ECS-FD exchange guarantees message integrity.

The protocol also includes a request for message retransmission in the case of an incorrectly received message.

In order to avoid the presence of errors during a remote connection and hence the consequent retransmission of data causing excessive delays, the messages have a reduced length.

In the case of partial loading of the customer data, the calls in progress are not interrupted if an "Immediate partial loading" is requested, due to modifications being implemented only on those tables that don't have effect on the traffic in progress.

6.4 Automatic Generation of Customer Data

Customer Data is generated automatically in the case when there is no customer data present in the ECS-FD exchange memory at power up.

The ECS-FD exchange assumes a minimum equipment level, necessary to allow the connection of the administration terminal (TEGEST) in either local or remote mode.

The "default" configuration will have the following characteristics:

- velocity of 9600/1200 bit/s for the local/remote configuration, with the ALUbid group inserted in subframe position 1, the 8CLG group inserted in subframe position 2, the CAU group inserted in subframe position 3 and the US group inserted in subframe position 18
- The Night Service is performed by the first extension in the CAU group (default extension number is "5") while the remote maintenance will respond to the default number of "3".

It is necessary to know the trunk telephone number of the first ALUbid termination, which is configured for multi-frequency dialling (i.e. "TLBMFi/p").

Upon completion of this phase the ECS-FD exchange activates its normal telephone traffic management program.

Upon power up of the ECS-FD exchange, if the control acknowledges that the memory dedicated to customer data has been loaded and that this data is "valid", the normal programs for telephone traffic management are activated immediately. The validity is checked by verifying the presence of defined values in fixed memory locations.

In the case of "non valid" data, the ECS-FD exchange proceeds with the automatic configuration, activating however the telephone traffic, but signalling the situation on the Administration terminal (TEGEST).

This signal is eliminated at the first loading of new customer data.

6.5 Customer Data for Redundant CPU

The communication channel between the two traffic management cards (GT) transfers all customer data synchronously between the GT's at a velocity of 512 kbit/s.

This transfer happens in the following cases:

- the ECS-FD exchange is powered-up with one of the GT cards without customer data or with non-valid data.This GT card assumes the "slave" state and requests data from the other GT card
- the ECS-FD exchange is powered-up with both GT cards without customer data. One of the two cards assumes the "master" state and proceeds with an automatic configuration while the other in the "slave" state waits until the end of the initialization before requesting data via the communication channel
- the ECS-FD exchange is powered-up with both GT cards loaded with valid customer data. One of the two assumes the active state and transfers all of its data to the other. If the initial data in the two GT cards was the same, this procedure reconfirms the data already memorized. In the case when the initial data within the two GT cards is different and it is required to give priority to one of the two GT cards, then it is necessary to insert the GT card with the priority first and upon termination of the inizialization phase, the other GT card can be inserted
- if during normal system operation a second GT card is inserted without customer data, it will be loaded with customer data present in the "master" GT
- if during normal system operation a second GT card is inserted with valid customer data, this second GT card will have the "slave" state and will request the customer data resident in the "master" GT

For more detailed information about the procedure necessary for the preparation, loading and management of the customer data to the ECS-FD exchanges refer to the "TEGEST" software library.

7 Technical Characteristics

7.1 Introduction

This chapter specifies all the relevant technical characteristics of the ECS-FD224, ECS-FD 500 and ECS-FD1000 exchanges.

7.2 Architecture and Technology

- Traffic Management unit (GT) and peripheral groups with microprocessors
- Flash memory containing the ECS-FD exchange control program (non-volatile memory with electrically modifiable contents).
- Customer data contained in battery backed RAM memory with long-life lithium battery.
- Voice coding according to PCM A-law ITU-T G.711.
- PCM , TDM switching matrix; switches channels at 64 kbit/s organized in frames of 32 channels.
- Signalling messages to GT and command messages from GT PLUS on full-duplex asynchronous serial interface.
- Emergency
- Extensive use of HCMOS technology components with surface mount assembly.
- Standard dimensions of printed circuit boards; multilayered structure.Insertion in back plane sockets of subframe.

7.3 Capacity and Modularity of Peripheral Groups

	ECS-FD224	**ECS-FD500**	**ECS-FD1000**
	224 ports	**528 ports**	**1088 ports**
ALUbid bi-directional analogue trunk terminations	4/8		
ALUna Digital trunk accesses to the PSTN with channel associated signalling:	30		
ALUnb EURO-ISDN trunk network Basic Access terminations (2B+D) with emergency:	2/4		
ALUnc EURO-ISDN trunk network Primary Rate Access (30B+D):	30		
ALUsp Direct-inward-dialling analogue trunk terminations:	8		
ALUbEM bi-directional analogue trunk terminations with emergency:	4		
CLG Analogue 2/4Wire E&M tie-line terminations:	4/8		
CAU Analogue terminations for Pulse/DTMF type telephones:	8/16		
CAUn Digital terminations (2-wire) for internal digital terminals:	8/16		
CAUnS0 Digital terminations (4-wire) EURO-ISDN Basic Access (2B+D) S0 interface:	4		

EM Emergency circuits:	4/8
3T01S0 digital trunk network EURO-ISDN Basic Access (2B+D) T0 interface and digital termination (4-wire) EURO-ISDN Basic Access (2B+D) S0 interface:	3 1
CGQSIGA Analogue tie-line terminations with Q_SIG signalling (4/8B+D):	4/8
CGQSIGN Digital tie-line terminations with Q_SIG signalling (30B+D):	30
CGVPN VPN digital tie-line terminations:	30/60

7.4 Private Numbering Plan and Internal Tones

The ECS-FD has a flexible internal numbering plan of up to 6 digits.

The tones have the following characteristics:

TONE TYPE	DURATION		FREQUENCY			LEVEL (at user termination)		
Dialling tone (CEI)	Continuous (sum of the frequencies)		350Hz 425Hz	+/- +/-	15Hz 15Hz	- 6	+/-	2dBm
Ringing tone	Presence Absence	1 sec 4 sec	425Hz	+/-	15Hz	- 6	+/-	2dBm
Engaged (busy)	Presence Absence	500 ms 500 ms	425Hz	+/-	15Hz	- 6	+/-	2dBm
Unobtainable	Presence Absence	100 ms 100 ms	425Hz	+/-	15Hz	- 6	+/-	2dBm
Inclusion	Presence Absence Presence Absence	200 ms 200 ms 200 ms 1400 ms	425Hz	+/-	15Hz	- 11	+/-	2dBm
Congestion	Presence Absence	200 ms 200 ms	425Hz	+/-	15Hz	- 6	+/-	2dBm
Hold	Presence Absence Presence Absence	200 ms 200 ms 200 ms 3400 ms	425Hz	+/-	15Hz	- 6	+/-	2dBm
Camp-on	Presence Absence	100 ms 4900 ms	425Hz	+/-	15Hz	- 11	+/-	2dBm
Confirmation	Presence Absence Presence Absence Presence Absence	100 ms 100 ms 100 ms 100 ms 100 ms 1500 ms	425Hz	+/-	15Hz	- 6	+/-	2dBm
Conference	Presence Absence	200 ms 9800 ms	425Hz	+/-	15Hz	- 11	+/-	2dBm

Continuous 1	Continuous		425Hz	+/-	15Hz	- 6	+/-	2dBm
Trunk dialling tone	Presence Absence Presence Absence	200 ms 200 ms 600 ms 4000 ms	425Hz	+/-	15Hz	- 6	+/-	2dBm
Dialling tone (Special)	Presence Absence Presence Absence Presence Absence	200 ms 200 ms 200 ms 200 ms 200 ms 1000 ms	425Hz	+/-	15Hz	- 6	+/-	2dBm
High pitched tone (generated by AV)	Presence Not repeated	2000 ms	800Hz	+/-	15Hz	- 6	+/-	2dBm

7.4.1 Call Rhythms

The telephone extensions can ring with the following call rhythms.

Call coming from trunk network
ring presence: 1000 ms
pause: 4000 ms

Internal call
ring presence: 600 ms
pause: 200 ms
ring presence: 200 ms
pause: 4000 ms

Call back (after booking connection with previous engaged trunk or extension)
ring presence: 200 ms
pause: 200 ms
ring presence: 200 ms
pause: 200 ms
ring presence: 200 ms
pause: 4000 ms

7.4.2 Trunk Tone Detector Characteristics

- Level and frequency of assured recognition:

  Level $\geq$ -25 dBm with 320 Hz $\leq f \leq$ 510 Hz

- Level and frequency of assured non-recognition

  Level $\leq$ - 30 dBm or $f \leq$ 290 Hz and $f \geq$ 540 Hz

7.4.3 Call Metering Pulse Detector at 12/16 kHz

Error probability	$< 10^{-5}$
Minimum duration of impulse:	80 ms
Minimum duration of pause:	200 ms
Minimum amplitude:	
at 12 kHz:	65 mVrms
from 11880 Hz to 12120 Hz	80 mVrms
at 16 kHz:	65 mVrms
from 15920 Hz to 16080 Hz	80 mVrms
Impedance:	R 100 KΩ
Undetected impulse threshold:	< 30 ms
Undetected pause threshold:	< 10 ms
Undetected 12 KHz impulses:	
for f = 12000Hz	V < 50 mVrms
f < 11500Hz and f >12500Hz	V ≤ 2 Vrms
Undetected 16 KHz impulses:	
for f = 16000Hz	V < 50 mVrms
f < 1584Hz and f >16160Hz	V ≤ 2 Vrms
Undetected ring current:	
20 < f < 50Hz	V ≤ 110 Vrms

7.4.4 DTMF Receiver Characteristics ITU-T Q23

Nominal input level:	0 dBm0
Overload level:	3.14 dBm0
Lower group frequencies of tone pair:	Lb = 697,770,852,941 Hz
Higher group frequencies of tone pair:	La = 1209,1336, 1477,1633 Hz
Frequency tolerance:	
definite recognition	+ 1.5%; - 1.5%
definite non-recognition	+ 4.0%; - 4.0%
Level of each individual frequency for:	
definite recognition	from - 3dBm0 to - 24dBm0
definite non-recognition	≤ - 33 dBm0
Level difference between tone pairs for:	
definite recognition	- 6 dB ≤ La/Lb ≤ 4dB
Signal and pause duration for:	
definite recognition	≥ 40 ms
definite non-recognition	≤ 20 ms

7.4.5 DTMF Transmitter Characteristics ITU-T Q23

Lower group frequencies of tone pair:	Lb = 697,770,852,941 Hz
Higher group frequencies of tone pair:	La = 1209,1336, 1477,1633 Hz
Frequency tolerance:	+ 1.5%; - 1.5%
Level of each individual frequency:	Lb= -8.0 +/-2 dBm0
	La= -6.0 +/-2 dBm0
Level difference between tone pairs:	La-Lb $\leq$ 2 +/-1 dBm0
Transmission duration of the tone pair signal and pause	80 ms (programmable in steps of 20ms)
Maximum level of spurious frequencies in the presence of signals:	
from 300 to 4300 Hz:	- 33 dBm
from 4300 to 28000 Hz:	falling by 12 dB/octave from level of -37dBm
from 28000 Hz to 10 MHz:	- 70 dBm

7.5 Transmission Quality

Levels

For the ECS-FD exchange the phonic input/output levels output relative to the interface type defined in the national standards are:

INTERFACE TYPE	INPUT LEVEL	OUTPUT LEVEL
B	-6.0 dBr	-1.0 dBr
C/C1	-0.0 dBr	-7.0 dBr
D	- 3.0 dBr	- 3.5 dBr

where the interface types acroynms have the following meanings:

type "B"	=	trunk line interface
type "C1"	=	internal extension interface
type "B"	=	2 wire tie line interface
type "C"	=	2 wire tie line interface
type "D"	=	4 wire tie line interface

and the dBr is relative to the 0 dBm level on the PCM channel.

The fundamental objective for the various types of connections that can be implemented is not to use plug-in connectors (even in the development phase of the connection).

The phonic levels provided for the various types of interface are however programmable.

Characteristics of voice connections between internal , trunk and tie line terminations

Nominal impedance (ALU):	600 Ω resistive
Nominal impedance (CLG):	600 Ω resistive
Nominal impedance (CAU):	180 Ω in series
equivalent to	630 Ω resistive
and	60 nF capacitive
Overload level from 300 to 3400 Hz:	3.14 +/- 0.3 dBm
Crosstalk attenuation between 300 and 3400 Hz:	≥ 70 dBm0
Return loss between 300 and 3400 Hz:	≥ 18 dB
Unbalanced attenuation between 300 and 3400 Hz:	≥ 46 dB
Spurious intermodulation products:	≤ -35 dB
Total distortion (with white noise test signals):	
to - 53 dBm	9.3 dB
to - 40 dBm	24.3 dB
to - 34 dBm	28.6 dB
to - 27 dBm	33 dB
to - 8 dBm	34 dB
to - 3 dBm	26.3 dB
Gain variation as function of input level:	
from - 3 to - 40 dB	≤ +/- 0.5 dB
from - 40 to - 50 dB	≤ +/-1 dB
from - 50 to - 55 dB	≤ +/-3 dB
Psophometric noise:	≤ - 66 dBmp
Individual frequency noise:	≤ - 60 dBm0
Protection against signals outside the input band:	≤ - 50 dBm0
Out of band signals (in the 4.6 - 72 KHz band):	≤ - 25 dBm0
Loss distortion as function of frequency:	
from 200 to 300 Hz	- 0.5 dB ≤ A ≤ 2 dB
from 300 to 500 Hz	- 0.5 dB ≤ A ≤ 1.5 dB
from 500 to 2000 Hz	- 0.5 dB ≤ A ≤ 0.5 dB
from 2000 to 3400 Hz	- 0.5 dB ≤ A ≤ 1.1 dB
Intermodulation	≤ - 35 dB
Group delay:	≤ 3 ms average
Group delay distortion:	according to CEI standards
Industrial frequency signal rejection:	≤ - 20 dBm0

7.6 Analogue Extension Line Interface CAU

Line type:		Telephone twisted pair
Line loop resistance:		< 2 x 500 Ω
	max. distance:	3.6 km (0.4 mm diameter wire)
	max. distance:	8.1 km (0.6 mm diameter wire)
Line insulation:		≥ 50 kΩ
Earth recall (optional) recognized by resistance to ground:		≤ 30 Ω
Line seizure (off-hook):		
	recognition time:	>100 ms
Dialling:		
	nominal break period:	60 ms
	nominal make period:	40 ms
	accepted break distortion:	40ms < duration < 80 ms
	accepted make distortion:	20ms < duration < 80 ms
	interdigit pause period recognition:	>150 ms
Line release (on-hook)		
	recognition time:	>200 ms
Resistance between the two line terminals during the break (loop open):		>100 kΩ
Voltage drop between the two line terminals during the make (loop closed):		≤ 5,5V for 18mA ≤ I ≤ 28 mA
Stabilization time of the line current for values greater than 15 mA:		≤ 15 ms
Attenuation on dialling impulses during conversation:		≥ 85 dB
Call signalling:		
	maximum voltage output:	V = 50 Vrms
	frequency:	f = 25 Hz
	minimum impedance allowed:	2200Ω
	maximum current supplied:	I = 21mArms (46 Vrms on 2.2 kΩ)
Twisted pair powering:		
	voltage:	- 48 V (-15%;+20%)
	idle current:	≤ 100 μ A
	loop current with loop resistance < 1KΩ	≥ 22 mA
	current with loop in short circuit	≤ 28 mA

7.7 Digital Extension Line Interface CAUn

Line type:		telephone twisted pair
Max distance possible for SAEfon Sets:	0.6 mm twisted pair	800 m
Max distance possible for Attendant Console OP2:	0.6 mm twisted pair	800 m
Power supply:	from the ECS-FD	- 48 V (+ 20%; -15%)
Current consumption for SAEfon Sets		30 mA max
Current consumption for Attendant Console OP2:		120 mA max
Transmission method:	Time division duplex (Ping-Pong)	
Line transmission:	512 kbit/s with MDPSK modulation	
Signal band:	20-1000 kHz	
Channels:		2 B channels at 64 kbit/s and 2 D channels at 16 kbit/s
Signalling on channel D:		Proprietary
Transmit signal level:		2.36 Vpp balanced
Demodulation error:		10^{-7}
Balance:		>40 dB (20-1000 kHz)
Return loss:		>16 dB (20-1000 kHz)

7.8 EURO-ISDN Basic Access S0 Interface CAUnS0

The internal line is a standard EURO-ISDN Basic Access (2B+D), comprised of two twisted pairs (one for each transmission direction) which terminate at the CAUnS0 group (S0 reference point).

Each group has up to 4 S0 Basic Accesses

The reference standards are:

layer 1 - ETSI 300 012
layer 2 - ETSI 300 125
layer 3 - ETSI 300 1 1/2

Characteristics of the transmitted signal

Frequency:		192 kHz +/- 100ppm
Line coding:		AMI
Impedence characteristics during transmission:		
During active state:		≥ 20 Ω
During the inactive state:	to 2 kHz	>250 Ω
	from 2 to 20 kHz	>2500 Ω
	from 106 to 1MHz	>2500 Ω /kHz
	1MHz	>250 Ω
Peak voltage of impulse:		750 mV +/- 10%
Nominal duration of impulse:		5.208 μs
Amplitude ratio between positive and negative impulses:		1 +/- 0.05
Rise time:		1040 ns
Overshoot:		10% max
The balancing of the output signal satisfies the following requirements		
	to 96 kHz	>54dB
	from 96 kHz to 1MHz	Atten.of 20 dB/decade

Characteristics of received signal

Frequency:		192 kHz +/- 100ppm
Impedence characteristics during transmission:		
During active state:		≥ 20 Ω
During the inactive state:	to 2 kHz	>250 Ω
	from 2 to 20 kHz	>2500 Ω
	from 106 to 1MHz	>2500 Ω /kHz
	1MHz	>250Ω

The interface is able to operate correctly in the presence of a longitudinal voltage VL = 2 Vrms in the 10Hz....30MHz frequency range.

Total input/ output phase deviation

The total phase deviation between the input and output of single terminations is between -0.07 * UI and 0.15 * UI
N.B. : 1 UI = 1 Unit Inverval = 5.208 μs.

Jitter in transmission

The output jitter from the termination is less than UI +/- 7%, under test conditions specified in the ETSI 300 012 recommendation.
N.B. : 1 UI = 1 Unit Inverval = 5.208 μs.

Jitter in reception

The group is able to function correctly and not introduce errors or slips when the input signal is subjected to jitter within the following limits:

at 5 Hz	0.5 UI
from 5 to 50 Hz	-0.01 UI/Hz
from 50 to 2000 Hz:	0.05 UI

N.B. : 1 UI = 1 Unit Interval = 5.208 μs

Impedence to ground

The impedence to ground Zo at both the input and output satisfies the following conditions:

From 10 Hz to 1 MHz	$\geq 1000\Omega$

Power feeding

Each single termination can supply up to 30mA with a voltage of 40V +6.5% / -35.5%. Each of the terminations also has automatic re-triggering protection against short circuits.

The remote powering of this group does not have a soft start , therefore the total number of ISDN telephones which can be connected to an Exchange is limited (maximum of 2 per termination) and depends upon the Exchange's power supply characteristics.

7.9 Bidirectional Analogue Trunk Interface ALUbid

Line type:	Telephone twisted pair
Line loop resistance:	< 2 x 500 Ω
Line insulation:	50 kΩ
Power supply (public exchange):	- 48 V (-15%; + 25%)
Idle current:	< 1 μA
Off-line impedance (at PCB):	
for f=25 Hz: and V=70 Vrms	>4000 Ω (capacitor < 1 μF)
for 300 < f < 3400 Hz and V=775 mVrms	>10 kΩ
Incoming call recognized by:	25 Hz < f < 50 Hz
Outgonig call (pulse dialling)	
The duration of the break (B), make (M) and the interdigit pause are programmable in steps of:	1 ms
The programmed default values are:	
B = 60 ms and M = 40 ms	(B/M=1.5)
Interdigit pause	900 ms
The pulse repetition rate is guaranteed within the range:	10 Hz +/- 1Hz
The resistance between two line terminals during the break (loop open):	>100 kΩ
Voltage drop between the two line terminals during make: (loop closed):	≤ 5,5 V for 18 mA ≤ I ≤ 28 mA
Stabilization time of the loop current with a value superior to 15 mA:	≤ 15 ms
Attenuation on dialling impulses during conversation:	85 dB
Loop current during seizure/ conversation phases:	18 mA ≤ I ≤ 80 mA
Calibrated break of the loop current for a recognized recall (flash key):	70/ 110/ 270 ms selectable

7.10 Direct Inward Dialling Analogue Trunk Interface ALUsp

Line type		telephone twisted pair
Line loop resistance:		< 2 x 500 Ω
Line insulation:		50 kΩ
Break/ Make ratio:		1.5 (60/ 40 ms)
Pulse repetition rate:		10 Hz +/- 1 Hz
Interdigit pause:		900 ms
Resistance in high impedance state:		>12 KΩ
Resistance in low impedance state:		< 560 Ω
Trunk call (long distance) recognized by:	V ≥ 30 Vrms	25 Hz < f < 50 Hz
Power supply (public exchange):		- 64 V ≤ V ≤ - 44 V
Range of recognized currents:		2 mA ≤ I ≤ 40 mA
Off-line impedance (at PCB):		
	for f = 25 Hz and V = 70 Vrms	>4000 Ω (capacitor < 1 μF)
	for 300 < f < 3400 Hz and V = 775 mVrms	>10 kΩ

7.11 EURO-ISDN Digital Trunk Interface T0 ALUnb

The digital trunk line is a standard EURO-ISDN Basic Access (2B+D), comprised of two twisted pairs (one for each transmission direction) which terminate at the ALUnb group (T reference point).

Each group can interface with up to 4 Basic Accesses and is able to switch two of these accesses to two emergency EURO-ISDN telephones or terminals in case of malfunction. The reference standards are:

layer 1 - ETSI 300 012
layer 2 - ETSI 300 125
layer 3 - ETSI 300 102 1/2

Frequency:		192 kHz +/- 100ppm
Line coding:		AMI
Impedence characteristics during transmission:		
during active state:		≥ 20 Ω
during the inactive state:	to 2 kHz	>250 Ω
	from 2 to 20 kHz	>125 Ω / kHz
	from 20 to 80 kHz	>2500 Ω / kHz
	from 80 to 1000 kHz	>-2.5 Ω / kHz
	1MHz	>200 Ω
Peak voltage of impulse:		750 mV +/- 10%
Nominal duration of impulse:		5.208 μs
Amplitude ratio between positive and negative impulses:		1 +/- 0.05
Rise time:		1040 ns
Overshoot:		10% max
The balancing of the output signal satisfies the following requirements		
	to 96 kHz	>54dB
	from 96 kHz to 1MHz	Atten.of 20 dB/decade

Characteristics of received signal

Frequency:		192 kHz +/- 100ppm
Impedence characteristics during transmission:		
during active state:		≥ 20 Ω
during the inactive state:	to 2 kHz	>250 Ω
	from 2 to 20 kHz	>125 Ω / kHz
	from 20 to 80 kHz	>2500 Ω / kHz
	from 80 to 1000 kHz	>-2.5 Ω / kHz
	1MHz	>200 Ω

The interface is able to operate correctly in the presence of a longitudinal voltage VL = 2 Vrms in the 10Hz....30MHz frequency range.

Total input/ output phase deviation

The total phase deviation between the input and output of single terminations is between -0.07 * UI and 0.15 * UI
1 UI = 1 Unit Interval = 5.208 μs

Jitter in transmission

The output jitter from the termination is less than UI +/- 7%, under test conditions specifiedin the ETSI 3000 012 recommendation.
1 UI = 1 Unit Interval = 5.208 μs

Jitter in reception

The group is able to function correctly and not introduce errors or slips when the input signal is subjected to jitter within the following limits:

at 5 Hz	0.5 UI
from 5 to 50 Hz	-0.01 UI/Hz
from 50 to 2000 Hz:	0.05 UI

1 UI = 1 Unit Interval = 5.208 μs

Impedence to ground

The impedence to ground Zo at both the input and output satisfies the following conditions:

from 10 Hz to 1 MHz	$\geq$ 1000 Ω

Power feeding

The individual terminations do not assorb current from the line.

7.12 4W E&M Analogue Tie-Line Interface CLG

Output signalling (M wire)

Output standard:	ground/ open
Output contact type:	open/ collector
Applicable negative voltage:	< 60 V (absolute value)
Max current with residual voltage < 3 V between contact and ground:	30 mA
Pulse repetition rate:	programmable
Break/ make ratio:	programmable
Break/ make ratio tolerance:	+/- 1 ms

Output signalling (Compandor exclusion wire)

Output standard:	ground/ open
Output contact type:	open/ collector
Applicable negative voltage:	< 60 V (absolute value)
Max. current with residual voltage < 3 V between contact and ground:	30 mA

Input signalling (E wire)

Applicable incoming standards:		
	Ground	R < 200 Ω
	Open	R >50 kΩ
Pulse repetition rate:		programmable
Break/make ratio:		programmable
Minimum duration of break/make allowed:		programmable
Input signalling filter:		digital
Assured recognition of break:		>10 ms
Assured non-recognition of break:		< 6 ms

Input signalling (Vector alarm wire)

Applicable input standards:		
	Ground	R < 200 Ω
	Open	R > 50 kΩ

7.13 2 Mbit/s Digital Trunk Interface ALUna

The digital trunk is comprised of two twisted pairs or two coaxial cables (one for eachsmission direction) which terminate at the ALUna group.

The digital trunk supports a frame of 32 channels at 64 Kbit/s (numbered from 0 to 31); channel 0 is relative to the synchronization and to the service bits, channels 1 to 15 and 17 to 31 are relative to information (voice/ data), channel 16 is used for the channel signalling. The method with which the signalling is attributed to the various channels is of an "associated" type. Thus involves that:

- the frames are organized in a multi-frame of 16 frames numbered from 0 to 15 (the duration of one multi-frame is 125 μ s x 16 = 2 ms)
- the channel 16 of frame 0 contains the multiframe alignment word
- the channel 16 of the frames from 1 to 15 contains the channel signalling according to the following definition:

CHANNEL 16		
	a b c d	**a b c d**
FRAME 1	RELAT.CHAN.1	RELAT.CHAN.17
FRAME 2	RELAT.CHAN.2	RELAT.CHAN.18
FRAME 15	RELAT.CHAN.15	RELAT.CHAN.31

The use of bits a,b,c,d, to achieve the signalling standard of the line conforms to the standard CEI 103-1 Part. 7.

Characteristics of the transmitted signal

Frequency:	2048 kHz +/- 50 ppm
Line coding:	HDB3

Number of couplings for each transmission direction:	1(coaxial)	1 balanced twisted pair
Impedence characteristic:	75 Ω	120 Ω
Nominal peak voltage of the impulse:	2.37 V	3.0 V
Maximum voltage in impulse absence	+/- 0.237 V	+/- 0.3 V

Nominal duration of impulse	244 ns
Amplitude ratio between positive and negative impulses with reference to ground:	1 +/- 0.05
Ratio of duration between positive and negative impulses at 50%:	1 +/- 0.05
Rise-time	64 ns max
Overshoot	20% max
Return loss:	
from 5.12 kHz to 102.4 kHz	8 dB
from 102.4 kHz to 2048 kHz	14 dB
from 2048 kHz to 3072 kHz	10 dB

On idle channels the bit sequence "01010100" is transmitted in which with binary coding the

signal bit is the first on the left (most significant bit).

The balancing of the output signal, when a 120Ω balanced twisted pair connection is used, satisfies the following requirements:

up to 1MHz	≥ 40dB
from 1MHz to 30 MHz	atten.of 20dB/decade

Characteristics of received signal

The impulses received from the termination must have the same characteristics as those transmitted by it, less the transmission degradations that present the following characteristics:

Impedance characteristic:	75 or 120 Ω
Attenuation: max. with variations proportional to square root of f	6 dB
Return loss:	
from 5.12 kHz to 102.4 kHz	12 dB
from 102.4 kHz to 2048 kHz	18 dB
from 2048 kHz to 3072 kHz	14 dB

When a 120Ω balanced twisted pair connection is used, the interface is able to operate correctly in the presence of a longitudinal voltage VL = 2 VRMS in the 10 Hz...30 MHz frequency range.

Jitter in transmission

The intrinsic jitter introduced by the group (or rather the output jitter when the input jitter is zero) is such that, when performing measurement by means of two band-pass filters with cut off frequencies f1 and f2, there are two jitter values inferior to B1 and B2, indicated as follows:

f1	**f2**	**jitter**
20 Hz	100 kHz	B1 = 1,5 UI
700 Hz	100 kHz	B2 = 0,2 UI

where 1 UI --- 1 Unit Interval = 488 ns

The jitter transfer function [f (H)], intended as the ratio between the jitter amplitude at the input and the jitter amplitude at the output is within the limits indicated as follows:

for freq. from 10 Hz	to	40 Hz:	0.5 dB max
for freq. from 40 Hz	to	400 Hz:	attenuation of 20 dB/ decade
for freq. from 400 Hz	to	100 kHz:	- 19.5 dB max

Jitter and wander during reception

The digital interface is able to function correctly and not introduce errors or slips when jitter and wander present on its input are within the following limits:

for freq. from (Hz)	to (Hz)	
0	$12x10^{-6}$	20 μ s

$12x10^{-6}$	20	attenution of 20 dB/decade
20	2400	1,5 UI
2400	18000	attenuation of 20 dB/decade
18000	100000	0,2 UI

where 1 UI --- 1 Unit Interval = 488 ns

The limits are specified for sinusoidal jitter and wander.

Impedance to earth

The impedance towards earth Zg both on the input and the output satisfies the following conditions (using a 120 Ω balanced connection):

for freq. from 10 Hz to 1 MHz: 1000 Ω

Maximum line length

- with 120Ω balanced twisted pair 150 m
- with a 75Ω co-axial cable 300 m

7.14 EURO-ISDN Primary Rate Access (30B+D) Interface ALUnc

The digital trunk line is a standard EURO-ISDN 30B+D Primary Rate Access, comprised of two twisted pairs or two coaxial cables (one for each transmission direction) which terminate at the ALUnc group.

The principle elements of the operational frame are compliant with (I.431):

- 32 channels at 64 kBit/s (Time Slot from 0 to 31), at 8 bits/slot
- TS1...TS15 + TS17...TS31 : 30 B channels for voice/data
- TS16: D signalling channel
- TS0: service and maintenance channel (frame and multi-frame alignment , CRC-4, RAI alarm).

The reference standards are:

layer 1 - ETSI 300 011
layer 2 - ETSI 300 125
layer 3 - ETSI 300 102 1/2

Characteristics of the transmitted signal

Frequency:	2048 kHz +/- 50 ppm
Line coding:	HDB3

Number of couplings for each transmission direction:	1(coaxial)	1 (balanced twisted pair)
Impedance characteristic:	75 Ω	120 Ω
Nominal peak voltage of the impulse:	2.37 V	3.0 V
Maximum voltage in impulse absence	+/- 0.237 V	+/- 0.3 V

Nominal duration of impulse	244 ns
Amplitude ratio between positive and negative impulses with reference to ground:	1 +/- 0.05
Ratio of duration between positive and negative impulses at 50%:	1 +/- 0.05
Rise-time	64 ns max
Overshoot	20% max
The balancing of the output signal, when a 120Ω balanced twisted pair connection is used, satisfies the following requirements:	
up to 1MHz	≥ 40dB
from 1MHz to 30 MHz	atten.of 20dB/decade

Characteristics of received signal

The impulses received from the termination must have the same characteristics as those transmitted by it, less the transmission degradations that present the following characteristics:

Impedance characteristic:	75 or 120 Ω
Attenuation: max. with variations proportional to square root of f	6 dB

Return loss:

from 5.12 kHz to 102.4 kHz	12 dB
from 102.4 kHz to 2048 kHz	18 dB
from 2048 kHz to 3072 kHz	14 dB

When a 120 Ω balanced twisted pair connection is used, the interface is able to operate correctly in the presence of a longitudinal voltage VL = 2 VRMS in the 10 Hz...30 MHz frequency range.

Jitter in reception

The digital interface is able to function correctly and not introduce errors or slips if the jitter and wander present on its input are within the following limits:

for freq. from (Hz)	**to (Hz)**	
0	$12x10^{-6}$	20,5 UI
$12x10^{-6}$	20	attenution of 20 dB/decade
20	2400	1,5 UI
2400	18000	attenuation of 20 dB/decade
18000	100000	0,2 UI

1 UI --- 1 Unit Interval = 488 ns
The limits are specified for sinusoidal jitter and wander.
Freq. signal: 2048 kHz +/- 32 ppm

Jitter in transmission

The intrinsic jitter introduced by the group (or rather the output jitter when the input jitter is zero) is such that, when performing measurement by means of two band-pass filters with cut off frequencies f1 and f2, there are two jitter values inferior to B1 and B2, indicated as follows (ETSI 300 011):

f1	**f2**	**Jitter**
20 Hz	100 kHz	B1 = 1.6 UI
700 Hz	100 kHz	B2 = 0.11 UI

1UI --- 1 Unit Interval = 488 ns
The limits are specified for sinusoidal jitter and wander.
Freq. signal: 2048 kHz +/- 32 ppm

Impedance to ground

The impedance to ground Zg at both the input and output satisfies the following conditions:

for freq. from 10 Hz to 1 MHz: >1000 Ω

Maximum line length

The length of the line must be such that the maximum attenuation does not exceed 6dB at 1 MHz.

7.15 Analogue Tie-Line with Q-SIG Signalling CGQSIGA

4 wire voice

Nominal input impedance:	600 Ω	
Nominal input level:	ENEL	CEI
(Lric)	0 dBm	- 3.5 dBm
Nominal output impedance:	600 Ω	
Nominal output level:	ENEL	CEI
(Ltras)	-8 dBm	- 3.5 dBm
Return loss from 300Hz to 3400Hz:	>20dB	
Balanced attenuation	>40dB	

2 wire voice

Nominal input impedance:	600 Ω	
Nominal input level: CEI	(type B)	(type C)
(Lric)	-6 dBm	0 dBm
Nominal output impedance:	600 Ω	
Nominal output level: CEI	(type B)	(type C)
(Ltras)	-1 dBm	- 7 dBm
Return loss from 300Hz to 3400Hz:	>20dB	
Balanced attenuation	>40dB	

Transmission Quality

Compliant with ITU-T G.712 recommendation.

Settings for Vector alarm wire

Applicable input standards:		
Input standard	Ground/open	
Applicable standard	Ground	(< 200 Ω)
	Open	(50 kΩ)

Settings for Compandor exclusion

Output standard:	Ground/ open
Output contact type:	Open/ collector
Applicable negative voltage (absolute value):	< 60 V
Max. current with residual voltage < 3 V between contact and ground:	30 mA

Interface private channel

Modem characteristics (data channel of 2/4 wire)

Standard:	ITU-T V.32
Modulation speed	14400 baud max
Modulation type:	FSK
Recognition threshold of carrier detect for a change from OFF to ON:	-43...-45.5 dBm
Recognition threshold of carrier detect for a change from ON to OFF:	-45.5...-48 dBm

RS232 V24 (data channel of multiplexer)

Standard:	EIA-232
Data rates:	19200 kbps max
Async parameters:	8N2
Clock:	from DCE
Code:	NRZ
Protocol:	HDLC sync

Interface with the ECS-FD

Data Voice Communication:	On 8 channels with a 2048 clock
Signalling and Commands	On a asynchronous full duplex serial bus at 374kbit/s

Visual indications

RED LEDs:
DL1: Watchdog alarm (active=LED alight)
DL2: Level 2 alarm (active=LED alight)

GREEN LEDs:
DL3 connected to DCDTL (m L18-29): DCD state (ON=led alight)
DL4 connected to RXDTL (m L18-30): RXD state (ON=led alight)
DL5 connected to DTRTL (m L18-31): DTR state (ON=led alight)
DL6 connected to TXDTL (m L18-32): TXD state (ON=led alight)

Manual Settings

The 3 wire links on the group (i.e. ZP2-ZP9) define whether the transmission must be with 2 or 4 voice wires, for each of the line terminations on the group.

The link must be set to the 2F position in order to select 2 wires for voice transmission or to the 4F position in order to select 4 wires for voice transmission.

Powering

Voltage:	+ 5Vdc (-0.1V, +0.3V)
Current consumption	250 mA max
Voltage:	- 5 Vdc (-0.1V, +0.3V)
Current consumption:	90mA max when call on termination 25mA min (termination idle)
Voltage:	- 48Vdc
Current consumption:	10 mA max

Secondary protection - Lightning tests

Lightning tests:	1000V 10/700 μ 1500 V 10/700 μ s in common mode

Secondary protection - Radio Frequency Disturbances

This exists both in the 150kHz to 30 MHz band towards the internal and external line terminations, and in the 30MHz to 1GHz band, according to the V.D.E. 0875 ediz. 1984 standard.

7.16 Digital Tie-Line with Q_SIG Signalling CGQSIGN

The digital tie-line with Q_SIG signalling (30B+D), comprised of two twisted pairs or two coaxial cables (one for each transmission direction) which terminate at the CGQSIGN group.

The principle elements of the operational frame are compliant with (I.431):

- 32 channels at 64 kbit/s (Time Slot from 0 to 31), at 8 bits/slot
- TS1...TS15 + TS17...TS31 : 30 B channels for voice/data
- TS16: D signalling channel
- TS0: service and maintenance channel (frame and multi-frame alignment , CRC-4, RAI alarm).

The reference standards are:

layer 1 - ETSI 300 012
layer 2 - ETSI 300 125
layer 3 - ETSI 300 102 1/2

Characteristics of the transmitted signal

Frequency:	2048 kHz +/- 50 ppm
Line coding:	HDB3

Number of couplings for each transmission direction:	1(coaxial)	1 balanced twisted pair
Impedance characteristic:	75 Ω	120 Ω
Nominal peak voltage of the impulse:	2.37 V	3.0 V
Maximum voltage in impulse absence	+/- 0.237 V	+/- 0.3 V

Nominal duration of impulse	244 ns
Amplitude ratio between positive and negative impulses with reference to ground:	1 +/- 0.05
Ratio of duration between positive and negative impulses at 50%	1 +/- 0.05
Rise-time	64 ns max
Overshoot	20% max
The balancing of the output signal, when a 120Ω balanced twisted pair connection is used, satisfies the following requirements:	
up to 1MHz	≥ 40dB
from 1MHz to 30 MHz	Atten.of 20dB/decade

Characteristics of received signal

The impulses received from the termination must have the same characteristics as those transmitted by it, less the transmission degradations that present the following characteristics:

Impedance characteristic:	75 or 120 Ω
Attenuation: max. with variations proportional to square root of f	6 dB
Return loss:	

from 5.12 kHz to 102.4 kHz	12 dB
from 102.4 kHz to 2048 kHz	18 dB
from 2048 kHz to 3072 kHz	14 dB

When a 120Ω balanced twisted pair connection is used, the interface is able to operate correctly in the presence of a longitudinal voltage VL = 2 VRMS in the 10 Hz...30 MHz frequency range.

Jitter in reception

The digital interface is able to function correctly and not introduce errors or slips if the jitter and wander present on its input are within the following limits:

for freq. from (Hz)	to (Hz)	
0	$12x10^{-6}$	20,5 UI
$12x10^{-6}$	20	attenution of 20 dB/decade
20	2400	1,5 UI
2400	18000	attenuation of 20 dB/decade
18000	100000	0,2 UI

1 UI --- 1 Unit Interval = 488 ns
The limits are specified for sinusoidal jitter and wander.
Freq. signal: 2048kHz +/- 32 ppm

Jitter in transmission

The intrinsic jitter introduced by the group (or rather the output jitter when the input jitter is zero) is such that, when performing measurement by means of two band-pass filters with cut off frequencies f1 and f2, there are two jitter values inferior to B1 and B2, indicated as follows (ETSI 300 011):

f1	**f2**	**Jitter**
20 Hz	100 KHz	B1 = 1.6 UI
700 Hz	100 KHz	B2 = 0.11 UI

1 UI --- 1 Unit Interval = 488 ns
The limits are specified for sinusoidal jitter and wander.
Freq. signal: 2048kHz +/- 32 ppm

Impedance to ground

The impedance to ground Zg at both the input and output satisfies the following conditions:

for freq. from 10 Hz to 1 MHz	>1000Ω

Maximum line length

The length of the line must be such that the maximum attenuation does not exceed 6dB at 1 MHz.

7.17 EURO-ISDN 3T0 , 1S0 Interfaces 3T01S0

Allows the connection of 3 T0 Basic Access EURO-ISDN trunks and 1 S0 Basic Access EURO-ISDN extension. The group also has the capability to switch one of the Basic Access trunk lines to a telephone or ISDN terminal in case of an emergency.

T0 access digital line interface characteristics
Refer to par. 8.16.

S0 access digital line interface characteristics
Refer to par. 8.13.

7.18 VPN Digital Tie-Line CGVPN

Characteristics of the transmitted signal

Frequency:	2048 kHz +/- 50 ppm
Line coding:	HDB3

Number of couplings for each transmission direction:	1(coaxial)	1 balanced twisted pair
Impedance characteristic:	75 Ω	120 Ω
Nominal peak voltage of the impulse:	2.37 V	3.0 V
Maximum voltage in impulse absence	+/- 0.237 V	+/- 0.3 V

Nominal duration of impulse	244 ns
Amplitude ratio between positive and negative impulses with reference to ground:	1 +/- 0.05
Ratio of duration between positive and negative impulses at 50%:	1 +/- 0.05
Rise-time	64 ns max
Overshoot	20% max
Return loss:	
from 5.12 kHz to 102.4 kHz	8 dB
from 102.4 kHz to 2048 kHz	14 dB
from 2048 kHz to 3072 kHz	10 dB

On idle channels the bit sequence "01010100" is transmitted in which with binary coding the signal bit is the first on the left (most significant bit).

The balancing of the output signal, when a 120Ω balanced twisted pair connection is used, satisfies the following requirements:

up to 1MHz	≥ 40dB
from 1MHz to 30 MHz	atten.of 20dB/decade

Characteristics of received signal

The impulses received from the termination must have the same characteristics as those transmitted by it, less the transmission degradations that present the following characteristics:

Impedance characteristic:	75 or 120 Ω
Attenuation: max. with variations proportional to square root of f	6 dB
Return loss:	
from 5.12 kHz to 102.4 kHz	12 dB

from 102.4 kHz to 2048 kHz	18 dB
from 2048 kHz to 3072 kHz	14 dB

When a 120Ω balanced twisted pair connection is used, the interface is able to operate correctly in the presence of a longitudinal voltage VL = 2 VRMS in the 10 Hz...30 MHz frequency range.

Jitter in transmission

The intrinsic jitter introduced by the group (or rather the output jitter when the input jitter is zero) is such that, when performing measurement by means of two band-pass filters with cut off frequencies f1 and f2, there are two jitter values inferior to B1 and B2, indicated as follows:

f1	**f2**	**jitter**
20 Hz	100 KHz	B1 = 1,5 UI
700 Hz	100 KHz	B2 = 0,2 UI

UI --- 1 Unit Interval = 488 ns

The jitter transfer function [f (H)], intended as the ratio between the jitter amplitude at the input and the jitter amplitude at the output is within the limits indicated as follows:

for freq. from 10 Hz	To	40 Hz:	0.5 dB max
for freq. from 40 Hz	To	400 Hz:	attenuation of 20 dB/ decade
for freq. from 400 Hz	To	100 kHz:	- 19.5 dB max

Jitter and wander during reception

The digital interface is able to function correctly and not introduce errors or slips when jitter and wander present on its input are within the following limits:

for freq. from (Hz)	to (Hz)	
0	$12x10^{-6}$	20 μ s
$12x10^{-6}$	20	attenution of 20 dB/decade
20	2400	1,5 UI
2400	18000	attenuation of 20 dB/decade
18000	100000	0,2 UI

where 1 UI --- 1 Unit Interval = 488 ns

The limits are specified for sinusoidal jitter and wander.

Impedance to earth

The impedance towards earth Zg both on the input and the output satisfies the following conditions (using a 120Ω balanced connection):

for freq. from 10 Hz to 1MHz	>1000 Ω

Maximum line length

with 120 Ω balanced twisted pair	150 m
with a 75 Ω co-axial cable	300 m

7.19 Service Unit US

US Group Service Relays

Maximum switchable voltage:	150 Vdc
Maximum switchable current:	2 A
Switchable power on resistive load:	60 W
Contact resistance:	< 100 MΩ
Insulation resistance (100 V for 1 min.):	$>10^5$ MΩ

US Group Input Signals

One input is present that can be controlled from an external work contact with reference to the electrical system earth (GND).

The input wire has the - 48 Vdc voltage as its internal reference and is protected against damaging external effects.

The consequent action upon activation of one of the inputs must be programmed within the ECS-FD exchange.

US Group Modem

Standard:	ITU-T V.23/V22/V22bis (US)
Modulation speed:	600/1200/2400 bit/s Tx/Rx
Modulation type:	FSK
Character format:	8 bit per character + 2 stop bits
fa (binary zero):	2100 Hz/1700 Hz
fz (binary one):	1300 Hz/1300 Hz
Respond time of carrier detect circuit for a change from ON to OFF:	12-20 ms
Respond time of carrier detect circuit for a change from OFF to ON:	12-16 ms
Hysteresis of carrier detector:	2.5 dB
Recognition threshold of carrier detect for a change from OFF to ON:	(-43) - (-45.5) dBm
Recognition threshold of carrier detect for a change from ON to OFF:	(-43) - (-45.5) dBm

US Group Serial Ports

Input voltage:	+ 3V/ + 25V	ON space
	- 25V/ - 3V	OFF mark
Input impedance:	≥ 5,4 KΩ	
Output voltage:	≥ + 5V	ON space
	≤ - 5V	OFF mark
Output impedance:	≤ 300Ω	
Slew rate:	≤ 30 V/ μ sec	

Protection against excess voltage and excess current

Character format:	8 bits/ character without parity	
	+ 2 stop bits	
V 24 connection length at:	19200 baud:	≤ 10 metres
	9600 baud:	≤ 15 metres
	2400 baud:	≤ 30 metres
	1200 baud:	≤ 50 metres
	300 baud:	≤ 100 metres
	with 0,6 mm diameter twisted pair	
Maximum bit error rate (BER):	≤ 10^{-7} (1 bit in 10 million)	

Data Interface

Connections are possible between asynchronous data terminals with a V 24 interface type. Only the signals Tx, Rx and GND are used.

The characteristics of such an interface are:

input voltage:	+ 3V/+ 25V	ON space
	- 25V/-3 V	OFF mark
input impedance:		≥ 5,4 KΩ
output voltage:		≥ + 4V ON space
		≤ - 4V OFF mark
output impedance:		≤ 300Ω
slew rate:		≤ 30 V/μ s
protection against overvoltarrent overloading		
V 24 connection length:		≤ 10 metres 0.6 diameter twisted pair
error rate on data connection:		≤ 10^{-7}
managed signals:		Tx, Rx, GND
velocity:	300 : 1200 : 2400 : 4800 : 9600 : 19200 baud	
number of stop bits:		1
word length:		8 bits
parity:		none

7.20 AV Group External Phonic Source

- Input disconncted from the internal ground.
- External phonic source termination input impedance: >20 KΩ
- Maximum input signal: 135 mV

7.21 Power Supply Specification ECS-FD224

- **Electrical characteristics of -48 Vdc/ +5, -5, +48 Vdc, -48 Vdc converter 200W**

Input:		
	Voltage	- 48 Vdc
	Tolerance	- 15% : + 20%, -42 ... 58 VDC
	maximum current	4 A
- 48 Vdc output:		
	Voltage	- 48 Vdc
	Tolerance	+ / - 20%
	maximum current	3A
	psophometric voltage	< 2 mv
+5 Vdc output:		
	Voltage	+ 5.4 V
	Tolerance	+ / - 2%
	maximum current	5 A
-5 Vdc output:		
	Voltage	- 5.4 V
	Tolerance	+ / - 2%
	maximum current	2.5 A
+48 Vdc output:		
	Voltage	+ 48 V
	Tolerance	+ / - 1%
	maximum current	0.3 A

General characteristics of the DC/DC converters

Efficiency at nominal load:	>75%
Efficiency at 25% load:	>70%
Isolation class :	1^ cl. CEI norm

Dielectric rigidity and insulation resistance as defined by the CEI norm 103-1 part 11, chapter 11.2.05.

The DC/DC converters allow gradual variations of the input voltage, without causing current absorption of any kind during the disactivation phase.

The DC/DC converters guarantee the correct system operation even when input voltage undergoes interruptions and reductions defined as follows:

a) Interruption test:
for interruptions of $\leq$ 50 ms the system continues to function regularly;

for interruptions of 50 ms to 200 ms the apparatus continues to function regularly (or automatically starts functioning on the return of the primary current after temporary suspension of activity during power failure).The interval between two consecutive interruptions may vary from 1 second to 10 seconds.

b) Reduction test:
the system continues to function regularly with the reduction of input supply voltage ranging from 20% to 50% with respect to the nominal values and for time lapses of between 1 ms and 50 ms.

Current limitation upon power-on
This circuit defines the gradual load on the power supply capacitors avoiding the absorption of the high current peaks upon power-on.

T					i		
0.1 ms		<	t	<1 ms	i	<	10 In
1 ms		<	t	<100 ms	i	<	3.0 In
100 ms		<	t	<1s	i	<	1.2 In
1 sec		≤	t		i	≤	1.0 In
Where	**i** **in** **t**	**=** **=** **=**	**Instantaneous consumption** **normal current consumption** **time, t=0 power-up instant**				

Battery back-up power station characteristics

A.C. INPUT

Single phase mains voltage:	230Vac +/-15%
Mains frequency:	50/60 Hz
Current consumed:	3A
Mains fuses:	3.15A-230V type T

D.C. OUTPUT

Nominal voltage output:	48Vdc
Battery load voltage:	54Vdc +/-1%
Maximum current :	5A +/-3%
Voltage stability upon a +/- 15% mains voltage variation	+/ -1%
Efficiency:	>80%
Disconnect from Exchange to allow overcharged battery discharge:	43.2V +/-2%
System fuse	3.15A - 230V
Battery fuse	10A - 230V

7.22 Power Supply Specification ECS-FD500/1000

The power supply is comprised of an input module (UI) connected to an external battery backed power station and three DC/ DC converters whose inputs are connected to the output of the input module (UI).

The input module supplies a system voltage of -48 Vdc and three converters generate the +5 Vdc, -5 Vdc, +48 Vdc voltages.

Input module characteristics

Nominal input voltage	-48 Vdc (-15%, +20%)
Psophometric noise level:	< 2 mV
Ripple on input voltage	< 3.0 Vpp at 100 Hz
The presence of the primary input voltage is signalled by a green led situated on the input module (UI) front panel being continuously alight.	
Single pole switch on the input.	
Protection against polarity inversion.	
Protection against high voltages:	intervenes at V1.2 Vnom
Protection:	compliant with CEI 103-I Part 12 standard
Reflection	compliant with CEI 103-I Part 11
Maximum current absorbed at power-on:	
for 0,1 ms < t < 1 ms:	i < 10 In
for 1,0 ms < t < 100 ms:	i < 3 In
for 100 ms < t < 1 s:	i < 1.2 In
for t >1 s :	i $\leq$ 1,0 In
where: i = instantaneous consumption In = nominal consumption t = time, with t = 0 power up instant	
The power supply circuits do not generate disturbance voltages on the input terminal block higher than the following defined values:	
psophometric type:	< 3mV
non-psophometric type:	< 10mV

48 V power supply output characteristics

nominal output voltage:	maximum input voltage - 2VDC due to filter circuits and isolating diode
psophometric voltage	2mV
Max noise voltage in the band 20 Hz -10 MHz with respect to nominal voltage:	0.5%
Nominal current:	14 A
Variation of current with respect to nominal value:	0%, 100%
Max capacitive load:	15000 μ F
Protection against overload and short circuits.	

The presence of the output voltage is signalled by an led on the front panel of input module.

The input module efficiency is set between 95% and 98% during operation, generated not only by conversion but also by filtering.

General characteristics of the DC/DC converters

Efficiency at nominal load:	>75%
Efficiency at 25% load:	>70%
Isolation class :	1^ cl. CEI norm

Dielectric rigidity and insulation resistance as defined by the CEI norm 103-1 part 11, chapter 11.2.05.

Output characteristics

	+5Vdc	**-5Vdc**	**+48Vdc**
Nominal voltage	+ 5.3Vdc	+5.3Vdc	+48Vdc
Voltage tolerance with respect to nominal	+/- 1%	+/- 1%	+/- 1%
Maximum noise voltage, in the 20 Hz - 10 MHz band, with respect to nominal voltage	0.5%	0.5%	0.5%
Nominal current:	19.0A	11.0A	1.0A
Current tolerance with respect to nominal	5%-100%	5%-100%	0%-100%
Protection against overloading and short circuits			
Protection against high voltage:	Intervenes for V >1.2 Vnom		

The DC/DC converters allow gradual variations of the input voltage, without causing current absorption of any kind during the disactivation phase.

The DC/DC converters guarantee the correct system operation even when input voltage undergoes interruptions and reductions defined as follows:

a) Interruption test:
for interruptions of ≤ 50 ms the system continues to function regularly;

for interruptions of 50 ms to 200 ms the apparatus continues to function regularly (or automatically starts functioning on the return of the primary current after temporary suspension of activity during power failure).The interval between two consecutive interruptions may vary from 1 second to 10 seconds.

b) Reduction test:
the system continues to function regularly with the reduction of input supply voltage ranging from 20% to 50% with respect to the nominal values and for time lapses of between 1 ms and 50 ms.
The correct functioning of each single converter is signalled by an led on the front panel.

The input module (UI) collects all generated alarm signals from the converters and outputs them to the GT.

The alarm signal is indicated by logic level "I" on the POWAL wire.

7.23 Power Consumption

ECS-FD224

Peak power	190W
Minimum power (in absence of traffic)	50W

ECS-FD500

Peak power with configuration	48/448
equipped with only analogue telephones:	416W
Peak power with configuration	48/448
equipped with only digital telephones	230W
Minimum power with configuration :	48/448
equipped with only analogue telephones	83W
Minimum power with configuration :	48/448
equipped with only digital telephones	144W

ECS-FD1000

Peak power with configuration	96/960
equipped with only analogue telephones:	830W
Peak power with configuration	96/960
equipped with only digital telephones	487W
Minimum power with configuration :	96/960

equipped with only analogue telephones	180W
Minimum power with configuration :	96/960
equipped with only digital telephones	290W

7.24 Diagnostics

Automatic diagnostics occur during system operation.

It is possible to implement diagnostic procedures by means of the administration terminal (TEGEST).

For full details it is necessary to consult "TEGEST software library" internet manual.

7.25 Environmental Characteristics

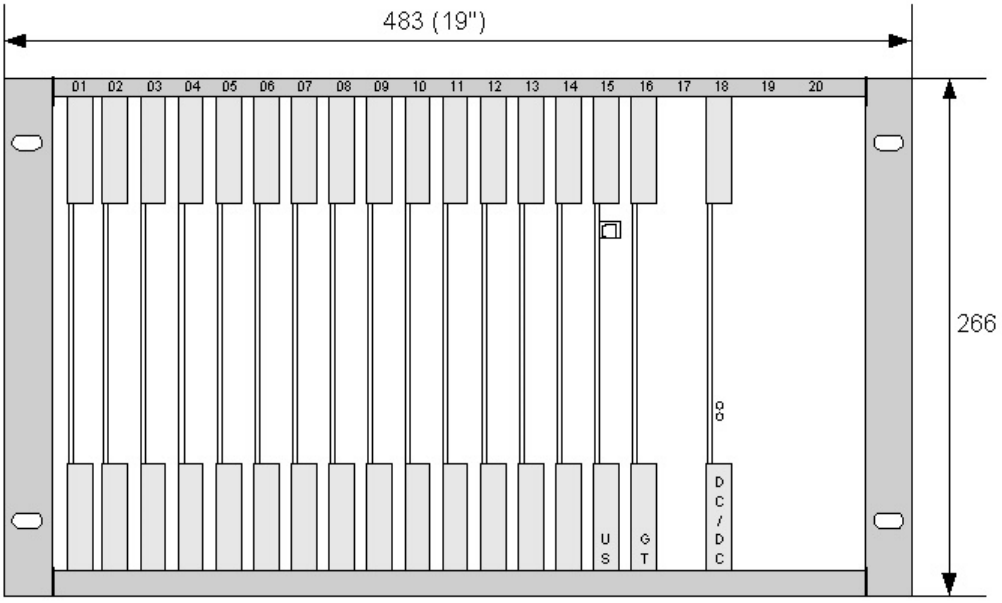
Operating temeperature range:	0-45°C
Relative humidity at 35°C ambient temeperature:	from 5% to 90%

Forced cooling is not required.

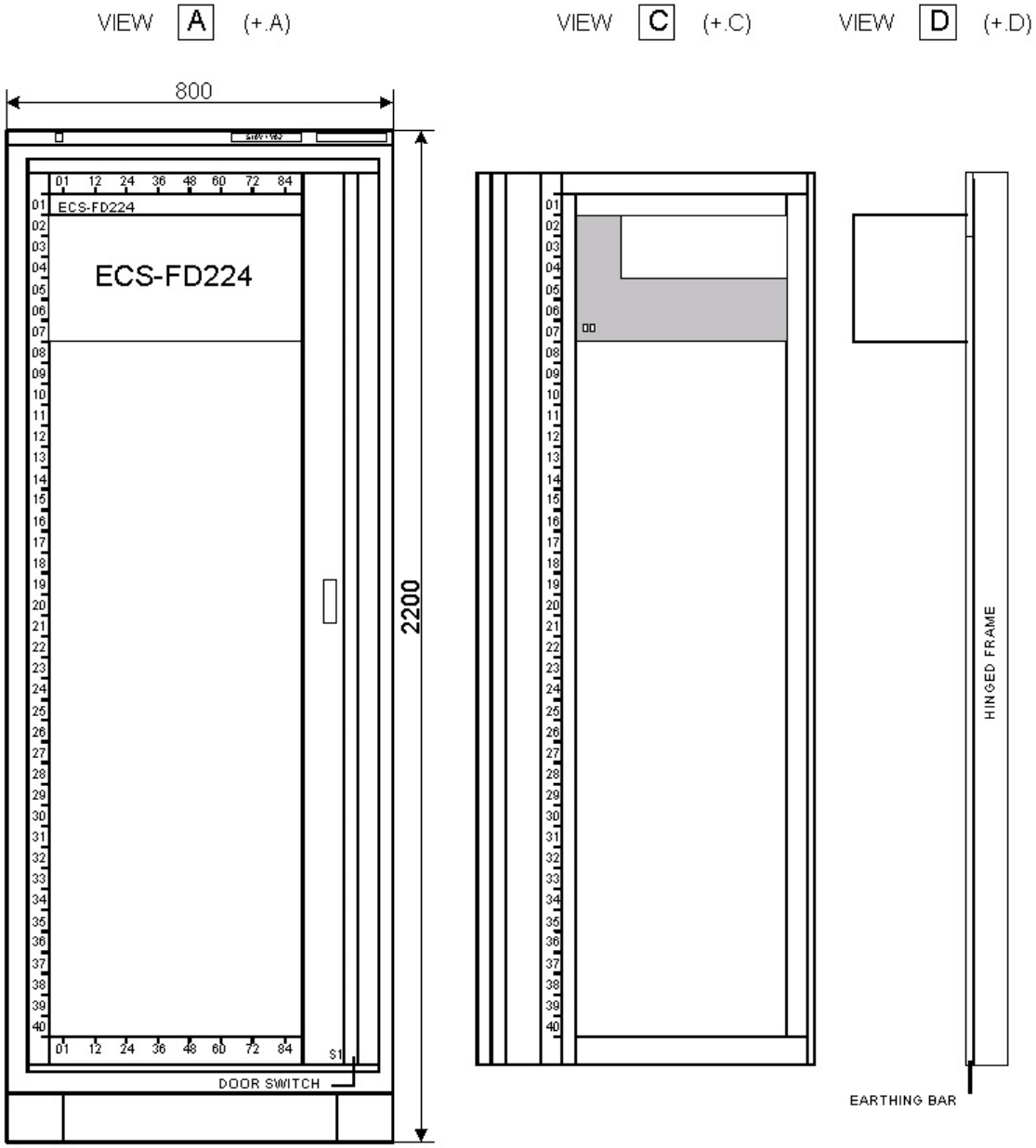
7.26 Main Distribution Frame

Is external to the system cabinet.

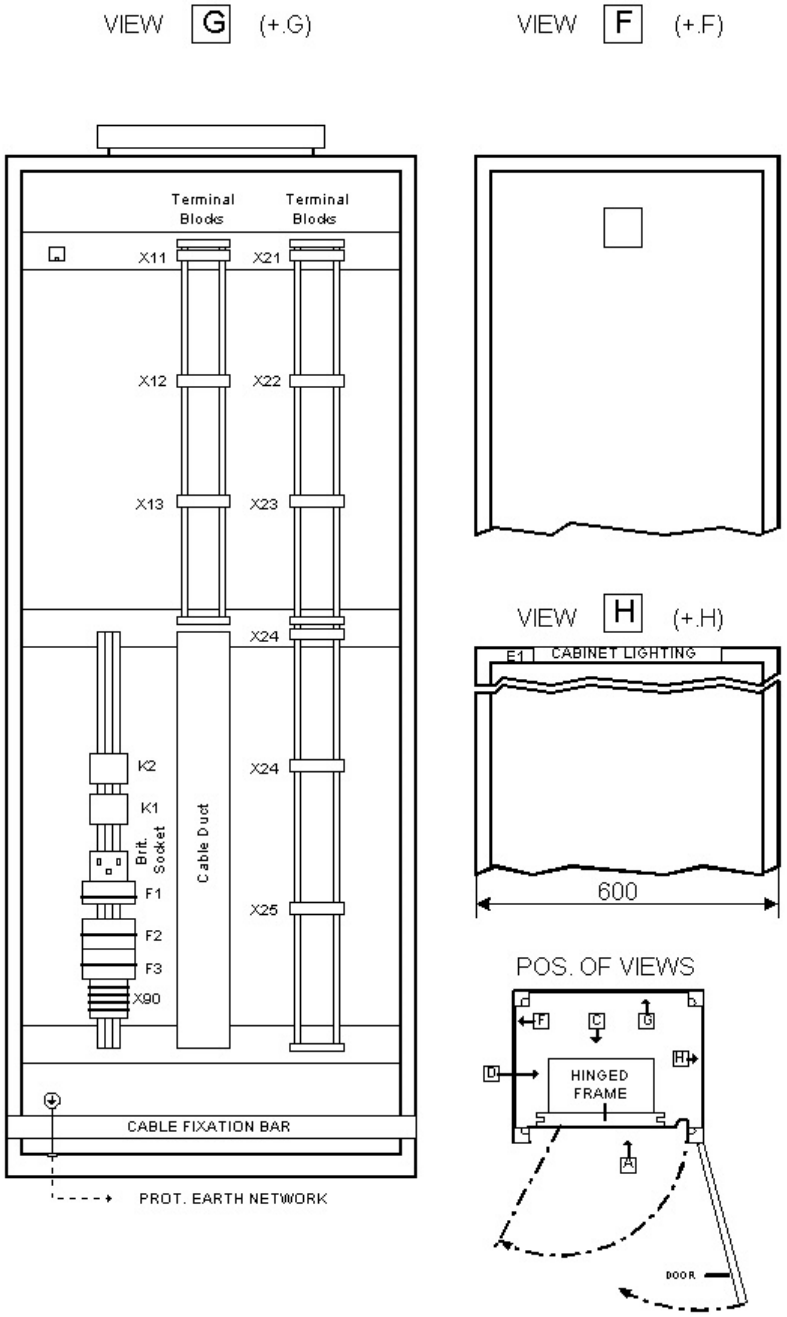
7.27 System Size and Weight



19" version (weight 18 kg)



Free standing cabinet version



7.28 Electromagnetic Compatibility

The product conforms to the standards:

- EN 50082-1 (IMMUNITY)
- EN 55022 (RADIO FREQUENCY)
- EN 60950 (ELECTRICAL SAFETY)

According to the regulations of the EMC 89/336/CEE, 73/23 CEE requirement