

Interoperability Telindus SHDSL products

1. Introduction

There are many questions on the interoperability between the different SHDSL products Telindus has in its portfolio and their interoperability with DSLAMs. This document gives an overview of the interoperability. Telindus products considered in this document are:

- Crocus SHDSL TT and TWIN-CV BU (with modular interfaces)
- Crocus SHDSL G703 TT (including RP versions)
- Crocus SHDSL RS530 TT (including RP versions)
- Crocus SHDSL QUAD-CV
- Crocus SHDSL Repeater
- Telindus 1420 SHDSL Router
- Telindus 1421 SHDSL Router
- Telindus 1422 SHDSL Router
- Telindus 1423 SHDSL Router (several versions)
- Telindus 1431 SHDSL CPE
- Telindus 2300 SHDSL Series
- Telindus 2400 Series

Different sections are present per product or product group. First of all, a distinction is made between devices made for TDM and those made for broadband applications.

2. TDM versus broadband devices

SHDSL devices can be divided into 2 categories: devices for TDM networks and devices for broadband networks. In general, devices for TDM networks are interoperable with each other and devices for broadband networks are interoperable with each other. Some devices can be used for both networks. In the list below both 1 pair and 2 pair versions are included.

Product	Suitable for TDM	Suitable for broadband
Crocus SHDSL TT and TWIN-CV BU (with modular interfaces)	✓	
Crocus SHDSL G703 TT / Crocus SHDSL RS530 TT (including RP versions)	✓	
Crocus SHDSL QUAD-CV	✓	
Crocus SHDSL Repeater	✓	
Telindus 1420 SHDSL Router (phase-out)	✓	
Telindus 1421 SHDSL Router	✓	✓
Telindus 1422 SHDSL Router		✓
Telindus 1423 SHDSL 2ETH-4P		✓
Telindus 1423 SHDSL 2ETH-4P HWA / Telindus 1423 SHDSL 2ETH-4P ISDN HWA	✓	✓
Telindus 1431 SHDSL CPE		✓
Telindus 2300 SHDSL Series	✓	
Telindus 2400 Series		✓

The main differences between products for TDM networks and products for broadband networks are the following:

TDM networks	Broadband networks
SHDSL plesiochronous mode <ul style="list-style-type: none"> Many clocking options 	SHDSL synchronous mode <ul style="list-style-type: none"> Clocking slaved on network
Either the product is transparent for layer 2 or a variety of layer 2 protocols (HDLC, PPP, Frame Relay, ATM)	Layer 2 is ATM

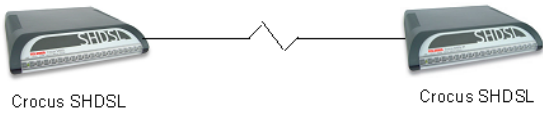
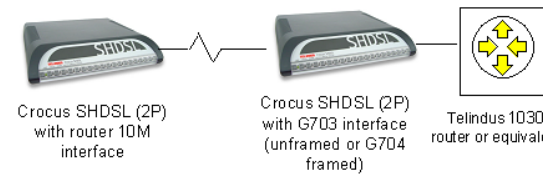
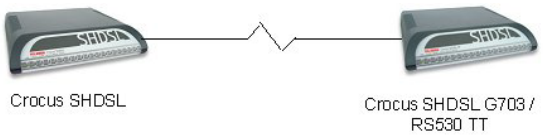
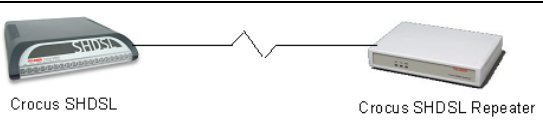
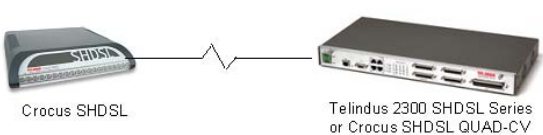
3. Crocus SHDSL TT and TWIN-CV BU

The Crocus SHDSL BU versions are the Crocus SHDSL modems with modular interface slots. They have different application firmware codes depending on the hardware and the loader firmware as shown in the table below (see also document Crocus SHDSL firmware codes).

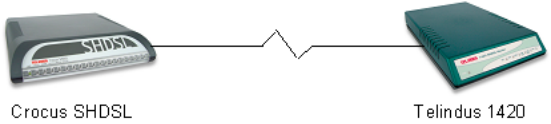
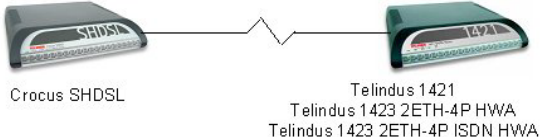
Firmware code	Hardware 0.X with long service down time	Hardware 0.X with short service down time	Hardware 1.X
Boot	T2135/XXX00	T2135/XXX00	T2140/XXX00
Loader	T2137/00300	T2137/00400	T2142/XXX00
Application	T2136/XXX00	T2145/XXX00	T2141/XXX00

The Crocus SHDSL operates by default in plesiochronous mode. Plesiochronous mode allows all clocking modes.

The table below shows the use of Crocus SHDSL TT and TWIN-CV with other SHDSL products. In the drawings always a Crocus SHDSL (2P) TT is shown. Unless explicitly mentioned, this may equally be a Crocus SHDSL (2P) TWIN-CV. Default values for configuration attributes are not always mentioned in the 'interoperability issues' column.

Set-up	Interoperability issues
 <p>Crocus SHDSL</p>	In general no interoperability issues (see next 2 combinations).
 <p>Crocus SHDSL (2P) with router 10M interface</p> <p>Crocus SHDSL (2P) with G703 interface (unframed or G704 framed)</p> <p>Telindus 1030 router or equivalent</p>	This combination is possible for PPP and Frame Relay WAN encapsulations. It is not possible in ATM WAN encapsulation.
 <p>Crocus SHDSL</p> <p>Crocus SHDSL G703 / RS530 TT</p>	Use always plesiochronous mode on Crocus SHDSL. The minimum speed per line pair is 192 kbit/s. As of firmware T2141/01300 on Crocus SHDSL, lower user speeds (on e.g. serial interfaces) are possible.
 <p>Crocus SHDSL</p> <p>Crocus SHDSL Repeater</p>	Use always plesiochronous mode on Crocus SHDSL and line/eocChannel = itu-G.991.2. Line speeds between 192kbit/s (384kbit/s for 2 pairs) and 2Mbit/s.
 <p>Crocus SHDSL</p> <p>Telindus 2300 SHDSL Series or Crocus SHDSL QUAD-CV</p>	Use always plesiochronous mode on Crocus SHDSL. The minimum line pair speed is 192kbit/s. One needs minimum firmware T2141/01300 for user speeds below 192 kbit/s per line pair.

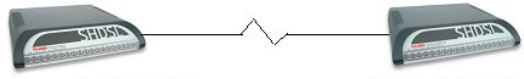
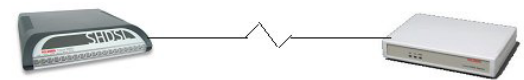
Interoperability Telindus SHDSL products

 <p>Crocus SHDSL</p> <p>Telindus 1420</p>	<p>On the Crocus SHDSL configure the following:</p> <ul style="list-style-type: none"> • line/region = annexA • line/eocChannel = proprietary
 <p>Crocus SHDSL</p> <p>Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p>	<p>General requirements: One needs at least firmware release T2136/00800, T2145/00100 or T2141/00100 on the Crocus SHDSL. On the Crocus SHDSL, configure line/eocChannel = itu-G.991.2.</p> <p>One needs firmware release T2852/00600 on Telindus 1421. On the Telindus 1421 and 1423 configure line/timingMode = plesiochronous .</p> <p>The line speed is between 192 and 2048 kbit/s. For 2P operation with G703 interface or external clock, one needs minimum firmware release T2141/00300 on Crocus SHDSL.</p> <p>User speeds below 192 kbit/s per line pair are only supported starting from firmware release T2852/02100 of Telindus 1421.</p> <p>Notes:</p> <ul style="list-style-type: none"> • This combination does not work when a Crocus Router 10M Interface is used on the Crocus SHDSL and ATM WAN encapsulation is configured over the link. • The Telindus 1421 and 1423 do not support RDL requests (Crocus SHDSL with router interface does). • If the interface module on the Crocus SHDSL is not a G703 interface, one can also select line/timingMode = synchronous on both devices. In that case, the full speed range is available.

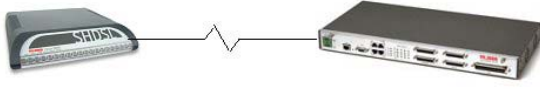
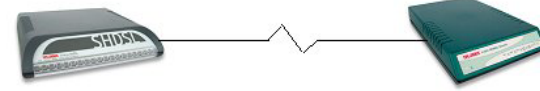
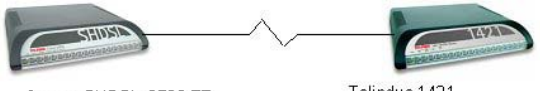
4. Crocus SHDSL G703 / RS530 TT

The Crocus SHDSL G703 TT and Crocus SHDSL RS530 TT are the Crocus SHDSL versions with integrated user interfaces. They operate always in plesiochronous mode. Line speeds are limited between 192 and 2048 kbit/s per line pair.

The table below shows the use of Crocus SHDSL G703 / RS530 TT with other SHDSL products. Default values for configuration attributes are not always mentioned in the 'interoperability issues' column.

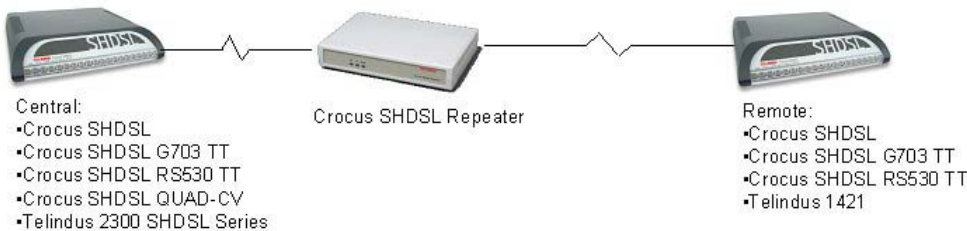
Set-up	Interoperability issues
 <p>Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p> <p>Crocus SHDSL BU Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p>	<p>Use always plesiochronous mode on Crocus SHDSL. Line speed between 192kbit/s (384 kbit/s for 2 pairs) and 2Mbit/s. As of firmware T2141/01300 on Crocus SHDSL, lower user speeds (on e.g. serial interfaces) are possible.per line.</p>
 <p>Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p> <p>Crocus SHDSL Repeater</p>	<p>Use always line/eocChannel = itu-G.991.2. Line speeds between 192kbit/s (384kbit/s for 2 pairs) and 2Mbit/s.</p>

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 <p>Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p> <p>Telindus 2300 SHDSL Series or Crocus SHDSL QUAD-CV</p>	<p>Line speed between 192kbit/s (384 kbit/s for 2 pairs) and 2Mbit/s. On serial interfaces lower user speeds are possible.</p>
 <p>Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p> <p>Telindus 1420</p>	<p>On the Crocus SHDSL G703 / RS530 TT configure the following:</p> <ul style="list-style-type: none"> • line/region = annexA • line/eocChannel = proprietary <p>Line speeds between 192 and 2048 kbit/s (1 pair only).</p>
 <p>Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p> <p>Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p>	<p>On the Telindus 1421 / 1423, configure line/timingMode = plesiochronous.</p> <p>Line speeds between 192 (384 for 2 pairs) and 2048 kbit/s. As of firmware T2148/00400 on Crocus SHDSL G703 TT, all firmware of Crocus SHDSL RS530 TT and firmware 2852/02100 on Telindus 1421 / 1423, lower user speeds are possible.</p>

5. Crocus SHDSL Repeater

The figure below shows in which combinations the Crocus SHDSL Repeater can be used.

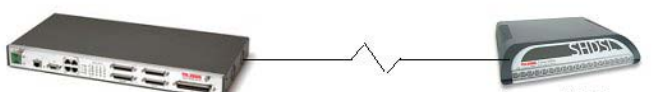


In all cases the central and remote units need to be configured in plesiochronous mode. In order to have management over the EOC channel available, one needs to configure line/eocChannel = itu-G.991.2. Several repeaters can be put in cascade (not shown in the figure).

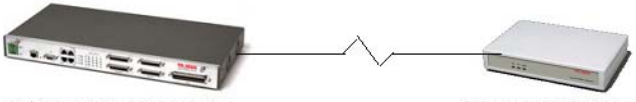
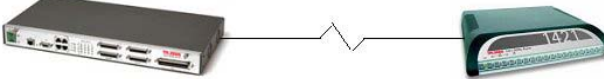
Note: another document describes the possibilities with remote powering.

6. Crocus SHDSL QUAD-CV and Telindus 2300 SHDSL Series

The table below shows the use of Crocus SHDSL QUAD-CV and Telindus 2300 SHDSL Series with other SHDSL products. The Telindus 2300 SHDSL Series and the Crocus SHDSL QUAD-CV both are always use as central modems!

Set-up	Interoperability issues
 <p>Telindus 2300 SHDSL Series or Crocus SHDSL QUAD-CV</p> <p>Crocus SHDSL Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p>	<p>The Crocus SHDSL must be configured in plesiochronous mode (default) and line/eocChannel = itu-G.991.2.</p> <p>The minimum line pair speed is 192 kbit/s. User speeds (or # G704 time slots) below 192 kbit/s per line pair are only supported as of firmware T2141/01300 Crocus SHDSL and firmware T2148/00400 on Crocus SHDSL G703.</p>

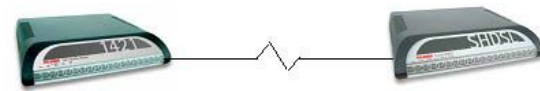
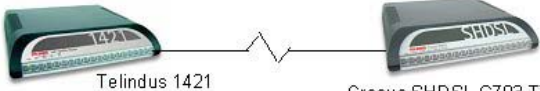
Interoperability Telindus SHDSL products

 <p style="font-size: small;">Telindus 2300 SHDSL Series or Crocus SHDSL QUAD-CV</p> <p style="font-size: small; text-align: center;">Crocus SHDSL Repeater</p>	<p>The line speed is in the range 192 kbit/s – 2Mbit/s (1P only).</p>
 <p style="font-size: small;">Telindus 2300 SHDSL Series or Crocus SHDSL QUAD-CV</p> <p style="font-size: small; text-align: center;">Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p>	<p>The Telindus 1421 must be configured in plesiochronous mode.</p> <p>The minimum line pair speed is 192 kbit/s. User speeds below 192 kbit/s per line pair are only supported starting from firmware release T2852/02100 of Telindus 1421.</p>

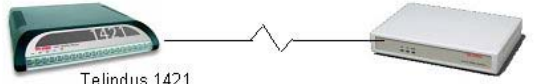
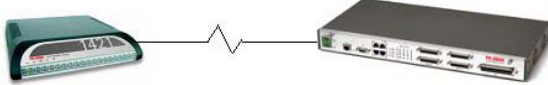
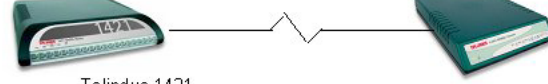
7. Telindus 142X CPEs and TDM products

The table below shows the use of the following CPEs with TDM products:

- Telindus 1421 SHDSL Router (including 3DES versions)
- Telindus 1423 SHDSL 2ETH-4P HWA
- Telindus 1423 SHDSL 2ETH-4P ISDN-BRI HWA

Set-up	Interoperability issues
 <p style="font-size: small;">Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p> <p style="font-size: small; text-align: center;">Crocus SHDSL</p>	<p>General requirements: One needs at least firmware release T2136/00800, T2145/00100 or T2141/00100 on the Crocus SHDSL. On the Crocus SHDSL, configure line/eocChannel = itu-G.991.2.</p> <p>On the 1421 / 1423 configure line/timingMode = plesiochronous.</p> <p>The line speed is between 192 and 2048 kbit/s per line pair. For 2P operation with G703 interface or external clock, one needs minimum firmware release T2141/00300 on Crocus SHDSL.</p> <p>Notes:</p> <ul style="list-style-type: none"> • One needs minimum firmware release T2852/00600 on Telindus 1421. • This combination does not work when a Crocus Router 10M Interface is used on the Crocus SHDSL and ATM WAN encapsulation is configured over the link. • In case of a serial or LAN interface on Crocus SHDSL, one can also configure synchronous timing mode. In that case line pair speeds between 64 and 2304kbit/s are possible.
 <p style="font-size: small;">Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p> <p style="font-size: small; text-align: center;">Crocus SHDSL G703 TT Crocus SHDSL RS530 TT</p>	<p>On the Telindus 1421 / 1423, configure line/timingMode = plesiochronous.</p> <p>Line between 192 (384 for 2P) and 2048 kbit/s. User speeds below 192kbit/s per line pair as of firmware T2148/00400 on Crocus SHDSL G703 and T2852/02100 on Telindus 1421.</p>

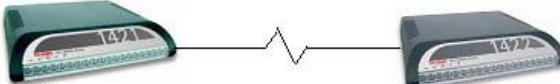
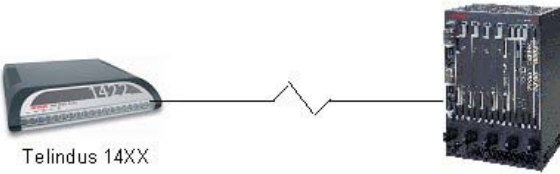
Interoperability Telindus SHDSL products

 <p>Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p> <p style="text-align: center;">Crocus SHDSL Repeater</p>	<p>Only possible with Telindus 1421 / 1423 as remote unit. On the Telindus 1421 / 1423, configure line/timingMode = plesiochronous.</p> <p>Line and user speeds are between 192 and 2048 kbit/s.</p>
 <p>Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p> <p style="text-align: center;">Telindus 2300 SHDSL Series or Crocus SHDSL QUAD-CV</p>	<p>The Telindus 1421 / 1423 must be configured in plesiochronous mode and line/eocChannel = itu-G.991.2 (default).</p> <p>The minimum line pair speed is 192 kbit/s per line pair. User speeds below 192 kbit/s per line pair are only supported starting from firmware release T2852/02100 of Telindus 1421.</p>
 <p>Telindus 1421 Telindus 1423 2ETH-4P HWA Telindus 1423 2ETH-4P ISDN HWA</p> <p style="text-align: center;">Telindus 1420</p>	<p>On the Telindus 1421 / 1423, configure line/timingMode = plesiochronous.</p> <p>Notes:</p> <ul style="list-style-type: none"> • Management happens over IP, not over the EOC channel. • This combination is possible, starting from firmware release T2852/00600 on Telindus 1421.

8. Telindus 142X CPEs and broadband products

The table below shows the use of the following CPEs with broadband products:

- Telindus 1421 SHDSL Router (including 3DES versions)
- Telindus 1422 SHDSL Router
- Telindus 1423 SHDSL 2ETH-4P
- Telindus 1423 SHDSL 2ETH-4P HWA
- Telindus 1423 SHDSL 2ETH-4P ISDN-BRI HWA
- Telindus 1431 SHDSL CPE (for Ethernet traffic)

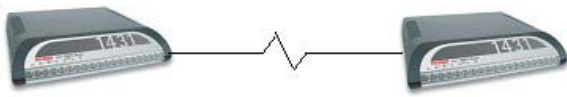
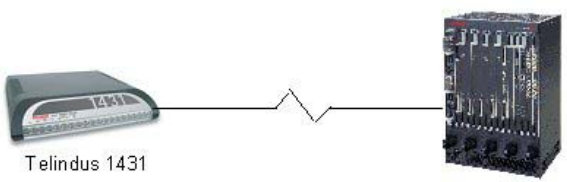
Set-up	Interoperability issues
 <p>Telindus 14XX</p> <p style="text-align: center;">Telindus 14XX</p>	<p>Use line/timingMode = synchronous (default) and ATM encapsulation (default).</p>
 <p>Telindus 14XX</p> <p style="text-align: center;">DSLAM</p>	<p>This combination is generally possible, both with ATM and Ethernet based DSLAMs. See document 'S(H)DSL CPE - DSLAM Interoperability overview' for detailed information on interoperability tests that have been done with specific DSLAMs.</p> <p>Interoperability includes as well the Telindus 2400 Series (SHDSL versions).</p>

9. Telindus 1431 SHDSL CPE

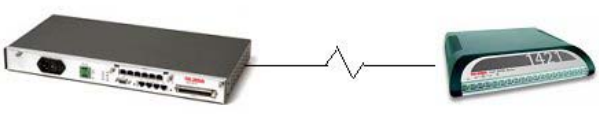
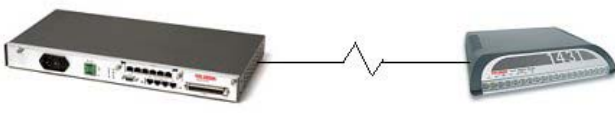
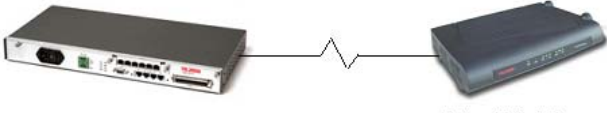
This section defines interoperability of the Telindus 1431 SHDSL CPE for its specific Interworking Functions (IWF) ATM CES, FRF.5, FRF.8 and ATM switching (ATM over E1).

Set-up	Interoperability issues
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Interoperability Telindus SHDSL products

 <p>Telindus 1431 Telindus 1431</p>	<p>Use line/timingMode = synchronous (default) and ATM encapsulation (default).</p>
 <p>Telindus 1431 ATM DSLAM</p>	<p>Interoperable for CES, FRF and ATM over E1 with ATM DSLAMs (not with Ethernet DSLAMs). See document 'S(H)DSL CPE - DSLAM Interoperability overview' for detailed information on interoperability tests that have been done with specific DSLAMs.</p>

10. Telindus 2400 Series

Set-up	Interoperability issues
 <p>Telindus 2400 Series Telindus 142X</p>	<p>Interoperable</p>
 <p>Telindus 2400 Series Telindus 1431</p>	<p>Interoperable for CES, FRF and ATM over E1 if the Telindus 2400 Series is configured in ATM switching mode. For Ethernet traffic, always interoperable. Especially for CES traffic, the Telindus 2400 does not support ATM QoS. Therefore this combination is to be avoided.</p>
 <p>Telindus 2400 Series Other DSL CPEs</p>	<p>In general interoperable with ADSL resp. SHDSL CPEs.</p>

11. User speed interoperability

The SHDSL recommendation defines line pair speeds between 192 and 2312kbit/s. The Telindus devices support the 64Kbit/s multiples (except 2312kbit/s on the Telindus 1431 and 2400 Series). On some devices also lower line speeds are supported. On some devices the user and line speeds may be different when operating in plesiochronous mode.

The table below shows the different combinations of possible user speeds for central and remote units. The user speeds are indicated with value N. N is a 64kbit/s multiple (e.g. N = 32 = 2048kbit/s). A line speed different from the user speed is only possible starting from a firmware revision as listed in the table below. In some cases this adds extra user speeds, which are put in bold.

Device	Minimum firmware version for Nx64K operation
Crocus SHDSL TT & TWIN-CV BU	T2141/01500 using attribute minLinePairSpeed (value different from <OPT>)
Crocus SHDSL G703 TT (RP)	T2148/00400 using attribute minLinePairSpeed (value different from <OPT>)

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Telindus 1421 SHDSL Router	T2852/02100: Use minSpeed = maxSpeed = 64kbit/s or 128kbit/s respectively to obtain a user speed of 64 resp. 128kbit/s at a line speed of 192kbit/s. Similarly on a 2P version use minSpeed2P = maxSpeed2P = 128kbit/s or 256kbit/s to obtain a user speed of 128 resp. 256kbit/s at a line speed of 384kbit/s. For other values the user and line speeds are the same.
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The cells in grey have few practical use. This does not mean the devices cannot operate in this way as central or remote units.

1 Pair versions

Remote device Central device	Cr SHDSL + serial/router if	Cr SHDSL + G703 Nx64K	Cr SHDSL G703 (RP)	Crocus SHDSL + Dual Port if	Telindus 1421 / 1423 in plesiochronous mode
Crocus SHDSL + serial/router if	N = 1...36	N = 1...32	N = 1,2,3...32		N = 1,2,3...32
Crocus SHDSL + G703 Nx64K	N = 1...32	N = 1,2,3...32	N = 1,2,3...32	N = 1,2,3...31*	N = 1,2,3...32
Crocus SHDSL G703 (RP)	N = 1,2,3...32	N = 1,2,3...32	N = 1,2,3...32	N = 1,2,3...31*	N = 1,2,3...32
Crocus SHDSL + G703-Serial DP				N = 1,2,3...32*	
Crocus SHDSL QUAD	N = 1,2,3...32	N = 1,2,3...32	N = 1,2,3...32	N = 1,2,3...31*	N = 1,2,3...32
Telindus 2300 SHDSL	N = 1,2,3...32	N = 1,2,3...32	N = 1,2,3...32	N = 1,2,3...31*	N = 1,2,3...32

* N is the sum of time slots (64kbps) for both the G703 and serial interface. There is at least 1 time slot in use for the G703 interface. The time slots on the central G703 destined for the G703 on the remote DP interface have the lowest time slot values.

2 Pair versions

Remote device Central device	Crocus SHDSL + serial/router if	Crocus SHDSL + G703 Nx64K	Crocus SHDSL G703 (RP)	Crocus SHDSL + Dual Port if	Telindus 1421 / 1423 in plesiochronous mode
Crocus SHDSL + serial/router if	N = 2...72 (N = even)	N = 2...32 (N = even)	N = 1...4,5...32		N = 2,4,6...32 (N = even)
Crocus SHDSL + G703 Nx64K	N = 2...32 (N = even)	N = 1...4,5...32	N = 1...4,5...32	N = 1...4,5...31*	N = 2,4,6...32 (N = even)
Crocus SHDSL G703 (RP)	N = 2,4,6...32 (N = even)	N = 1...4,5...32	N = 1...4,5...32	N = 1...4,5...31*	N = 2,4,6...32 (N = even)
Crocus SHDSL + G703-Serial DP				N = 1...4,5...32*	
Crocus SHDSL QUAD	N = 2,4,6...32 (N = even)	N = 1...4,5...32	N = 1...4,5...32	N = 1...4,5...31*	N = 2,4,6...32 (N = even)
Telindus 2300 SHDSL	N = 2,4,6...32 (N = even)	N = 1...4,5...32	N = 1...4,5...32	N = 1...4,5...31*	N = 2,4,6...32 (N = even)

* N is the sum of time slots (64kbps) for both the G703 and serial interface. There is at least 1 time slot in use for the G703 interface. The time slots on the central G703 destined for the G703 on the remote DP interface have the lowest time slot values