KEYMILE

User Manual

TUGE1
tuge1_r1c, tuga1_r1a

TDM G.703 interfaces

XMC20

XMC20

Document PEC

EN/LZTBU 372 143/2 RB

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1 Preface

1.1 Precautions and Safety

Before you handle any equipment you must comply with the safety advices.

Adherence to the safety instructions ensures compliance with the safety requirements as defined in EN 60950 (Safety of Information Technology Equipment).

Please refer to the following document:

[202] Safety Instructions “Precautions and safety”.

1.2 Symbols and Notations

This User Manual uses the following symbols:

Risk of operating trouble!

Indicates that an action may lead to operating trouble or loss of data.

→ Possible actions are given.

Please note:

Shows significant information.

→ Possible actions are given.

1.3 Interfaces and Circuit Categories

Table 1: Electrical interfaces and circuit categories

TUGE1 interface	Circuit category according to EN 60950-1	Max. rating	
		Voltage	Current
Local power supply	TNV2	< 72 V_{DC}	< 0.2 A
G.703	TNV1	< 2 V	< 15 mA

1.4 Document History

Table 2: Document history

KEYMILE PEC	Date	XMC20 Release	Changes since previous version
LZTBU 372 143/2 RB	November 2015	R4C/R6B	Revision for the XMC20 system releases R4C and R6B
LZTBU 372 143/2 RA	May 2015	R4C/R6A	Support of contradirectional interfaces with the new ESW tuga1_r1a.
LZTBU 372 143/1 RA	March 2015	R6A	Revision for the XMC20 system release R6A
LZTBU 372 143 RC	February 2015	R4C	First revision for the XMC20 system release R4C

1.5 Target Audience

This User Manual is targeted at persons who are entrusted with the installation, provisioning, operation and administration of the system.

The persons targeted are

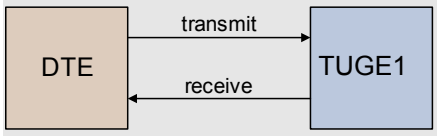
- the installation personnel, and/or
- the provisioning personnel, and/or
- the operation and administration personnel

Please note:

Only trained and skilled personnel (maintenance staff as per EN 60950) may install and maintain the system.

1.6 Definition of Terms

Table 3: Specific terms

Term	Explanation
Receive direction	Direction from the TUGE1 data interface towards the DTE.
Transmit direction	Direction from the DTE towards the TUGE1 data interface. 

2 Introduction

2.1 General

This document describes the architecture and functions of the TUGE1 unit and shows, how this unit is commissioned and operated as part of the XMC20.

The TUGE1 unit is a 1-slot wide service unit of XMC20. It supports eight codirectional or two contradirectional E0 (64 kbit/s) full duplex data interfaces according to ITU-T G.703.

- With the tuge1_r1c ESW the TUGE1 unit provides the **codirectional** interface type.
- With the tuga1_r1a ESW the TUGE1 unit provides the **contradirectional** interface type.

The interface timing is synchronised to the XMC20 network element PETS (plesiochronous equipment timing source).

The TUGE1 unit supports the connection of two DTEs via a synchronous TDM network. At both ends the DTE is connected to a TUGE1 unit which converts the E0 data signal to a 64 kbit/s digital signal (and vice versa). The digital signal is transported through the TDM network to a XMC20 network element where the TUGE1 unit converts the digital signal back to the E0 data signal (and vice versa).

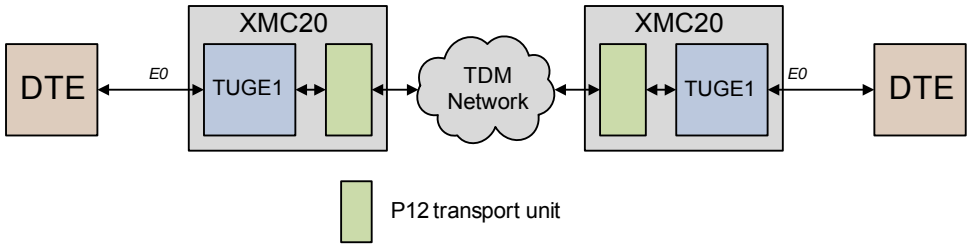


Figure 1: DTE connection to a TUGE1 unit

The TUGE1 unit as a XMC20 TDM unit provides PBUS (XMC20 TDM bus) access. TUGE1 has a physical access capacity of 4 x 2 Mbit/s towards the XMC20 internal cross connection backplane, PBUS, allowing access of the eight or two data user ports with 8 x 64 kbit/s or 2 x 64 kbit/s.

The following network features help to enhance the systems availability:

- 1+1 linear trail protection switching.
- 1+1 linear subnetwork connection protection switching.

TUGE1 is connected to a TDM transport unit as e.g. a STM14 unit via the PBUS in the backplane of XMC20.

2.2 Unit View

Figure 2: TUGE1 unit view

Figure 2 "TUGE1 unit view" shows the TUGE1 unit hardware. On the front plate are two LEDs for the unit- and traffic failure indication. The connector for the eight data interfaces is based on the standard DIN 41 612.

3 Functions and Specifications

The TUGE1 unit provides the following functions and conforms to the corresponding standards and recommendations (conformance to applicable parts of the standards).

3.1 Feature Licences

Part of the XMC20 functionality is subject to feature licences. For more information on feature licences please refer to [012] Release Note “XMC20” and to [915] Technical Bulletin “Feature Licences for XMC20”.

3.2 Summary of Standards

Table 4: Standards

Feature	Standard	
Data interface and transport	ITU-T - ITU-T G.703 (11/2001) Physical/electrical characteristics of hierarchical digital interfaces ETSI - ETSI EN 300 417-5-1 V1.2.1, 2001-10 Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 5-1: Plesiochronous Digital Hierarchy (PDH) path layer functions - ETSI EN 300 417-1-1 V1.2.1, 2001-10 Transmission and Multiplexing (TM); Generic requirements of transport functionality of equipment; Part 1-1: Generic processes and performance - EN 300 166 V1.2.1 (2001-09) Transmission and Multiplexing (TM); Physical and electrical characteristics of hierarchical digital interfaces for equipment using the 2 048 kbit/s - based plesiochronous or synchronous digital hierarchies	r1a
Performance parameters and limits	ITU-T - ITU-T G.826, 12/2002 End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections	r1a
Maintenance functions	ITU-T - ITU-T X.150, 11/88 Principles of maintenance testing for public data networks using Data Terminal Equipment (DTE) and Data Circuit terminating Equipment (DCE) test loops	r1a

3.3 Data interface Functions and Specifications

Table 5: Data interface functions and specifications

Feature	Rating or standard	Release
Type of interfaces	G.703, 64 kbit/s codirectional, or G.703, 64 kbit/s contradirectional	r1a
Codirectional interface (ESW tuge1_rxx)		
- Number of available data interfaces	8	r1a
- Wire pairs	One wire pair per transmission direction	r1a
- Impedance	120 Ohm, balanced	r1a
- Code	According to Figure 4 of ITU-T G.703 - octet timing = violation of the polarity alternation	r1a
- Data signalling rate	256 kbaud	r1a
- Jitter tolerance	According to Table 15 of ITU-T G.823	r1a
- Line attenuation at 128 kHz	0 … 3 dB	r1a
- Synchronization	Synchronized to the network element (NE) timing source with octet slips	r1a
Contradirectional interface (ESW tuga1_rxx)		
- Number of available data interfaces	2	r1a
- Wire pairs	Two wire pairs per transmission direction	r1a
- Impedance	120 Ohm, balanced	r1a
- Code	According to Figure 7 of ITU-T G.703 - octet timing = violation of the timing signal polarity alternation	r1a
- Data signalling rate	64 kbaud	r1a
- Line attenuation at 32 kHz	0 … 3 dB	r1a
Common specification		
Pulse amplitude, R_L = 120 Ohm	1.0 ± 0.1 V	r1a
Output jitter	0.001 UIpp [a]	r1a
Transfer delay, data interface to data interface	≤ 1291 µs	r1a

a. 1 UI = 15.625 µs

3.4 General Functions and Specifications

Table 6: General functions and specifications

Feature	Rating or standard	Release
Front connector data interface	DIN 41612 2 x 32 pins, rows a and c	
No hardware settable options on the unit	All unit parameters are software settable with the element manager	
Hot swapping	You can replace a TUGE1 unit without interfering with any other units. No actions on powering, configuration or commissioning need to be taken if you remove/replace a TUGE1 unit	
PBUS access	4 x P12	r1a
Cross connections	Flexible cross connections to any other XMC20 TDM unit on the P0_nc traffic layer	r1a
Traffic protection		r1a
- Linear trail protection	1+1 unidirectional, revertive 1+1 unidirectional, non revertive	
- SNC/I protection	1+1 unidirectional, revertive 1+1 unidirectional, non revertive	
- Switching time	< 50 ms	
Performance monitoring	Octet slips (codirectional only) Protection switchover events	r1a
Alarm reporting	ITU-T X.733 (1992) Information technology – open systems interconnection – systems management: Alarm reporting function	r1a
Loops	Data signal	r1a
- Loop 2b	Remote loop, back-to-back	
- Loop 3b	Local loop, front-to-front	
Power consumption		
- Power supply range V_{BAT}	refer to [201] System Description “XMC20”	
- Maximum current consumption, I_{VBAT} V_{BAT} = -48 V	43 mA	
- Maximum total power requirement from battery, P_{TOT} V_{BAT} = nominal voltage	2.1 W	
Mechanical parameters		
- Construction practice	19 inch	
- Height of unit (1 HU = 44.45 mm)	6 HU	
- Width of unit (1 TE = 5.08 mm)	4 TE (1 slot)	
- Size of the PCB (H x D)	233 mm x 220 mm	
- Weight	400 grams	
- RoHS	Directive 2002/95/EC of the European Parliament and of the Council of 27.1.2003 on the Restriction of the use of certain hazardous substances in electrical and electronic equipment	
- WEEE	Directive 2002/96/EC of the European Parliament and of the Council of 27.1.2003 on waste electrical and electronic equipment	

Table 6: General functions and specifications (continued)

Feature	Rating or standard	Release
Reliability		
- Calculated MTTF at 35 °C (MIL-HDBK-217F)	109 years	
Emission	refer to [201] System Description “XMC20”	
Immunity	refer to [201] System Description “XMC20”	
Safety	refer to [201] System Description “XMC20”	
Ambient conditions	refer to [201] System Description “XMC20”	

4 Installation

4.1 Prerequisites

Before installing a TUGE1 unit take care to follow the safety advice as listed in [202] Safety Instructions “Precautions and safety”.

Valid combinations of hardware (HW) and embedded software (ESW) versions are given in [012] Release Note “XMC20”.

For the installation of XMC20 HW
refer to [301] User Guide “XMC25 Installation”, or
refer to [310] User Guide “XMC23 Installation”, or
refer to [322] User Guide “XMC22 Installation”.

Please note:

The XMC22 subrack is not available in the system release R4C.

4.2 Slots and Deployment Scenarios for the TUGE1 Unit

The TUGE1 unit uses one slot in the XMC20 subrack.

In a XMC20, the TUGE1 unit can be operated in any of the following slots:

- XMC25: 1 … 10, 12 … 21.
- XMC23: 7 … 10, 12 … 14.
- XMC22: 9 … 10, 12.

Slot 11 is reserved for the working COGE5 unit.

In maximum 20 TUGE1 units (without network connection) can be operated in a XMC25. The number of TUGE1 units is reduced when using TDM transport units as connection to the TDM network.

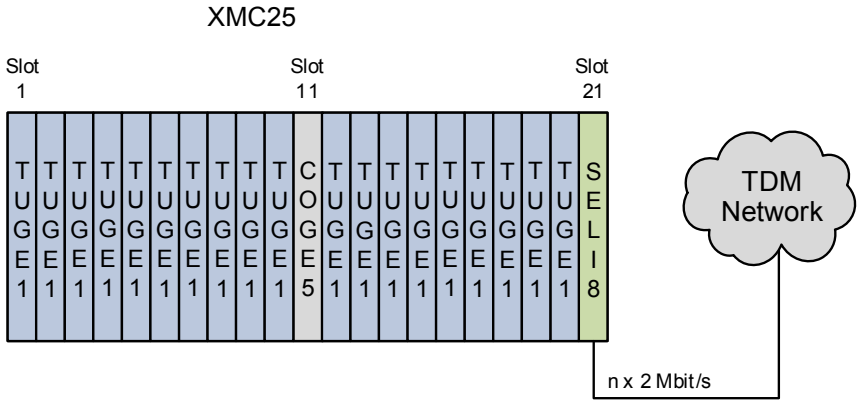


Figure 3: XMC25 subrack with 19 TUGE1 units and 1 SELI8 unit

The example above shows a XMC25 subrack equipped with 19 TUGE1 units, i.e. 152 codirectional or 38 contradirectional user data ports, which can be transported over a number of 2 Mbit/s links over the TDM network.

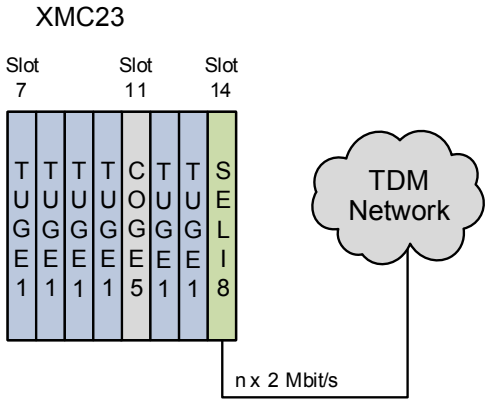


Figure 4: XMC23 subrack with 6 TUGE1 units and 1 SELI8 unit

The example above shows a XMC23 subrack equipped with 6 TUGE1 units, i.e. 48 codirectional or 12 contradirectional user data ports, which can be transported over a number of 2 Mbit/s links over the TDM network.

4.3 Compatibility

4.3.1 XMC20 Units

The deployment of a TUGE1 unit in XMC20 is compatible with any other XMC20 unit.

4.3.2 UMUX Units

The TUGE1 unit in XMC20 is interoperable with the GECOD unit in UMUX.

The TUGE1 unit in XMC20 is interoperable with the G.703 module of the subscriber interfaces for data (DSK) unit in XMP1.

4.3.3 Previous ESW Revisions

The TUGE1 unit with ESW release tuge1_r1c was first released for the XMC20 system release R4C. The ESW is compatible with the XMC20 system releases R6A and R6B.

The TUGE1 unit with ESW release tuga1_r1a was first released for the XMC20 system release R4C. The ESW is compatible with the XMC20 system releases R6A and R6B.

4.4 Connections and Cables

4.4.1 Connectors and Signals

The front connector of the TUGE1 unit has 64 pins (2x32, rows a and c are equipped).

4.4.1.1 Codirectional interfaces

The eight codirectional interfaces use 32 pins. Every interface consists of four wires, the a- and the b-wires for the receive and transmit direction.

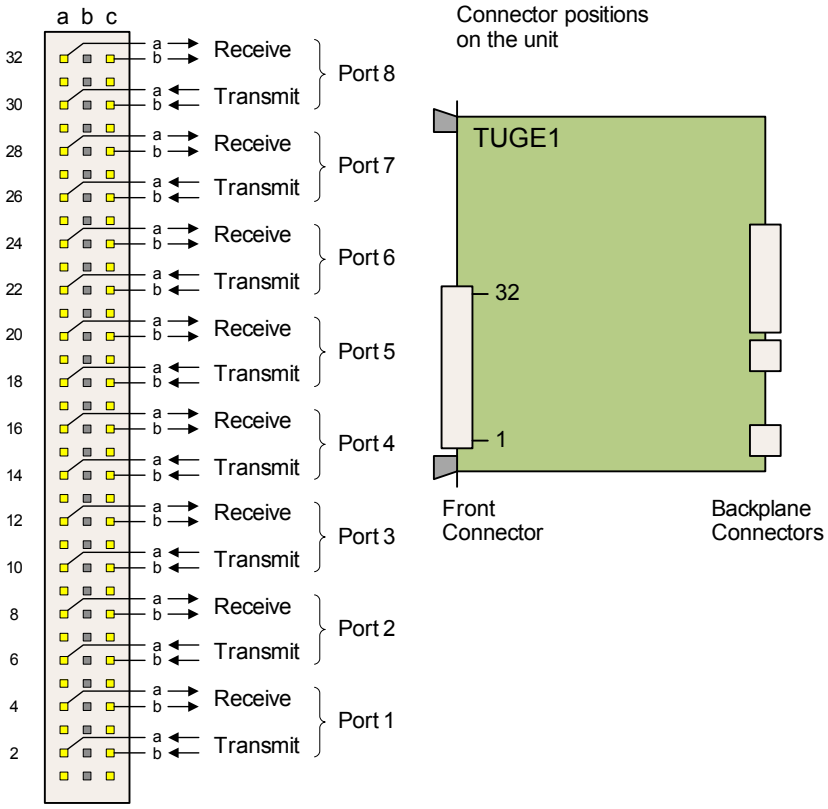


Figure 5: Pin-out of the TUGE1 front connector, codirectional, front view

4.4.1.2 Contradirectional interfaces

The two contradirectional interfaces use 16 pins. Every interface consists of eight wires, the a- and the b-wires for the receive and transmit direction.

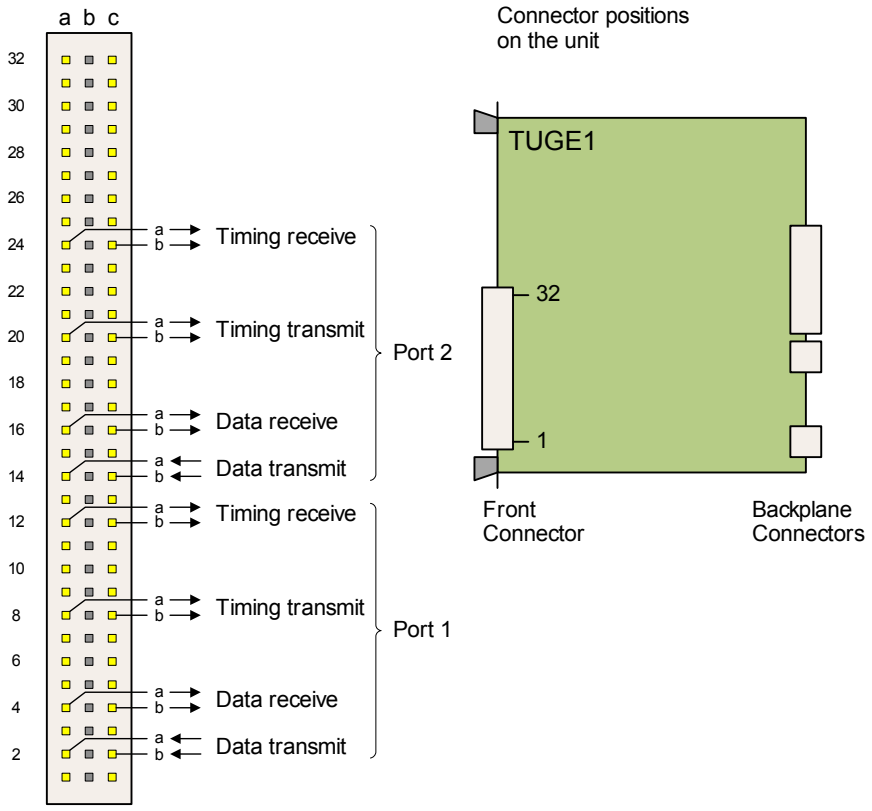


Figure 6: Pin-out of the TUGE1 front connector, contradirectional, front view

4.4.2 Cable 16 Pairs, DIN 41612 to open End

An open ended or unterminated cable with 16 pairs is used to connect the eight or two interfaces of the TUGE1 unit to the MDF. The MDF end of the cable is open ended.

The length of the cable can be specified (minimum length 2 m).

Latching clips must be used to secure the cable to the TUGE1 front connector.

For details on TUGE1 cables, please refer to [506] User Manual “XMC20 cables”.

4.4.3 Fixing the Cables to the Cable Tray

The cables must be attached to the cable tray of the XMC25 or the corresponding device of the XMC23 or XMC22.

The figure below shows the cable/cable tray assembly of the XMC25.

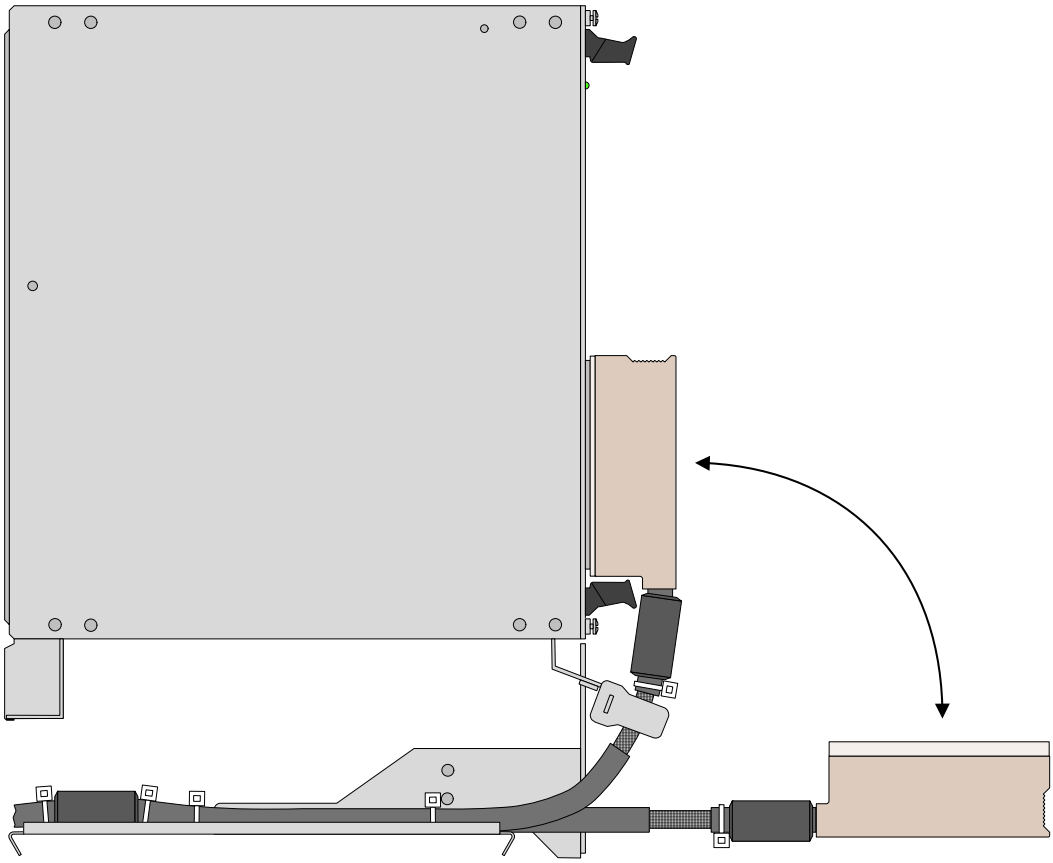


Figure 7: Side view of the XMC25 cable tray and cables

Please note:

The cable route on the cable tray should follow approximately the projection of the unit slot on the cable tray.

With the XMC23 and XMC22 the cable tray functionality is implemented differently and depends on the type of installation (rack-, wall-mounted).

For more information on fixing the cables with the XMC23 or XMC22 refer to [310] User Guide “XMC23 Installation” or refer to [322] User Guide “XMC22 Installation”.

5 Functional Description

This chapter gives the detailed functional description of the TUGE1 unit in the XMC20 subrack.

5.1 Data Interface Functions

5.1.1 Synchronous transmission

The TUGE1 unit supports the codirectional or contradirectional E0 interface according to ITU-T G.703.

5.1.1.1 Codirectional interface

The term “codirectional” describes an interface where the information and its associated timing are transported in the same direction.

The interface carries three signals for the transmit and receive direction on one balanced wire pair per direction:

- 64 kbit/s data signal (transmit or receive data),
- 64 kHz timing signal (bit timing),
- 8 kHz timing signal (octet timing).

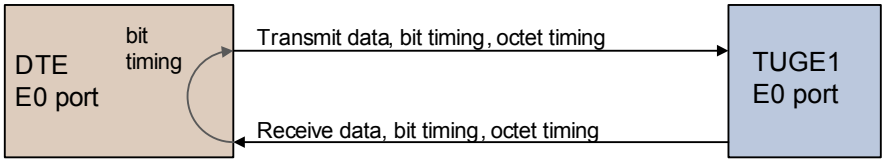


Figure 8: Codirectional timing

Typically in the DTE the bit timing is looped from the receive direction to the transmit direction.

On the TUGE1 unit in transmit direction, the bit and octet timing are recovered from the transmit data signal. The data are written to a 6 octet buffer with the recovered timing and finally mapped, octet by octet, to a 64 kbit/s time slot with the NE timing (PETS). In case the transmit signal is not synchronous to the NE timing the data rate is adapted with the repetition or elimination of a complete octet.

The transmit signal is monitored for a loss of signal condition or a loss of 8 kHz timing condition. Any of these conditions activates an alarm and activates the AIS insertion in transmit direction.

The 8 kHz timing monitoring and consequent AIS insertion can be enabled.

Please note:

When the 8 kHz timing monitoring is disabled, but the 8 kHz timing signal is still present, it will be used for the octet aligned mapping of user data to time slots.

Please note:

The transmit data signal cannot be used to synchronize the network element.

In receive direction, the user data rate is derived from the NE timing. The data and timing signals are fed to the interface.

In case of an alarm condition an alarm is reported and an AIS is inserted in receive direction.

In case of a loss of signal in transmit direction the octet timing in receive direction can be removed.

5.1.1.2 Contradirectional interface

The term “contradirectional” describes an interface where the timing for the receive and for the transmit direction is provided by the DCE, i.e. by the TUGE1 unit.

In receive direction the information and its associated timing are transported in the same direction.

In transmit direction the information and its associated timing are transported in opposite directions.

The interface carries the

- 64 kbit/s data signal for the transmit and receive direction on one balanced wire pair per direction.
- 64 kHz timing (bit timing) and the 8 kHz timing (octet timing) for the transmit and receive direction on one balanced wire pair per direction.

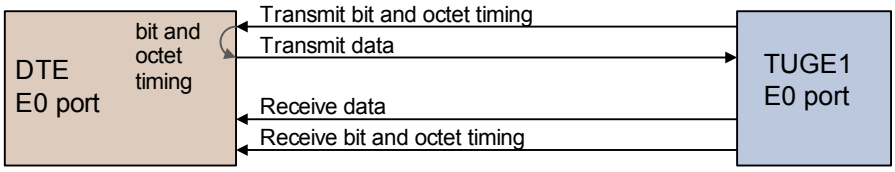


Figure 9: Contradirectional timing

In the DTE the transmit bit and octet timing are use to generate the transmit data signal.

On the TUGE1 unit the transmit data are mapped, octet by octet, to a 64 kbit/s time slot with the NE timing (PETS).

The transmit data signal is monitored for a loss of signal (LOS) condition. A LOS condition activates an alarm and activates the AIS insertion in transmit direction.

Please note:

The transmit data signal cannot be used to synchronize the network element.

In receive direction, the user data rate is derived from the NE timing. The data and timing signals are fed to the interface.

In case of an alarm condition an alarm is reported and an AIS is inserted in receive direction.

In case of a loss of signal in transmit direction the octet timing on the transmit timing signal can be removed.

5.1.2 Coding and Octet Timing

According to ITU-T G.703 the 8 kHz timing must be generated by the controlling equipment, i.e. the TUGE1 unit, but it is not mandatory for the DTE on the other side of the interface to either utilize or generate the 8 kHz timing signal. Therefore the 8 kHz timing monitoring and consequent AIS insertion can be enabled or disabled.

Please note:

The 8 kHz timing monitoring is only applicable for the codirectional interface type.

5.1.2.1 Codirectional interface

The E0 interface uses a 1B4T code with three voltage levels. Each data bit is coded with a 4 bit block on the line:

- A binary one is coded as 1100 block.
- A binary zero is coded as 1010 block.
- The polarity of consecutive blocks is alternated.
- The polarity alternation is violated every eighth block. The violation block marks the last bit in an octet.

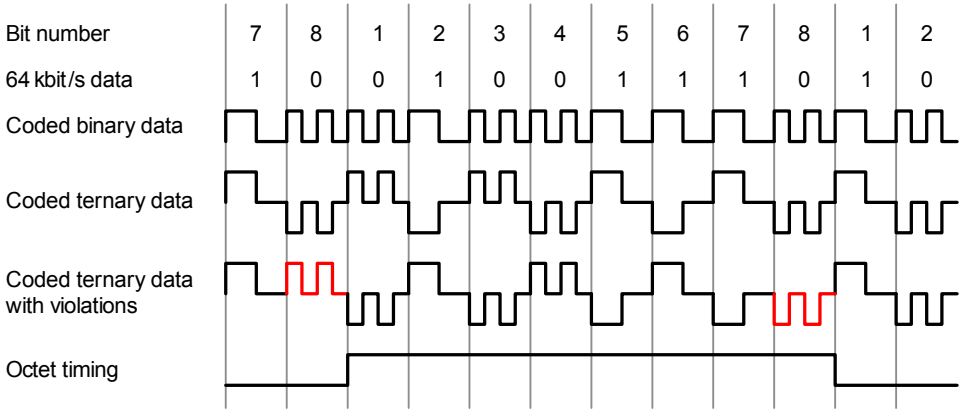


Figure 10: Codirectional signal coding

5.1.2.2 Contradirectional interface

The E0 interface uses for the data signal the AMI (Alternate Mark Inversion) code with a 100% duty cycle.

The 64 kHz timing signal is coded with the AMI code with a 50% duty cycle.

The 8 kHz timing is coded as AMI code violation in every eighth bit of the 64 kHz timing signal. The violation block marks the last bit in an octet.

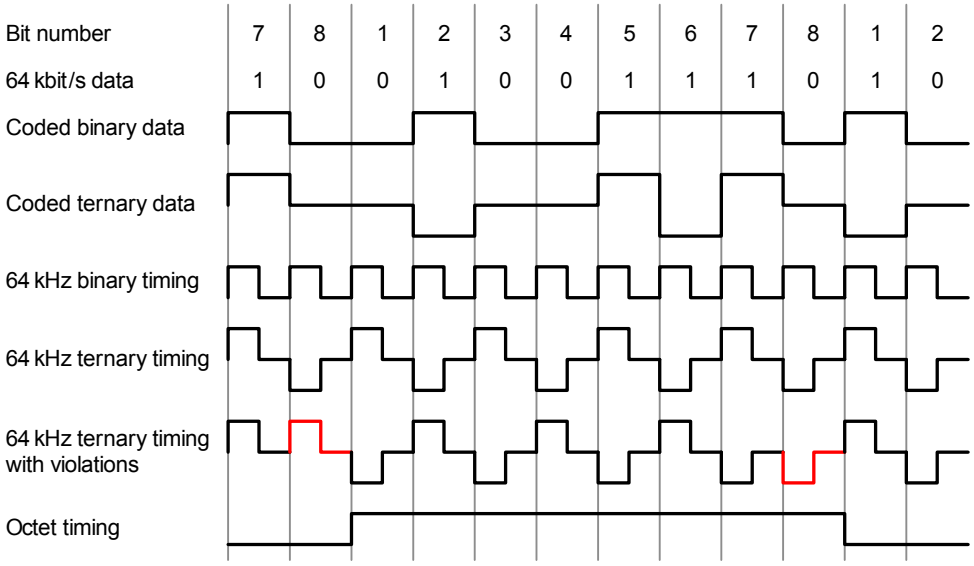


Figure 11: Contradirectional signal coding

5.2 Data and Timing Handling

The 64 kbit/s data interfaces of the TUGE1 unit are bit sequence independent.

5.2.1 Codirectional Interface

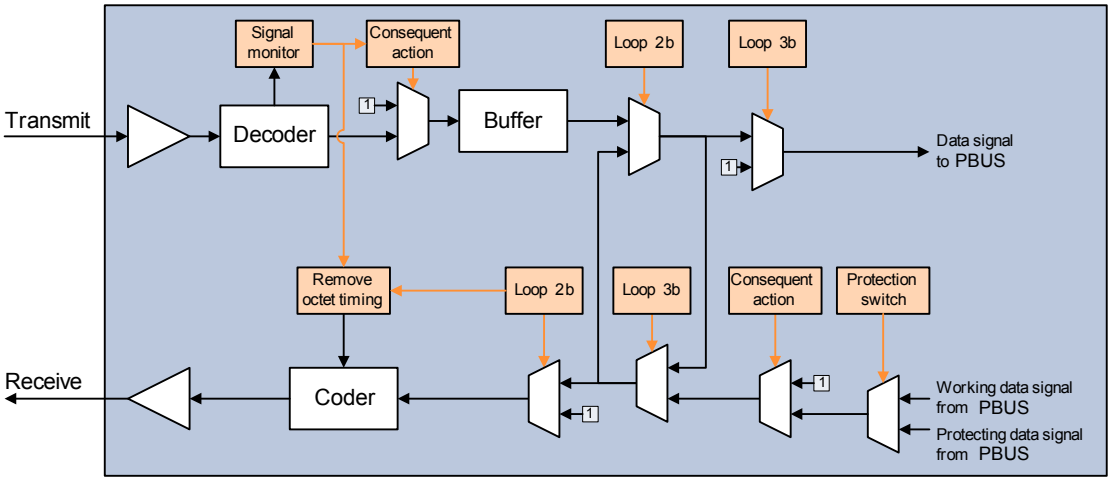


Figure 12: Codirectional data and timing transport

The data handling can be controlled with the following mechanisms. For the loop and consequent action handling please refer to section 5.2.3 Loops and consequent Actions (on page 26).

- Decoder:
  The decoder extracts the user data, bit and octet timing from the transmit signal.
- Signal monitor:
  The transmit signal is monitored for a loss of signal condition or a loss of 8 kHz timing condition.
  The 8 kHz timing monitoring can be enabled.
- Consequent action (transmit signal):
  A loss of signal condition or a loss of 8 kHz timing condition (if enabled) activates the following consequent actions.
  - Data AIS insertion in transmit direction.
  - 8 kHz timing removal in receive direction (configurable, loss of signal condition only).
- Buffer:
  The buffer with a depth of six octets adapts the transmit data timing to the NE timing.
  Positive and negative octet slips are counted.

5.2.2 Contradirectional Interface

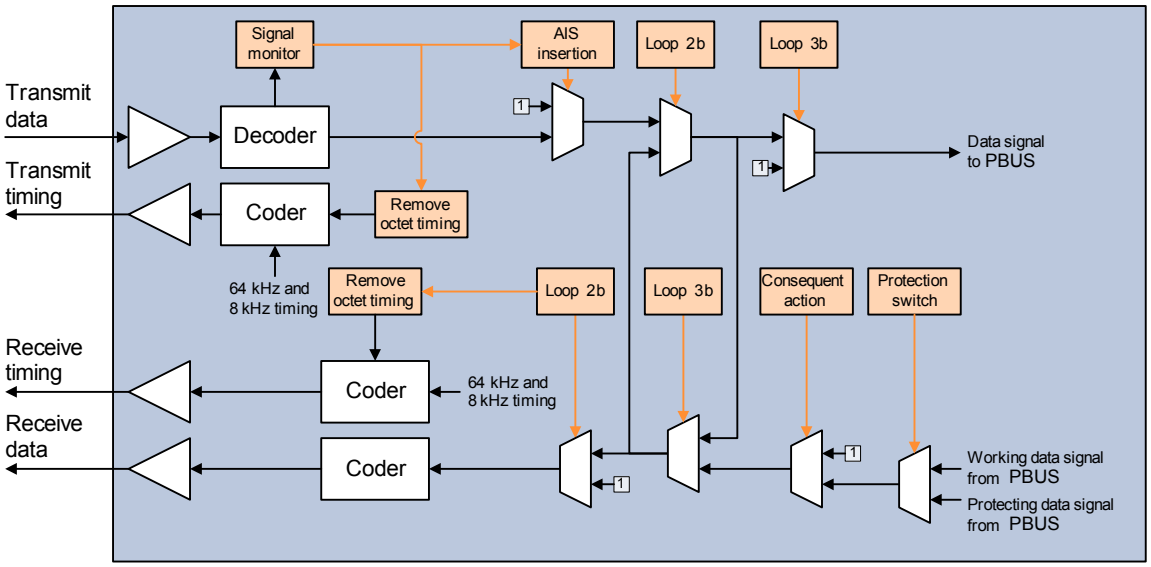


Figure 13: Contradirectional data and timing transport

The data handling can be controlled with the following mechanisms. For the loop and consequent action handling please refer to section 5.2.3 Loops and consequent Actions (on page 26).

- Decoder:
  The decoder extracts the user data from the transmit signal.
- Signal monitor:
  The transmit signal is monitored for a loss of signal condition.
- Consequent action (transmit signal):
  A loss of signal condition activates the following consequent actions.
  - Data AIS insertion in transmit direction (configurable).
  - 8 kHz timing removal in transmit direction (configurable).

5.2.3 Loops and consequent Actions

Please refer to Figure 12 "Codirectional data and timing transport" or to Figure 13 "Contradirectional data and timing transport" for the implementation of the control and maintenance mechanisms.

- Loop 2b:
  The maintenance function “Back-To-Back-2b” loop loops the receive data signal back to the transmit direction. With an active loop 2b
  - the receive data signal is replaced by AIS,
  - the 8 kHz timing in receive direction can be disabled (configurable).

  For details please refer to section 7.2 Loops (on page 34).
- Loop 3b:
  The maintenance function “Front-To-Front-3b” loop loops the transmit data signal back to the receive direction. With an active loop 3b the transmit data signal is replaced by AIS.
  For details please refer to section 7.2 Loops (on page 34).

- Protection switch:
  In receive direction a working and a protecting channel can be configured. Switching criteria are “trail signal fail” and “trail signal degrade” from the P12 transport unit. With CAS enabled in the CTP configuration, CAS AIS is an additional switching criterion.
- Consequent action (receive signal):
  A detected failure in the receive signal activates the following consequent actions.
  - Data AIS insertion in receive direction.
  - 8 kHz timing removal in receive direction.
- Consequent action (transmit signal):
  A detected failure in the transmit signal activates the following consequent actions.
  - Data AIS insertion in transmit direction (configurable for the contradirectional port type only).
  - 8 kHz timing removal in transmit direction (contradirectional port type).
  - 8 kHz timing removal in receive direction (codirectional port type).

5.3 Protection

5.3.1 Subnetwork Connection and linear Trail Protection

TUGE1 supports 1+1 linear trail protection (LTP) and 1+1 inherently monitored subnetwork connection protection (SNCP/I).

The difference between the two protection scenarios lies in the availability and usage of CAS.

- If CAS is available and used on the P12 transport path, the CAS AIS failure can be detected, which is then the 1+1 linear trail protection. Linear trail protection protects against server failures and disconnected matrix connections (via CAS AIS detection).

Please note:

LTP requires that CAS is available in the P12 transport signal (P12 termination mode = PCM30 or PCM30C) and that CAS is enabled in the user port configuration (CAS AIS Supervision = true).

- If CAS is not available only the server layer defects can be detected, which is then the 1+1 SNCP/I protection. SNCP/I protects against server failures.

1+1 protection provides the 1+1 unidirectional protection. The operation type can be configured to revertive or non-revertive.

The switching of the working and the protecting channel is done in sink direction only. On the source side a fixed bridge is used.

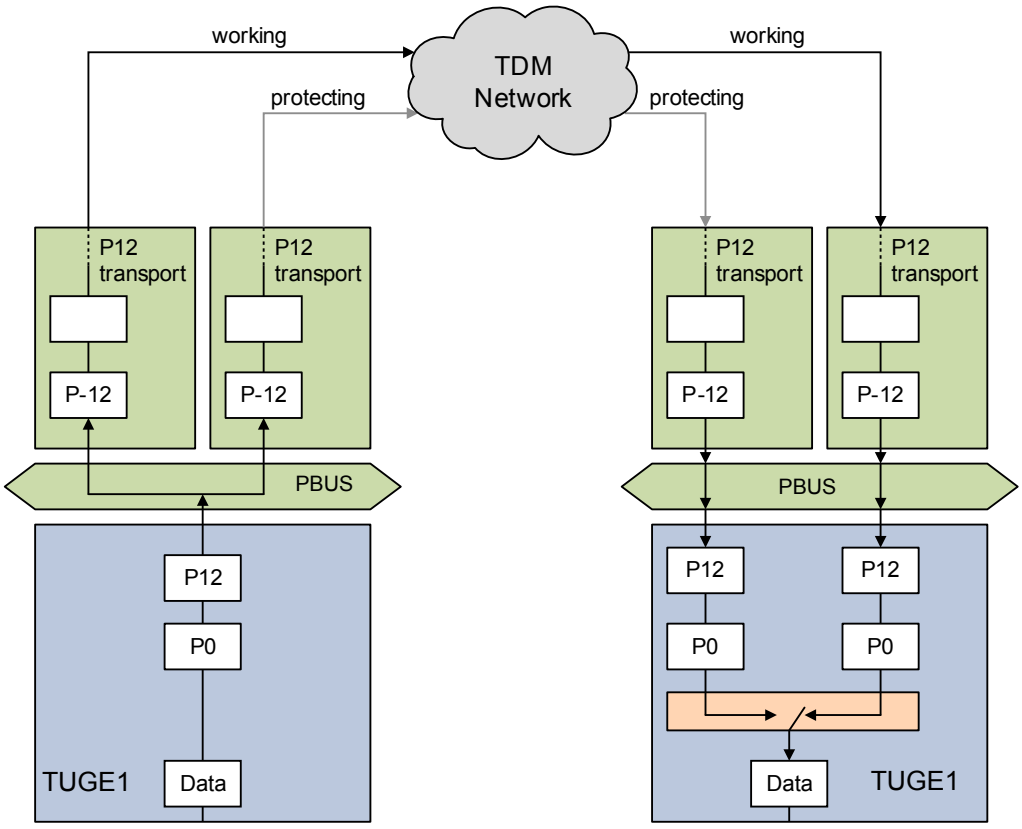


Figure 14: 1+1 protection

5.3.2 Protection Configuration

P0-nc protection switching takes place in the TUGE1 cross connect function.

Protection switching action can be driven by two different request types:

- Traffic signal requests:
  - Signal fail (SF)
    The SF state is activated if the analysis of the incoming server signal on the transport unit reports a signal failure, e.g. loss of signal.
  - CAS-AIS
    The CAS signalling pattern abcd of the received signal exhibits an AIS, i.e. abcd = 1111.
  - Signal degraded (SD)
    The SD state is activated if the analysis of the incoming server signal on the transport unit reports a degraded signal, e.g. BER 10^{-5}.
- External command requests:
  - Forced switch to working
  - Forced switch to protecting
  - Manual switch to working
  - Manual switch to protecting

Note that a forced switch is executed even when there is a failure on the target signal. A manual switch is executed only if the target signal exhibits no degradation or a less severe degradation than the active signal.

The external command requests are maintenance functions, i.e. they are not stored in the units database.

It is possible to check the status of the protection switch (working, protecting circuit) via the CTP status function.

For more information on cross connections and protection switching please refer to [314] User Guide “TDM Services and Cross Connections in XMC20”.

6 Commissioning

In this section, you will find a commissioning example of the TUGE1 unit and the configuration of a codirectional data interface.

Please refer to [355] User Manual “ECST” for details on the general ECST aspects, and to [302] User Guide “XMC25/XMC23/XMC22” for specific characteristics of the XMC20.

6.1 Commissioning of a Data Interface

6.1.1 Prerequisites

Before starting the commissioning of a data interface on the TUGE1 unit, the following prerequisites need to be fulfilled.

6.1.1.1 COGE5 unit

In a XMC20, a COGE5 needs to be in operation in slot 11 of the XMC20 subrack.

6.1.1.2 TUGE1 unit

The TUGE1 service unit is inserted into a slot of the XMC20 subrack. Available slots are listed in section 4.2 Slots and Deployment Scenarios for the TUGE1 Unit (on page 16).

A valid ESW (tuge1_r1c) is installed on the TUGE1 unit. For the management of ESW, refer to [355] User Manual “ECST”. For details about compatible ESW versions, refer to [012] Release Note “XMC20”.

Port-y of the TUGE1 unit is connected to a DTE.

6.1.1.3 TDM transport unit

A TDM transport unit is inserted in the XMC20 and is running with a proper ESW:

- SELI8,
- SDSL8,
- STM14,
- NUSA1,
- NUSA2.

6.1.1.4 Element manager

ECST needs to be installed on a PC, and a management connection from the ECST to the XMC20 needs to be up and running. For details about the installation and operation of the ECST, please refer to [355] User Manual “ECST” and [354] Quick Guide “ECST”.

The amount and accessibility of operations depend on the user profile with which you are logged in. For more information, please refer to [323] User Guide “Management Communication”.

6.1.1.5 PETS

The plesiochronous equipment timing source (PETS) on the XMC20 network element must be configured to an appropriate synchronization clock source, i.e. a clock source traceable to a PRC. For the PETS configuration refer to [314] User Guide “TDM Services and Cross Connections in XMC20”.

6.1.2 Configuration of a Data Interface

For the configuration of the user port, the following steps have to be performed.

Port configuration

This action list shows step by step how to configure a user port. The given example uses mostly the default values.

The following assumptions and identifiers are used:
- The TUGE1 unit is assumed to be plugged in slot-17 of a XMC25.
- The TUGE1 unit is assigned.
- The TUGE1 unit uses the codirectional port mode.
- The port to be configured has the identifier port-8.

Configure the port general parameters

Proceed as follows:

1. Navigate to the general parameters:
   - AP:/unit-17/port-8, Configuration - General.
2. Disable the octet timing monitoring:
   - Input Octet Timing Monitored = false.
3. Disable the consequent action on loss of the input signal:
   - Output Octet Timing Removed = false.
4. Execute “Apply”.

Configure the port CTP parameters

Proceed as follows:

1. Navigate to the CTP parameters:
   - AP:/unit-17/port-8, Configuration - CTP.
2. The CTP Configuration parameters are implicitly set and fixed. All displayed parameters are read-only.
3. Configure the z-End:
   - Enable the Revertive Protection Switching = true.
   - Disable the CAS AIS Supervision = false.
   - Disable the Switch-Over Logging = false.

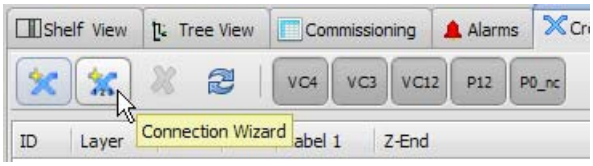
4. Execute “Apply”.

Result: The user port is completely configured.

Create the cross connection

Proceed as follows:

1. Configure the cross connection from the user port to a time slot on a STM14 unit. It is assumed that the connection termination point (CTP) on the STM14 unit has been created before on pdh/vc12-2/p12/chan-1.
2. Select the “Cross connections” view of the ECST.
   - Click on the “Connection Wizard” button:



   - The “Create TDM Connection” dialogue opens.
3. Set the connection parameters:
   - Layer Rate = P0-nc.
   - Directionality = Bidirectional.
   - Protected = No.
   - Label 1 = <anyName>.
   - Label 2 = <anyName>.
   - Number = 1.
4. Execute “Next ->”.
5. Select the Z-End CTP:
   - Select the TUGE1 unit, port-8.
6. Execute “Next ->”.
7. Select the A-End CTP:
   - Select the STM14 unit, pdh/vc12-1/p12/chan-1.
8. Execute “Create”.

Result: The bidirectional cross connection from the STM14 channel to the TUGE1 port is created.

Activation

Proceed as follows:

1. Select the “Tree View” of the ECST.
2. Set the administrative state of the port-8 to up
   AP:/unit-17/port-8, Main - Admin And Oper Status:
   - Set the Administrative Status to “Up”.
3. Execute “Apply”.

   → The “Operational Status” changes to “Up”.

Result: The port is activated.

End of instruction

7 Operation

This section describes the operation functions of the TUGE1 unit.

Please note:

The operation functions described in this section assume a correctly configured and operational TUGE1 unit.

7.1 Unit optical Indicators

LEDs on the front of the TUGE1 unit are used to indicate to the user the alarm status summary of the unit and of the network traffic signals.

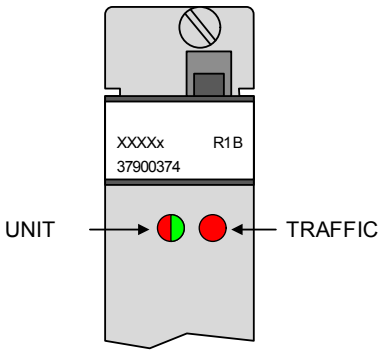


Figure 15: Fault indication LEDs on the TUGE1 unit

Table 7: LED signalling on TUGE1

LED name	Colour	State	Meaning
UNIT	Red	Failure	The unit is not in service. The unit is not able to provide the requested function due to: - equipment failure (total breakdown) - mismatch of HW and/or SW Replace the HW and/or ESW to recover from this situation.
	Green / Red (blinking 1 Hz)	Booting or waiting	The unit has not been taken into service yet or the unit has not been provisioned. Recovery from this situation is done by taking the unit into service with ECST.
	Green	Running	The unit is up and running, it is ready to provide the required service.
	Off	Failure	The system is not powered, or outage of the power supply on the unit, or outage of the LED, or the control unit is booting.
TRAFFIC	Red	Failure	One or more active failures on the unit independent from severity. Information about the failure/s can be obtained via ECST.
	Off	Normal	Error free operation. This is the default state under normal circumstances.

7.2 Loops

For maintenance purposes TUGE1 offers for the user ports two types of diagnostic loops.

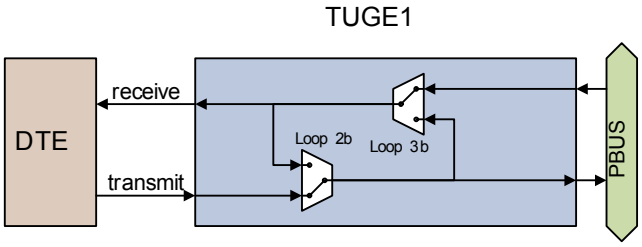


Figure 16: Loops 2b and 3b

- Local loopback 3b (Front-To-Front-3b):
  The signal from the local DTE is looped back to the local DTE.
  AIS is sent onward to the remote DTE.
  The connection between DTE and local user port can be tested.
- Network loopback 2b (Back-To-Back-2b):
  The signal from the remote DTE is looped back to the remote DTE.
  AIS is sent to the local DTE. The 8 kHz octet timing can be enabled or disabled during an active loop 2b to inform the DTE of the loop activation.
  The network connection between the local user port and the remote user port can be tested.

The loop signal conditions are according to ITU-T X.150.

Only one loop 2b or 3b can be active at the same time per port.

All loops can be activated by the element manager ECST.

Please note:

An active loop 2b or 3b is traffic disturbing.

Please note:

An active loop generates the alarm “Maintenance Function Active”.

7.3 Maintenance

7.3.1 Inventory Data

It is possible to read inventory data from the TUGE1 unit via the ECST at the following access point:

AP: /unit-x, Main - Inventory.

7.3.2 Unit ESW Download

It is possible to update the embedded software (ESW) of the TUGE1 unit via software download.

Please refer to [355] User Manual “ECST” for the description of the ESW download procedure.

Please note:

The assignment of new embedded software restarts the TUGE1 unit.
In most cases the traffic functions of the TUGE1 unit are not affected.

Risk of operating trouble!

If the new embedded software incorporates a code change of the onboard FPGA, the installation of new ESW on the unit will affect the traffic functions of the TUGE1 unit.

8 User Interface Reference

This section gives a complete reference of the managed objects, properties, and commands of the TUGE1 service unit as far as these are not covered in the generic descriptions in [302] User Guide “XMC25/XMC23/XMC22”.

For a description on how to configure and bring into operation the TUGE1 unit and its main functions, please refer to section 6 Commissioning (on page 30).

8.1 Introduction

Below, you will find a detailed description of all the configuration parameters and operations belonging to the managed objects model (MOM) for the specific parts of the TUGE1 unit.

The Figure 17 "MOM (managed object model) of the TUGE1 unit" shows the access point (AP) tree for the TUGE1 unit with its managed objects.

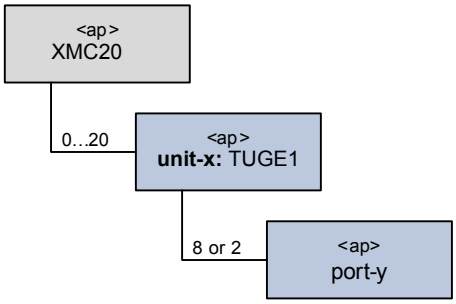


Figure 17: MOM (managed object model) of the TUGE1 unit

Please note:

The number of available ports per TUGE1 unit is as follows:

→ 8 codirectional ports with the ESW tuge1_r1c, or

→ 2 contradirectional ports with the ESW tuga1_r1a.

With these managed objects (MOs) the following functions are covered:

Table 8: Managed objects (MOs) for TUGE1

MO	Description of the management functions
unit-x: TUGE1 Rxx	Restart of the unit, management of the unit ESW, labelling, indication of equipment status, read of inventory data, access to logbooks. The detailed properties are described in section 8.2 AP: / unit-x: TUGE1 (on page 38).
port-y	Management of the data interface related functions, like the signal monitoring and consequent action handling. Maintenance functions. The detailed properties are described in section 8.3 AP: / unit-x / port-y (on page 40)

For each of the managed objects, properties and commands, the GUI “Tree Views” are given.

This reference section comprises the management functions:

- Overview,
- Main,
- Configuration,
- Fault Management,
- Performance Management, and
- Status.

Most of the APs only offer a part of the management functions listed above.

The order of appearance of the management function descriptions is in accordance with the APs in the ECST AP tree and the availability of the management functions of each AP.

In the tables of the sections below, the parameter default values for properties are underlined.

Please note:

For better legibility of numbers in this user guide, inverted commas are used when the number’s size exceeds three digits (e.g. 40’000). In parameter entry fields of the ECST, these inverted commas must not be entered. Instead, the numbers are entered without these inverted commas (e.g. 40000).

Please note:

Screenshots presented in this reference are examples and show configurations or data that may not correspond to the view you see when managing your XMC20 equipment.

8.2 AP: / unit-x: TUGE1

8.2.1 AP: / unit-x, Overview

For a description of the

- "Overview - Alarms", and
- "Overview - Cross Connections"

management functions, please refer to [302] User Guide "XMC25/XMC23/XMC22".

8.2.2 AP: / unit-x, Main

For a description of the

- "Main - General",
- "Main - Equipment",
- "Main - Inventory",
- "Main - Logbooks", and
- "Main - Software"

management functions, please refer to [302] User Guide "XMC25/XMC23/XMC22".

8.2.3 AP: / unit-x, Fault Management

For the a description of the general aspects of the

- "Fault Management - Status", and
- "Fault Management - Configuration"

management functions, please refer to [302] User Guide "XMC25/XMC23/XMC22". The following table lists the fault causes of the current AP.

Table 9: AP: / unit-x, Fault Management

ID	Fault Cause	Event Type	Traffic Affecting	Default Severity	Description
SWM	Software Mismatch	Equipment Alarm	☐	Minor	The running ESW does not match the assigned ESW.
SSWNA	Scheduled Software Not Available	Equipment Alarm	☐	Minor	The ESW that is scheduled for installation is not available on the unit. Make sure that the ESW is downloaded to the unit.
SWIN	Software Incompatible With Network Element	Equipment Alarm	☑	Major	The running ESW is not compatible with the version required by the NE type or version.
PRC	PBUS Resource Conflict	Processing Error Alarm	☑	Major	Unit has been plugged into a slot which conflicts with another unit, e.g. when using an outdated ESW on an ISDN-BA linecard.

Table 9: AP: / unit-x, Fault Management (continued)

ID	Fault Cause	Event Type	Traffic Affecting	Default Severity	Description
EQM	Equipment Malfunction	Equipment Alarm	☐	Critical	The TUGE1 controller detects any anomalies on the unit, e.g. a voltage is missing, a chip does not respond, etc.
HWIC	Hardware Incompatible With Configuration	Equipment Alarm	☑	Major	The plugged HW is not compatible with the unit configuration HW stored in the database. You may need to change the HW or re-create the configuration for the unit.
SWIC	Software Incompatible With Configuration	Equipment Alarm	☑	Major	The ESW running on the unit is not compatible with the unit configuration stored in the database. You may need to upgrade, or downgrade the ESW, or re-create the configuration with the currently running ESW.
GSW	General Software Alarm	Equipment Alarm	☐	Major	An ESW internal error has been detected that might inhibit the ESW from running correctly.
MFA	Maintenance Function Active	Communication Alarm	☑	Warning	A maintenance function has been activated by the operator from the unit status.
NSW	No Application Software	Equipment Alarm	☑	Major	There is no application ESW installed on the unit, or the application ESW has not yet finished its boot process.
UIC	Unit Incompatible	Equipment Alarm	☑	Major	The inserted unit is not compatible with the assigned unit.
UNAS	Unit Not Assigned	Equipment Alarm	☐	Warning	The unit is not assigned and cannot be configured. To assign the unit, execute the “Assign” command in the “Main” function of the unit.
UNAV	Unit Not Available	Equipment Alarm	☑	Critical	The unit that is configured is either not plugged or not recognized due to a failure.
PWRSVE	Battery Power Saving	Equipment Alarm	☑	Critical	Power saving is active on the unit, i.e. it is kept in the “reset” state during battery power backup.

8.3 AP: / unit-x / port-y

8.3.1 AP: / unit-x / port-y, Overview

For a description of the

- "Overview - Alarms",
- "Overview - Cross Connections", and
- "Overview - CTP"

management functions, please refer to [302] User Guide "XMC25/XMC23/XMC22".

8.3.2 AP: / unit-x / port-y, Main

8.3.2.1 AP: / unit-x / port-y, Main - General

For a description of the

- "Main - General"

management function, please refer to [302] User Guide "XMC25/XMC23/XMC22".

8.3.2.2 AP: / unit-x / port-y, Main - Admin And Oper Status

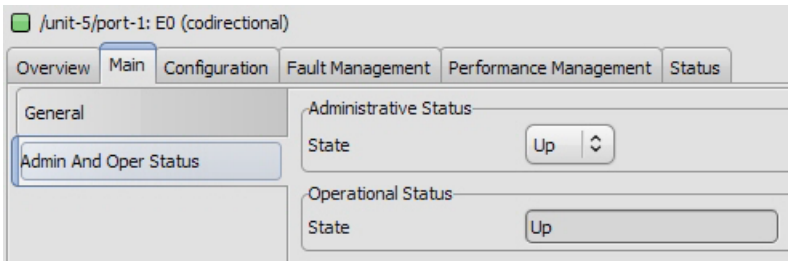


Table 10: AP: / unit-x / port-y, Main - Admin And Oper Status

Operation Name	Parameter Name	Range	Description / Details
Administrative Status	State	Up	Set the IETF administrative status of the port.
		Down	
Operational Status	State	Up	Display of the IETF operational status of the port. The operational state of a port is up when - the administrative state is up, and - the port is the z-End of a cross connection, and - the trail status has no TSF.
		Down	
		Testing	
		Unknown	
		Dormant	
		Not Present	
		Lower Layer Down	

8.3.3 AP: / unit-x / port-y, Configuration

8.3.3.1 AP: / unit-x / port-y, Configuration - General (codirectional only)

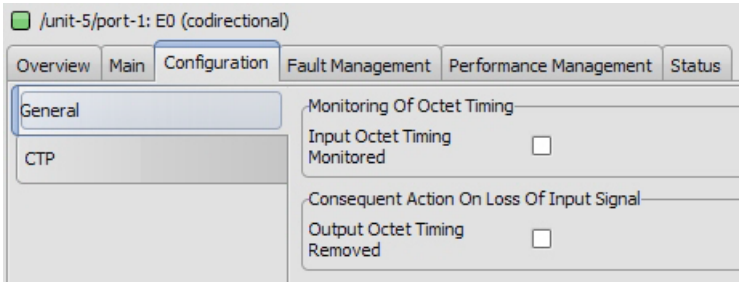


Table 11: AP: / unit-x / port-y, Configuration - General

Operation Name	Parameter Name	Range	Description / Details
Monitoring Of Octet Timing	Input Octet Timing Monitored	☑ ☐	Monitor the 8 kHz octet timing of the transmit signal. In case of a loss of the octet timing signal the LOOT alarm is activated. Data AIS is inserted in transmit direction.
Consequent Action On Loss Of Input Signal	Output Octet Timing Removed	☑ ☐	As a consequent action of the LOS alarm remove the 8 kHz octet timing in the receive direction on the data signal.

8.3.3.2 AP: / unit-x / port-y, Configuration - Error Handling (contradirectional only)

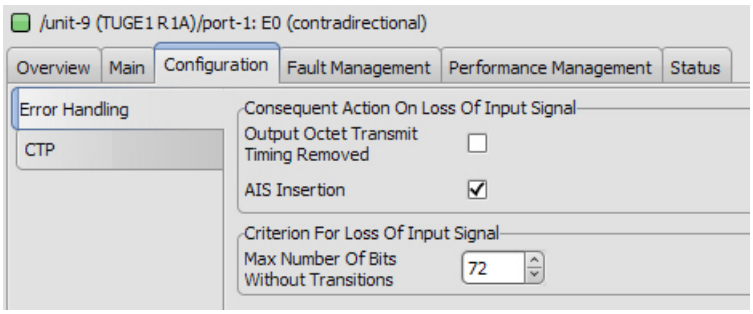
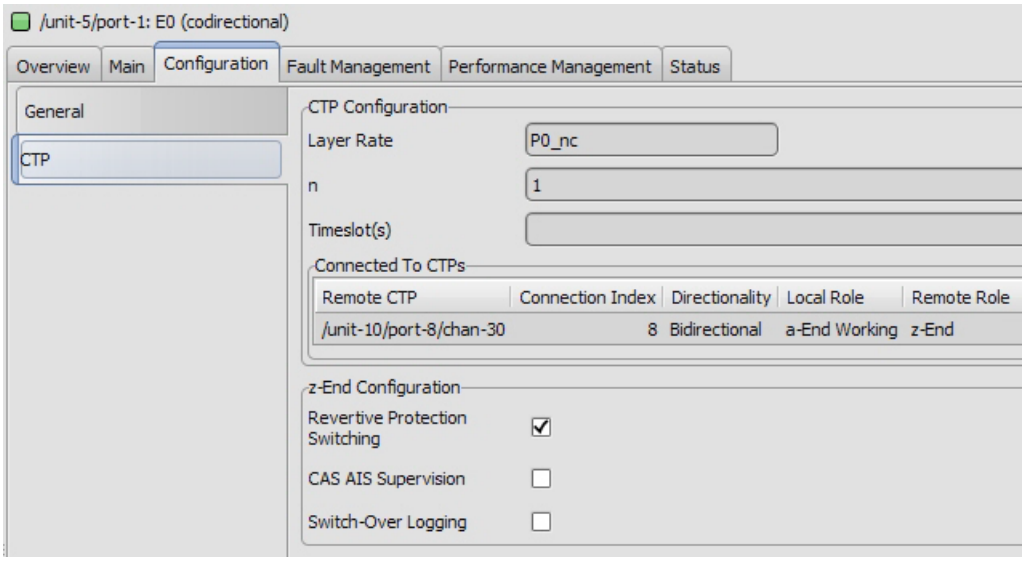


Table 12: AP: / unit-x / port-y, Configuration - Error Handling

Operation Name	Parameter Name	Range	Description / Details
Consequent Action On Loss Of Input Signal	Output Octet Transmit Timing Removed	☑ ☐	As a consequent action of the LOS alarm remove the 8 kHz octet timing in the transmit direction on the timing signal.
	AIS Insertion	☑ ☐	As a consequent action of the LOS alarm insert an AIS in transmit direction.
Criterion For Loss Of Input Signal	Max Number Of Bits Without Transitions	64 … 72 … 65'535	Enter the number of consecutive "0" on the transmit data signal to be declared as LOS.

8.3.3.3 AP: / unit-x / port-y, Configuration - CTP



Please note:

All layer rate, number of time slots and time slot allocation parameters are read only.

Table 13: AP: / unit-x / port-y, Configuration - CTP

Operation Name	Parameter Name	Range	Description / Details
CTP Configuration	Layer Rate	P0_nc	Layer rate of the connection termination point is P0_nc, i.e. n x 64 kbit/s. The layer rate property of a TUGE1 port is fixed to P0_nc.
		P12	Layer rate of the connection termination point is P12, i.e. 2048 kbit/s.
	n	0 … 2 characters	Number of timeslots in case of P0_nc. The possible range is from 1 to 32. The number of time slots of a TUGE1 port is fixed to 1.
	Timeslot(s)	0 … 64 characters	Used timeslots in a structured P12 in case of P0_nc, e.g. 1 … 31. The timeslot(s) property of a TUGE1 port is empty.
Connected to CTPs	Remote CTP	<MO address>	Address string of a connections remote end. Without a connection the parameter is empty
	Connection Index	0 … 65“535	Index of a connection assigned to the port. Without a connection the parameter is empty
	Directionality	Bidirectional	Directionality of the connection.
		Unidirectional	
	Local Role	z-End	The port is the ending point of a connection. Please refer to [314] User Guide “TDM Services and Cross Connections in XMC20”
		a-End Working	The port is the working starting point of a protected or unprotected connection.
		a-End Protecting	The port is the protecting starting point of a protected connection.

Table 13: AP: / unit-x / port-y, Configuration - CTP (continued)

Operation Name	Parameter Name	Range	Description / Details
	Remote Role	z-End	The CTP at the connections remote end is the ending point of a connection. Please refer to [314] User Guide "TDM Services and Cross Connections in XMC20"
		a-End Working	The CTP at the connections remote end is the working starting point of a protected or unprotected connection.
		a-End Protecting	The CTP at the connections remote end is the protecting starting point of a protected connection.
z-End Configuration	Revertive Protection Switching	☑	Enable revertive protection switching. The z-End will preferably select the working a-End.
		☐	
	CAS AIS Supervision	☑	Use CAS AIS as protection switching criterion.
		☐	
	Switch-Over Logging	☑	Enable the logging of the protection switch-over events.
		☐	

Please note:

The z-End of a protected connection shows two entries in the "Connected to CTPs" table, one for the working and one for the protecting path.

8.3.4 AP: / unit-x / port-y, Fault Management

For the a description of the general aspects of the

- "Fault Management - Status", and
- "Fault Management - Configuration"

management functions, please refer to [302] User Guide "XMC25/XMC23/XMC22". The following table lists the fault causes of the current AP.

Table 14: AP: / unit-x / port-y, Fault Management

ID	Fault Cause	Event Type	Traffic Affecting	Default Severity	Description
MFA	Maintenance Function Active	Communication Alarm	☑	Warning	A maintenance function has been activated by the operator from the port status.
TSF	Trail Signal Failure	Communication Alarm	☑	Major	Trail signal fail (TSF) from the P12 transport unit is active, or CAS AIS active (only available if CAS is enabled). In a protected connection the working AND the protecting path have failed.
RTSF	Redundant Trail Signal Failure	Communication Alarm	☑	Minor	Trail signal fail (TSF) from the P12 transport unit is active, or CAS AIS active (only available if CAS is enabled). In a protected connection the working OR the protecting path has failed. In an unprotected connection this fault cause is not applicable.

Table 14: AP: / unit-x / port-y, Fault Management (continued)

ID	Fault Cause	Event Type	Traffic Affecting	Default Severity	Description
LOS	Loss Of Signal	Communication Alarm	☑	Major	Loss of the incoming transmit data signal: - Codirectional: An alarm is set if no transitions of the rectified input signal are detected in 8 bit times (125 µs). The alarm is cleared if at least 32 transitions occur in 16 bit times (250 µs). - Contradirectional: An alarm is set if no transitions of the transmit data signal are detected in the configured number of bit times for the LOS detection (see section 8.3.3.2 AP: / unit-x / port-y, Configuration - Error Handling (contradirectional only) (on page 41). The alarm is cleared if a transition is detected on the transmit data signal. If the input signal fails, an AIS is inserted into the data time slot (configurable for the contradirectional interface type). It is configurable to disable the 8 kHz octet timing signal towards the interface during an active LOS alarm (remote alarm indication to the DTE). However, the data transmission to the DTE remains active.
LOOT	Loss Of Octet Timing	Communication Alarm	☑	Minor	8 kHz octet timing failure (codirectional only). An alarm is set if less than 6 violations of the polarity alternation rule are detected in 6 ms (48 octets). The alarm is cleared if 6 or more violations of the polarity alternation rule are detected in 6 ms (48 octets). In the event of an octet timing failure and the octet timing monitoring is enabled, an AIS is inserted into the data time slot. The octet timing monitoring can be disabled. If however the octet timing is still active, it is used to insert the octet aligned data into the data time slot.
AIS	Alarm Indication Signal From Tributary Interface	Communication Alarm	☑	Minor	AIS failure. An alarm is set if the transmit signal has no octet timing and is an all-one signal containing not more than 1 zero during 15.6 ms (1000 bit). The alarm is cleared when the transmit signal has a valid octet timing or contains more than 3 zeros in 15.6 ms (1000 bit).

Please note:

The monitoring of the TSF and RTSF alarms is disabled by default.

8.3.5 AP: / unit-x / port-y, Performance Management

For the a description of the general aspects of the performance management (PM) functions, please refer to [302] User Guide “XMC25/XMC23/XMC22”.

The PM parameters are presented in different groups. The following counter groups are available for the TUGE1 ports:

- “Protection” group, see section 8.3.5.1 AP: / unit-x / port-y, Performance Management - Protection (on page 45),
- “P0” group, see section 8.3.5.2 AP: / unit-x / port-y, Performance Management - P0 (codirectional only) (on page 45), for codirectional interfaces only.

The following counter intervals are available, depending of the counter group:

Table 15: PM counter interval availability

Counter interval	Protection	P0
User Counter	yes	yes
History 15min	yes	yes
History 24h	yes	yes
Alarm 15min	no	no
Alarm 24h	no	no

8.3.5.1 AP: / unit-x / port-y, Performance Management - Protection

Table 16: PM group: Protection

PM parameter	Description
Switch-Over	The protection switch-over count gives information about the number and distribution of protection switching events.

8.3.5.2 AP: / unit-x / port-y, Performance Management - P0 (codirectional only)

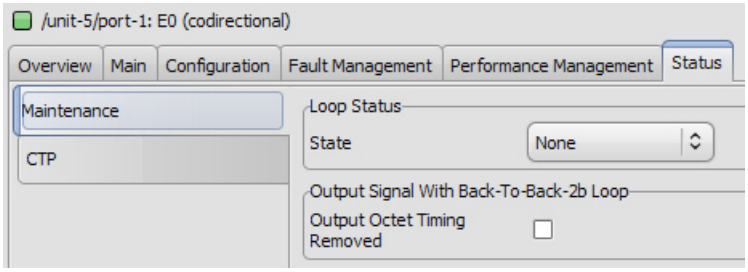
Table 17: PM group: P0

PM parameter	Description
Positive Octet Slips	Count of the positive octet slips between the incoming data signal and the NE timing. The DTE source clock frequency is higher than the NE clock.
Negative Octet Slips	Count of the negative octet slips between the incoming data signal and the NE timing. The DTE source clock frequency is lower than the NE clock.

8.3.6 AP: / unit-x / port-y, Status

8.3.6.1 AP: / unit-x / port-y, Status - Maintenance

Codirectional port:



Contradirectional port:

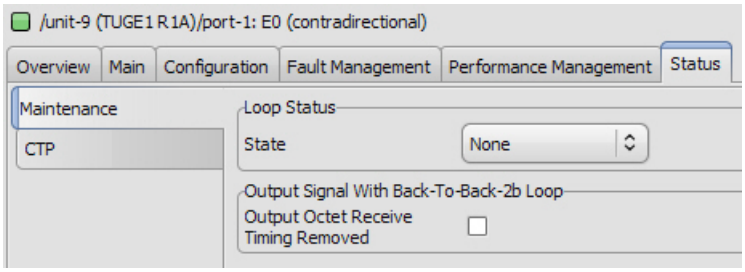


Table 18: AP: / unit-x / port-y, Status - Maintenance

Operation Name	Parameter Name	Range	Description / Details
Loop Status	State	None	Deactivate any loop.
		Front-To-Front-3b	Activate the front-to-front loop 3b. For more information refer to section 7.2 Loops (on page 34).
		Back-To-Back-2b	Activate the back-to-back loop 2b. For more information refer to section 7.2 Loops (on page 34).
Output Signal With Back-To-Back-2b Loop	Output Octet Timing Removed	☑	Remove the octet timing on the AIS at the E0 port when the back-to-back-2b loop is active. This parameter is only applicable for the codirectional interface.
		☐	
	Output Octet Receive Timing Removed	☑	Remove the octet timing on the receive timing signal when the back-to-back-2b loop is active. This parameter is only applicable for the contradirectional interface.
		☐	

8.3.6.2 AP: / unit-x / port-y, Status - CTP

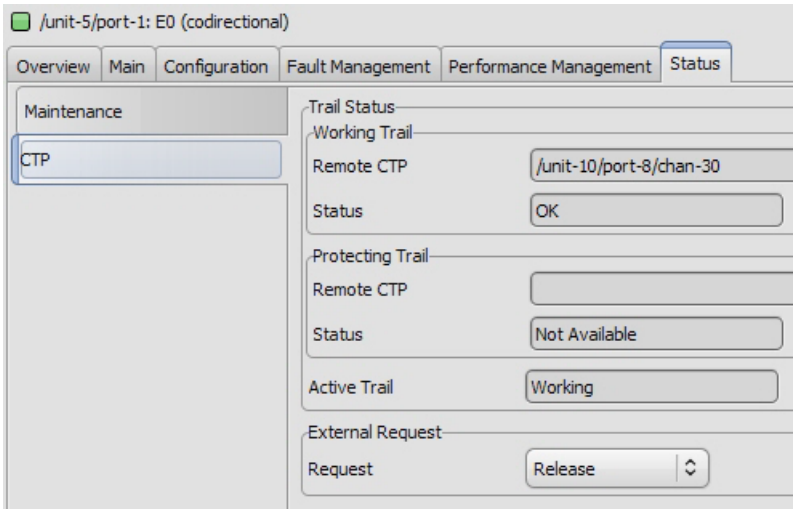


Table 19: AP: / unit-x / port-y, Status - CTP

Operation Name	Parameter Name	Range	Description / Details
Trail Status	Working Trail, Remote CTP	<MO Address>	Managed object address of the CTP (connection termination point) where the P0-nc signal is connected to, e.g. /unit-21/port-1/chan-1.
	Working Trail, Status	OK	No failure on the received signal.
		SF	Signal Fail status on the received signal.
		CAS AIS	CAS AIS status in the received signal, i.e. a “1111” signal in the signalling pattern.
		SD	Signal Degraded status on the received signal.
		Not Available	The status of the received signal is not available, e.g. when the CTPs role is a-end in a unidirectional connection.
	Protecting Trail, Remote CTP	<MO Address>	Managed object address of the CTP (connection termination point) where the P0-nc signal is connected to, e.g. /unit-21/port-2/chan-1.
	Protecting Trail, Status	OK	No failure on the received signal.
		SF	Signal Fail status on the received signal.
		CAS AIS	CAS AIS status in the received signal, i.e. a “1111” signal in the signalling pattern.
		SD	Signal Degraded status on the received signal.
		Not Available	The status of the received signal is not available, e.g. when the CTPs role is a-end in a unidirectional connection.
	Active Trail	Working	The trail from the a-end working remote CTP has been selected.
		Protecting	The trail from the a-end protecting remote CTP has been selected.
		Not Available	There is no active trail.

Table 19: AP: / unit-x / port-y, Status - CTP (continued)

Operation Name	Parameter Name	Range	Description / Details
External Request	Request	Release	Automatic trail selection.
		Force Working	Force the selector to use the trail from the a-end working remote CTP.
		Force Protecting	Force the selector to use the trail from the a-end protecting remote CTP.
		Manual Working	Prefer the trail from the a-end working remote CTP. Use this trail only if the fault status is not worse than the fault status of the protecting trail.
		Manual Protecting	Prefer the trail from the a-end protecting remote CTP. Use this trail only if the fault status is not worse than the fault status of the working trail.

9 Annex

9.1 Associated XMC20 Documents

Any version(s) and/or release(s) indicated with the below listed document titles identify the specific state of the software and/or feature set at the creation time of the present document. If the present document is published as part of a document collection, the hyperlinks might open a document valid for a newer version/release. That updated version is valid in the context of all units and features described in the document collection.

Please note:

For the HTML-based documentation site there are no interdocument hyperlinks realized yet.

→ Please find the required document via the navigation tree on the left.

[012] Release Note “XMC20”

[201] System Description “XMC20”

[202] Safety Instructions “Precautions and safety”

[301] User Guide “XMC25 Installation”

[310] User Guide “XMC23 Installation”

[322] User Guide “XMC22 Installation”

[302] User Guide “XMC25/XMC23/XMC22”

[323] User Guide “Management Communication”

[354] Quick Guide “ECST”

[355] User Manual “ECST”

[314] User Guide “TDM Services and Cross Connections in XMC20”

[340] Quick Guide “TDM Services over PDH/SDH”

[447] User Manual “COGE5, COGE5-F co5ne_r2, co5un_r2”

[506] User Manual “XMC20 cables”

[915] Technical Bulletin “Feature Licences for XMC20”

9.2 Technical Support

Please refer to the KEYMILE Extranet (via http://www.keymile.com) for support contact information.

9.3 Product Training

Training courses are available for a wide range of KEYMILE products and applications.

For contact information, course descriptions, locations and dates, refer to the Website: http://www.keymile.com, then search for “product training”.