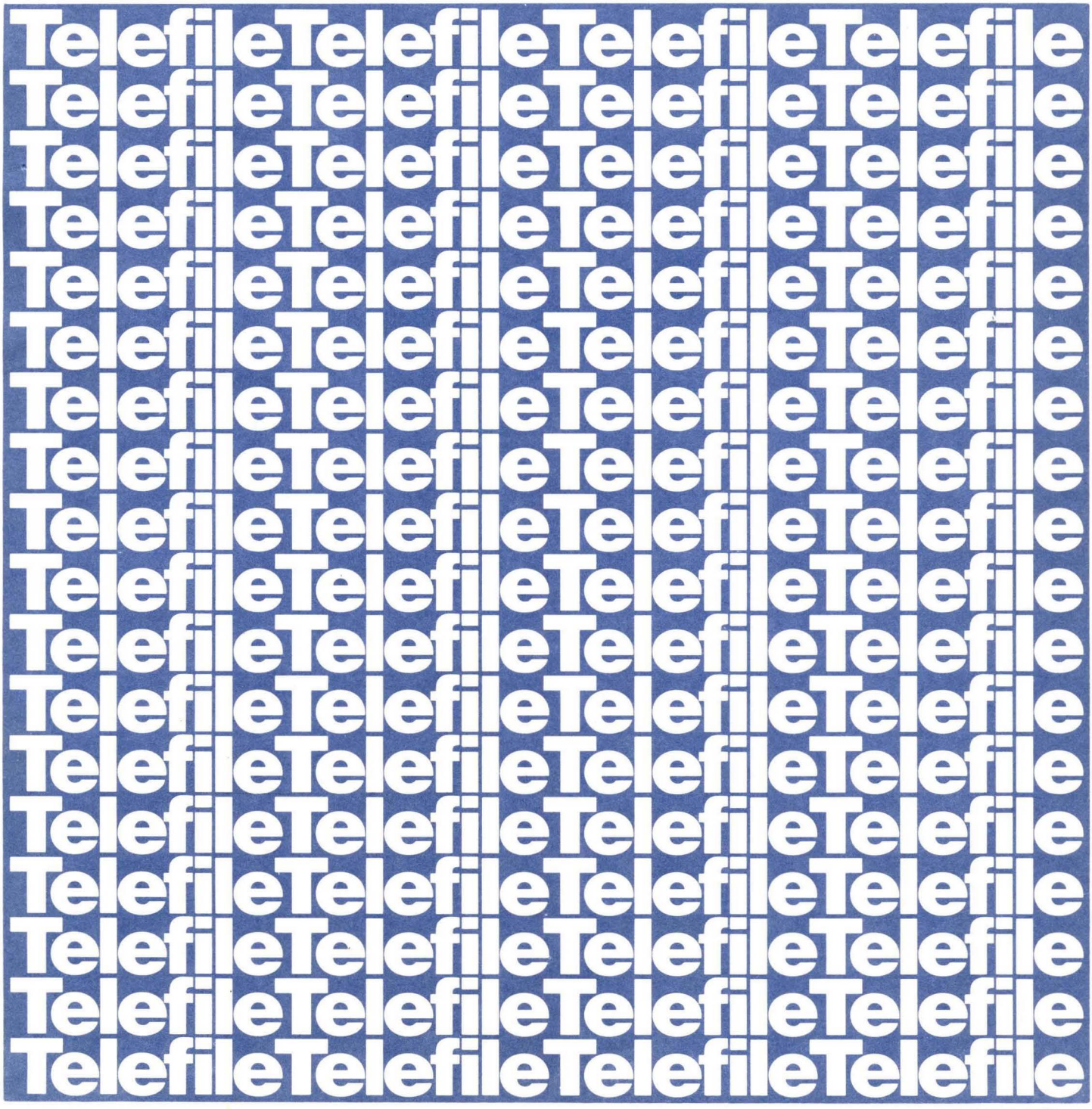
Tele-SWITCH

Installation And User Manual



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Tele-SWITCH

INSTALLATION

AND

USER MANUAL

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Tele-SWITCH

INSTALLATION AND USER MANUAL

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PART I: OVERVIEW

1. INTRODUCTION

This Manual describes all aspects of the Tele-SWITCH X.25 network switch.

The Manual consists of four parts and it is intended that these can be read separately or together as required. In order to achieve the necessary independence of the various sections, it has been necessary for there to be a certain degree of repetition but this has been minimised.

Part I is an overview of the device and its capabilities. It also discusses the CCITT Recommendation X.25 (upon which the Tele-SWITCH is based) and its relevance to the International Standards Organisation's Reference Model of Open Systems Interconnection (OSI).

There are two Appendices, the first giving a list of relevant International Standards and the second listing acronyms used in this Manual.

Part II describes the hardware of the Tele-SWITCH, including a rather more detailed overview of the hardware, how to unpack the device and install it and its cables.

Part III is concerned with the software of the system.

Part IV describes how to set up a network, including assigning network addresses, and how to configure the hardware accordingly.

2. THE CCITT X.25 RECOMMENDATION

Although provided with additional facilities, the main purpose of the Tele-SWITCH is as an X.25 switch. This Section discusses the CCITT X.25 Recommendation and how it fits into the context of other international standards.

2.1 INTERNATIONAL STANDARDS AND STANDARDS-MAKING BODIES

There are many bodies in the world that promulgate standards. These vary from single manufacturers, through consortia of manufacturers, to national and international bodies.

The latter vary from those spanning a few countries (e.g. the EEC) or a single continent to those which span the entire world. Also, some bodies represent specific interests whereas others are completely independent.

In the early 1960s, interest began to focus on telecommunications standardisation and the two international bodies particularly involved were CCITT and ISO.

2.1.1 CCITT

CCITT is the Comite Consultatif International de Telephonie et de Telegraphie and is one of the four permanent bodies of the International Telecommunications Union (ITU), itself a specialised agency of the United Nations. ITU's predecessor, the International Telegraph Union, was founded in 1865.

CCITT is basically concerned with telecommunications and works through Study Groups which are set up at Plenary Assemblies, held every four years. These Study Groups produce "Recommendations" which are approved at Plenary Assemblies (or, occasionally, in between). Although termed "Recommendations", these have the full force of international standards.

The Recommendations are published in many volumes, known by the colour of their covers. For example, the 1984 Recommendations are known as the "Red Book" and the 1988 Recommendations will be the "Blue Book".

The Recommendations are split into groups, each designated by a single letter. The most relevant to this Manual are the V-series, relating to analogue transmission, and the X-series, relating to digital transmission. Perhaps the best known Recommendations are V.24 and X.25. In the past, the numbers were allocated sequentially but, more recently, the Recommendations are being grouped so that, for example, Message Handling Systems are in the X.400 series (i.e. X.400 to X.430 at present).

The members of CCITT are the national PTTs (i.e. telecommunications authorities).

CCITT now works very closely with the other major standardisation body, the International Standards Organisation (ISO).

2.1.2 ISO

ISO was formed in 1947 and its member bodies are the national standards bodies (e.g. the British Standards Institution (BSI) and the American National Standards Institute (ANSI)). Other standards bodies such as CCITT are often represented on ISO committees as non-voting observers.

ISO is concerned with standardisation in the widest sense but, in recent years, a great deal of its work has concentrated on computer communications.

ISO has a hierarchical structure consisting of a large number of Technical Committees (e.g. TC97 concerned with Information Processing Systems), each of which has a number of Sub-Committees (e.g. TC97/SC6 concerned with data communications). Each Sub-Committee has a number of Working Groups.

When a proposed standard is considered to be fairly stable, it is published as a "Draft Proposal" (DP). If agreed by the voting members, it then proceeds to the stage of "Draft International Standard" (DIS), then eventually becomes a full "International Standard". There are occasionally additional stages (e.g. a second DP) but, at the DIS stage, the standard is considered technically stable and few changes are likely to be made.

A list of ISO Standards and CCITT Recommendations is given in Appendix 1.

2.2 THE ISO REFERENCE MODEL OF OSI

Early computer communication networks implemented sets of "protocols" (a protocol is "a set of two processes' agreements on the format and relative timing of messages to be exchanged"). These protocols were often hierarchical.

It wasn't until 1977 that work started internationally on defining a set of protocols for interconnecting computers from different manufacturers ("Open Systems Interconnection") when ISO set up Sub-Committee 16 of Technical Committee 97 (TC97/SC16). Rather than defining protocols, the Sub-Committee decided that it would first define a "Reference Model" into which all the protocols would fit. This "ISO Reference Model of Open Systems Interconnection" consisted of seven layers and was published as a formal International Standard (ISO 7498) in Spring 1983 (although it had remained virtually unchanged since 1980).

The seven layers of the OSI Model (together with a brief description of their functions) are as follows:

Physical Layer:	The interface to the communications medium (e.g. X.21).
Data-Link Layer:	The means of sending a continuous transparent stream of bits through a network with some error detection and recovery (e.g. HDLC)
Network Layer:	Provides the interconnection of separate sub-networks into a global network.
Transport Layer:	The lowest end-to-end layer, providing reliable service and allowing specification of Quality of Service.
Session Layer:	Maps between logical and physical sessions.

Presentation Layer: Allows data to be presented to the Application Layer in a meaningful way.

Application Layer: The layer in which all application-oriented protocols (e.g. File Transfer, Access and Management) reside.

Thus there are the communications-oriented layers (Physical, Data-Link and Network) and the application-oriented (Application, Presentation and Session), separated by the Transport Layer. The lower three layers are node-to-node while the upper four are end-to-end. Also, the Transport Layer "insulates" the network-independent upper layers from the network-dependent lower layers.

A schematic of the OSI Model is shown in Fig 1.

2.3 THE EVOLUTION OF X.25

From the late 1960s onwards, various protocols were developed and used, often very widely (e.g. IBM's BISYNC). However, none was internationally standardised and it became apparent that there was a need for international standards in this area, particularly for the use of PTTs implementing public (packet-switched) data networks. As a result, work started in the early 1970s to define such a standard for interfacing between user equipment and public PTT networks. This work culminated in the X.25 Recommendation at the CCITT Plenary in 1976.

The formal title of the X.25 Recommendation is "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit" (this title has changed slightly since 1976). It is important to note that it merely defines the interface between user equipment (DTE) and the PTT (or other) network (DCE) and does not define how the latter network operates.

Since 1976, X.25 has changed, especially in view of the fact that it pre-dated work on the OSI Model and, although it conformed to that Model to a great extent (since both were attempting to solve the same problem), changes had to be made as the Model developed in order to ensure that it fully conformed.

Thus there have been two revisions of X.25, in 1980 and in 1984. Most PTT networks use the first of these revisions, known as X.25(1980), but are likely to implement X.25(1984) in the fairly near future.

2.4 X.25 AND OSI

X.25 covers the lower three layers of the OSI Model. At the Physical Level, X.25 uses another CCITT Recommendation, X.21 ("Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks"). At Level 2, it uses "High-Level Data Link Control" (HDLC) and its Network Layer is merely referred to as X.25 Level 3.

2.5 THE Tele-SWITCH IMPLEMENTATION OF X.25

As described above, X.25 covers three layers of the OSI Model, the Physical, Data Link and Network. The Tele-SWITCH covers all three layers, allowing a number of options at each level. At the Physical Level, a wide variety of interfaces is permitted. At the Link level, both LAP and LAP-B are supported.

3. HARDWARE

3.1 GENERAL DESCRIPTION

The Tele-SWITCH is based on the M68000 range of microprocessor products and the standard VME bus. The processor board has an internal bus for instruction fetch and stack-oriented operations. In order to achieve high throughput, link input and output operations are independent of the main processor using separate processors running in DMA mode.

High-speed DMA channels are also used to interlink Tele-SWITCH units, in order to create large Packet Switching Exchanges (PSEs), Mega-SWITCH statistically multiplexing nodes or a combination of both with the option of running severral user-programmable processors.

Battery backed-up RAM provides the primary level of Tele-SWITCH configuration protection. A second level can be provided as an option by means of floppy disk drives on which copies of the configuration can be saved and retrieved automatically by the system.

A range of link interfaces are available:

V.24 (RS-232),
V.10/V.11 (RS-423/RS-422),
V.35
X.21.

The Tele-SWITCH is provided in stand alone form or 19" rack mountable and is able to operate in a wide range of environments, including a normal office environment.

3.2 FEATURES AND OPTIONS

Each Tele-SWITCH can support up to 30 individual links, configured as X.25 or statistically multiplexed (the latter also being able to support switching). Up to 1500 logical channels can be configured per Tele-SWITCH. A Mega-SWITCH may be configured by connecting together up to 16 separate Tele-SWITCHs.

The Tele-SWITCH is capable of high sustained throughput, according to the following table:

Maximum individual link speed:	153,000 bit/s
Maximum aggregate link speed:	312,000 bit/s
Maximum packets per second	1162
Maximum stat mux data rate	32,000 bit/s

4. SOFTWARE

In order to understand the software facilities of the Tele-SWITCH, it is necessary to understand first the logical structure of the device.

4.1 ORGANISATION OF THE TELE-SWITCH

The organisation of the Tele-SWITCH maps, as closely as possible, the OSI Reference Model i.e. it is layered and the layers correspond to the first four layers of the OSI Model.

Figure 2 demonstrates the layered concept of the design and Figure 3 shows the mapping between the layers of the OSI Model and the functions of the Tele-SWITCH.

Above the Physical Level, there are three important layers which assume greater or lesser importance, according to the device connected and the protocol used.

4.1.1 Controller Level

This provides the Data Link Level control which is thus responsible for controlling the state of the data link and for preserving the integrity of higher level data at the link level. For X.25 and MUXPORT, the same controller is used with minor parameter differences.

4.1.2 Channel Level

This provides the protocol dependent networking operations in terms of logical channels. For X.25, this consists of handling X.25 Level 3 (Network Layer) packets; for MUXPORT, this consists of analysing and constructing multiplexed frames (i.e. data from more than one channel is in the same frame).

4.1.3 Transport Level

This level is common to all current and future interfaces and provides a device and protocol independent method of passing and flow controlling data and, in particular, for referencing, routing and cross-connecting (forming virtual circuits) device independent logical channels. This scheme is based on the principle of "named" channels and all transport level operations take place in terms of these names (which may be up to four characters long). This is discussed below in more detail.

4.1.4 Transport Level Names

All logical channels at the transport level are assigned names by default when a system is started for the first time. Thereafter, the Tele-SWITCH manager may reconfigure these names to be anything that is meaningful to him and to the structure of the network. Many channels can have the same name (e.g. a contention group or a trunk link group). To form a virtual circuit through a Tele-SWITCH, it is often necessary to search for the requested name (the resource). This simple operation is common to all protocol types and happens invisibly to the higher and lower levels.

A common approach to several problems has been taken with the transport level names:

1. For configuration and diagnostic purposes, the names are used to reference channels. The concept has been extended by allowing controllers to be named for configuration and diagnostic purposes.

2. Call addresses (in X.25 call packets) are mapped to and from the transport level reference names.

3. For menu driven users, the names are the resource selectors.

4. The names are used to represent the hierarchical structure of network addressing.

5. An internal routing option, which is protocol independent and which is called the "dial option" consists of passing names from one Tele-SWITCH to another.

To generalise the naming conventions, wild characters (*) are permitted in names and multiple synonyms ("""") are used to simplify the expression of multiple groups on trunk links.

In addition to the physical links to which users may connect, there is also a "virtual control port" which is analogous to the physical control port in early network equipment.

4.2 COMMAND STRUCTURE

There are a wide variety of commands that are described in more detail in Section 3. As stated above, network resources are allocated names of up to four characters. The user selects a resource by quoting that name and specifying the required command. Commands operate on the current resource ("configuration block") but this can be changed by one of a number of mechanisms. First, the user can specify the name of the new resource; secondly, the user can use special control characters to move between configuration blocks in a specified order; thirdly, the user can specify "ALL" in which case the command is repeated from the current position to the end of the configuration blocks. This is discussed in more detail in Section 3.

5. THE NETWORK MANAGEMENT SYSTEM

At present, there are no international standards on Network Management, although there is a draft Appendix to the OSI Reference Model defining an OSI Network Architecture. As a result, it is necessary to implement proprietary network management protocols and this has been done for the Tele-SWITCH.

There are two aspects of network management which can be differentiated by the timescales involved. There is the short-term day-to-day management of the network, including troubleshooting; also, there is the longer term which is more concerned with strategic planning.

The Tele-SWITCH provides a great deal of management information that is of use to staff involved in both aspects of network management. Furthermore, it implements a "Network Management Presentation Service" which uses an IBM-PC/AT and is able to provide a visual display of many of the network parameters.

The Tele-Manager Network Management system is the subject of another Telefile publication.

APPENDIX 1: LIST OF RELEVANT INTERNATIONAL STANDARDS

CCITT V-SERIES RECOMMENDATIONS

V.1	Equivalence between binary notation symbols and the significant conditions of a two condition code
V.2	Power levels for data transmission over telephone lines
V.3	International Alphabet No 5
V.4	General structure of signals of International Alphabet No 5 for data and message transmission over public telephone networks
V.5	Standardization of modulation rates and data signalling rates for synchronous data transmission in the general switched telephone network
V.6	Standardization of modulation rates and data signalling rates for synchronous data transmission on leased telephone-type circuits
V.10	Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications
V.11	Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications
V.13	Answer-back unit simulators
V.15	Use of acoustic coupling for data transmission
V.16	Transmission of medical analogue data
V.19	Modems for parallel data transmission using telephone signalling frequencies
V.20	Parallel data transmission modems standardized for universal use in the general switched telephone network
V.21	300 bits per second duplex modem standardized for use in the general switched telephone network
V.22	1200 bits per second duplex modem standardized for use on the general switched telephone network and on leased circuits
V.22bis	2400 bits per second full-duplex 2-wire modem standardized for use in the general switched telephone network with 1200 bits per second fall-back
V.23	600/1200 baud modem standardized for use in the general switched telephone network
V.24	List of definitions for interchange circuits between Data Terminal Equipment and Data Circuit Terminating Equipment
V.25	Automatic calling and/or answering equipment on the general switched telephone network, including disabling of echo suppressors on manually established calls
V.26	2400 bit/s modem standardized for use on 4-wire leased telephone-type circuits
V.26bis	2400/1200 bit/s modem standardized for use in the general switched telephone network
V.26ter	2400 bit/s duplex modem using the echo cancellation technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits
V.27	4800 bit/s modem with manual equalizer standardized for use on leased telephone-type circuits
V.27bis	4800 bit/s modem with automatic equalizer standardized for use on leased telephone-type circuits

V.27ter	4800/2400 bit/s modem standardized for use in the general switched telephone network
V.28	Electrical characteristics for unbalanced double-current interchange circuits
V.29	9600 bit/s modem standardized for use on point-to-point 4-wire leased telephone-type circuits
V.30	Parallel data transmission systems for universal use on the general switched telephone network
V.31	Electrical characteristics for single-current interchange circuits controlled by contact closure
V.32	A family of 2-wire duplex modems operating at data signalling rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits
V.35	Data transmission at 48 Kilobits per second using 60-108 kHz group band circuits
V.36	Modems for synchronous data transmission using 60-108 kHz group band circuits
V.37	Synchronous data transmission at a data signalling rate higher than 72 Kbits per second using 60-108 kHz group band circuits
V.40	Error indication with electro-mechanical equipment
V.41	Code independent error control system
V.50	Standard limits for transmission quality of data transmission
V.51	Organisation of the maintenance of international telephone-type circuits used for data transmission
V.52	Characteristics of distortion and error rate measuring apparatus for data transmission
V.53	Limits for the maintenance of telephone-type circuits used for data transmission
V.54	Loop test device for modems
V.55	Specification for an impulsive noise measuring instrument for telephone-type circuits
V.56	Comparative tests of modems for use over telephone-type circuits
V.57	Comprehensive data test set for high data signalling rates
V.110	Support of DTEs with V-series type interfaces by an ISDN

CCITT X-SERIES RECOMMENDATIONS

X.1	International user classes of service in public data networks and Integrated Services Digital Networks (ISDN)
X.2	International user services and facilities in public data networks
X.3	Packet assembly/disassembly facility (PAD) in a public data network
X.4	General structure of signals of International Alphabet No 5 code for data transmission over public data networks
X.10	Categories of access for Data Terminal Equipment (DTE) to Public Data Transmission Services provided by PDNs and ISDNs through terminal adaptors
X.20	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for start-stop transmission services on public data networks
X.20bis	Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to asynchronous duplex V-series modems
X.21	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks
X.21bis	Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to synchronous V-series modems
X.22	Multiplex DTE/DCE interface for user classes 3-6
X.24	List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) on public data networks
X.25	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit
X.26	Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications
X.27	Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications
X.28	DTE/DCE interface for a start-stop mode data terminal equipment accessing the packet assembly/disassembly facility (PAD) in a public data network situated in the same country
X.29	Procedures for the exchange of control information and user data between a packet assembly/disassembly (PAD) facility and a packet mode DTE or another PAD
X.30	Support of X.21 and X.21bis based data terminal equipments (DTEs) by an integrated services digital network (ISDN) (I.461)
X.31	Support of packet mode terminal equipment by an ISDN (I.462)
X.32	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and accessing a packet switched data network through a public switched telephone network or a circuit switched public data network
X.33	Standardization of an international text for the measurement of the margin of start-stop machines in accordance with International Alphabet No 5
X.40	Standardization of frequency-shift modulated transmission systems for the provision of telegraph and data channels by frequency division of a primary group
X.50	Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks

X.50bis	Fundamental parameters of a 48 Kbits per second user data signalling rate transmission scheme for the international interface between synchronous data networks
X.51	Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks using 10-bit envelope structure
X.51bis	Fundamental parameters of a 48 Kbits per second user data signalling rate transmission scheme for the international interface between synchronous data networks using 10-bit envelope structure
X.52	Method of encoding anisochronous signals into a synchronous user bearer
X.53	Numbering of channels on international multiplex links at 64 Kbits per second
X.54	Allocation of channels on international multiplex links at 64 Kbits per second
X.60	Common channel signalling for synchronous data applications - data user part
X.61	Signalling system No 7 - data user part
X.70	Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks
X.71	Decentralised terminal and transit control signalling system on international circuits between synchronous data networks
X.75	Terminal and transit call control procedures and data transfer systems on international circuits between packet-switched data networks
X.80	Interworking of interchange signalling systems for circuit switched data services
X.87	Principles and procedures for realization of international user facilities and network utilities in public data networks
X.92	Hypothetical reference connections for public synchronous data networks
X.93	Hypothetical reference connection for packet switched data transmission services
X.95	Network parameters in public data networks
X.96	Call progress signals in public data networks
X.110	Routing principles for international public data services through switched public data networks of the same type
X.121	International numbering plan for public data networks
X.130	Provisional objectives for call set-up and clear-down times in public synchronous data networks (circuit switching)
X.131	Provisional objectives for grade of service for public data networks when providing international packet-switched networks
X.132	Provisional objectives for grade of service in international data communications over circuit switched public data networks
X.135	Delay aspects of grade of service for public data networks when providing international packet-switched data services
X.150	DTE and DCE test loops for public data networks
X.180	Administrative arrangements for international closed user groups (CUG)
X.200	Reference Model of OSI for CCITT applications
X.210	Layer Service conventions of OSI for CCITT applications
X.211	Physical Layer service definition of OSI for CCITT applications
X.212	Data Link Layer service definition of OSI for CCITT applications
X.213	Network Layer Service Definition of OSI for CCITT applications
X.214	Transport Layer Service Definition of OSI for CCITT applications

X.215	Session Layer Service Definition of OSI for CCITT applications
X.216	Presentation Layer Service Definition of OSI for CCITT applications
X.217	Common Application Service Elements Definition for OSI for CCITT applications
X.224	Transport Protocol Specification of OSI for CCITT applications
X.225	Connection Oriented Session Protocol of OSI for CCITT applications
X.244	Procedure for the exchange of protocol identification during virtual call establishment on packet switched public data networks
X.250	ESTELLE - A formal description technique based on an extended state transition model
X.300	General principles and arrangements for interworking between Public Data Networks and other networks
X.400	Message Handling System: System Model - Service Elements
X.401	Message Handling System: basic service elements and optional user facilities
X.408	Message Handling System: encoded information type conversion rules
X.409	Message Handling System: Presentation transfer syntax and notation
X.410	Message Handling System: remote operations and reliable transfer server
X.411	Message Handling System: Message Transfer Layer
X.420	Message Handling System: interpersonal messaging User Agent Layer
X.430	Message Handling System: Access protocol for Teletex terminals

APPENDIX 2: LIST OF ACRONYMS

ANSI	American National Standards Institute
BSI	British Standards Institution
CCITT	Comite Consultatif International Telephonique et Telegraphique
CIU	Channel Interface Unit
CPU	Central Processor Unit
CRC	Cyclic Redundancy Check
DIS	Draft International Standard
DP	Draft Proposal
DTU	Data Terminating Unit
HDLC	High-level Data Link Control
ISO	International Standards Organisation
LAP	Link Access Protocol
LAP-B	Link Access Protocol - Balanced
LCGN	Logical Channel Group Number
OSI	Open Systems Interconnection
PAD	Packet Assembler/Dissasembler
PSE	Packet Switching Exchange
PVC	Permanent Virtual Circuit
SVC	Switched Virtual Circuit

APPENDIX 3: THE ASCII CHARACTER SET

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

PART II: HARDWARE

1. HARDWARE OVERVIEW

The Tele-SWITCH is based on the M68000 micro-processor and its architecture is based on the VME bus. The cpu, memory, port and interface modules all plug in to this bus and hence the system is fully expandable in the field.

The processor board has an internal bus for instruction fetch and stack-oriented operations. In order to optimise throughput, input-output operations are independent of the main processor, being carried out via separate processors using DMA transfers. high-speed DMA channels are also used to interlink individual Tele-SWITCH units thus allowing the creation of very large Packet Switching Exchanges (PSEs), Mega-SWITCH statistically multiplexing nodes or a combination of both with the option of running several user-programmable processors.

The configuration of a Tele-SWITCH is contained in battery-backed RAM in order to protect this information in the event of power failure. A second level of protection can be provided (optionally) by means of floppy disk drives.

Each Tele-SWITCH is a free standing unit or it can be 19-inch rack mounted.

A range of link interfaces are available.

1.1 PHYSICAL CHARACTERISTICS

The usual Tele-SWITCH configuration is a 20-slot frame which has the following characteristics:

	Single	Double
Height	13.00 cm	26.67 cm
Width	48.26 cm	48.26 cm
Depth	21.59 cm	21.59 cm
Weight	3.65 Kg	15.50 Kg

The power supply unit, when supplied separately fitted to a 19 inches panel has the following characteristics:

Height	23.10 cm
Width	48.26 cm
Depth	7.00 cm
Weight	4.25 Kg

1.2 ELECTRICAL REQUIREMENTS

The Tele-SWITCH can operate at 115 VAC 60 Hz or 240 VAC 50 Hz. More specifically, the electrical requirements are:

Voltage	196-264 VAC 98-132 VAC
Frequency (single phase)	48-400 Hz
Power consumption	less than 300 W
Input fuse rating	5A

1.3 OPERATING ENVIRONMENT

Temperature	0 to 50 deg C
Humidity	0 to 90% (non-condensing)

1.4 HARDWARE FEATURES

The Tele-SWITCH is based on a high-throughput 16-bit microprocessor, the M68000, and uses the VMEbus architecture. The clock speed is 8 MHz. Each Tele-SWITCH can contain from 64 Kbytes to 4 Mbytes MOS RAM (battery backed). It has a four (hex) digit display and two RS-232-C control console interfaces are provided. A wide variety of hardware options are provided.

1.5 PERFORMANCE

The performance of the Tele-SWITCH varies according to the model chosen (see Section 1.6) but the following are the maxima:

* Up to 153 Kbit/s per link
* 1.1 Mbit/s aggregate link speed
* 1162 packets per second (128 byte data field)
* Up to 2000 concurrent virtual circuits per link

1.6 HARDWARE OPTIONS

The specific options permitted vary according to the model chosen (see next section) but, overall, are as follows:

* Up to 30 individual links
* Link speeds from 1200 bit/s to 153 Kbit/s
* RS-232 (V.24), RS-422/423 (V.11/V.10), V.35, V.54 and X.21 interfaces
* X.25 (LAP or LAP-B) and MUXPORT protocols
* RTS/CTS and XON/XOFF flow control

1.7 Tele-SWITCH MODELS

There are six models of the Tele-SWITCH currently available. A summary of their features is as follows:

Model	Links	Height	Width	Depth	Notes
T-3671	2-6	11.45"	14.68"	10.22"	a
T-3672	2-6	11.61"	13.50"	15.91"	
T-3673	2-12	11.61"	21.26"	15.91"	
T-3674	2-18	16.89"	21.26"	15.91"	b
T-3675	2-30	22.13"	21.26"	15.91"	c
T-3676	2-140	63.38"	23.09"	32.75"	d

Notes

a The portable Tele-SWITCH
b This version includes a second 64Kb memory module for 16 or 18 link configurations.
c This version includes a second 64Kb memory module for 16 or more links.
e This is the Mega-SWITCH model for over 18,000 packets/second.

2. INSTALLATION

2.1 UNPACKING

Various configurations of the rack mountable Tele-SWITCH are available but, in general, these consist of a Logic Frame (single or double height) and a Power Supply Unit (PSU), together with all necessary DIN connectors and fixing screws.

All Logic Frames are delivered fully assembled with modules installed to the user's requirements. The PSU is delivered complete with a primary power cable and plug, together with a prewired DC logic power loom.

Each of the above items is individually bubble-wrapped, together with protective corners. The logic frame(s) are protected front and rear with foam and cardboard. All items are packed together in a single container.

2.2 DELIVERY CHECKLIST

In addition to the hardware, as listed above, the container should also contain the following:

Packing list
Installation manual
User manual
Technical manual

After unpacking the units, check all items against the packing list. Then check for damage and, if any is found, contact the shipping agent.

It is recommended that, after unpacking, the packing materials be retained in case it is necessary to re-ship the Tele-SWITCH.

2.3 SITE SURVEY AND PREPARATION

It is assumed that, by the time the equipment has been evaluated and ordered, a full site survey has been carried out. However, it is worth emphasising that it is necessary to check that there is adequate space for the equipment, that there is a suitable power outlet within reasonable distance and that the environment (with or without air conditioning) is compatible with that required by the equipment (as specified above). It is strongly recommended that the equipment be installed in an air-conditioned room wherever possible and that, in any case, extremes and rapid changes of temperature and/or humidity be avoided.

2.4 INSTALLATION PROCEDURE T3638 AND T3679

No special tools or equipment are required in order to install the Tele-SWITCH. A standard field service tool kit is all that is required.

The Tele-SWITCH Logic Frame(s) and PSU are designed to be installed in a standard 19 inches rack and the following sections describe this installation.

There are two basic types of Tele-SWITCH the first using an SIO interface with four ports per module and the second using a T3679-401 DIO interface with two ports per module. The Tele-SWITCH with the T3679-401 DIO interface requires one or more extra single high logic frames to house the interface modules.

2.4.1 Installation of T3638

The Tele-SWITCH T3638 (with an SIO interface) consists of a Tele-SWITCH double height Logic Frame which is complete and ready to be installed in a standard 19 inches rack.

The Tele-SWITCH Logic Frame should be mounted in a convenient position in the front of the rack. Please note that, since a wide variety of different screws may be required, these are not supplied. Once the Logic Frame is installed, it will be necessary to connect the interface cable(s) to the rear of the Logic Frame.

Each interface cable consists of a DIN 41612 socket connected via a 64-way ribbon cable terminating in four 25-way 'D' plugs (RS-232-C/ISO 2110). For every SIO board, there will be one such cable that mates onto the rear wirewrap pins of the lower DIN connector of each SIO board.

Each unit is supplied with at least five pre-mounted lower DIN connectors for ease of future field expansion. The address mapping for SIO boards is achieved with wire-wrap straps on each of these DIN connectors. This is described in more detail in Section 3.14.

The interface cable into the Tele-SWITCH Logic Frame should be installed next. This cable must be oriented correctly, namely the largest cut-away part of the ribbon cable must be uppermost. The DIN connector end is then located carefully over the wire-wrap pins of the lower fixed DIN connector of the first SIO slot. The connector should merely be located at this stage, not pressed in.

Visually check that all pins are corectly mated, then gently apply even pressure to the top and bottom of the ribbon cable connector until fully home (N.B. When fully home, there will be a 7 mm gap between connectors).

Follow the same procedure with each SIO board to be installed.

The 'D' plug end of the ribbon cables must not be left hanging from the Tele-SWITCH motherboard without some support. It is recommended that the 'D' connector covers be removed and the connectors be fitted to a sub-panel mounted at the rear of the 19 inches rack.

The final stage is the fitting of the PSU. This is mounted directly behind the Tele-SWITCH unit and screwed to the rear of the 19 inches rack (N.B. screws not supplied).

Although the position of the PSU is not critical, it is limited by the length of the DC power loom.

Once the PSU is securely fixed, the DC power loom should be connected to the spade connectors on the rear of the Tele-SWITCH motherboard. The spade connectors on the top of the motherboard are grounds except for the +5V standby which is not used. The ones along the bottom of the motherboard are for +5V, +12V and -12V. Ensure that the correct connections are made, according to the colour code:

BLACK	GROUND
RED	+5V
ORANGE	+12V
BLUE	-12V

Fit the power-fail cable (terminated in a socket) to the 5-pin polarized plug at the end of the motherboard, which is above the T3679-400 CPU module in slot A1. Do not yet connect any of the 'D' plugs to other equipment.

Proceed to Section 2.5 for initial testing.

2.4.2 Installation of T3679

The first stage in the installation of the Tele-SWITCH with T3679-401 DIO ports (the T3679) is to remove all DIO modules from the Tele-SWITCH. Keep a note of the slots from which they are removed since each has a unique address.

Each DIO module has two DIN connectors but the Tele-SWITCH Logic Frame only contains one matching connector per slot. Each slot intended for a DIO module requires a second DIN connector to be fitted into the rear of the Tele-SWITCH Logic Frame (these connectors are not factory-fitted in order to simplify packing).

Note that the DIN connector has a ribbon cable that is split into two, making two 32-way ribbons which, in turn, are terminated in two more 64-way DIN connectors. The DIN connector with the split ribbon cable must be fitted, red edge up that is, pin 01 at the top-to the rear of the DIO slot.

The connector must be offset by one screw hole to the right from the actual slot containing the DIO module in order to line up with the module connector (two 2.5 mm screws are supplied for each connector).

The Tele-SWITCH Logic Frame can now be mounted into the front of the 19 inches rack (screws not supplied) and the DIN connector ribbons can be draped out of the rear of the Tele-SWITCH Logic Frame.

Re-install the T3679-401 DIO modules in the same order that they were removed.

The next stage is the fitting of the PSU. This is mounted directly behind the Tele-SWITCH unit and screwed to the rear of the 19 inches rack (N.B. screws not supplied).

Although the position of the PSU is not critical, it is limited by the length of the DC power loom.

Once the PSU is securely fixed, the DC power loom should be connected to the spade connectors on the rear of the Tele-SWITCH motherboard. The spade

connectors on the top of the motherboard are grounds except for the +5V standby which is not used. The ones along the bottom of the motherboard are for +5V, +12V and -12V. Ensure that the correct connections are made, according to the colour code:

BLACK	GROUND
RED	+5V
ORANGE	+12V
BLUE	-12V

Fit the power-fail cable (terminated in a socket) to the 5-pin polarized plug at the end of the motherboard, which is above the T3679-400 CPU module in slot A1. Do not yet connect any of the 'D' plugs to other equipment.

Once the PSU installation is complete, the Nest Interface must be fitted. The Nest Interface is a single height Logic Frame designed to hold all the interface modules.

A convenient place to position it is just below the PSU. No DC power connection is required.

The Nest Interface is supplied complete with interface modules fitted but not socketed. Once the Nest Interface is mounted in the rack, all the interface modules should be removed in order to allow access to the rear of the Logic Frame to fit the DIN sockets.

Ribbon pairs from the Tele-SWITCH Logic Frame terminate in 64-way DIN sockets. These sockets must be fixed, one at a time, at the rear of the Nest Interface unit (two 2.5 mm screws are supplied for this purpose).

Starting at module slot position 01, the first ribbon/socket should be installed, offset by one screw hole to the right of the module slot (i.e. screw hole number 02). This is to allow it to mate with the DIN connector of the first interface module.

It is important to note that the first pair of ribbons must come from the first T3679-401 DIO module slot in the Tele-SWITCH Logic Frame and the second pair from the second T3679-401 DIO module slot etc. The DIN sockets must also be oriented so that the upper half is the part connected to the 32-way ribbon cable. The ribbon with the red upper edge must be fitted to the first slot. The second ribbon always goes to the next interface slot to the right. The above procedure must be undertaken for each T3679-401 DIO module installed.

Proceed to Section 2.5 for initial testing.

2.4.3 Freestanding Units

The free-standing Tele-SWITCH units are delivered fully assembled. After unpacking the unit a physical examination should be completed and the power supply voltage should checked before applying power to the Tele-SWITCH

The unit should be placed in a suitable position, then connected to a mains socket. Initial testing should now take place.

2.5 INITIAL TESTING

Power should be applied to the Tele-SWITCH and the LED displays observed on the following modules:

2.5.1 CPU

The hexadecimal STATUS LED should show a blurred figure of eight (i.e. all segments lit). This indicates that the CPU is in the run state. If the display shows a static hexadecimal character, then it is in an abort state. If it shows two decimal points, then it is in a halt state (due to a double bus error). To clear and restart, press CPU RESET.

2.5.2 Memory

The memory module single DISPLAY LED should not be lit. If it is, then this indicates a memory parity error. Press CPU RESET to clear and restart.

2.5.3 Display

The display module should show a continually incrementing count on the four hexadecimal DISPLAY LEDs and the rate of incrementation should be constant.

2.5.4 SIO 4-Port

The first SIO module is configured by default and the single DISPLAY LED should be green. If it is red, then a fault exists. For all other SIOs, the DISPLAY LED will probably be red since the module has not been configured.

If the DISPLAY LED is not lit, then it may indicate that that the module is not seated properly. Power off the Tele-SWITCH then re-seat the SIO module.

2.5.5 DIO 2-Port

None of the 12 DISPLAY LEDs should be lit on the DIO module if the interface modules associated with the particular DIO module are installed. If any of the LEDs are lit, then this could indicate a fault or that the interface modules are not installed.

If the above tests give the correct status on the display LEDs, then proceed to next Section.

2.6 TEST CONFIGURATION

A production test configuration is normally present in battery-backed RAM situated on the memory module. However, if this becomes corrupted during storage, then it will be necessary to re-configure the system before continuing.

To re-establish a test configuration, connect a 'D'-type ribbon cable to the SP1 socket on the cpu module and plug the other end into a suitable terminal set to 9600 baud.

At this stage, do not connect any external links to the interface modules.

Enter the configuration as shown in the Tele-SWITCH Manual Appendix A.2.

3. HARDWARE DESCRIPTION

3.1 CPU (T3679-201)

The CPU is an M68000, operating with a clock speed of 8 MHz. It utilises a 16-bit data bus and allows an address space of up to 16 Mbytes. The cpu interfaces to a VMEbus.

The CPU performs additional functions as Interrupt Handler, Bus Arbiter and Bus Watchdog Timer

Two user accessible buttons are available, marked ABORT and RESET.

Both of these buttons should be used with care. Operation of the ABORT button causes the Tele-SWITCH to shut down all the links and to enter a monitor-only mode. It is from this mode that initial configuration is entered. The only access to the software is via the top 25 pin "D" connector at 9600 bit/s.

Operation of either button will cause all user data and all calls in progress to be lost.

The ABORT button causes all execution to cease but allows access via the control port. Thus ABORT is used when it is necessary to reconfigure the Tele-SWITCH.

RESET is used to perform a complete hardware reset and software restart.

There is a single (hex) digit display which merely counts from 0 to F. Since this is updated as a low priority background task, the speed at which it changes is useful as a measure of CPU loading. In conditions of light loading, the display changes so rapidly that it appears to be exhibiting the digit '8' (i.e. all sectors lit).

3.1.1 CPU Strap Selection

All straps with the exception of K7 and K15, are factory set and should not be altered without reference to the factory.

K1	13-14 15-16
K2	7-8
K3	1-2 3-4 5-6 7-8 9-10
K4	1-2 for SIO Systems
K4	7-8 for DIO Systems
K5	1-2 3-4 5-6 7-8 9-10 11-12 13-14
K6	1-2 3-8 5-10 11-12
K8	no straps
K9	1-2-3 4-5
K10	1-2-3 4-5
K11	1-4 2-3 5-6 7-10 9-12 13-16 18-21 19-20
K12	1-4 2-3 5-6 7-10 9-12 13-16 18-21 19-20
K13	1-4 2-3 5-6 7-10 9-12 13-16 18-21 19-20
K14	1-4 3-6 7-10 8-11 12-15 13-16 14-17 18-21 19-20
K16	no straps

Straps K7 or K15 as DCE	
1-2	connects pin 8 to +12v
5-7	connects pin 6 to DTR
10-12	connects pin 5 to RTS
13-15	connects pin 2 to RxD
14-16	connects pin 3 to TxD

Straps K7 or K15 as DTE	
1-2	connects pin 8 to +12v
5-6	connects pin 20 to DTR
11-12	connects pin 4 to RTS
13-14	connects pin 3 to RXD
15-16	connects pin 2 to TXD

3.1.2 CPU Memory Configuration

The CPU is fitted with on-board RAM for use as local storage of such functions as house-keeping data. Also fitted to this module is the program memory in EPROM.

The allocation of memory is 48 Kbytes of RAM and 64 Kbytes of Program memory.

3.2 DISPLAY MODULE (T3679-202)

This module has three main functions.

The first function is to provide the system with an accurate interrupt timer function at a rate of 10 per second.

The second function is the provision of the Time and Date Clock. This clock is software controlled and also battery backed up to preserve the date and time over a power failure (this battery will provide power for the clock for a period in excess of 6 months and is recharged by the system automaticaly).

The third function of this module is to controls the four (hex) digit counter which normally increments from 0000 to FFFF at a count rate of 10 per second. The display is also used for diagnostics in that it may be used to examine memory locations.

3.2.1 Display Module Strap Selection

There are NO user alterable straps on this module.

3.3 64 KB MEMORY MODULE (T3679-203)

A red LED connected to the memory module lights in the case of a failure of the memory module.

3.3.1 64 KB Memory Module Strap Selection

There are two parameters on the Tele-SWITCH 64K battery-backed memory card that can be altered by strapping. LK1 sets the address boundary for the card and LK2 sets the memory access speed timing. Note that the latter MUST be set by the factory and is dependent on the type and speed of memory chip used. Therefore this MUST NOT be altered outside the factory.

Link LK1 is in the top half of the board adjacent to connector J1 and below IC50. The even pin numbers are along the top edge starting with pin 2 nearest IC38 (i.e. at the top left hand side of the strap set) and running to pin 32 on the top right hand edge of the set. The odd numbers 1-31 run along the bottom edge with number 1 directly below pin 2 and pin 31 on the bottom right hand side of the set. The straps are always jumpered vertically (i.e. 1-2 or 9-10) never horizontally (e.g. 2-4 or 1-3).

Link LK2 is on the left hand edge adjacent to C11 with strap set 1-2 towards the top edge of the board and 7-8 nearest the leg of resistor R4.

LK1 Memory Address Strapping				
MEM1	MEM2	MEM3	MEM4	MEM5
3 - 4	3 - 4	3 - 4	3 - 4	3 - 4
7 - 8	7 - 8	7 - 8	7 - 8	7 - 8
11 - 12	9 - 10	11 - 12	9 - 10	11 - 12
13 - 14	13 - 14	15 - 16	15 - 16	13 - 14
19 - 20	19 - 20	17 - 18	17 - 18	17 - 18
21 - 22	21 - 22	21 - 22	21 - 22	21 - 22
25 - 26	25 - 26	25 - 26	25 - 26	25 - 26
29 - 30	29 - 30	29 - 30	29 - 30	29 - 30

Note that this guide for LK1 is valid for two-EPROM T3679-400 CPU systems only. For details of four-EPROM systems, please consult your distributor.

LK2 Memory Timing Strapping	
1-2	62 nsec minimum
3-4	124 nsec minimum
5-6	186 nsec minimum
7-8	248 nsec minimum

Since the memory chips usually used are LP8s, then the memory cycle time is 100 nanoseconds plus delays for decoding and bus driving; thus position 5-6 should be used for optimum performance. For example, however, if 70 nsec chips were used, position 3-4 would be required for optimum performance; position 1-2 could NOT be used and the other positions would be excessively slow

3.4 MASS MEMORY MODULE (T3679-204,5,6)

This is a Dynamic Memory module which is available in 3 variations;

T3679-204	1MB Mass Memory Module
T3679-205	2MB Mass Memory Module
T3679-206	4MB Mass Memory Module

All Mass Memory modules have parity as standard.

3.4.1 Mass Memory Module Strap Selection

There are 40 strap locations on this module and these straps should be installed as listed in the following table:

X = Strap installed O = No strap installed

Strap		Strap		Strap	
1	O	13	X	31	O
2	X	14	X	32	O
3	O	15	O	33	O
4	O	16	O	34	O
5	X	21	O	35	X
6	O	24	O	36	O
7	O	25	O	37	O
8	X	26	O	38	O
9	X	27	X	39	O
10	X	28	X	40	O
11	X	29	X	41	O
12	X	30	X	42	O

43	O	48	O
44	X	49	X
45	O	50	O
46	O		
47	X		

Straps 17, 18, 19, 20, 22, and 23 define the memory size and should be set as follows:

X = Strap installed O = No strap installed

MEM Size	Strap 17	Strap 18	Strap 19	Strap 20	Strap 22	Strap 23
1 Mbyte	X	X	O	O	O	O
2 Mbyte	X	O	X	O	O	O
4 Mbyte	O	X	X	O	O	O

3.5 DIO 2-PORT MODULE (T3679-401)

Each DIO module has two ports, for each of which there are six LEDs, labelled as follows with the specified meanings:

TX	Transmit data
RX	Receive data
CS	Clear to send
CD	Data carrier detect
SR	Data set ready
LB	Loopback enabled

3.5.1 DIO Module Strap Selection

It is important for ease of diagnostics that the first DIO module nearest the CPU module is always board number 1 and that the remaining DIO modules follow in numeric order sequenced from left to right without gaps.

Number	Address	SW1	SW2
1	FFC000	3	F
2	FFC200	3	D
3	FFC400	3	B
4	FFC600	3	9
5	FFC800	3	7
6	FFCA00	3	5
7	FFCC00	3	3
8	FFCE00	3	1
9	FFD000	2	F
10	FFD200	2	D
11	FFD400	2	B
12	FFD600	2	9
13	FFD800	2	7
14	FFDA00	2	5
15	FFDC00	2	3

3.6 CHANNEL INTERFACE UNIT (T3679-901)

The Tele-SWITCH Channel Interface Unit (CIU) has been designed to allow two Tele-SWITCH units to be interlinked via a high speed parallel interface. The CIU operates at 1 Mbyte/second full duplex over an 8-bit parallel interface. The CIU has two identical full duplex channels on each module.

The CIU module must be located to the right of any DIO modules that may be present in the Tele-SWITCH. There should be no gaps when the modules are in place. The FDC (when fitted) should be to the right of the CIU modules.

3.6.1 CIU Address Switch Settings

The Tele-SWITCH CIU has two hexadecimal address switches which should be set as follows, with the first switch setting (F5) being physically located nearest to the CPU module and subsequent addresses located in sequence thereafter:

Board	Switch	Address
1	F5	FFA000
2	E5	FFA100
3	D5	FFA200
4	C5	FFA300
5	B5	FFA400
6	A5	FFA500
7	95	FFA600
8	85	FFA700
9	75	FFA800
10	65	FFA900
11	55	FFAA00
12	45	FFAB00
13	35	FFAC00
14	25	FFAD00
15	15	FFAE00
16	05	FFAF00

3.6.2 CIU Strap Selection

There is only one strap selection on the CIU module, LK3. This strap either disables (position D) or enables (position E) the bus error watchdog timer. This strap should always be in the enabled (E) position when the unit is in service. The disabled position (D) must only be used for diagnostic purposes.

3.6.3 CIU Interconnection (T3679-9011)

Interconnection of the CIUs is via a two metre 60-way ribbon cable. One interconnecting cable is supplied with each CIU. Great care must be taken to ensure that the cables are fitted to the module correctly. The board connectors have keys fitted to ensure that the cables cannot be reversed. If the keyways have been removed or are damaged, refer to the suppliers for instructions as incorrect cabling may cause serious damage to the module.

The first channel connector is that nearer the front of the module, the second being the one nearer the back edge of the module.

The cables are brought out to the rear of the subframe and should be routed clear of any power cables or power supplies. The cable should be adequately supported with enough slack to allow easy removal of the module complete with cable.

3.7 DISK CONTROLLER MODULE (T3679-301)

This module is able to control up to 4 floppy disk drives in single density mode.

This module has its analogue circuitry set by the Telefile factory. These adjustments are not user settable.

3.7.1 Disk Controller Switch Settings

The address selection switch S2 may either be hard-wired in the factory, or may be fitted with a switch. If a switch is fitted then it should be set as in the following table:

1	Open
2	Closed
3	Open
4	Open

3.7.2 Dual Disk Drive Module (T3679-303)

Only two jumpers are set on each disk drive as follows:

Drive 0	
Motor On	(MO)
Drive 0	(DO)

Drive 1	
Motor On	(MO)
Drive 1	(D1)

Note

Earlier Tele-SWITCH Units may be fitted with 5.25 inch Disk Drives and the strapping for these units is as follows.

This strapping information is for the TEAC FD-55-AV 5.25 inch Disk Drive Units. If another type of unit is installed, please contact the factory for strap information.

For Drive Number 0 straps DS0, U2 and FG only should be installed

For Drive Number 1 straps DS1, U2 and FG only should be installed

3.8 X.21 INTERFACE (T3679-403)

The Tele-SWITCH X.21 interface is configured as DTE with the pin designations as follows:-

PIN	Signal
1	Protective Ground
2	Send Data +
3	Request to Send +
4	Receive Data +
5	Clear to Send +
6	Receive Timing +
8	Signal Ground
9	Send Data -
10	Request to Send -
11	Receive Data -
12	Clear to Send -
13	Receive Timing -

3.8.1 X.21 Strap Selection

There are NO user alterable straps on this module

3.9 V.35 INTERFACE (T3679-406)

The Tele-SWITCH V.35 interface is configured as DTE via a panel-mounted 25-way 'D' socket. To complete the connection to the V.35 environment, an external cable is supplied. The cable is equipped with a plug at each end and the plug/pin designations are as follows:

'D' plug	IEEE-488	Signal
1	Y	Send timing
2	U	Terminal Timing +
3	T	Receive Data -
4	P	Send Data +
5	V	Receive Timing +
7	B	Signal Ground
8	F	Data Carrier Detect
10	E	Data Set Ready
12	D	Clear to Send
14	a(AA)	Send Timing -
15	W	Terminal Timing -
16	R	Receive Data +
17	S	Send Data -
18	X	Receive Timing -
20	C	Request to Send
21	A	Protective Ground

3.9.1 V.35 Strap Selection

The Tele-SWITCH V.35 interface is supplied with an on-board clock to provide a timing source when the DTE/DCE to which the Tele-SWITCH is connected cannot do so. This clock can also be installed on the Tele-SWITCH V.24 interface as an option if required.

The on-board clock can be set to various frequencies from 1200 bit/s to 153.6 Kbit/s by setting switch S1. The frequency is set according to the following table:

Bit-Rate	A	B	C	D
1.2	ON	ON	OFF	OFF
2.4	OFF	OFF	OFF	ON
3.6	ON	OFF	ON	OFF
4.8	OFF	OFF	ON	OFF
9.6	ON	OFF	OFF	ON
19.2	OFF	ON	OFF	OFF
38.4	ON	OFF	OFF	OFF
76.8	OFF	ON	ON	OFF
153.6	OFF	ON	ON	ON

3.10 V.24 INTERFACE (T3679-402)

The Tele-SWITCH V.24 interface is configured as DTE with the pin designations as follows:

'D' plug	Signal
1	Protective Ground
2	Transmit Data
3	Receive Data
4	Request to Send
5	Clear to Send
6	Data Set Ready
7	Signal Ground
8	Data Carrier Detect
15	Transmit Timing
17	Receive Timing
20	Data Terminal Ready
24	External Clock

3.10.1 V.24 Strap Selection

The V.24 interface module can be supplied with an on-board clock if required. When installed, its output can be selected to be ON or OFF by means of a strap (LK9). The default condition is ON. The printed circuit strap LK9 must be cut for the OFF condition.

The clock speed can be selected by means of jumper pad LK8. Use jumper links supplied to select the required speed by referring to the printing on the PCB.

All control signals (LK1-5) have an option to allow them to be held HIGH ('H'), LOW ('L') or NORMAL ('N'), the level being selectable dynamically. The default is NORMAL.

If a different level is required, it is necessary to cut the 'LK' to 'N' straps on the PCB, then to insert wire links from 'LK' to 'H' or 'L' as appropriate.

The Receive Clock (RxC) and Transmit Clock (TxC) can be inverted by means of LK6 and LK7 respectively. In order to do this, first cut the straps between LK6 to 'N' and LK7 to 'N'. Then insert wire links from LK6 to 'I' and LK7 to 'I'.

The possible strapping options on the V.24 interface are as follows:

Strap	Function	Options
LK1	Request to Send	High, Normal, Low
LK2	Data Terminal Ready	High, Normal, Low
LK3	Clear to Send	High, Normal, Low
LK4	Data Set Ready	High, Normal, Low
LK5	Data Carrier Detect	High, Normal, Low
LK6	Receive Clock	Normal, Inverted
LK7	Transmit Clock	Normal, Inverted
LK8	Clock Speed Select	1.2 - 19.2 Kbit/s
LK9	On-board Clock pin 24	ON, OFF

The bit-rate at pin 24 can be set by LK8 as follows:

Bit-Rate	A	B	C	D
1.2	ON	ON	OFF	OFF
2.4	OFF	OFF	OFF	ON
3.6	ON	OFF	ON	OFF
4.8	OFF	OFF	ON	OFF
9.6	ON	OFF	OFF	ON
19.2	OFF	ON	OFF	OFF
38.4	ON	OFF	OFF	OFF
76.8	OFF	ON	ON	OFF
153.6	OFF	ON	ON	ON

3.11 V.24 AND V.54 COMBI INTERFACE T3679-405

The V.24 and V.54 Combi Interface has been designed to provide a standard V.24 interface with the addition of V.54 ("Loop test device for modems") which facilitate the local and remote testing of attached modems under software control using the extra signals as detailed in the V.54 Recommendation. In addition to the V.54 modem diagnostic control signals, the interface has the ability to be configured as either DTE or DCE. The change between DTE and DCE is effected by the simple removal, rotation and replacement of a 40-pin header plug with the status (DTE or DCE) being indicated by a front panel LED.

There are only four standard variables that can be changed on the physical module, namely:

The DTE/DCE header plug
The bit rate switch
The RTS to CTS delay in the DCE mode (2 links)

There are three front panel LEDs, "DI", "DO", and "DT". These LEDs indicate the following functions:

DI	Data being input to the module
DO	Data being output from the module
DT	Module is in DTE mode

The data connector is a 25-way "D" socket (IS 2110) which is configured by the DTE/DCE header plug to be a true DTE/DCE configuration as follows:

Pin	Circuit	Signal	DTE	DCE
1	101	Protective Ground	-	-
2	103	Tx Data	O	I
3	104	Rx Data	I	O
4	105	RTS	O	I
5	106	CTS	I	O
6	107	DSR	I	O
7	102	Signal Ground	-	-
8	109	LSD	I	O
15	114	Tx Clock	I	O
17	115	Rx Clock	O	I
18	141	Local LB	O	X
20	108	DTR	O	I
21	140	Remote LB	O	X
24	113	External Clock	O	I

0 = Output I = Input X = No Connection (open circuit)

The DTE/DCE configuration header is located on the printed circuit card and can be located easily. The header can be removed from its socket by gently levering it upwards at both ends with a small screwdriver.

The orientation of the header is determined by the DTE or DCE legend on the header itself.

The DT LED will be illuminated when the module is configured for DTE and be extinguished for DCE.

Although bit rates in excess of 19.2 Kbit/s are available from the clock circuit, the interface is not designed to work at speeds above this, in accordance with the CCITT V.24 Recommendation.

3.11.1 V.24 & V.54 Combi Strap Selection

There are a number of strap options available on this module. The only straps that are fitted as standard are LKJ and LKK; all other straps are made via printed circuit jumpers on the solder side of the PCB. If it is desired to use any of the options normally made by the printed circuit jumpers, then the relevant tracks should be cut and the new function strapped.

The LKJ strap (RTS/CTS delay selection jumper) is located below the DTE/DCE header. There are three delays that can be chosen (4 msec, 8 msec or 24 msec) and these are marked on the printed circuit board.

To enable the delay circuit, LKK (located to the right of the DCE/DTE header) should be in the D(elayed) position. If the delay circuit is not being used, then this link should be in the N(ormal) position.

LKA Selects the bit rate speed set as specified in section 3.12.1.1.

LKB Selects the bit rate speed set as specified in section 3.12.1.1.

LKC Allows the phase of the External Clock signal on pin 24 to be reversed

LKD Allows either the internal bit rate generator or pin 24 to be the clock source when in the DCE mode

LKE Allows the Rx Clock phase to be inverted from pin 17 when in the DTE mode

LKF Allows the Tx Clock phase to be inverted from pin 15 when in the DTE mode

LKG Allows the Rx Clock phase to be inverted on pin 17 when in the DCE mode

LKH Allows the Tx Clock phase to be inverted on pin 15 when in the DCE mode

LKJ Allows for a RTS/CTS delay of either 4, 8 or 24 mSecs when in the DCE mode

LKK Allows for a RTS/CTS delay in the DCE mode and for normal operation in the DTE mode.

Link Strap Options				
LINK	Function	PIN	MODE	OPTIONS
LKA	Bit Rate Divider	-	-	Table 3.12.1.1
LKB	Bit Rate Divider	-	-	Table 3.12.1.1
LKC	External Clock In	24	DCE	Invert, Normal
LKD	Clock Generation	24	DCE	Internal, External
LKE	Rx Clock	17	DTE	Invert, Normal
LKF	Tx Clock	15	DTE	Invert, Normal
LKG	Rx Clock	17	DTE	Invert, Normal
LKH	Tx Clock	15	DTE	Invert, Normal
LKJ	RTS-CTS Delay	-	DCE	4, 8 or 24 msec
LKK	RTS-CTS	-	-	Normal, Delayed

3.11.2 V.24 & V.54 Combi Bit-Rate Settings

The Combi interface uses a multi-frequency bit rate generator which is capable of a wide range of operating speeds. The bit rate of the interface is selected by the DIP slider switch which has eight positions. The normal set are:-

Speed	Position
1.2	3
2.4	4
4.8	5
9.6	6
14.4	1
19.2	7

However, links A and B may be used to select a different subset according to the following:

LKA	LKB	Selection
0	0	Opt3
0	1	Normal (factory setting)
1	0	Opt2
1	1	Opt1

Where the various options select subsets as follows:

Switch	Opt1	Opt2	Norm	Opt3
1	115.2	28.8	14.4	1.8
2	230.4	57.6	28.8	3.6
3	9.6	2.4	1.2	0.15
4	19.2	4.8	2.4	0.3
5	38.4	9.6	4.8	0.6
6	76.8	19.2	9.6	1.2
7	153.6	38.4	19.2	2.4
8	614.4	153.6	76.8	9.6

All rates in Kbit/s

3.12 X.27 INTERFACE (T3679-404)

The Tele-SWITCH X.27 interface is configured as DTE with the pin designations of the 37-pin panel-mounted plug as follows:

PIN	Signal
1	Shield
4	Send Data +
5	Send Timing +
6	Receive Data +
7	Request to Send +
8	Receive Timing +
9	Clear to Send +
11	Data Mode +
12	Terminal Ready +
13	Receiver Ready +
17	Terminal Timing +
19	Signal Ground
22	Send Data -
23	Send Timing -
24	Receive Data -
25	Request to Send -
26	Receive Timing -
27	Clear to Send -
29	Data Mode -
30	Terminal Ready -
31	Receiver Ready -
35	Terminal Timing -

Cont'd

This interface conforms to the requirements of :

X.27

X.26

V.10

V.11

RS-422

RS-423

3.12.1 X.27 Interface Strap Selection

The Tele-SWITCH X.27 interface is supplied with an on-board clock to provide a timing source when the DTE/DCE to which the Tele-SWITCH is connected cannot do so. This clock can also be installed on the Tele-SWITCH V.24 interface as an option if required.

The on-board clock can be set to various frequencies from 1200 bit/s to 153.6 Kbit/s by setting switch S1 for the X.27 and V.35 interfaces and strap LK8 for the V.24 interface. The frequency is set according to the following table:

Bit-Rate	A	B	C	D
1.2	ON	ON	OFF	OFF
2.4	OFF	OFF	OFF	ON
3.6	ON	OFF	ON	OFF
4.8	OFF	OFF	ON	OFF
9.6	ON	OFF	OFF	ON
19.2	OFF	ON	OFF	OFF
38.4	ON	OFF	OFF	OFF
76.8	OFF	ON	ON	OFF
153.6	OFF	ON	ON	ON

3.13 POWER SUPPLY 30 PORT UNIT (T3679-803)

The only user-configurable option on the power supply is the input voltage range.

In order to do so, first

UNPLUG THE DEVICE FROM THE AC POWER SOURCE!

Then remove the shroud covering the mains input terminals. The two leftmost terminals are marked on the PCB as "LINK FOR 115V" and, in order to convert from 240V to 115V, these two terminals must be linked together (for the opposite conversion, they must be unlinked).

Should the Tele-SWITCH be used in a country other than the country of origin, it is recommended that the entire AC power cord be replaced by a new cord, using the appropriate country's colour codes for the wires (where they differ from the country of origin).

Replace the mains terminal cover shroud and, if the AC power cord has been replaced, secure the cord to the PSU mounting panel.

The DC output from the SMM300 PSU is as follows (terminals being numbered from the left-hand side of the DC block):

1	+5V sense
2	+5V
3	+5V
4	0V
5	0V
6	0V
7	--
8	--
9	+12V
10	0V
11	0V
12	-12V
13	--
14	--
15	Power fail (to 0V on motherboard)
16	Power fail (to system reset on motherboard)

3.14 SIO MODULE (T3679-xxx)

The SIO Module is fitted with a Tri-Colour LED which shows RED when the module is not operational and GREEN when the module is in service.

3.14.1 SIO Module Strap Selection

The base address for the SIO module is wire wrapped on the rear of the J2 connector. This is normally installed at the factory.

	A5	A6	A7	A8
SIO No	Pin 6a	Pin 5c	Pin 5a	Pin 4c
1	X	X	X	X
2		X	X	X
3	X		X	X
4			X	X
5	X	X		X
6		X		X
7	X			X
8				X
9	X	X	X	
10		X	X	
11	X		X	
12			X	
13	X	X		
14		X		
15	X			

The address is strapped by wire wrapping the logic 0 as indicated by "X" in the above table to the 0 volt line on pin "2b". In addition the following pins should also be wire wrapped to the 0 volt line on pin "2b"

4a, 3c, 3a, 2c, 2a, 1c, 1a, 2b.

APPENDIX 1: CABLES

This Appendix lists the required pin connections for various cables. Although the information contained herein is as accurate as possible, the cables required in specific circumstances may vary and it is recommended that, if cables are made up, the pin connections should be confirmed with Telefile before use.

A1.1 V.24 LOOP TEST CABLE

The Tele-SWITCH V.24 Loop Test Connector is used for local interface testing of V.24 interfaces fitted with clock options. The speed of operation is set by the on-board clock speed straps as specified in Part II Section 3.10.1.

A1.1.1 Pin Connections

The following pins on the V.24 Loop Test Connector should be wired together.

PINS	FUNCTION
2, 3	Data
15, 17, 24	Clocks
4, 5, 8	Control
6, 20	Control

A1.2 V.24 Tele-SWITCH TO MODEM CABLE

The Tele-SWITCH to Modem Cable allows the Tele-SWITCH to be connected to most types of synchronous modems currently available. The clocks should normally be originated from the modem, although the cable allows for the provision of a DTE originated clock on pin 24. The speed of operation of the on-board clock is set by the speed select straps as specified in Part II Section 3.10.1.

A1.2.1 Pin Connections

MODEM					Tele-SWITCH
Pin No	I/O	EIA RS232	CCITT V24	Signal Name	Pin No
1	-	AA	101	Protective Ground	1
2	<	BA	103	Transmitted Data	2
3	>	BB	104	Received Data	3
4	<	CA	105	Request to Send	4
5	>	CB	106	Clear to Send	5
6	>	CC	107	Data Set Ready	6
7	-	AB	102	Signal Ground	7
8	>	CF	109	Signal Detect	8
15	>	DB	114	Transmit Clock	15
17	>	DD	115	Receive Clock	17
20	<	CD	108	Data Terminal Ready	20
24	<	DA	113	External Clock	24

A1.3 V.24 Tele-SWITCH TO V.24 Tele-SWITCH CABLE

The Tele-SWITCH V.24 to Tele-SWITCH V.24 Cable provides for the interconnection of two V.24 interfaces (with clocks) over short distances without the need for modems or external clock generators. The V.24 interfaces both supply clocks to each other; therefore the clocks on both interfaces should be set to the same speed. The speed of operation is set by the on-board clock speed straps as specified in Part II Section 3.10.1.

A1.3.1 Pin Connections

Tele-SWITCH Pin No	EIA RS232	CCITT V24	Signal Name	Tele-SWITCH Pin No
1	AA	101	Protective Ground	1
2	BA	103	Transmitted Data	3
3	BB	104	Received Data	2
4	CA	105	Request to Send	5
5	CB	106	Clear to Send	4
6	CC	107	Data Set Ready	20
	CF	109	Signal Detect	8
7	AB	102	Signal Ground	7
15	DB	114	Transmit Clock	17
24	DA	113	External Clock	
17	DD	115	Receive Clock	15
	DA	113	External Clock	24
20	CD	108	Data Terminal Ready	6
8	CF	109	Signal Detect	

A1.4 V.35 LOOP TEST CABLE

The Tele-SWITCH V.35 Loop Test Connector is used for local testing of V.35 interfaces. The speed of operation is set by the on-board clock speed straps as specified in Part II Section 3.9.1.

A1.4.1 Pin Connections

The V.35 Loop Test Connector should be wired as specified the following table:

PINS	FUNCTION
3, 17	Data +
4, 16	Data -
1, 2, 5	Clock +
14, 15, 18	Clock -
8, 10, 12, 20	Control

A1.5 V.35 Tele-SWITCH TO MODEM CABLE

The Tele-SWITCH V.35 to Modem Cable is used to interconnect the Tele-SWITCH V.35 interface to a V.35 Modem or Data Interface Unit. The clocks are normally provided by DCE interface although provision is made for the Tele-SWITCH V.35 interface to provide terminal timing. The terminal timing is provided by the on-board clock which is set as specified in Part II Section 3.9.1.

A1.5.1 Pin Connections

Tele-SWITCH				Modem
'D' plug pins	I/O	CCITT V35	Signal Name	IEEE-488
1	<	114	Send timing+	Y
2	>	113	Terminal Timing +	U
3	<	104	Receive Data -	T
4	>	103	Send Data +	P
5	<	115	Receive Timing +	V
7	-	102	Signal Ground	B
8	<	109	Data Carrier Detect	F
10	<	107	Data Set Ready	E
12	<	106	Clear to Send	D
14	<	114	Send Timing -	a
15	>	113	Terminal Timing -	W
16	<	104	Receive Data +	R
17	>	103	Send Data -	S
18	<	115	Receive Timing -	X
20	>	105	Request to Send	C
21	-	101	Protective Ground	A

A1.6 V.35 Tele-SWITCH TO Tele-SWITCH CABLE

The Tele-SWITCH V.35 to Tele-SWITCH V.35 Interface Cable allows the interconnection of two interfaces without the need for modems or external clock generators. The speed of operation is set by the clocks at each end of the cable; therefore both interface on-board clock speeds must be set to be equal. The speed of the on-board clocks should be set as specified in the Part II Section 3.9.1.

A1.6.1 Pin Connections

Tele-SWITCH 'D' plug pins	CCITT V35	Signal Name	Tele-SWITCH 'D' plug pins
3	104	Receive Data -	17
4	103	Send Data +	16
16	104	Receive Data +	4
17	103	Send Data -	3
21	101	Protective Ground	21
7	102	Signal Ground	7
1	114	Send timing +	5
2	113	Terminal Timing +	
14	114	Send Timing -	18
15	113	Terminal Timing -	
5	114	Send timing+	1
	113	Terminal Timing +	2
18	114	Send Timing -	14
	113	Terminal Timing -	15
8	109	Data Carrier Detect	
10	107	Data Set Ready	20
12	106	Clear to Send	
	105	Request to Send	8
20	107	Data Set Ready	10
	106	Clear to Send	12

A1.7 X.27 LOOP TEST CABLE

The Tele-SWITCH X.27 Loop Test Connector is used for local interface testing of the X.27 interface. The speed of operation is set by the on-board clock speed straps as specified in Part II section 3.12.1.

A1.7.1 Pin Connections

The X.27 Loop test connector should be wired as specified in the following table:

PINS	FUNCTION
4,6	Data +
22,24	Data -
7,9,11	Control +
25,27,29	Control -
12,13	Control +
30,31	Control -
5,8,17	Clocks +
23,26,35	Clocks -

A1.8 X.27 Tele-SWITCH TO D.T.U. CABLE

The X.27 Tele-SWITCH to Data Terminating Unit Cable allows the interconnection of a X.27 DTU with the X.27 Tele-SWITCH Interface. The clocks are normally provided by the DTU but provision has been made for the Tele-SWITCH X.27 interface to provide the terminal timing. The speed of the clock as provided by the on-board clock is strapped as specified in Part II Section 3.12.1.

A1.8.1 Pin Connections

Tele-SWITCH				D.T.U
Pin No	I/O	EIA RS-449	Signal Name	Pin No
1	-	...	Shield	1
4	>	SD+	Send Data +	4
5	<	ST+	Send Timing +	5
6	<	RD+	Receive Data +	6
7	>	RS+	Request to Send +	7
8	<	RT+	Receive Timing +	8
9	<	CS+	Clear to Send +	9
11	<	DM+	Data Mode +	11
12	>	TR+	Terminal Ready +	12
13	<	RR+	Receiver Ready +	13
17	>	TT+	Terminal Timing +	17
19	-	SG	Signal Ground	19
22	>	SD-	Send Data -	22
23	<	ST-	Send Timing -	23
24	<	RD-	Receive Data -	24
25	>	RS-	Request to Send -	25
26	<	RT-	Receive Timing -	26
27	<	CS-	Clear to Send -	27
29	<	DM-	Data Mode -	29
30	>	TR-	Terminal Ready -	30
31	<	RR-	Receiver Ready -	31
35	>	TT-	Terminal Timing -	35

A1.9 X.27 Tele-SWITCH TO Tele-SWITCH CABLE

The X.27 Tele-SWITCH to Tele-SWITCH Cable allows the interconnection of two interfaces without the need for Data Terminal Interface Units or external clock generators. The clocks are generated from each end; therefore the speed of the on-board clocks must be set equal. The speed of operation is set by the on-board clock speed select straps as specified in Part II Section 3.12.1.

A1.9.1 Pin Connections

Tele-SWITCH Pin No	EIA RS-449	Signal Name	Tele-SWITCH Pin No
4	SD+	Send Data +	6
6	RD+	Receive Data +	4
7	RS+	Request to Send +	9
9	CS+	Clear to Send +	7
11	DM+	Data Mode +	12
12	TR+	Terminal Ready +	11
22	SD-	Send Data -	24
24	RD-	Receive Data -	22
25	RS-	Request to Send -	27
27	CS-	Clear to Send -	25
29	DM-	Data Mode -	30
30	TR-	Terminal Ready -	29
19	SG	Signal Ground	19
1	...	Shield	1
5	ST+	Send Timing +	8
17	TT+	Terminal Timing +	
23	ST-	Send Timing -	26
35	TT-	Terminal Timing -	
26	RT-	Receive Timing -	23
	TT-	Terminal Timing -	35
8	RT+	Receive Timing +	17
	TT+	Terminal Timing +	5

A1.10 X.21 Tele-SWITCH TO DTU CABLE

The Tele-SWITCH to X.21 Data Terminating Unit Cable allows the connection of the Tele-SWITCH X.21 Interface to a standard Data Terminating Unit.

A1.10.1 Pin Connections

Tele-SWITCH				D.T.U.
Pin No	I/O	X.24	Signal Name	Pin No
1	-	G(a)	Protective Ground	1
2	>	T(a)	Send Data +	2
3	>	C(a)	Request to Send +	3
4	<	R(a)	Receive Data +	4
5	<	I(a)	Clear to Send +	5
6	<	S(a)	Signal Timing +	6
8	-	G(a)	Signal Ground	8
9	>	T(b)	Send Data -	9
10	>	C(b)	Request to Send -	10
11	<	R(b)	Receive data -	11
12	<	I(b)	Clear to Send -	12
13	<	S(b)	Signal Timing -	13

A1.11 V.54 LOOP TEST CABLE

The Tele-SWITCH V.54 Loop Test Connectors are used for local interface testing of V.54 interfaces. Two connectors are shown for both DTE and DCE interface configurations. The speed of operation is set by the on-board clock speed straps as specified in Part II Section 3.11.1.

A1.11.1 Pin Connections

The X.27 Loop test connector should be wired as specified in the following table:

DTE Mode

PINS	FUNCTION
2, 3	Data
24, 15, 17	Clocks
4, 5, 8	Control
2, 20	Control
18, 21	Control

DCE Mode

PINS	FUNCTION
2, 3	Data
4, 5, 8	Control
2, 20	Control

A1.12 V.54 Tele-SWITCH TO MODEM CABLE

The Tele-SWITCH V.54 to Modem cable is to allow the interconnection of the Tele-SWITCH V.54 interface to standard synchronous modems. The modem need not be to the V.54 specification if the Loop Diagnostic Features are not required. The clocks are normally provided from the modem although the clock may be derived from the Tele-SWITCH V.54 interface if required on pin 24 of the interface connector. The speed of the on-board clock may be set via the speed select switch as specified in Part II Section 3.11.1.

A1.12.1 Pin Connections

MODEM DCE					Tele-SWITCH DTE
Pin No	I/O	EIA RS-232	CCITT V.24	Signal Name	Pin No
1	-	AA	101	Protective Ground	1
2	<	BA	103	Transmitted Data	2
3	>	BB	104	Received Data	3
4	<	CA	105	Request to Send	4
5	>	CB	106	Clear to Send	5
6	>	CC	107	Data Set Ready	6
7	-	AB	102	Signal Ground	7
8	>	CF	109	Signal Detect	8
15	>	DB	114	Transmit Clock	15
17	>	DD	115	Receive Clock	17
18	>	--	141	Local Loop-Back	18
20	<	CD	108	Data Terminal Ready	20
21	<	--	140	Remote Loop-Back	21
24	<	DA	113	External Clock	24

A1.13 V.54 Tele-SWITCH TO V.54 Tele-SWITCH CABLE

The Tele-SWITCH V.54 to Tele-SWITCH V.54 Cable allows two interfaces to be interconnected without the need for modems or external clock generators. The interface that is set to be a DCE will provide the clocks for the interconnection. The speed of the on-board clock should be set via the clock speed select switch as specified in Part II Section 3.11.1.

A1.13.1 Pin Connections

Tele-SWITCH DTE Pin No	EIA RS232	CCITT V24	Signal Name	Tele-SWITCH DCE Pin No
1	AA	101	Protective Ground	1
2	BA	103	Transmitted Data	2
3	BB	104	Received Data	3
4	CA	105	Request to Send	4
5	CB	106	Clear to Send	5
6	CC	107	Data Set Ready	6
7	AB	102	Signal Ground	7
8	CF	109	Signal Detect	8
15	DB	114	Transmit Clock	15
17	DD	115	Receive Clock	17
20	CD	108	Data Terminal Ready	20

A1.14 V.54 Tele-SWITCH TO V.24 Tele-SWITCH CABLE

The Tele-SWITCH V.54 to Teleswitch V.24 Interface cable allows two interfaces to be interconnected without the need for modems or external clock generators. The clocks are provided by the Tele-SWITCH V.54 interface which should be set as DCE. The clock speed is set via the on-board clock speed switch as specified in Part II Section 3.11.1

A1.14.1 Pin Connections

Tele-SWITCH V.24 DTE				Tele-SWITCH V.54 DCE
Pin No	EIA RS-232	CCITT V.24	Signal Name	Pin No
1	AA	101	Protective Ground	1
2	BA	103	Transmitted Data	2
3	BB	104	Received Data	3
4	CA	105	Request to Send	4
5	CB	106	Clear to Send	5
6	CC	107	Data Set Ready	6
7	AB	102	Signal Ground	7
8	CF	109	Signal Detect	8
15	DB	114	Transmit Clock	15
17	DD	115	Receive Clock	17
20	CD	108	Data Terminal Ready	20
24	DA	113	External Clock	24

A1.15 Tele-SWITCH CIU TO CIU CABLE (T3679-9011)

The Tele-SWITCH CIU to Tele-SWITCH CIU cable is provided to interlink two Tele-SWITCH units via a high speed interface.

A1.15.1 Pin Connections

The cable is supplied ready assembled by Telefile. This cable should not be altered in any way. Should the cable become damaged or defective in any manner, then a replacement cable assembly should be obtained from Telefile.

THIS CABLE IS NOT A STANDARD RIBBON CABLE

PART III: SOFTWARE

1. INTRODUCTION

A major advantage of the Tele-SWITCH is the flexibility available to the user. There is a wide range of commands that can be accessed by a suitably authorised user. These commands are accessible from anywhere in the network (subject, as already mentioned, to an appropriate level of security) and hence there is no need for operator intervention at each site (which would be completely impracticable in a large network).

This Part of the Manual discusses the basic concepts of the software and gives detailed information on each command.

2. BASIC CONCEPTS

In order to understand each command, it is first necessary to understand the organisation of the Tele-SWITCH and the facilities provided.

As with the OSI Model (which the Tele-SWITCH closely follows), the Tele-SWITCH is layered. At the lowest level (the Physical Layer), there is the physical link to the communications medium, implemented by means of SIO or DIO cards. The actual interfaces are described in some detail in the Hardware part of this Manual.

Fig 2.1 shows the data structure of the Tele-SWITCH

The Tele-SWITCH "Controller Level" corresponds approximately to the OSI Data-Link Layer. Similarly, the Tele-SWITCH "Channel Level" corresponds to the OSI Network Level.

It is helpful to consider the Tele-SWITCH in terms of an "onion-skin" architecture and a diagram of this was shown in Fig 2.0

The Controller Level is shown as being implemented for X.25 and MUXPORT only. However, these two controllers are very similar (differing only in a few parameters) and hence additional controllers can be added fairly simply.

Each controller can control a number of different logical channels (which are assigned names) and communication can take place between logical channels, irrespective of the controller to which they are attached. Channel names are not unique and it is convenient for similar resources (e.g. a "hunting group") to have the same name. Connection takes place between these logical names (which are mapped to hardware or protocol addresses as appropriate).

For convenience, names may also be allocated to the Controller Level and hence the user may refer to any Tele-SWITCH resource in terms of its name, without any necessity to understand the underlying structure.

The key to accessing the Tele-SWITCH facilities is the "Virtual Control Port" and this is now discussed.

2.1 THE VIRTUAL CONTROL PORT

In early communications equipment, access to the control software was often provided by a "systems console" attached to a particular hardware port. In order to change configuration parameters or to obtain network information for control purposes, it was necessary to access this particular port. Originally this was achieved by means of a terminal being directly connected (which has considerable advantages in terms of security) but, as networks grew in size, such a port was often connected to a modem so that it could be accessed remotely.

Since a network provides communications paths, the logical development is to use the network to provide access to this control port and this leads to the concept of a "virtual control port" (VCP). Thus the control port appears (subject to security controls) exactly as any other network resource. One way in which security can be enforced is for the name of the VCP is for its name not to be published. In addition, it would be protected by the usual password/privilege level mechanisms (with a high privilege level).

There is, of course, physical access to the VCP. On the main processor card of the Tele-SWITCH there are two asynchronous ports which allow local access to the VCP.

There is only one set of circumstances in which there is a need to access a physical port and this is in the case of network failure. In such a case (almost irrespective of the severity of the problem), network integrity cannot be guaranteed and so a network dump is directed to a specified physical port (the top one of the two just mentioned).

The commands are split into a number of sets and commands are provided for moving between the sets. These sets are the base set, link configuration and channel configuration. The command sets and the methods for moving between them are described in the next section; this is followed by a description of each command, one to a page (for quick reference).

Each command is up to four characters long, together with any necessary parameters. At any stage, typing a '?' gives context-dependent help.

3. THE COMMAND SYSTEM

In order to obtain access to the command system, the user connects to the virtual control port (by typing the four-character resource name - default "BE00").

The machine will respond with the prompt "BASE:" indicating that access is now available to the base set of commands, as follows:

EXAM	Examine configuration parameters or values in memory file record.
CONF	Configure parameters or configure memory file record.
STAT	Provide statistics and diagnostic information
COPY	Enter copy mode, and mark the logical channel from which the parameters will be copied.
REST	Restart channel or controller, reloading the configuration parmeters.
BOOT	Boot the system.
QUIT	Exit (disconnect) from the virtual control port.
TIME	Configure the time.
MEM	Configure the size of configuration memory, and the sizes of the memory files.
PASS	Access the password file.
BILL	Access the billing file.
MENU	Access the menu file.
NAME	Access the service name file
X25	Access the X.25 address routing file.
LIST	Provide listing format information on configuration parameters, or memory file.
POLL	Provide single line of statistics information for controller or logical channel.
DELE	Delete memory file record or reset statistics of controller or channel.
DISK p	Perform disk operation where p is command and parameter list.
XXXX	Access controller or channel by direct name.
>	Move forward through controllers, channels or records.
<	Move backwards through controllers, channels or records
ALL	Automatic move forward from current position to end of controllers or channels or memory file with repeated command execution.
\	Flip-flop between controller and channel levels.
/	Repeat command.
+	Concatenate parameter entries.
ESC	Escape from current operation.
BS	Erase character or go to previous configuration parameter.

Each network resource (e.g. controller or logical channel) is controlled by a named "context block" which contains the necessary control information (e.g. relevant parameters, status information, statistics). In practice (and transparent to the user), the configuration parameters are held in battery-backed RAM whereas the remaining information is held in ordinary (volatile) RAM. Context blocks are also set up for "memory files" such as the password file, the billing file, the menu file and the X.25 routing file.

The names of the context blocks serve two purposes: the first is ease of reference for diagnostic and configuration purposes; the second is, at the transport level, to identify channels and to map out the network topology as

described later. Names will frequently be duplicated, as on trunk lines or in "hunt" groups.

At each stage, the prompt will be the name of the context block to which the user currently has access. The first context block at the controller level is "BASE" with a Logical Channel Name of "BE00".

There is another pre-defined Link Controller, named "EPCI" or "enhanced Peripheral Controller Interface". It has two associated logical channels EI00 and EI01. The former is a preconfigured permanent virtual circuit which provides access to all resources. EI01 is hardware configured and is primarily used for connection to a printer. Reports and statistics can also be sent to these ports.

There are two ways in which a user can move between context blocks (Fig 3.1). The first is by giving the actual name of the block, followed by carriage return (controller names should be kept unique; channel names will frequently be duplicated in groups: at the channel level, the name in the prompt must be followed by the relevant channel number to enable the item in a group to be distinguished).

The second method of moving between context blocks is sequentially by means of the commands ">", "<" and "/".

The ">" command moves forward across the controller level, or across the channels attached to a particular controller. The "<" command is identical except that it moves backwards. The "/" command changes levels between a controller and the first of its channels or from a channel to its controller. In addition, the command "ALL" automatically moves forward from the current position to the end of the controllers or channels or memory file (Fig 3.2), repeating the current command (i.e. equivalent to repeating the ">" command).

Once a command has been given, it remains active until another command is given (or the ESC key is pressed or the RETURN key is pressed twice). That is, if a command is issued and the user moves to another context block, the command is re-issued automatically by the system for that context block.

For consistency to the user, the memory files are accessed in exactly the same way. Currently defined memory files are:

BILL	Billing file
MENU	Menu file
PASS	Password file
X.25	X.25 routing file
NAME	Resource mapping
HELP	Help file
NEWS	(not yet implemented)

The next Section gives details of the commands described above. Where necessary, an example is used. This example consists of a Tele-SWITCH with six Controllers, each of which has one or more logical channels under its control. This can be demonstrated in the following table:

Controller	Logical Channel(s)
BASE	BE00
EPCI	E100 E101
PS01	P100 P101 P102 P103
PS02	P200 P201
MUX1	M100 M101
MUX2	M200 M201 M202

There is one important point to note in the above table, namely the mnemonic character of the names. Thus the first X.25 channel is known as PS01 (for "packet switch") and the second as "PS02". The former's channels are known as P1xx and the latter's as P2xx. A similar scheme is implemented with the multiplexor controllers and so, from examining the controller or channel names, it is possible to deduce an appreciable amount of information.

4. COMMANDS

This Section lists all the available commands, in alphabetical order (with non-alphabetic commands given first in ASCII collating sequence). Each command occupies a separate page for easy reference (and updating). The general format is the name of the command, the syntax for its use (where this is other than merely giving the command), a brief description of its functions (exactly as given in the HELP file) then, where necessary, a longer description of the functions.

Please note that all commands must be issued in upper case. Use of lower case or input of an illegal command will give the message:

ERROR 'xxxx'

where 'xxxx' is the command in error.

Environment: **All** Command: **BS**

Syntax: **BS**

Function: Erase character or go to previous configuration parameter

Description: The backspace key (ctrl-H) is used in the conventional manner, namely to erase the last character input. Where a number of parameters are being input (e.g. when using the TIME or CONF commands), the BS key can be used to return to the previous parameter when at the beginning of a line (i.e. it treats all the user's input as a single line).

Environment: **All** Command: **CR**

Syntax: **CR**

Function: Go to next configuration parameter or return to BASE

Description: The carriage-return key (ctrl-M) is used to return to BASE when at the channel or controller level. In addition, where a number of parameters are being input (e.g. when using the TIME or CONF commands), the CR key can be used to skip over the next parameter. Thus, in order to skip all remaining parameters and return to BASE, the CR key should be hit repeatedly.

Environment: **All** Command: **ESC**

Syntax: **ESC**

Function: Escape from current operation

Description: There are a number of functions performed by the ESC key. In general, it is used to escape from the operation currently being performed.

As stated earlier, the current command is repeated on moving from one context block to another. In order to deactivate the command, the ESC key should be pressed. This has the additional function of returning the environment to BASE.

When configuring a context block, the ESC key returns either to channel or controller level. Using the key a second time has the above effect.

Environment: **All** Command: **+**

Syntax: **+**

Function: To concatenate parameters

Description: This command is used when configuring the Tele-SWITCH in order to concatenate parameters. The various configuration parameters are discussed in the next few sections. It can be seen that there are a number of cases where the parameters are not exclusive and so the different parameter values are concatenated by use of the "+" operator.

Environment: **BASE** Command: /

Syntax: /

Function: Repeat command

Description: Use of the "/" command is identical to repeating the previous command.

Environment: **All** Command: <

Syntax: <

Function: Move backward through controllers, channels or records

Description: This command allows the user to move from one context block to another (or, in the case of memory files, from one record to another). The command is extremely useful in repeating the same command throughout a number of context blocks. The required command should be given (when it will have effect on the current context block), then the "<" command given. This will move to the previous context block and repeat the required command.

The command is identical to the ">" command except for the direction of the move.

Environment: **All** Command: **>**

Syntax: **>**

Function: Move forward through controllers, channels or records

Description: This command allows the user to move from one context block to another (or, in the case of memory files, from one record to another). The command is extremely useful in repeating the same command throughout a number of context blocks. The required command should be given (when it will have effect on the current context block), then the ">" command given. This will move to the next context block and repeat the required command.

This command is identical to the "<" command except for the direction of the move.

Environment: **All** Command: **?**

Syntax: **?**

Function: Provide help information

Description: Pressing the "?" key gives context-dependent help information. It only lists the inputs permissible in response to the current prompt.

Environment: **BASE** Command: \

Syntax: \

Function: Flip between controller and channel levels

Description: This command allows the user to move between the controller and channel levels, as required. Thus, in the quoted example, if the current context block were PS01, use of the "\" command would move to P100, then use a second time would move back to PS01.

Environment: **All** Command: **ALL**

Syntax: **ALL**

Function: To move forward from current position to end of controllers or channels or memory file with repeated command execution.

Description: It is often convenient to repeat the same command a number of times (e.g. the COPY command). The ALL command permits this simply. Thus, in the specified example, it were necessary to set the parameters for all the logical channels of the form P1xx, the first one (P100) should be configured (see CONF command), then the ALL command issued. This will copy that configuration across all context blocks within the group (i.e. P101, P102 and P103).

The command is equivalent to the repeated use of the ">" command.

Environment: **BASE** Command: **BILL**

Syntax: **BILL**

Function: Access the billing file

Description: Memory files are treated in the same way, as far as possible, as context blocks and this command gives access to the billing file in the same way as giving the context block name (or using the various commands to move about context blocks) gives access to such a block. Commands such as LIST then operate on the billing records. The change of context and the command can be given together, for example:

BILL LIST ALL

will list all the records in the billing file. The format of the records in the billing file is:

<seq> <password> <time> <source> <dest> <traffic>

where

<seq> is an eight-bit rotating sequence number, used by the Network Management System to detect missing or duplicated records.

<password> is the eight-character password used to access the network. If password control was not enabled, this field will be displayed as "....."

<time> is the hour and minute at which the call was connected (in the form "hh:mm") followed by the connect time ("mm/ss") with the seconds rounded down to the nearest five seconds.

<source> is the caller's address. If the incoming channel is an X.25 channel and is not a PVC then if the incoming packet contained a caller's address, this is displayed. If the outgoing channel was an X.25 channel and the Tele-SWITCH supplied a caller's address (the "-" routing option in the X.25 file), then whether the incoming caller was an X.25 channel or not (even if it were a PVC), the generated X.25 caller's address is displayed.

In all other cases, the controller level name is displayed.

For an X.25 address, the format is one leading zero, followed by the address, padded out to 16 characters with zeros. For other addresses, the format is the four-character controller name, followed by four spaces.

<dest> is the called address. If an X.25 address was used to specify the destination, then this is displayed here. Otherwise, the controller level name of the destination resource is

displayed. If address translation is used, the original X.25 destination address is displayed.

<traffic> consists of four separate fields - the total number of packets or frames received, the total number of packets or frames transmitted, the total number of characters received and the total number of characters transmitted.

Environment: **BASE** Command: **BOOT** System

Syntax: **BOOT**

Function: To re-boot the system

Description: This command re-boots the entire Tele-SWITCH and clears all calls in progress. There may be two reasons for using this command. The first is to re-initialise the Tele-SWITCH, using new parameters that have been input (N.B. changing parameters does not take effect until the controller or channel is restarted). The second is in the case of malfunction of the Tele-SWITCH (as in re-booting a computer).

Because the command resets the entire Tele-SWITCH, it should only be used as a last resort and, wherever possible, the RESTart command should be used instead.

Environment: **All** Command: **CONF**igure

Syntax: **CONF**

Function: Configure parameters or configure memory file record

Description: This command allows the configuration parameters of a controller, channel or memory file to be changed. The user selects the appropriate context block, then types the "CONFigure" command, whereupon the possible parameters are listed, one at a time, and the user has the option of changing each. The various parameters that are available to be changed are listed in the subsequent sections of this Manual.

The user may escape from the configure operation by pressing the ESC key.

NOTE The modified configuration parameters do not take effect until the relevant controller is restarted or the Tele-SWITCH is re-booted (see the RESTart and BOOT commands).

Environment: **All** Command: **COPY**

Syntax: **COPY**

Function: Enter COPY mode and mark the logical channel from which the parameters will be copied

Description: It is often required to replicate the same configuration information from one channel in a group to the remainder of that group. The COPY command allows this to be done simply. First, configure the first channel in the group (using the CONFigure command) or, if it has already been configured, give its name. Then enter:

COPY <return>

Followed by the ">" command, once for each copy required.

Alternatively, the command:

COPY ALL <return>

will copy the current configuration across all channels to the end of the channel list.

Environment: **BASE** Command: **DELEte**

Syntax: **DELE**

Function: Delete memory file record or reset statistics of controller or channel

Description: In the case of a memory file, the user should access the appropriate record, then issue the DELEte command (which deletes the record).

In the case of a context block, the same command is used to reset the statistics (which can then be viewed via the POLL command).

Environment: **BASE** Command: **DISK**

Syntax: **DISK command ; drive ; parameters**

Function: Perform disk operation.

Description: Optionally, a Tele-SWITCH may have up to four floppy disk drives installed. These are detected by the firmware when the system is powered up. They have a number of uses, mainly consisting of backing-up the battery-backed RAM.

The system manager can save copies of configurations from RAM to floppy disk(s), either for security reasons or in order to save alternate configurations which can later be restored. Also various diagnostic programs may be saved on floppy disk.

When the Tele-SWITCH is powered up, if it detects a fault in RAM (e.g. parity error), it attempts to read the configuration from the floppy disk(s), trying each in turn until a valid configuration is obtained. If this fails, a default configuration is used.

The DISK command is used to give access to the floppy disk drives (numbered 0 to 3). The following commands are permitted, with the <parameters> as described (separated by semi-colons):

Command	Description
I	Initialise disk. One parameter, a text field (up to 56 characters long) which is written as the header label. Initialisation is not permitted if the disk already has a valid header label without the consent of the operator. Disks can only be initialised when the system is in the ABORT state.
S	Save a configuration. One parameter, a text field which is written as the header label. If the disk already has a valid header label, the operator is asked to confirm whether to proceed. SAVE can be performed during normal network operation.
R	Restore a configuration from floppy disk. No parameters. The firmware checks whether a configuration has been saved to the disk and that the disk has a valid header label. After the RESTORE has been performed, a system restart is forced. This operation can be performed while the network is operational (although all virtual circuits through the node will be cleared when the system restart takes place).
D	Dump memory contents to disk. Three parameters, the first is the buffer address (hex), the second is the number of bytes to dump (hex) and the third is text to be written

as the header label. The firmware checks whether the disk already has a valid header label containing a SAVE or DUMP. If not, the dump proceeds; if so, a warning message is displayed and the operator is asked to confirm whether he wants to continue. A DUMP can be performed while the network is operational.

L Load a program from disk. One parameter, the address at which the program is to be loaded. The firmware checks that the specified disk contains a DUMP.

E Examine sectors on a disk. One parameter, the sector number (in decimal). The sector is displayed in both hexadecimal and alphanumeric format. In order to display contiguous sectors, the normal ">" and "<" commands may be used to step through sectors forwards and backwards respectively.

C Copy disk. One parameter, the destination drive (0- 3). Note that the <drive> field is the source drive. The destination disk is checked for the presence of valid information, such as a SAVE or DUMP file. If this exists, the header sector is displayed and the operator asked to confirm whether to continue. If so (or if the destination disk did not contain valid data), the copy takes place, track by track.

P Print (display) disk header sectors. No parameters. The format of the display includes the original label used when the file was created or when the disk was initialised. The disk status field (INIT, SAVE or DUMP) is also displayed.

Environment: **BASE** Command: **EXAMine**

Syntax: **EXAM**

Function: Examine configuration parameters or values in memory file record

Description There are two versions of this command, the first allowing the user to examine configuration parameters, the second allowing access to memory files (see above).

At the BASE level, the following information is given:

NODE IDENTIFIER/ Telefile Tele-SWITCH IXP

RELEASE VERSION/ B03

RELEASE DATE/ 03/87

REPORTS/ EI00

SESSION STATISTICS / EI00

BUFFER THRESHOLD/ 0

Note that a node identifier field now exists. The node identification field is a 24-character alphanumeric string. The one show above is the default but this may be changed by the user.

The version number consists of three characters. The first one is a letter, indicating the major release. The second and third are digits, indicating the minor release number. In addition, a "release date" field is included (month/year). Needless to say, the version number and release date fields are not alterable by the user.

Environment: **BASE** Command: **LIST**

Syntax: **LIST**

Function: Provide listing format information on configuration parameters or memory file

Description: For a memory file, this command lists the entries within that file (subject, of course, to appropriate security privileges). In the case of context blocks, the command lists the configuration parameters.

Environment: **BASE** Command: **MEMory**

Syntax: **MEM**

Function: To set the size of configuration memory and the sizes of the memory files

Description: This command allows the size of configuration memory to be set.

The memory required is calculated as described in section 5.6

The command is used in the following way (where "nnnnn" is the current memory size and "mmmmm" is the new memory size required):

User:	MEM
Display:	MEM: RESET/N
User:	Y<CR>
Display:	MEM: SIZE/nnnnn
User:	mmmmm
Display:	BASE

NOTE The new memory size does not take effect until the next time the Tele-SWITCH is re-booted (see the BOOT command) and that, when implemented, the configuration of the Tele-SWITCH will be deleted).

Environment: **BASE** Command: **MENU**

Syntax: **MENU**

Function: Access the menu file

Description: Memory files are treated in the same way, as far as possible, as context blocks and this command gives access to the menu file in the same way as giving the context block name (or using the various commands to move about context blocks) gives access to such a block. Commands such as LIST then operate on the menu records.

Environment: **BASE** Command: **PASS**

Syntax: **PASS**

Function: Access the password file

Description: Memory files are treated in the same way, as far as possible, as context blocks and this command gives access to the password file in the same way as giving the context block name (or using the various commands to move about context blocks) gives access to such a block. Commands such as LIST then operate on the password records.

If the user does not have sufficiently high privileges, then commands such as LIST do not operate. The user can revert to BASE by hitting the RETURN key.

Environment: **BASE** Command: **POLL**

Syntax: **POLL**

Function: Provide single line of statistics information for controller or logical channel

Description: The user selects a context block, then issues the POLL command, whereupon a single line of statistics is given.

Environment: **BASE** Command: **QUIT**

Syntax: **QUIT**

Function: Disconnect from the virtual control port

Description: The terminal is disconnected from the Virtual Control Port and the user is returned to the "ready" prompt. In order to reconnect to the VCP, its four-character resource name (default "BE00") should be typed.

Environment: **BASE** Command: **REST**art link

Syntax: **REST**

Function: Restart channel or controller, reloading the configuration parameters

Description: This command resets a controller, but not all the other controllers in the Tele-SWITCH. Thus the command should be used when parameters for one or more logical channels on a controller have been changed and it is required for these to take effect. The effect of this command is local to a controller and should be used in preference to the BOOT command which performs the same function for all controllers simultaneously.

Environment: **All** Command: **STAT**istics

Syntax: **STAT**

Function: Provide statistics and diagnostic information

Description: The STAT command is used to give statistics or diagnostic information about a context block. The statistics shown depend on the current context.

The available statistics are detailed in Section 9.

Environment: **BASE** Command: **TIME**

Syntax: **TIME**

Function: To set the date and time

Description: This command allows the date and time of the local node to be set. The command is issued and the time and date are entered, one field at a time starting with the seconds field. Thus to set the date and time to 25 April 1987, 17:05:00, the following is the sequence of commands:

User: TIME<CR>

Display: TIME: SECONDS/XX

User: 00<CR>

Display: TIME: MINUTES/XX

User: 05<CR>

Display: TIME: HOURS/XX

User: 17<CR>

Display: TIME: DAY/XX

User: 25<CR>

Display: TIME: MONTH/XX

User: 4<CR>

Display: TIME: YEAR/XX

User: 87<CR>

Environment: **BASE** Command: **X25**

Syntax: **X25**

Function: Access the X.25 address routing file

Description: Memory files are treated in the same way, as far as possible, as context blocks and this command gives access to the X.25 routing file in the same way as giving the context block name (or using the various commands to move about context blocks) gives access to such a block. Commands such as LIST then operate on the X.25 routing records.

Environment: **All** Command: **resource name**

Syntax: **resource name**

Function: Access controller or channel by direct name

Description: There are two ways to move through context blocks. The first is the indirect method, using commands such as "<" and ">" in which case the channels or controllers are stepped through, one at a time. Alternatively, the context block can be accessed directly by specifying its name. It should be noted that the "current" command, if active, will operate on the newly selected context block.

5. CONFIGURATION PARAMETERS

The Tele-SWITCH allows a wide variety of options to be configured. This Section discusses the configurable options and describes the valid parameters for each.

In nearly every case (with the exception of a few parameters such as TIME), the Tele-SWITCH is configured by moving to the appropriate context block (by any of the means previously outlined), then issuing the CONFigure command.

The possible options are then listed, one at a time, and the user given the choice of leaving them unaltered (by typing RETURN) or altering them. Typing a "?" will give the range of valid parameters (e.g. "DECIMAL 0 - 8").

The possible parameters that may be configured fall into a number of groups. First, there are those at BASE level. Secondly, there are those at link level. Thirdly, there are those at controller level. Finally, there are global parameters such as time.

All are described below. For convenience, the first and the fourth are combined.

5.1 BASE CONFIGURATION PARAMETERS

At the BASE level, a number of items may be configured and these are described in the remainder of this Section. In addition, commands other than the "CONF" command may be used to configure various aspects of the BASE level of the Tele-SWITCH and these are also discussed.

5.1.1 Version

This consists of a three character field, the first (alphabetic) character denoting the major revision level and the second and third (numeric) characters denoting the minor revision level. This parameter cannot be changed by the user.

5.1.2 Reports

This is a Channel Level name (i.e. four characters) and denotes the name of the resource to which diagnostic reports are directed. Changes to this field are only effective after a BOOT or reset.

5.1.3 Session Statistics

This is a Channel Level name (i.e. four characters) and denotes the name of the resource to which session statistics reports are directed. Changes to this field are only effective after a BOOT or reset.

5.1.4 Buffer Threshold

This parameter may take the values 5-1000 (decimal)

5.2 BILLING TABLES

The billing file is stored in battery-backed RAM. It is NOT, however, included in the list of files saved and restored on disk when disk operations take place (since they are transient and not part of the configuration).

The size of the billing file is specified by means of the MEM command which gives the prompt:

NUMBER OF BILLING RECORDS REQUIRED/

Each entry in the billing file occupies 48 bytes (and its format is described under the BILL command in the previous Section).

It must be emphasised that the billing file is a transient, memory file and is not intended for permanent storage. Nevertheless, the size of the file is likely to be fairly large as it may be required to store a substantial number of billing records, depending on the usage of the Tele-SWITCH and the rate at which the Network Management System polls the billing file.

5.3 MEMORY ALLOCATION

The main memory of the Tele-SWITCH is organised into two sections:-

1. Configuration memory
2. Dynamic memory

Configuration memory is backed-up by battery. It holds the basic characteristics of the controllers (links) and channels which are used to build a data structure in variable memory whenever the system is restarted. Configuration memory also holds the X25, PASS, MENU and BILL files. Of the files, BILL is the only one which is not saved on floppy disk in systems with a floppy disk controller installed.

Configuration Memory cannot exceed 64 Kbytes.

The Dynamic Memory contains the Context Tables and buffers used at run-time (the Context Tables hold dynamic information about the links and the logical channels). The Dynamic Memory is initialised each time the Tele-SWITCH is powered on or reset.

In systems without a mass memory board installed, variable memory occupies that portion of the battery-backed memory boards which is left over after the configuration space has been extracted. In systems with a mass memory board, all variable memory (apart from a few stacks) is situated on the mass memory board.

The minimum memory size required for the Configuration Memory depends on the maximum permitted number of various items. It is given by the formula (Release B03):

CMS = 1538	+ (NCC+3)*52 + (BILL*48) + (HELP*1024) + (MENU*256) + (PASS*18) + (NAME*18) + (X25*54)

where

NCC	Number of different channel configurations
BILL	Maximum number of billing records
HELP	Maximum number of help screens
MENU	Maximum number of menus
PASS	Maximum number of passwords
NAME	Maximum number of service names
X25	Maximum number of entries in routine table

The size of the Configuration Memory required is specified by means of the MEM command. As stated above, it cannot exceed 62 K (63488 bytes).

The amount of space required for the Dynamic Memory is given by (Release B03):

DMS = 10058	+ (LX*912) + (LM*958) + (CX*182) + (CM*190) + (B*S*152)

where

LX	Number of X.25 links
LM	Number of MUXPORT links
CX	Number of X.25 logical channels
CM	Number of MUXPORT logical channels
B	Number of buffers (must be approximately equal to (CM+CX)/2 for optimum performance)
S	1 if buffer size is 128 bytes 2 if buffer size is 256 bytes

5.4 INFORMATION SCREENS

The Tele-SWITCH provides a number of screens that are handled internally in similar ways, although they appear rather differently to the user. There are three such screens, "menu screens", "help screens" and "news screens". The last of these is not implemented at present.

In each case, the screen is handled in the same way as other network resources in that it is given a name and the network manager may alter its contents using the commands described above.

The specific functions of the various screens is described below.

5.4.1 Menu Screens

As the name implies, these screens are intended to be shown to the user to allow him to make a choice of function. If a menu is defined for a channel during the configuration process, that menu is shown to the user of the channel if the Tele-SWITCH receives an address that it cannot find in the routing table.

There is one special menu function. Menu 0 is used for prompting for passwords (the actual text on the menu screen is defined during the configuration process). When an incoming call is received, the Tele-SWITCH checks whether password checking has been enabled for that channel. If so, Menu 0 is displayed and the user must enter the password. This is then checked against the password file and, if found, the user is allowed to proceed (the password file specifies the DRC mask and routing is performed as described in Section 5.6).

5.4.2 Help Screens

As the name implies, the help screen gives on-screen help to a user. One such screen can be defined per incoming logical channel and this is displayed to the user on that channel. As in the case of the Menu screens, Help screens can be amended during the configuration process by the commands detailed in Section 4.

As with Menu screens, Help screen 0 has a special purpose. If service names have been used (see Section 5.5), Help screen 0 is displayed if an illegal name is specified by an incoming call.

5.4.3 News Screens

The purpose of these screens is to give information to specified users. The facility is not implemented in the current release.

5.5 NAME TABLES

This is a facility to enable a service name to be assigned to any network resource. The appropriate tables are set up by use of the CONFigure command:

NAME CONF

whereupon the user is prompted for various parameters, including the name, the DRC mask, the call priority, whether billing is enabled and whether password checking is enabled e.g.:

> NAME/ MANAGER DRC MASK/ BE00 CALL PRIORITY/ 0 BILLING/ D PASSWORD/ D

The user is then able to specify a name which is then translated into the appropriate resource identifier (provided the NAME option has been configured). If an illegal name is given, then Help screen 0 is displayed.

5.6 PASSWORD TABLES

The password file is stored in battery-backed RAM and is saved to floppy disk when security dumps are taken.

The size of the password file is configured by means of the MEMory command. This command has a number of parameters, one of which is the number of password entries required in the password file. The prompt given by the MEMory command is:

NUMBER OF PASSWORDS REQUIRED/

and the appropriate number should be input. Each entry in the password file requires 18 bytes of memory.

The password file can be accessed by the usual commands such as CONFigure, LIST, EXAM, >, <, DELE, ALL. When stepping through the password file, the prompt is PASS(n) where "n" is the number of the record.

Each record in the password file consists of five fields (which can be accessed by means of the CONFigure command). These fields, their types and meanings are as follows:

PASSWORD	0-8 characters Used for locating entries in the password file and remembered for possible insertion into billing records
DRC MASK	4 characters This determines the user's routing access. If the mask is set up (e.g. to "ICLC"), then only that resource may be accessed. If restricted access is required, the mask may have some characters specified (e.g. "...L" meaning that the user can only access resources ending with "L"). "...." gives the user completely unrestricted access.
CALL PRIORITY	0-15 (decimal)

This is set into the caller's call priority field and he is limited to resources at a priority or privilege level equal to or less than his own.

MENU NUMBER 0-32 (decimal)

This defines the menu to which the user has access (zero meaning no menu).

BILLING E/D

If set to "E" (enabled), then a billing record will be written to the billing file at the end of each session (i.e. whenever the virtual circuit is broken).

In order to install password control for a given access channel, it is necessary to configure the OPTIONS parameter for the specified channel to include the PASS option. For channels with this option configured, the mode of operation is as follows:

1. If a call packet is received which can be routed automatically, then a virtual circuit is set-up as normally and password control is bypassed. This can be overridden with the "GATE" option which can be applied to the receiving resource and which has the following effect:

   1.1 Connection of the virtual circuit is prepared, but not set up. The call packet is retained for further use.

   1.2 The user is prompted for his password (as below) and the DRC mask in the password record is checked against the required route. The connection is refused if an illegal access is attempted.

2. For channels which are not X.25 or for which the X.25 call cannot be routed (in which case, the user is assumed to require to converse with the gateway), then the caller is prompted for his password by means of menu number zero (MENU(0)). He then types the password (which is not echoed), terminated by carriage return. Only the first eight characters typed are echoed. This password is then checked against the password memory file. If no match is found, then the user is simply prompted again and so on until the time-out period expires, at which point the user is disconnected.

5.7 TIME

The user may configure the current time and date. The procedure for doing this is specified under the "TIME" command in Section 4.26.

5.8 X.25 ADDRESS TABLE

The X.25 Address Routing File is stored in battery-backed RAM and is saved to floppy disk when the appropriate commands are given, whence it can be restored.

The number of entries in the X.25 Address Routing File is specified by means of the MEMory command, in response to the prompt:

NUMBER OF X.25 ADDRESSES REQUIRED/

The X.25 Address File is access simply by specifying "X25" as the context name. The prompt given is then "X25 (0)", indicating that the user is at the first record of the file. The usual commands, such as DELE, LIST, EXAM, CONF etc. may be given.

Each record in the file has four fields as follows:

NAME	4 characters	The transport level resource name
ADDRESS GROUP	0-15 (decimal)	
ADDRESS	0-16 characters	The X.25 address (full or partial)
USERDATA	0-30 characters	Facilities and user data

The X.25 file is used symmetrically, both for incoming and outgoing packets. The following describes the specific algorithms used.

5.8.1 Incoming X.25 Calls

On receiving an incoming call-setup packet, the X.25 file is scanned sequentially and an attempt is made to match the incoming address with an address in the X.25 file. When a match has been made, a transport level name is retrieved from the record for onward routing. A match is deemed to have occurred if all the digits in the record entry have been matched (this is a form of "wild-card") and allows many different addresses to be mapped on to the same route simply by specifying as many leading digits as necessary in the X.25 file. Since the file is scanned sequentially from the beginning, more specific addresses should be inserted before less specific ones (i.e. in order of number of digits specified). As an example, consider the following fragment of an X.25 file:

**AB	93487652101022
**AC	93487652121232
**AD	93487

Thus an incoming address of 93487652101022 would be matched to **AB, 93487652121232 would be matched to **AC and anything else beginning with 93487 would be mapped on to **AD.

If the transport level name that is extracted from the table corresponds to an outgoing X.25 channel then, in general, the call packet will be routed transparently in the sense that a copy of the incoming call packet will be transmitted on the outgoing channel. There are two exceptions to this general rule, corresponding to two facilities provided.

1. Insertion of a caller's address can be specified by terminating the X.25 address in the file with a hyphen. For example, if the record in the above example were written as "93487-" then all calls matched on to 93487 are required to have a caller's address inserted by the Tele-SWITCH. If the call packet already contains an address, this takes precedence. Otherwise, the transport level name of the incoming channel (usually a channel group) is used to make a second pass of the file (corresponding to the type of scan described in 2 below) and, if a match if found, then the address is extracted and inserted as the caller's address. As an example, consider the following entries in the X.25 file:

**IC93487-
. . . . .
. . . . .
**PS2342191

   Assume the incoming channel is **PS and the incoming address is 934875321122. This address is matched by the first entry shown and "**IC" is selected as the route, with address insertion required. The file is therefore scanned for "**PS" and the address 2342191 extracted.

2. The above is semi-transparent routing. A second facility provided is that of address translation. This uses similar facilities to those described in the next Section and the call packet is rebuilt. This can be used, for example, to extract the caller's address, to insert a different address or to add user data or facilities.

   Address translation is specified by appending a "T" to the address in the X.25 table (the format "T-" is also allowed, in order to specify address translation and caller's address insertion).

   When this option has been specified, then the transport level name is extracted in the normal way to obtain the onward routing but, even if the channel is an X.25 channel, the call-packet is rebuilt. A second scan of the table is made using the transport level name previously extracted. As the table is scanned sequentially, the required entry must be earlier in the file than the original that requested translation, unless all that is required is to onward route but to remove the caller's address, to change it (T-) or to add user data or facilities; in such a case, it can be the same entry.

For example, consider the following entry in the X.25 file:

Name	Address	User Data
PA02	12319287652102	T012D0300

Assuming that there is no other PA02 or otherwise matching name in the file, then the same entry would be used for onward route specification and for rebuilding the call packet. The effect of this would be to enforce onward call packets to have the following form:

}

Address	23419287652102
Caller's address	none
User data	012D0300

5.8.2 Building Outgoing Call Packets

If the outgoing channel corresponding to a resource name selection is X.25 and is not a PVC, then a call packet needs to be built. In this case, the file is scanned for the first record that matches the resource selector and the contents of the record used to build the call-packet. As usual, "*" in the name field is used as a "wild-card" character (i.e. it will match any character).

In addition to extracting the address from the record and putting it in the call-packet (zero length - null - addresses are permitted for setting up loop tests and for use with the transport level DIAL routing feature), the following operations can be specified:

1. Caller's Address Insertion

   If the address field in the record is followed by "-", then this specifies the above facility. As described above, this involves a second scan of the table, using the incoming caller's channel name (normally a channel group name) as the key. If a matching entry is found, then the corresponding address field is extracted and inserted in the call packet as the caller's address.

2. User Data and Facilities

   If user data are required to be inserted in the call packet, this is specified as a string of hexadecimal digits in the USER DATA field of the record. Any non-hexadecimal character terminates input.

   If facilities are required, these are specified as hexadecimal digits in parentheses before any user data (if required). The facilities length byte is computer automatically and should not be included. Thus the following formats are all valid:

012D0300	User data on its own
(430404)012D0300	Facilities plus user data
(430404)	Facilities on their own

NOTE that if extended format call-processing is required on a given link, then the link level OPTIONS field should have the option EXT specified.

5.9 LINK CONFIGURATION PARAMETERS

The following sections list the parameters that may be configured at the link level, together with a brief explanation of each and their possible values. Where the field name, as listed by the Tele-SWITCH differs significantly from the headings below, the name as listed is given in parentheses. Where a parameter is given in text in the following, it is enclosed in double-quotes to delimit the parameter. The double-quotes do not form part of the parameter and must not be typed.

5.9.1 Name

This is a maximum of four alphanumeric characters which define the name of the link.

5.9.2 Type

This parameter defines the type of the link at level 3. The possible values are:

CIU

HDLC

X25

MUXPORT

NULL

The first four are self-explanatory. The last means that the link has not been configured. All NULL type links should occur after configured ones.

5.9.3 Address

Defines whether the address is DTE or DCE. If DTE, then the address parameter is "A"; if DCE, then "B" (Fig 5.1). Obviously the two ends of the same connection must be complementary.

5.9.4 Channels

Defines the number of X.25 or MUXPORT channels at Level 3. This is a decimal integer in the range 1..2000.

5.9.5 Options

This parameter defines the permitted options. The following are permitted:

POLL

BOOT

EXT

HOLD

STAT

NET

NONE

Any meaningful combination may be specified, with the individual options being separated by "+". The meaning of the various parameters is as follows:

POLL	Channel is a polling device
BOOT	Send the remote boot sequence at link initialisation (MUXPORT links only)
EXT	Allow extended facility codes
HOLD	(MUXPORT links only)
STAT	Generate statistics
NET	????
NONE	As the name implies

5.9.6 Initialisation Frame (INIT FRAME)

This defines the X.25 frame sent when a link is restarted. Possible parameters are:

SARM

SABM

DISC

The first means that a SARM command ("Set Asynchronous Response Mode") is sent. This implies the LAP protocol ("Link Access Protocol"); this is an unbalanced protocol - ie. master/slave.

The second means that a SABM command ("Set Asynchronous Basic Mode") is sent. This implies the LAP-B protocol ("Link Access Protocol - Balanced").

The third means that a DISC ("Disconnect") command is sent initially, then the link goes into the disconnected state. This may be required by some networks in their start up sequences.

5.9.7 T1 counter

This defines the time between retransmissions in hundredths of a second. It is a decimal integer and can take values between 2..80.

5.9.8 Retries counter (TRIES)

This parameter defines the number of retransmissions of an information frame before it is decided that the link has failed and a restart is initiated. It is a decimal integer in the range 2..50.

5.9.9 Level 2 Window Size (K LEVEL2)

This parameter defines the window size at Level 2. (i.e. the number of level 2 frames that can be sent without an acknowlegment). It is a decimal integer in the range 1..7. It is normally set to 7 (Fig 5.2).

5.9.10 Level 3 Default Window Size (K LEVEL3)

This defines the default window size at Level 3. (i.e. the number of level 3 packets that can be sent without an acknowlegement). It is a decimal integer in the range 1..7. It is normally set to 2.

5.9.11 Line Group

This is a mechanism for assisting in load sharing amongst different links, achieved by controlling the way in which the table of logical names is scanned. The Tele-SWITCH tries to balance the load between links in the same group (using the number of logical calls and the number of CRC errors; it does not use the line bandwidths nor the line utilisation). Therefore each line is assigned to a line group in the range 0..15.

5.9.12 Logical Channel Group Number (LCGN)

For virtual calls, a logical channel group number (in the range 0..15) is assigned during the call set-up phase. (For permanent virtual circuits, the LCGN is assigned when the PVC is set up). In the Tele-SWITCH, this option allows the LCGN to be specified.

5.9.13 Address Group

This is a facility to divide the logical channels (X.25 only) into a number of domains (address groups) in the range 0..15. When the X.25 table is scanned, as described in Section 5.8 above, only addresses in the same address group are valid. Thus, when an incoming call is received, it is looked up in the table and its address group determined. A second scan of the table will only examine addresses in that address group.

5.9.14 Frame Sequence (FRAME SEQ)

Normally, the X.25 protocol uses a sequence number in the range 0..7 (and employs a single control byte). In certain circumstances (e.g. on satellite links), it is necessary to use a wider range and X.25 provides "extended mode" in which the sequence numbers are in the range 0..127 (and two control bytes are required). This parameter defines which of the two is required and the permissible values are "NORM" or "EXT". For MUXPORT links it is usual to specify "EXT"

5.9.15 Call Time Out

Defines the time (in seconds) that the Tele-SWITCH will wait for response on channels on this link at resource connection time. It is a decimal integer in the range 2..200.

5.9.16 Error Threshold

This is an integer in the range 1..250 which defines the level at which the user is informed that errors have occurred on his logical channel. Once the specified threshold is exceeded, the user receives a message indicating that an error has occurred on every subsequent CRC error.

5.9.17 Loop Bar Priority

This is a mechanism to ensure that packets (i.e. on X.25 calls only) cannot loop indefinitely when an error condition occurs. Three priorities are defined, the call priority, the resource priority and the loop bar priority.

When a call is received in a Tele-SWITCH, it is routed to the appropriate outgoing link which has the same resource priority as the call priority of the incoming call (or, if there is no such link, one with a lower priority). This call is thus routed to a second Tele-SWITCH and, in normal circumstances, would be onward routed to a third Tele-SWITCH and so on to the destination.

However, if the appropriate outgoing link from the second Tele-SWITCH is unavailable (usually because the line is "down"), then the call could be routed back to the first Tele-SWITCH which would then route it back to the second Tele-SWITCH and so on.

The purpose of the Loop Bar Priority parameter is to prevent this endless looping by specifying a priority which is used instead of the resource priority in the case of a loop occurring. Thus, in normal circumstances, the Loop Bar Priority would be higher than the normal resource priority for a specified link.

As in the case of the other two priorities, the Loop Bar Priority is an integer in the range 0..15.

5.9.18 LOGN

Causes an X.25 Level 2 poll (RR command plus P-bit) to be transmitted if data has not passed in the last 3 seconds. This parameter should be specified on trunk links on which alternate routing is required. It is a decimal integer and can take the values 0..4.

5.10 CHANNEL CONFIGURATION PARAMETERS

The following sections list the parameters that may be configured at the channel level, together with a brief explanation of each and their possible values. Where the field name, as listed by the Tele-SWITCH differs significantly from the headings below, the name as listed is given in parentheses. Where a parameter is given in text in the following, it is enclosed in double-quotes to delimit the parameter. The double-quotes do not form part of the parameter and must not be typed.

5.10.1 Name

This is the resource name for access and configuration purposes (i.e. the name of the context block). It is an alphanumeric string of up to four characters.

5.10.2 Destination Resource Code Mask (DRC MASK)

If calls are enabled (see CIRCUIT TYPE), this parameter defines resource selection method. The parameter is a four-character field consisting of alphanumeric characters with "." as a "wild-card". The user is only allowed to access resources whose name matches the DRC MASK. Thus, if the mask were "....", then the user would have access to all facilities (since "." matches any character). If the mask were "PS0.", then the user could only access resources whose name began with the characters "PS0".

5.10.3 Terminal Type

This parameter is only valid for MUXPORT channels and defines whether the channel is to be used in synchronous or asynchronous mode. It can take the values "ASYN" or "SYNC".

5.10.4 Parity

This parameter is only valid for MUXPORT channels and defines the parity of characters when in asynchronous mode. The possible values of the parameter are:

SPAC

MARK

ODD

EVEN

5.10.5 Circuit Type

This defines various characteristics of the channel. It may take a number of values (as listed below) and these may be combined by the use of the "+" operator.

CALL Channel is permitted to initiate calls

QUEU Channel is permitted to initiate calls but, if the selected resource is busy, the call will be queued

PVC The channel is a permanent virtual circuit. For MUXPORT, this indicates that the EIA signals are not relevant. In the case of an X.25 channel, this goes immediately into the data state.

SVC The channel (MUXPORT only) is a switched virtual circuit (at the EIA signal level) and is on a trunk link

OUT The channel is only able to initiate outgoing calls (i.e. it is only a selectable resource and not a resource selector)

DIAL Used to provide an onward addressing mechanism for inter-TeleSWITCH links which are configured as MUXPORT. However, it is not restricted to MUXPORTs and can be used as a supplementary addressing mechanism for X.25 links. This option performs the equivalent function to the address in X.25 call packets. It operates differently according to whether the channel is initiating or receiving a call. In the case of initiating a call, the resource selector used (after source DRC processing) to select the channel is passed as the first four data characters to the port on which the call was initiated as a continuous string. These will then onward-select the route at the next Tele-SWITCH node. If "wake-up" has been configured by setting the DRC mask for a channel specified as OUT only, the wake-up takes precedence but the DIAL option overrides the one second timer between wake-up characters which are thus sent as a continuous string. In the case of a channel receiving a call, this parameter simply forces a total disconnection from the Tele-SWITCH when its adjacent (onward) channel drops its line signals, instead of the default of keeping the channel connected to the Tele-SWITCH for further menu selection. Thus, in a multi-stage call, at (for example) host disconnection, the call will be cleared down in a cascade back to the outermost Tele-SWITCH.

5.10.6 Options

This allows various options to be specified (as below). These are additive and may be combined by use of the "+" operator.

RTS RTS as well as DTR is required to enable the channel

HOLD The Tele-SWITCH's record of the line control signals will be maintained after resource disconnection (for use with dumb terminals) unless the port itself drops DTR

NBRK Do not transmit a "break" to the channel

DIAG Put channel into diagnostic mode in order to get extended diagnostics

RECO Enable automatic call reconnection if the link opposite channel is restarted

PASS Password control required on the port

BILL Billing statistics required on this channel

MSGS Service messages enabled for this channel (e.g. "busy", "unavailable", "no response")

EOM

GATE Password implemented on outgoing channel

NAME

TALK

NONE As the name implies

5.10.7 Buffers

Specifies the number of 128-byte buffers which the channel can fill before the input is flow-controlled. This number plus the maximum X.25 Level 3 window size (8) defines the maximum number of buffers that can be filled before the Tele-SWITCH discards data for the channel ("data overrun"). It is a decimal integer in the range 1..25.

5.10.8 Slot Size

This parameter is only valid for a MUXPORT channel. It is a decimal integer in the range 1..255 which defines the maximum number of characters that can be put into a single output frame for the channel. Use of this parameter allows tuning of the channel by varying response against throughput.

5.10.9 FCA Threshold

This parameter is only valid for a MUXPORT channel. It is a decimal integer in the range 0..15 which defines the level at which input flow control is refreshed (multiples of 16).

5.10.10 FCA Value

This parameter is only valid for a MUXPORT channel. It is a decimal integer in the range 0..15 which defines the refresh value in multiples of 16. If the parameter is specified as zero, this disables input flow control.

5.10.11 Disconnect Mode (DISC MODE)

This parameter is only valid for a MUXPORT channel. It defines the control character to be used to force disconnection and is hence a decimal integer in the range 0..31.

5.10.12 Menu Number

A decimal number in the range 1..32 which defines the number of the menu to be displayed for the specified channel. If a value of zero is specified, this indicates that no menu is required for this channel.

5.10.13 Help Number

A decimal number in the range 1..32 which defines the number of the help screen to be displayed for the specified channel. If a value of zero is specified, this indicates that no help is required for this channel.

5.10.14 News Number

A decimal number in the range 1..32 which defines the number of the news screen to be displayed for the specified channel. If a value of zero is specified, this indicates that no news is required for this channel.

5.10.15 Call Priority

The priority level at which resource selection scans are initiated (looking for a resource priority equal or lower - equal takes precedence, then in decreasing priority). It is a decimal integer in the range 0..15.

5.10.16 Resource Priority

The priority level of the resource - a decimal number in the range 0..15. Only channels with the same or a greater call priority can access this resource.

5.10.17 PAD Enable

This can take three values, "D" (disabled), "E" (enabled) or "REV" (reverse). In the case of a MUXPORT channel, if disabled, only the ECHO, DRI and DRO parameters are effective (the following being disabled: PAD RECALL, DATA FORWARDING, DELAY, PAD SIGNALS, BREAK, PADDING, FOLD, LFI, LF PAD, EDIT, FORCE and BREAK CHAR). If enabled, all the above characters are enabled, including parameter updates from remote X.25 hosts via X.29 (Q-bit data).

In the case of an X.25 channel, "D" means disable remote X.29 update. In the case of the parameters PAD SIGNALS, PADDING, FOLD, LF PAD and EDIT, these are not currently implemented in the Tele-SWITCH but can be transmitted to remote PADs in qualified data packets. "E" means that the parameters below may be transmitted to a remote host in an X.25 Level 3 data packet with the Q-bit set.

If the value is REV (X.25 channels only), this means that the PAD parameters from the remote PAD should be returned to the calling Tele-SWITCH in a data packet (usually used when the Tele-SWITCH wishes to change the remote PAD parameters, then reset them to their original values later).

5.10.18 PAD Recall

X.3 parameter (1). It is a decimal integer in the range 0..126. If zero, this means that it is not possible to escape to the "talk to PAD" mode. If 1, the ctrl-P (DLE) is the escape character. Otherwise, the specified character is the escape character.

5.10.19 Echo Control (ECHO)

X.3 parameter (2) which specifies whether echoing is enabled ("E") or disabled ("D"). In addition, the parameter may take the value "CONT" which allows the user to control echo by means of the characters Ctrl-N (disable) or Ctrl-O (enable). It is permitted to combine "CONT" with "E" or "D" (by means of the "+" operator) which then specifies the initial state.

5.10.20 Data Forwarding

X.3 parameter (3). The parameter is a decimal integer in the range 0..255, formed by adding the values below (with addition of the appropriate criteria):

0	Forward only on buffer full
1	Forward on A..Z, a..z, 0..9
2	Forward on carriage return
4	Forward on ESC, BEL, ENQ, ACK
8	Forward on DEL, CAN, DC2
16	Forward on ETX, EOT
32	Forward on HT, LF, VT, FF
64	Forward on all other characters in first two columns of ASCII character set plus DLE
128	Forward on graphic characters

5.10.21 Delay

This is not an X.3 parameter. It defines the data forwarding timeout and is a decimal integer in the range 0..255. For the Tele-SWITCH, this defines multiples of 0.1 seconds; for external X.25 PADs, it defines multiples of 0.05 seconds.

5.10.22 Data Restraint In (DRI)

X.3 parameter (5). This defines whether X-ON/X-OFF flow control is enabled ("E") or disabled ("D").

5.10.23 PAD Signals

X.3 parameter (6), not implemented in the Tele-SWITCH. It defines whether PAD service messages are enabled ("E") or disabled ("D").

5.10.24 Break

X.3 parameter (7). This denotes the action to be taken on receipt of a break character. It is a decimal integer which can take the values 0, 1, 2, 5, 8 or 21. In all cases, an INTERRUPT packet is transmitted and all buffered data is purged. The specific meanings of the various values is as follows:

0	No action
1	Transmit INTERRUPT packet
2	Transmit RESET packet
5	Transmit INTERRUPT packet and Indication of Break PAD message
8	Escape from data transfer state
21	Transmit INTERRUPT packet and Indication of Break PAD message and set PAD parameter 8 to 1 (suppress data delivery)

5.10.25 Padding

PAD parameter (9), not implemented by the Tele-SWITCH. It defines the amount of padding after carriage return and is a decimal value in the range 0..7. A value of 0 specifies that the number of padding characters is terminal speed dependent. The other values define the number of padding characters to be inserted.

5.10.26 Fold

PAD parameter (10), not implemented by the Tele-SWITCH. It defines the number of characters after which line folding occurs. It is a decimal value in the range 0..255. A value of 0 specifies that no line folding should take place. The other values define the number of characters after which line folding should occur.

5.10.27 Data Restraint Out (DRO)

PAD parameter (12). It defines whether XON/XOFF flow control is enabled ("E") or disabled ("D") on output.

5.10.28 Line Feed Insert (LFI)

PAD parameter (13). It specifies the handling of linefeed after carriage return in accordance with the following table:

0	Do not insert linefeed after carriage return
1	Insert LF in output data
4	Insert LF in echo
*5	Insert LF in output data and echo
6	Insert LF in echo and in input data
*7	Insert LF in output data, echo and input data

* These PAD parameters are not implemented in the Tele-SWITCH

5.10.29 Line Feed Padding (LF PAD}

PAD parameter (14), not implemented by the Tele-SWITCH. It defines the amount of padding after linefeed and is a decimal value in the range 0..7. A value of 0 specifies that the number of padding characters is terminal speed dependent. The other values define the number of padding characters to be inserted.

5.10.30 Line Editing (EDIT)

PAD parameter (15), not implemented by the Tele-SWITCH. It defines whether editing characters (e.g. character delete) are enabled ("E") or disabled ("D").

5.10.31 Character Delete (CHAR DEL)

This specifies the character which is used by the PAD to delete the previous character. It is an integer in the range 0..127. In order for this parameter to be effective, line editing must be enabled.

5.10.32 Buffer Delay

This specifies the character which is used by the PAD to delete the entire buffer contents. It is an integer in the range 0..127. For obvious reasons, this must be a different character to that specified for character delete. In order for this parameter to be effective, line editing must be enabled.

5.10.33 Display (DISP)

This specifies a character which is used by the PAD to display the contents of the buffer (useful after line editing has been done). It is an integer in the range 0..127.

5.10.34 Force

This is not an X.3 parameter. It is a decimal value in the range 0..127 which specifies a character to force data forwarding.

5.10.35 Break Character

This is not an X.3 parameter. It is a decimal value in the range 0..32 which specifies a control character used to simulate BREAK.

5.11 VIRTUAL CONTROL PORT PARAMETERS

The following sections list the parameters that may be configured for the Virtual Control Port, together with a brief explanation of each and their possible values.

5.11.1 Name

This is the resource name for access and configuration purposes (i.e. the name of the Virtual Control Port). It is an alphanumeric string of up to four characters, default "BE00".

5.11.2 Resource Priority

The priority level of the Virtual Control Port - a decimal number in the range 0..15. Only channels with the same or a greater call priority can access this resource.

6. STATISTICS

As described under the STAT command in Section 4, a wide variety of statistics can be obtained on the Virtual Control Port using this command. The statistics produced depend on the current context (i.e. BASE, X.25 Level 2, X.25 Level 3, MUXPORT channel). The statistics for each type of context block are summarised below. In each case, an example is given, followed by a table summarising the meaning of the various values.

It should be remembered that a "/" will cause an automatic repeat of the current command (e.g. "STAT") for the current context block. This is useful when it is desired to obtain statistics at regular intervals. In addition, the usual means of moving from one context block to another (">", "<", "/" and <name>) can be used to change context blocks and to re-execute the current command ("STAT" in this case).

All integer parameters are given in decimal unless otherwise stated.

6.1 BASE STATISTICS

BUFFER POOL MAX/ 127	BUFFER POOL NOW/ 123
BUFFER POOL LOWEST/ 122	BUFFER POOL EMPTY/ 0
BUFFER THRESHOLD/ 0	MEMORY SIZE (K BYTES)/ 51
DATA FRAMES IN/ 0000	DATA FRAMES OUT/ 0000
DATA FRAME RATE IN/ 0	DATA FRAME RATE OUT/ 0
TOTAL CALL SET-UPS/ 0	CURRENT CALLS/ 0
RETRANSMISSIONS/ 0	REJECTS/ 0

6.1.1 Buffer Pool Max

Defines the value of the maximum size of the buffer pool (each buffer being 128 bytes).

6.1.2 Buffer Pool Now

Defines the value of the current size of the buffer pool (each buffer being 128 bytes).

6.1.3 Buffer Pool Lowest

Defines the lowest level reached by the buffer pool (in terms of 128 byte buffers).

6.1.4 Buffer Pool Empty

This defines the number of times that the number of free buffers has reached zero.

6.1.5 Buffer Threshold

This defines a number of buffers which the Tele-SWITCH requires to be kept available. Once this threshold is reached, the Tele-SWITCH stops data on all incoming links.

6.1.6 Memory Size

Defines the variable memory size in Kbytes.

6.1.7 Data Frames In

Defines the number of data frames that have been received since the counter was last reset.

6.1.8 Data Frames Out

Defines the number of data frames that have been sent since the counter was last reset.

6.1.9 Data Frame Rate In

Defines the rate of receipt of data frames since the frame counter was last reset. It is equal to the DATA FRAMES IN parameter, divided by the elapsed time.

6.1.10 Data Frame Rate Out

Defines the rate of transmission of data frames since the frame counter was last reset. It is equal to the DATA FRAMES OUT parameter, divided by the elapsed time.

6.1.11 Total Call Set-Ups

Defines the number of calls that have been set up since the counter was last reset.

6.1.12 Current Calls

Defines the number of calls currently in progress.

6.1.13 Retransmissions

Defines the number of frames that have been retransmitted.

6.1.14 Rejects

Defines the number of frames that have been rejected.

6.2 LINK LEVEL STATISTICS

There are a few differences between the statistics produced for an X.25 link and a MUXPORT link. An example of the output for an X.25 link is as follows:

```
TYPE/ X25          CRC ERRORS/ 0      RETRANSMISSIONS/ 0
REJECTS/ 0         TOTAL CALL SET-UPS/ 0
CURRENT CALLS/ 0                      FRAME SEQ/ NORM
STATE/ SABM        SUB-STATE/ NORM    NR/ 0
VS/ 0              TRIES/ 2           VR/ 0
VR(SENT)/ 0        OPTIONS/ NONE      LCGN/ 0
DATA IN/ 0000      DATA OUT/ 0000     DATA FRAMES IN/ 0000
DATA FRAMES OUT/ 0000                 DATA FRAME RATE IN/0
DATA FRAME RATE OUT/ 0                CALLS RECEIVED/ 0
CALLS SENT/ 0      CLEARS RECEIVED/ 0
RESETS RECEIVED/ 0                    INTERRUPTS RECEIVED/0
SLOTS OUT/ 0
```

and for a MUXPORT link:

```
TYPE/ MUX          CRC ERRORS/ 0      RETRANSMISSIONS/ 0
REJECTS/ 0         TOTAL CALL SET-UPS/ 0
CURRENT CALLS/ 0                      FRAME SEQ/ NORM
STATE/ SABM        SUB-STATE/ NORM    NR/ 0
VS/ 0              TRIES/ 4           VR/ 0
VR(SENT)/ 0        OPTIONS/ NONE      LCGN/ 0
DATA IN/ 0000      DATA OUT/ 0000     DATA FRAMES IN/ 0000
DATA FRAMES OUT/ 0000                 DATA FRAME RATE IN/0
DATA FRAME RATE OUT/ 0                CALLS RECEIVED/ 0
CALLS SENT/ 0      CLEARS RECEIVED/ 0
RESETS RECEIVED/ 0                    INTERRUPTS RECEIVED/0
SLOTS OUT/ 0
```

In the following sections, it should be obvious to which type of link the parameters refer.

6.2.1 Type

Defines the type of the link, whether X.25 ("X25"), MUXPORT ("MUX") or unconfigured ("NULL").

6.2.2 CRC Errors

Defines the accumulated count of cyclic redundancy check errors.

6.2.3 Retransmissions

Defines the number of retransmissions since the counter was last reset.

6.2.4 Rejects

Defines the number of rejects received since the counter was last reset.

6.2.5 Total Call Set-Ups

Specifies the total number of calls set-up, both in and out.

6.2.6 Current Calls

Specifies the number of calls, both in and out, currently active.

6.2.7 Frame Seq

Defines whether the link is in normal mode ("NORM") or extended mode ("EXT").

6.2.8 State

Defines the state of the link in accordance with the following table:

SABM	Link restart state - LAP-B
SARM	Link restart state - LAP
DISC	Link disconnected state
CLS	DISC frame transmitted; no response
DATA	Data transfer state
WAKE	I-frame transmitted after timeout (no response)
BLKD	Remote receiver not ready (RNR received)
RESP	(LAP) SARM received; UA, SARM transmitted
WAIT	(LAP) SARM sent; UA received; waiting for SARM

6.2.9 Sub-State

Defines whether current sub-state of data transfer state is normal ("NORM") or if an out-of-sequence frame has been received ("REJ").

6.2.10 NR

Defines the value of the last frame acknowledgement received.

6.2.11 VS

Defines the current transmit sequence number.

6.2.12 TRIES

Specifies the number of times the current command has been transmitted (e.g. I-frame, SABM, SARM).

6.2.13 VR

Defines the current receive sequence number.

6.2.14 VR (SENT)

Defines the last frame acknowledgement number transmitted.

6.2.15 Options

This specifies the options that have been set (the permissible options are described in Section 5.9.5).

6.2.16 LCGN

Logical channel group number of link (X.25 Level 3 only).

6.2.17 DATA IN

Specifies the count of the total number of data characters received since the counter was last reset.

6.2.18 DATA OUT

Specifies the count of the total number of data characters transmitted since the counter was last reset.

6.2.19 DATA FRAMES IN

In the case of an X.25 link, specifies the total number of frames received which contain data. In the case of a MUXPORT link, specifies the total number of frames received.

6.2.20 Data Frames Out

In the case of an X.25 link, specifies the total number of frames transmitted which contain data. In the case of a MUXPORT link, specifies the total number of frames transmitted.

6.2.21 Data Frame Rate In

Defines the rate of receipt of data frames since the frame counter was last reset. It is equal to the DATA FRAMES IN parameter, divided by the elapsed time.

6.2.22 Data Frame Rate Out

Defines the rate of transmission of data frames since the frame counter was last reset. It is equal to the DATA FRAMES OUT parameter, divided by the elapsed time.

6.2.23 Calls Received

Defines the number of calls that have been set up to this resource.

6.2.24 Calls Sent

Defines the number of calls that this resource has initiated.

6.2.25 Clears Received

Defines the number of CLEAR call packets that have been received.

6.2.26 Resets Received

Defines the number of RESET packets that have been received.

6.2.27 Interrupts Received

Defines the number of INTERRUPT packets that have been received.

6.2.28 Slots Out

This parameter applies to MUXPORT links only. It is a rotating count of the total number of transmitted slots (a slot is a segment of data for a channel). The difference between this figure and the number of transmitted frames indicates the extent to which the frames are being multiplexed. Not only data but also control signals and supervisory information are passed in channel slots. The degree of frame multiplexing increases with link utilisation.

6.3 CHANNEL LEVEL STATISTICS

This Section lists the statistics that can be obtained at the channel level. For many of the parameters, these are merely copies of the values that have been configured (see above) and, for this reason, they are not reproduced here.

It should be noted that certain of the parameters specified by the CONFigure command may have been altered. If the channel is of type MUXPORT and PAD ENABLE is set to "E", then the parameters which are X.3 compatible may have been modified by qualified data packets. For X.25 Level 3 channels with PAD ENABLE set, the X.3 values would have been transmitted to the remote PAD.

An example of statistics that may be obtained at channel level for a MUXPORT link is as follows:

```
STATE/ DATA          TOTAL FRAMES IN/ 0
TOTAL FRAMES OUT/ 0                    TOTAL CHARS IN/ 0
TOTAL CHARS OUT/ 0                     CONNECTED TO/ BE00
EIA/                 SESSION STATUS/ CALL
CSU IN/              CSU OUT/          PERM IN/ 0
PERM OUT/ 0          TERMINAL TYPE/ ????
PARITY/ ODD          CIRCUIT TYPE/ CALL + PVC  + STAT
OPTIONS/ MSGS        BUFFERS/ 2        SLOT SIZE/ 128
FCA THRESHOLD/ 2                       FCA VALUE/ 3
DISC MODE/ 11        MENU NUMBER/ 1    HELP NUMBER/ 0
NEWS NUMBER/ 0       CALL PRIORITY/ 0
RESOURCE PRIORITY/ 0                   PAD ENABLE/ D
PAD RECALL/ 0        ECHO/ E    + CONT
DATA FORWARDING/ 0                     DELAY/ 0
DRI/ E               PAD SIGNALS/ D
BREAK/ 1             PADDING/ 0        FOLD/ 0
DRO/ E               LFI/ 0            LF PAD/ 0
EDIT/ D              CHAR DEL/ 0       BUFFER DEL/ 0
DISP/ 0              FORCE/ 0          BREAK CHAR/ 0
```

For an X.25 channel, the following statistics may be obtained:

```
STATE/ DISC          TOTAL FRAMES IN/ 0
TOTAL FRAMES OUT/ 0                      TOTAL CHARS IN/ 0
TOTAL CHARS OUT/ 0                       CONNECTED TO/
EIA/ DOWN            SESSION STATUS/
RX WINDOW/ 2         TX WINDOW/ 2        RX SIZE/  128
TX SIZE/  128        PNR/ 0              PR/ 0
PACKETS TO ACK/ 0                        PR(SENT)/ 0
PS/ 0                CAUSE/ 0            DIAGNOSTIC/ 0
RESET CAUSE/ 0       RESET DIAGNOSTIC/ 0
RESET CAUSE RECEIVED/ 0        RESET DIAGNOSTIC RECEIVED/ 0
LEVEL 3 STATE/ DISC                      TERMINAL TYPE/ ????
PARITY/ ODD          CIRCUIT TYPE/ CALL + STAT
OPTIONS/ NONE        BUFFERS/ 2          SLOT SIZE/ 128
FCA THRESHOLD/ 2                         FCA VALUE/ 3
DISC MODE/ 0         MENU NUMBER/ 0      HELP NUMBER/ 0
NEWS NUMBER/ 0       CALL PRIORITY/ 0
RESOURCE PRIORITY/ 0                     PAD ENABLE/ D
PAD RECALL/ 0        ECHO/ CONT          DATA FORWARDING/ 0
DELAY/ 0             DRI/ D              PAD SIGNALS/ D
BREAK/ 1             PADDING/ 0          FOLD/ 0
DRO/ D               LFI/ 0              LF PAD/ 0
EDIT/ D              CHAR DEL/ 8         BUFFER DEL/ 0
DISP/ 0              FORCE/ 0            BREAK CHAR/ 0
```

These are now discussed in the above order, as far as possible.

6.3.1 State

Defines the internal (network level) state of the channel. It may be one of the following:

DISC	Channel is disconnected
BUSY	Channel has been busied out, either temporarily (due to timer) or permanently
RUNG	Channel has received the ring indicator
ADDR	Channel is waiting for completion of the resource selection NAME (address)
ROUT	Channel is scanning for the selected resource (i.e. routing)
SETU	Channel is waiting for the selected resource (channel) to complete its call set-up
CALL	Channel was selected as a resource and is in the call set-up state
WAKE	Channel has been connected to its selected resource but is transmitting wake-up characters to the adjacent channel (resource)
DATA	Channel is in the normal data transfer state and is connected to another channel
MNGE	Channel is in the network management state - it is receiving reports and/or session statistics or it is receiving POLLs for information
POST	The channel is in the post-processing state for received input (prior to onward forwarding for output). In this state, each input character is examined whatever the protocol used. It occurs if the channel to which it is connected (i.e. the channel which will receive the input as output) is a MUXPORT channel (or similar) with PAD ENABLE and certain functions set, such as line feed insertion. This state will also occur if the channel is in trace mode.

6.3.2 Total Frames In

Total frames received in current session (previous session if state is DISC).

6.3.3 Total Frames Out

Number of frames sent in current session (previous session if state is DISC).

6.3.4 Total Chars In

Total number of characters received in current session (previous session if state is DISC).

6.3.5 Total Chars Out

Total number of characters sent in current session (previous session if state is DISC).

6.3.6 Connected To

Name of the resource (channel) to which the channel is connected. The controller name (link name) and channel number, where relevant, are given in parentheses.

6.3.7 EIA

This specifies a number of EIA logical signals which are additive. Possible values are:

DCD	Carrier detected, mapped from EIA signals (in the case of a MUXPORT channel) DTR or DTR+RTS according to configuration, or from call packet received and accepted (X.25 Level 3).
RING	Ring indicator received
DOWN	Channel is marked down because the link level is inactive

6.3.8 Session Status

A number of additive values which define the current status of the session, as follows:

CALL	This channel initiated the call
DRI	Channel is data restrained/flow controlled on input
DRO	Channel is data restrained/flow controlled on output
TRAN	This channel initiated the call and the routing was transparent - i.e. DRC MASK specified a complete route or call packet routed via destination address
QUEU	The channel is queued, waiting for its selected resource to become free (all channels in selected class are busy)
STAT	The channel is in the queued state and has asked for a queue status report
PAD	The channel is in the PAD recall state
DISC	Port will be disconnected when network clears (or after timeout period if it does not clear)

6.3.9 CSU In

This parameter only applies to MUXPORT channels and consists of additive values showing the last control signal update received in a frame for the channel. Possible values are:

DTR	DTR or DSR received
RTS	RTS or CTS received
RING	Ring indicator received - PAD recall state

6.3.10 CSU Out

This parameter only applies to MUXPORT channels and consists of additive values showing the last control signal update sent in a frame for the channel. Possible values are:

DTR	DTR or DSR sent
RTS	RTS or CTS sent
RING	Ring indicator sent

6.3.11 Perm In

This parameter only applies to MUXPORT channels and is the input permission count, i.e. the number of characters that the remote channel has been authorised to transmit on the composite link.

6.3.12 Perm Out

This parameter only applies to MUXPORT channels and is the output permission count, i.e. the number of characters that this channel has been authorised to transmit to the remote channel via the composite link. The value 24565 represents the flow control (output) disabled state (i.e. the channel is not currently running under flow control on output).

6.3.13 Rx Window

(X.25 channels only) Specifies the size of the receive window.

6.3.14 Tx Window

(X.25 channels only) Specifies the size of the transmit window.

6.3.15 Rx Size

(X.25 channels only) Specifies the size of the receive buffer.

6.3.16 Tx Size

(X.25 channels only) Specifies the size of the transmit buffer.

6.3.17 Packet Acknowledgement Number (PNR)

(X.25 channels only) Specifies the last packet acknowledgement number received.

6.3.18 Packet Sequence Number (PR)

(X.25 channels only) Specifies the current receive packet sequence number.

6.3.19 Packets to Acknowledge

(X.25 channels only) Specifies the number of packets received and not yet acknowledged.

6.3.20 Last Acknowledgement Number (PR(SENT))

(X.25 channels only) Specifies the last acknowledgement number transmitted.

6.3.21 Transmit Sequence Number (PS)

(X.25 channels only) Specifies the transmit sequence number.

6.3.22 Cause

(X.25 channels only) Specifies the cause code in the last CLEAR request.

6.3.23 Diagnostic

(X.25 channels only) Specifies the diagnostic code in the last CLEAR request.

6.3.24 Reset Cause

(X.25 channels only) Specifies the cause code of the last RESET sent.

6.3.25 Reset Diagnostic

(X.25 channels only) Specifies the diagnostic code of the last RESET sent.

6.3.26 Reset Cause Received

(X.25 channels only) Specifies the cause code of the last RESET received.

6.3.27 Reset Diagnostic Received

(X.25 channels only) Specifies the diagnostic code of the last RESET received.

6.3.28 Level 3 State

(X.25 channels only) Specifies the Level 3 channel state. The following values are permitted:

DISC	Disconnected
DATA	Data transfer state
CALL	Call request packet sent
CLS	Disconnect packet sent
RESE	Reset indication state
REST	Restart packet sent (Channel 0 only).

PART IV: NETWORK CONFIGURATION

1. INTRODUCTION

Configuring a large computer network is very complex and to complicate matters, networks are rarely static, usually evolving in response to new or differing user needs. Often the information provided by a Network Management System provides the necessary input to enable the network configuration to be altered.

It is difficult to give hard and fast rules for network configuration and, ideally, this should be undertaken in conjunction with a network specialist.

However, there are a number of fairly simple rules that need to be followed and this Section of the Tele-SWITCH Manual gives an indication of those rules and outlines the process of network configuration.

2. BASIC PRINCIPLES

The Tele-SWITCH is a very flexible tool and provides a wide range of facilities. Perhaps the first decisions that need to be taken are what facilities are to be used, e.g. whether MUXPORT links are required because of linkage to multiplexors (or for efficiency reasons) or whether X.25 is required.

Furthermore, some basic decisions need to be taken about the trade off between the provision of alternate routing and the cost of additional lines (the more lines that are provided, the greater the possibility of alternate routing and hence the greater overall network availability; however, increasing the number of lines increases the costs).

When configuring the network, it is important to remember that the initial configuration is extremely unlikely to be the final one and that the network will change - perhaps rapidly - with time. Therefore, techniques must be employed to facilitate those changes. For example, it is important to choose mnemonic names for links so that they can easily be remembered.

3. OUTLINE OF CONFIGURATION PROCESS

The main point to note when configuring a network is that it must first be done on paper (or, possibly, on some sort of CAD package) so that the optimum configuration can be arrived at before the nodes are configured since the latter is a relatively lengthy process. Of course, having a paper (or machine readable) version of the configuration allows the actual configuration to be checked more easily and simplifies making changes.

This Section is intended to outline, in broad terms, the methods by which a network should be configured.

3.1 List Network Nodes

The first step is merely to list the network nodes (i.e. the number of Tele-SWITCHes) and draw a diagram with them on. Such a diagram can be geographic but, more often than not, it is merely a representation of the relationship between the nodes (a topological transform). At all times in the configuration process, it is convenient to keep two items. The first is a list of the nodes and their characteristics and the second is a diagram corresponding to the list.

3.2 Decide Network Topology

The second step is to decide the network topology required. In many cases, this will be a "partially connected distributed network", i.e. each node will be linked to some, but not all, of the other nodes. In certain circumstances, other topologies will be required (e.g. hierarchical). The topology may require a change in the diagram already drawn and the links should be noted in the list of nodes.

3.3 Decide Protocols

At present, the Tele-SWITCH supports two basic protocols, X.25 and MUXPORT. The former is preferred for all links but there may be occasions where it is necessary to use the latter. Therefore, a decision on protocols must be taken for every link and this information added to the diagram and list.

3.4 Allocate Logical Channels

Each physical link can handle a relatively large number of logical channels, although the Tele-SWITCH sets certain maxima. This stage specifies the number of logical channels to be allocated to each physical link, subject to the overall constraints of the Tele-SWITCH (although these limits are extremely unlikely to be reached in practice). The number of logical channels is clearly related to the expected traffic in that the number of logical channels is equal to the number of simultaneous calls that can be made.

3.5 Determine Naming Conventions

So far, no names have been assigned to any links and this is the next step. However, before doing so, it is highly recommended that a logical naming structure be decided and implemented. If suitable conventions are observed, the network manager can determine information about a link, merely by knowing its name, and this is likely to save substantial effort later. For X.25 addresses, it is convenient to split the address field into a number of sub-fields, each part conveying information (e.g. the geographical location of the node).

3.6 Allocate Names and Network Addresses

At this stage, names and network addresses should be allocated to all links and channels. It is convenient to name the external links first, then the local logical channels. After this, the network addresses can be allocated.

3.7 Determine Priorities

The Tele-SWITCH allows various priorities to be allocated, in order to control access to resources. There are two basic priorities which are interlinked, namely the CALL PRIORITY and the RESOURCE PRIORITY. The call priority is that of the initiator and the resource priority is that of the responder. A caller cannot access a resource whose priority is above his. Priorities are allocated in the range 0..15. A caller with priority 15 can access any resource; similarly, a resource with priority 0 can be accessed by any caller.

Thus, to allocate priorities, callers should be grouped in sixteen groups (or, often, less) and these listed in priority order. Numbers are then assigned. If sixteen groups are used, then it is necessary to use all possible priority levels. If less than 16 are used, then it is often convenient to assign priorities equally spaced (e.g. for five priority groups, it is more convenient to use levels 0, 4, 8, 12 and 15 rather than 0 to 4 since this assists future expansion). A similar procedure should be carried out with resource priorities, ensuring that these are matched with the appropriate call priorities.

4. CONFIGURE THE HARDWARE

Once the network configuration has been determined on paper, this should then be transferred to the network itself. This is a fairly tedious process and must be carried out carefully. It is straightforward and should be carried out in a logical, consistent manner (e.g. configuring node 1, then node 2 etc.). The commands required for this purpose have been listed in the previous Section of this Manual and will not be repeated here. However, two points should be made. First, moving between configuration blocks re-invokes the current command. Secondly, the command COPY allows one configuration block to be copied to another. Even if the second block has a number of different parameters to the first, it is often more convenient to change these rather than have to configure the block completely (as there is a large number of parameters).

5. NETWORK RECONFIGURATION

From time to time it will be necessary to reconfigure the network - for example, to add extra nodes or to alter the number of logical channels. If the procedures outlined above are followed, this should be a relatively straightforward procedure but it must be emphasised that the paper copy of the configuration MUST be kept up to date at all times. Indeed, it is almost certainly most convenient to repeat the above procedure each time it is required to reconfigure the network.

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