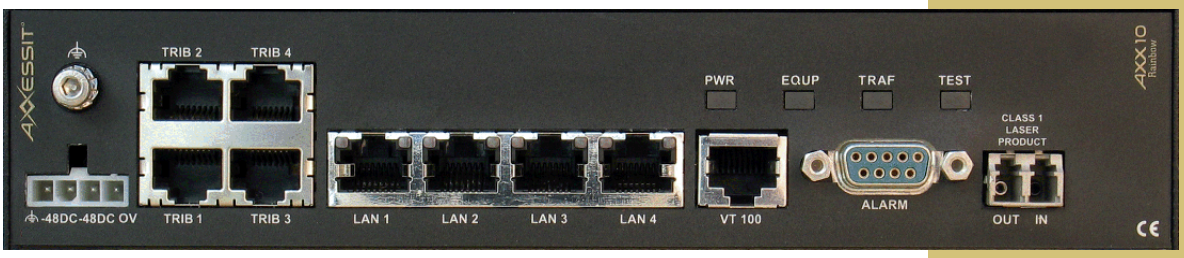
AXX10

Technical Description

Integrated Access Device used together with the AXXEDGE consolidation unit



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1.1 SYSTEM OVERVIEW

The AXX10 is a new Integrated Access Device for use in fibre optic networks. The AXX10 combine IP-and TDM-traffic, in a cost-effective way, by running IP- along with TDM-channels inside an SDH-frame structure that can be easily carried across the network. The bandwidth of the IP-channel is configurable to 10 Mb/s or 100 Mb/s true "wire-speed".

The AXX10 is optimised for very low cost solutions and therefore have limited functionality. The AXX10 supports only one customer per unit.

The AXX10 must be used together with the AXXEDGE consolidation unit (CU). It is not a fully working standalone SDH network element (NE).

The AXX10 is managed remotely by a management system that supervises both the IP-and TDM-parts of the system.

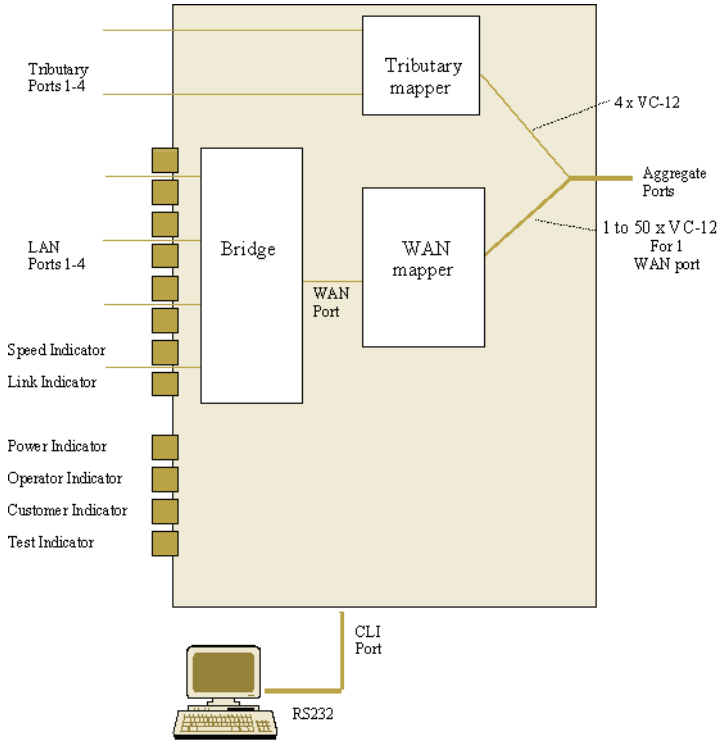

Figure 1-1. AXX10 Overview

1.1.1 Applications of AXX10

The AXX10 must be connected to the AXXEDGE. The AXXEDGE is placed in the operator's point of presence. This is shown in the figure below. The AXXEDGE integrates the functionality of the ADM, IP switch/router and connects to the number of AXX10 at the customer sites. The AXXEDGE may also function as a drop-shelf that is connected to an external ADM.

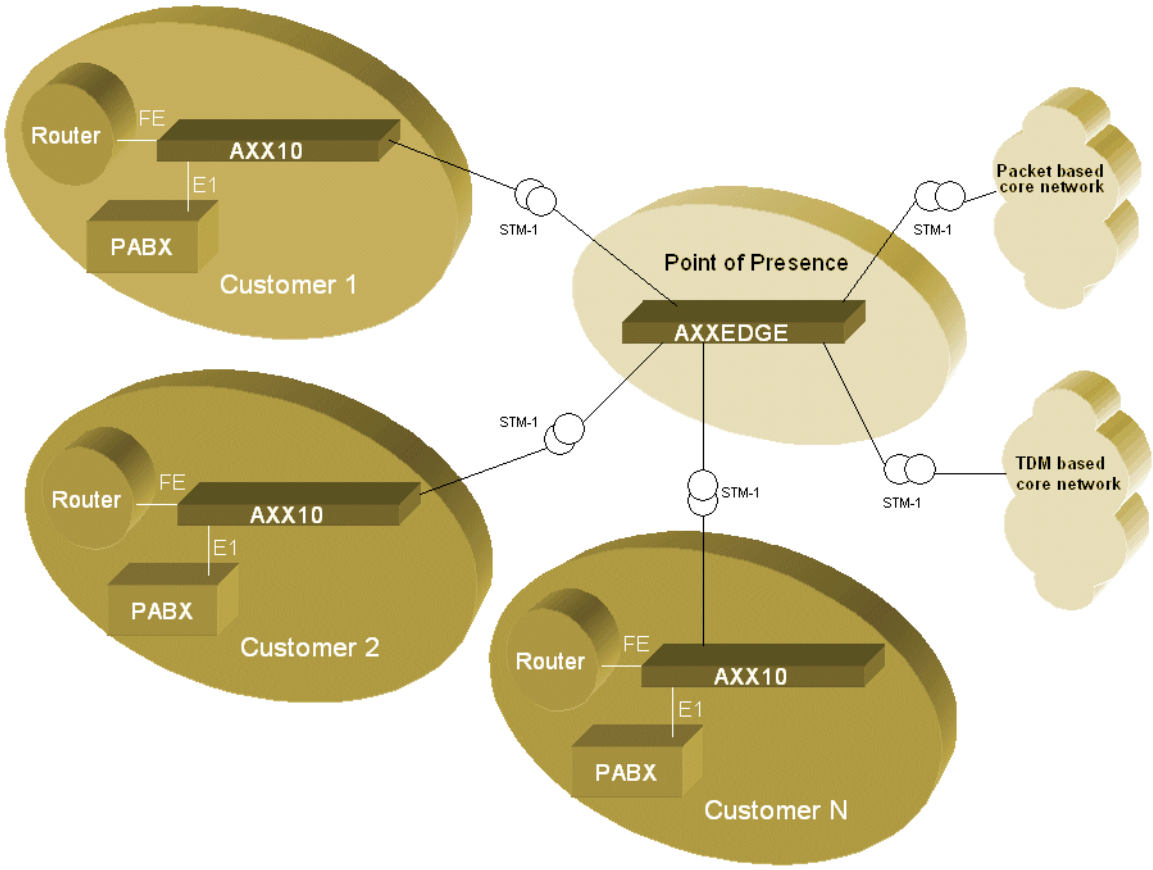

Figure 1-2. Typical system with AXX10 connected to an AXXEDGE

1.2 FEATURES

1.2.1 SDH Features

Multiplexing structure and Mapping modes

The aggregate interface supports only terminal multiplexer functions, and 63xVC-12 mapping. There is no support for VC-3 mapping.

The figure below shows the internal structure of AXX10. The bridge receives an Ethernet frame/IP datagram on one of the ports and decides on which port to send it out. The Ethernet Mapper converts between Ethernet frames and VC-12s while the Tributary Mapper converts between E1 signals and VC-12s. The SDH Multiplexer is responsible for the multiplexing of VC-12s into STM-1. The VC-12s are sent to - and received from - either the Tributary Mapper or the Ethernet Mapper.

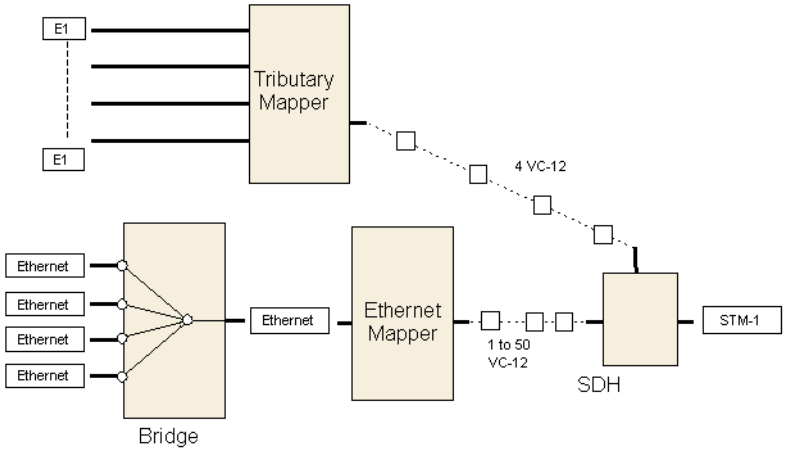

Figure 1-3. Multiplexing and mapping in AXX10.

Figure 4 shows the multiplexing structure supported in AXX10 R1.

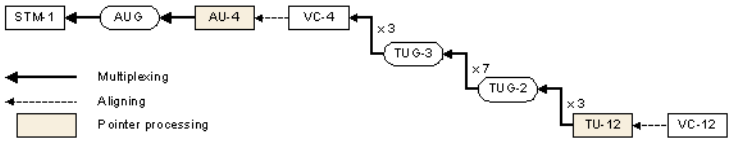

Figure 1-4. Multiplexing structure in STM-1.

The WAN traffic is mapped into a number of VC-12 containers in a round-robin fashion with an inverse multiplexer function. The IP traffic is mapped into 1 to 50 VC-12 containers.

The AXX10 only have one WAN channel. The total bandwidth for one WAN channel cannot be greater than 100 Mbit/s or 47xVC-12 containers.

The mapping between the tributary interfaces and the WAN port is fixed.

Protection

Protection is not supported.

Performance monitoring

The AXX10 R1 offers G.826 performance monitoring at the RS, MS, VC-4, and VC-12 levels in the SDH hierarchy. This includes B1 near end in RSOH section, B2 near and far end in MSOH section, B3 near and far end at VC-4 level and BIP-2 near and far end at VC-12 level.

The AXX10 transfers the content of the error counter to the AXXEDGE and the AXXEDGE calculates excessive error and degrade signal defects assuming Poisson distribution of errors, according to ITU-T G.826 for AXX10.

See the AXXEDGE R1.1 product specification for more details.

Synchronization

The AXX10 does not support full SDH SETS functionality.

AXX10 R1 can synchronize to the following sources:

- The STM-1 interface
- A local oscillator (AIS oscillator with an accuracy of +/- 20ppm).

The STM-1 interface has the highest priority. If it fails then the internal oscillator is used. Switchback to the selected source is performed automatically whenever it becomes possible again.

1.2.2 IP Features

Bridge

The bridge is a transparent multi-port remote Ethernet bridge as specified in IEEE 802.3. The Bridge consists of one to four LAN ports and one WAN port. Each port may have its own MAC address, but in most configurations one MAC address for the whole bridge is sufficient. The four LAN ports support 10/100BaseT Ethernet for UTP cables. Both 10 Mbit/s and 100Mbit/s are supported with auto-negotiation. The LAN ports are compatible with IEEE 802.3.

The bridge supports the following features:

- MAC switching
- Self-learning MAC Addresses
- Support of up to 1024 MAC addresses
- Automatic Ageing for MAC addresses
- Transparent Bridging
- Back pressure and flow control Handling
- Auto negotiation
- Auto crossover
- 802.1p priority

The filtering rate of the bridge is able to operate at full wire speed. The forwarding rate is only limited by the forwarding interface speed, i.e. the selected WAN channel speed.

The AXX10 supports two different WAN speeds; 10 Mbit/s and 100 Mbit/s.

1.2.3 TDM Features

AXX10 R1 provides four 120-ohm 2.048 MHz Tributary ports on the customer side. An external balun supports 75-ohm operation.

Each Tributary Port can be individually configured to run in one of the following modes:

- G.703 Transparent (TRA)
- ISDN Primary Rate Access (PRA)

PRA is implemented according to ETS 300011 and ETS 300233. Note that AXX10 only implements the PRA NTE functions.

Two test loops are provided per Tributary Port, one in the customer direction (LL3) and one in the network direction (LL2), see Figure 5.

One Tributary Port can have only one loop activated at a time.

The test loops can be activated, deactivated and monitored by the management system.

The loop control logic depends on the tributary mode (TRA or PRA).

- In TRA mode the management system can operate the loops at any time as long as the port is enabled.
- In PRA mode the loops are supposed to be controlled by some exchange termination equipment (ET) via inband channel 0 control bits. In this mode it is not possible to operate the loops from the AXX10 management system.

To change the tributary mode, the loop must be cleared.

The Test Indicator LED is ON if any tributary loop is closed, regardless of the tributary mode.

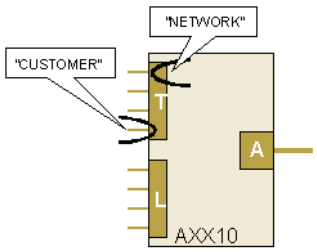

Figure 1-5. Test loops

The AXX10 does not have any X.21 interfaces or an E3 interface.

1.2.4 LED Indicators

The LED Indicators are used to visualize the AXX10 status:

Indicator	Colour	Function
Speed Indicators	GreenYellow	LAN Speed indicator (one LED per LAN Port)100 Mbit/s10 Mbit/s
Link indicator	GreenBlinking	LAN link status (one LED per LAN port)Link is up and with no trafficLink is up and with traffic
Equipment Indicator	Red	Alarm on the AXX10 customer side, i.e. Tributary Ports
Traffic Indicator	Red	Alarm on the AXX network side (Aggregate Port incl. VC12) or the device itself.
Test Indicator	Yellow	Test loop is present
Power Indicator	Green	Power OK

Table 1.1. LED Indicators

NOTE *The speed and link indicator LED's are an integral part of the LAN connectors. The upper right LED is the link indicator and the upper left LED is the speed indicator.*

1.2.5 DCN Features

General

The AXX10 use the SDH DCC channel to communicate with the AXXEDGE. The protocol format is proprietary and AXX10 cannot be connected to other network elements.

The details of this protocol are not described in this specification.

1.3 EQUIPMENT DESCRIPTION

1.3.1 Physical interfaces

This chapter describes the different types of physical interfaces in AXX10. The table below gives the relationship between the type of interface and the logical names used in this document (e.g. in Figure 1.1).

Interface	No. of interfaces	Logical Name
Optical	1	Aggregate Port
Tributary	4	Tributary Port
Tributary X.21	0	X.21 Port
Tributary E3	0	E3 Port
Ethernet	4	LAN Port
RS232	1	CLI Port
Power supply	1	-48V DC
Indicators	12	4 Speed Indicators, 4 link indicators, Power Indicator, Operator Indicator, Customer Indicator and Test Indicator

Table 1.2. Physical interfaces

Optical

For AXX10 the transmission over the optical interface is bi-directional on one fibre or uni-directional on two fibres. Different wavelengths are used in transmit and receiver direction.

The two-fibre interface is a standard S-1.1 interface. The single fibre interface is a proprietary interface with respect to optical parameters.

Connector type

The connector type can be one of the following:

- LC

Parameters

The definitions of optical parameters and reference points S and R refer to ITU-T G.957. Reference point S means transmit direction while R is the receive direction of the fibre.

Optical budget short haul two-fibre

Parameter	Value
Modulation rate on optical line	155 520 kbit/s
Wavelength range	1261 - 1360 nm
Transmitter at reference point S	
Source type	MLM
Spectral characteristics (max. RMS width)	7.7 nm
Mean launched power (max.)	-8 dBm
Mean launched power (min.)	-15 dBm
Min. extinction ratio	8.2 dB
Optical path between S and R	
Attenuation range	0 - 12 dB
Max. tolerable dispersion	96 ps/nm
Min. optical return loss	NA
Max. discrete reflectance between S and R	NA
Receiver at reference point R	
Min. sensitivity (BER < 1 in 1010)	-28 dBm
Min. overload	-8 dBm
Max. optical path penalty	1 db
Max. reflectance at R	NA

Table 1.3. Optical budget short haul two-fibre parameters

Optical output jitter

Filter bandwidth	Jitter limit
500 Hz - 1.3 MHz	0.50 Uipp
65 kHz - 1.3 MHz	0.10 Uipp

Table 1.4. Optical output jitter parameters

Input jitter

Frequency range	Jitter limit
500 Hz - 6.5 kHz	1.5 Uipp
6.5 kHz - 65 kHz	Decaying, slope equal to 20 dB/decade
65 kHz - 1.3 MHz	0.15 Uipp

Table 1.5. Optical input jitter parameters

Compliance

Standard	Comment
ITU-T G.652	Type of optical fibre (single fibre)
ITU-T G.707	Optical line signal
ITU-T G.783	RX pull-in and hold range
ITU-T G.813	Optical output jitter
ITU-T G.825	Optical input jitter
ITU-T G.957	Optical spectrumOptical output powerOptical eye diagram (Figure 2 in the specification)Optical extinction ratio (Chapter 6.2.4 in the specification)
ITU-T G.958	Input jitter measurement

Table 1.6. Optical interface compliance

Tributary Ports

Connectors

The connectors are RJ-45 connectors, with the following pin-out:

Pin	Signal
1	RxD+
2	RxD--
3	GND
4	TxD+
5	TxD--
6	Screen, Note 1
7	NC
8	NC

Table 1.7. Pin-out tributary interface

NOTE 1 *The outer screen is always connected to ground.*

Parameters

Input jitter

Frequency range	Jitter limit
20 Hz - 2.4 kHz	1.5 Uipp
2.4 kHz - 18 kHz	Decaying, slope equal to 20 dB/decade
18 kHz - 100 kHz	0.2 Uipp

Table 1.8. Tributary input jitter parameters

Input reflection loss

Frequency range	Reflection loss
51 kHz - 102 kHz	12 dB
102 kHz - 2048 kHz	18 dB
2048 kHz - 3072 kHz	14 dB

Table 1.9. Tributary input reflection loss

Output jitter

The requirements for output jitter in the absence of input jitter and pointer movements are:

Filter bandwidth	Jitter output (p-p)
20 Hz - 100 kHz	< 0.25 UI
700 Hz - 100 kHz	< 0.075 UI

Table 1.10. Tributary output jitter without pointer movements

The requirements for output jitter in the absence of input jitter but with pointer movements are:

Filter bandwidth	Jitter output (p-p)
20 Hz - 100 kHz	< 0.4 UI
700 Hz - 100 kHz	< 0.075 UI

Table 1.11. Tributary output jitter with pointer movements

Compliance

Standard	Comment
ETS 300 246	Connector
ETS 300 247	Connector
ETS 300 011	Impedance towards groundTolerable longitudinal voltage
ETS 300 126	Output signal balance
ITU-T G.703	Cable attenuationInput reflection lossInput port immunity against reflectionOutput pulse mask
ITU-T G.783	Output jitter in the absence of input jitter (Chapter 10.2.3.1 in the specification)Output combined jitter (Chapter 10.2.3.3 in the specification)
ITU-T G.823	Max. tolerable input jitter

Table 1.12. Tributary interface conformance

LAN Ports

Connectors

The connectors are RJ-45 connectors, with the following pin-out:

Pin	Signal
1	TxD+
2	TxD--
3	RxD+
4	NC
5	NC
6	RxD--
7	NC
8	NC

Table 1.13. Pin-out Ethernet ports

Parameters

The parameters on the Ethernet interface are in accordance with the specifications given in the Compliance chapter below.

Compliance

Standard	Comment
ISO/IEC8877	MAU MDI connector
IEEE 802.3	Section 14 and 24, physical medium.
ANSI X3.263 TP-PMD	Physical medium 100BASE-T

Table 1.14. Ethernet compliance

CLI Port

The CLI Port is accessible from the front side of the unit.

Connectors

The RS232 interface for AXX10 is provided using a RJ-45 connector, with the following pin-out:

Pin	Signal
1	GND
2	TxD
3	RxD
4	NC
5	NC
6	RTS
7	NC
8	NC

Table 1.15. Pin-out CLI connector

Parameters

The interface is running at a data rate of 19.200 baud.

The interface is in accordance with the specifications given in the Compliance chapter below.

Compliance

Standard	Comment
EIA RS-232	Physical interface

Table 1.16. CLI port compliance

Power supply (DC)

AXX10 support a dual -48V DC power supply interface.

Connectors

The -48V DC supply input is provided via a 4 pin power connector, (Molex Mini-fit 4x1) with the following pin-out:

Pin	Signal
1	0V
2	-48V (supply 1)
3	-48V (supply 2)
4	GND

Table 1.17. Pin-out DC connector

Parameters

The -48V DC input conforms to the specifications given in the table below.

Parameter	Limit
Power dissipation	Less than 9W (Note 1)
Fuse	0.5 A
Battery voltage range	-36 to -72V DC

Table 1.18. Electrical specifications at DC input

NOTE1 *Dependent on configuration*

Standard	Comment
ETS 300 132-2	Power supply interface, DC operating
ETS 300 253	Earthing and bonding

Table 1.19. Compliance power supply

Power supply (AC)

The AXX10 uses an external AC power-supply adaptor.

An external AC adapter can be ordered separately from AXXESSIT, Order code 50016-02AA.

Any AC-DC adapter with 48V nominal output that fulfills the requirements for AXX10 DC input port may be used. Be sure that the supply is double insulated and conforms to EN 60 950 standard.

Connectors

It is possible to support different markets with the necessary physical connectors.

Parameters

The 230V AC input conforms to the specifications given in the table below.

Parameter	Limit
Power dissipation	Less than 10W
Fuse	0.3A
Mains voltage	-230V AC +/- 10%

Table 1.20. Power supply parameters

Conformance

Standard	Comment
EN 60950	Single phase 230 V 50 Hz AC mains supply

Table 1.21. Power supply conformance

1.4 OTHER CHARACTERISTICS

1.4.1 Form of construction

The physical dimension of AXX10 is:

Height: 40 mm

Width: 300 mm

Depth: 160 mm

The weight of the unit is less than 1 kg.

The AXX10 can be used in desktop applications and rubber feet's are available.

It can also be used in wall mounting applications and a wall mounting kit is available.

A rack mounting kit for 19" racks as specified in IEC 60297 or ETSI racks as specified in ETS 300 119-4 is also available.

The thermal design of the unit meets the requirements of EN 60950.

1.4.2 Reliability

The service failure rate is met for an operational lifetime of at least 20 years.

The MTBF of a tributary channel is at least 40 years. This value does not include failures related to power supply or fibre infrastructure.

The overall error ratio of a tributary channel is better than $10E^{-10}$.

1.4.3 Environmental conditions

The equipment conforms to the requirements of EN50081-1 for radiated and conducted emissions.

The equipment conforms to the requirements of EN 50082-1 for radiated and conducted susceptibility.

The equipment is also compliant with these standards:

- EN 55022 Radiated emission
- EN 55024 Immunity requirements
- ETS 300 386 EMC for Telecom products
- EN 61000-3-2 Harmonic current emission
- EN 61000-3-3 Voltage changes, voltage fluctuations and flicker

- EN 61000-4-2 Electrostatic Discharge (ESD)
- EN 61000-4-3 Radiated Immunity
- EN 61000-4-4 Fast Transients
- EN 61000-4-5 Surges
- EN 61000-4-6 Conducted Immunity
- EN 61000-4-11 Voltage dips, short interruptions and voltage variation

1.4.4 Health and safety

The equipment meets the requirements in EN 60950 (Safety), ETS 300 753 (Acoustic noise) and EN60825 (laser safety).

1.4.5 Operation

The AXX10 operates in temperature controlled locations (Class 3.1 and 3.1E) and partly temperature controlled locations (Class 3.2) as specified in ETS 300 019-2-3.

1.4.6 Storage and transport

The AXX10 meets the requirements for storage in ETS 300 019-2-1 (Class 1.1).

It also meets the requirement for public transport in ETS 300 019-2-2 (Class 2.3).

1.4.7 History

This is the first release of the document.

1.5 APPENDIX

1.5.1 Abbreviations

Abbreviation	Description
ADM	Add Drop Multiplexer
BER	Bit Error Rate
CLI	Command Line Interface
COS	Class of service
DCC	Data Communications Channel
DCN	Data Communications Network
FTP	File Transfer Protocol
GUI	Graphical User Interface
HDLC	High-level Data Link Control
HW	Hardware
ICS	AXXESSIT version number
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISDN	Integrated Service Digital Line
ITU	International Telecommunications Union
KLM	Numbering scheme for containers in SDH
LAN	Local Area Network
LED	Light Emitting Diode
LL2/LL3	Local Loop 2/3
MAC	Medium Access
MIB	Management Information Base
MS	Multiplex Section
NE	Network Element
NTE	Network Termination Equipment
NV	Non-Volatile
PABX	Private Automatic Branch Exchange
PC	Personal Computer
PRA	Primary Rate Access
R1	Release 1
RAM	Random Access Memory
RFC	Request For Comment
RMON	Remote Monitoring
ROS	Routing Operating System
RS	Regenerator Section
RFC	Request For Comments
SDH	Synchronous Digital Hierarchy
SNMP	Simple Network Management Protocol
STM	Synchronous Transfer Mode

Abbreviation	Description
SW	Software
TFTP	Trivial File Transfer Protocol
TCP	Transport Control Protocol
TDM	Time Division Multiplex
TRA	Transparent (mode)
UDP	User Datagram Protocol
VC	Virtual Container
VLAN	Virtual LAN
VT-100	Terminal standard
WAN	Wide Area Network

1.5.2 References

AXXESSIT Documents

60016-01AA MR
AXX10 Market Requirements Specification

60006/5-1-2-1
Vision: Craft Terminal - AXXTMN Family

ITU-T Recommendations

G.652
Single Mode Optical Fibre

G.701
Vocabulary of Transmission and Multiplexing, and Pulse Code Modulation (PCM) Terms.

G.702
Digital Hierarchy Bit Rates

G.703
Physical/Electrical Characteristics of Hierarchical Digital Interfaces

G.704
Synchronous Frame Structures at Primary and Secondary Hierarchical levels.

G.706
Frame Alignment and Cyclic Redundancy Check (CRC) Procedures Relating to Basic Frame Structures Defined in Recommendation G.704

G.707
Network node interface for the synchronous digital hierarchy (SDH)

G.783
Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks

G.813
Timing characteristics of SDH equipment slave clocks (SEC)

G.825
The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)

G.832
Transport of SDH elements on PDH networks - Frame and multiplexing structures

G.841
Types and characteristics of SDH network protection architectures

G.957
Optical interfaces for equipments and systems relating to the synchronous digital hierarchy

G.958
Digital line systems based on the synchronous digital hierarchy for use on optical fibre cables

X.150
Principles of maintenance Testing for Public Data Network using Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) test Loops

Cenelec Documents

EN 50082-1
Generic immunity standard Industrial environment

EN 55022
Specification for Limits and methods of Measurement of Radio Interference Characteristics of Information Technology Equipment

EN 55024
Electromagnetic Compatibility Requirements for Information Technology Equipment (Previously EN 55101)

EN 60825
Radiation Safety of Laser Products

EN 60950
Safety of Information Technology Equipment Including Electrical Business Equipment

EN 61000-3-2
Electromagnetic compatibility (EMC). Part 3: Limits; Section 2: Limits for harmonic current emissions (equipment input current £16 A per phase)

EN 61000-3-3
Electromagnetic compatibility (EMC). Part 3: Limits; Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current £16 A

EN 61000-4-2
Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques; Section 2: Electrostatic discharge immunity test. Basic EMC Publication

EN 61000-4-3
Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques; Section 3: Radiated, radio-frequency, electromagnetic field immunity test

EN 61000-4-4
Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques; Section 4: Electrical fast transient/burst immunity test. Basic EMC Publication

EN 61000-4-5
Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques; Section 5: Surge immunity test

EN 61000-4-6
Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques; Section 6: Conducted disturbances induced by radio-frequency fields

ETSI documents

ETS 300 011
Integrated Services Digital Network (ISDN); Primary rate user-network interface; Layer 1 specification and test principles

ETS 300 019-2-1
Environmental engineering (EE); Environmental conditions and environmental tests for telecommunication equipment Part 2-1: Specification of environmental test; Storage

ETS 300 019-2-2
Environmental engineering (EE); Environmental conditions and environmental tests for telecommunication equipment Part 2-2: Specification of environmental test; Transportation

ETS 300 019-2-3
Environmental engineering (EE); Environmental conditions and environmental tests for telecommunication equipment Part 2-2: Specification of environmental test; Stationary use at weatherprotected locations

ETS 300 119-4
Equipment engineering (EE): European telecommunication standard for equipment practice Part 4: Engineering requirements for subracks in miscellaneous racks and cabinets

ETS 300 132-2
Environmental engineering (EE): Power supply interface at the input to the telecommunication equipment: Part 2 Operated by direct current (dc)

ETS 300 233
Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate

ETS 300 253
Environmental engineering (EE): Earthing and bonding configuration inside telecommunication centres

ETS 300 386
Electromagnetic compatibility and radio spectrum matters (ERM); Telecommunication network equipment; Electromagnetic compatibility (EMC) requirements

ETS 300 752
Equipment engineering (EE): Acoustic noise emitted by telecommunication equipment

IEEE Documents

IEEE 802.1p

IEEE 802.1d
IEEE Standard for Information technology--Telecommunications and information exchange between systems--IEEE standard for local and metropolitan area networks--Common specifications--Media access control (MAC) Bridges

IEEE 802.2
IEEE Standard for Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements--Part 2: Logical Link Control

IEEE 802.3
Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements--Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

IEC documents

IEC 60917-2
Modular order for the development of Mechanical structures for electronic equipment practice

IEC 60297-3
Dimension of mechanical structures of the 482.6mm (19 in) series Part 3 Subracks and associated plug-in units

Technical Description

Credits

This technical description could not have been created without the help from people involved in developing our products.

V.Sebjørnsen
Technical author

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