# HIRSCHMANN

A **BELDEN** BRAND

User Manual

Installation
Dragon PTN
Interface Module PTN-4-DSL-LW
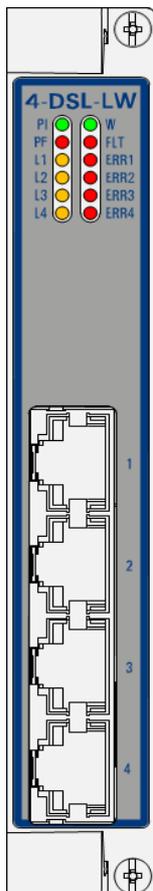
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1. INTRODUCTION

1.1 General

This document is valid as of Dragon PTN Release 4.0DR.

SHDSL (=Single-Pair High-Speed Digital Subscriber Line) is a data transmission technology that allows a copper telephone line to be used for faster data transport than a voice band modem can provide.

This document describes the 4-DSL-LW module which provides four SHDSL RJ45 ports on the front panel. The 4-DSL-LW interface module (=IFM) can be configured as a LAN or a WAN (WAN=currently not supported) module. 4-DSL-LW refers to '4 ports - SHDSL ports – LAN/WAN. SHDSL uses equal transmit and receive data rates, which indicates a symmetric data rate pattern.

Verify the 'Dragon PTN Bandwidth Overview' manual (Ref. [100] in Table 1) to see in which node and IFM slot this IFM can be used.

Main supported features:

▶ Ports: 4 SHDSL interface circuits;

▶ PAF (=PME aggregation function) or Bonding;

▶ Synchronization
    ▶ (currently not supported) SyncE;

▶ (currently not supported) Wetting Current;

▶ (currently not supported) EFM-C (=Ethernet in the first Mile – Copper) according to IEEE 802.3 section5;

▶ LAN or WAN (WAN=currently not supported) function selectable per module;

▶ E-Tree in an Ethernet Service;

This module interconnects a LAN network via an SHDSL to the MPLS-TP Dragon PTN network. A general SHDSL example can be found in the figure below. For CO/CPE, see §2.2.1.
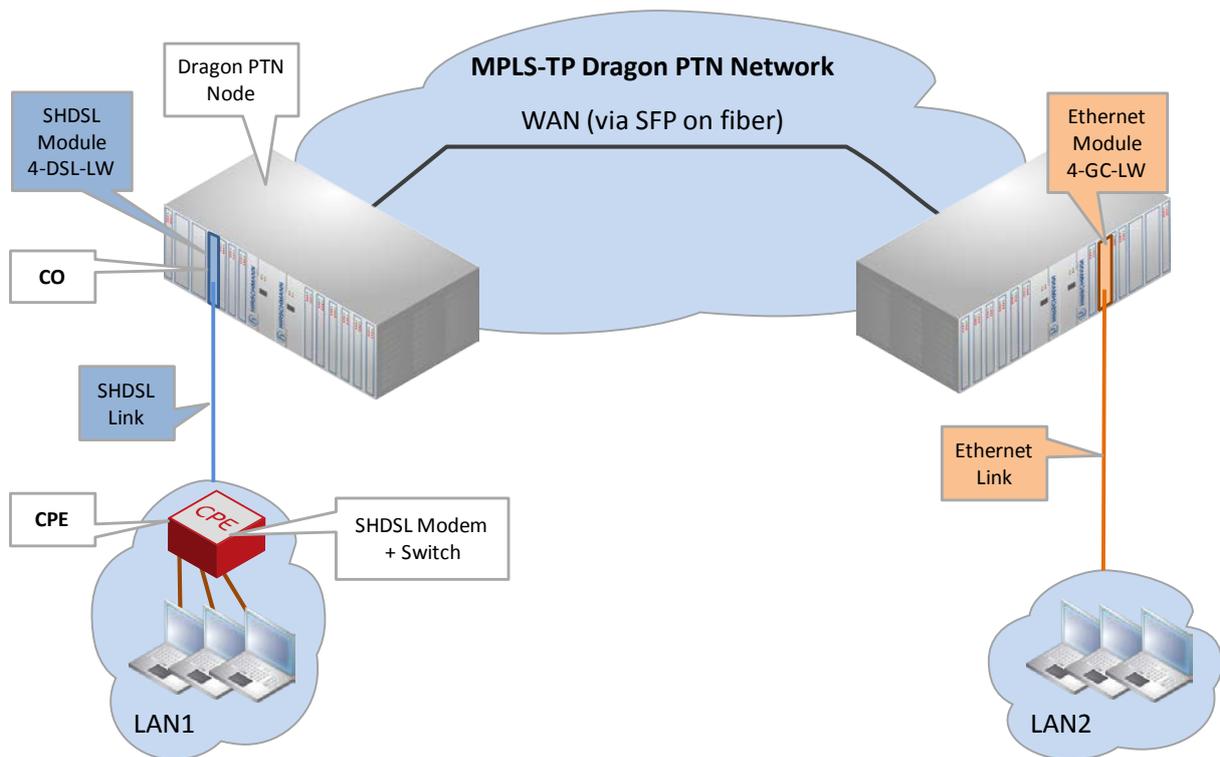
Figure 1 General SHDSL Example

1.2   Manual References

Table 1 is an overview of the manuals referred to in this manual. '&' refers to the language code, '*' refers to the manual issue. All these manuals can be found in the HiProvision (=Dragon PTN Management System) Help function.

Table 1 Manual References

Ref.	Number	Title
[1]	DRA-DRM821-&-*	Dragon PTN and HiProvision Operation
[2]	DRA-DRM801-&-*	Dragon PTN Installation and Operation
[4]	DRB-DRM803-&-*	Dragon PTN Switching Module: PTN-CSM310-A
[5]	DRA-DRM810-&-*	Dragon PTN General Specifications
[100]	DRA-DRM828-&-*	Dragon PTN Bandwidth Overview

2. MODULE DESCRIPTION

2.1 Front Panel
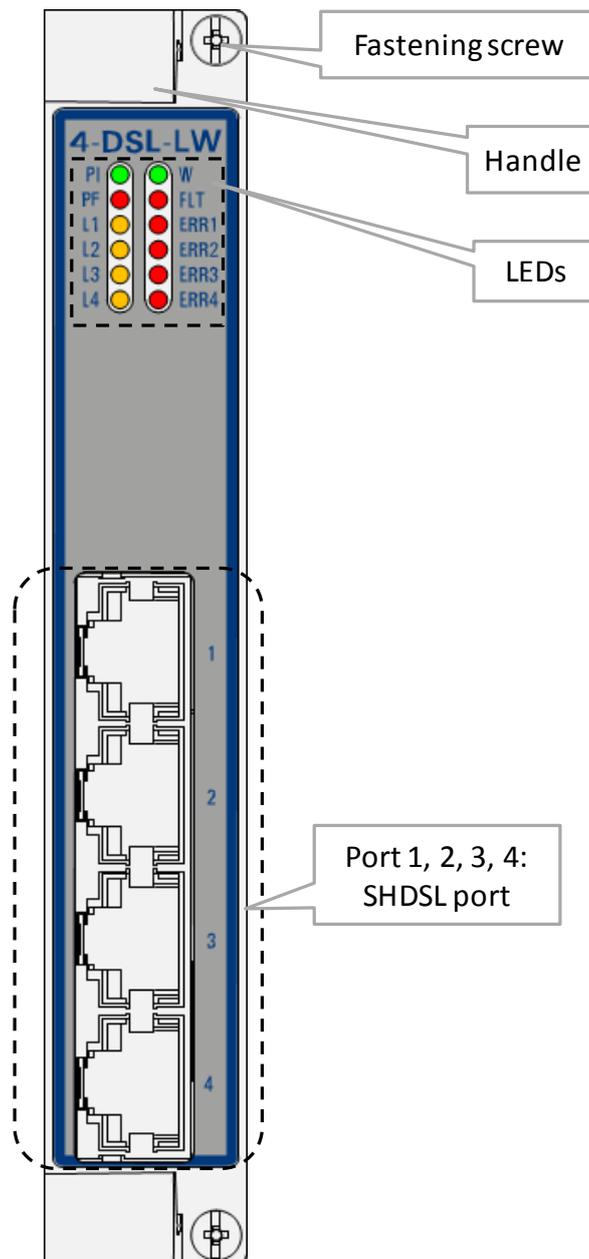
Figure 2 Front Panel

2.1.1 Insert/Remove Module into/from Node

See 'Dragon PTN Installation and Operation Manual' Ref.[2].

2.1.2 LEDs

The meaning of the LEDs depends on the mode of operation (= boot or normal) in which the 4-DSL-LW module currently is running. After plugging in the module or rebooting it, the module turns into the boot operation, see Table 2. After the module has gone through all the cycles in the table below (=rebooted successfully), the module turns into the normal operation, see LEDs in Table 3.

Table 2 LED Indications In Boot Operation

Cycle	PI	PF	FLT	W	L[1..4]	ERR[1..4]
1	x	---	Slow blinking	---	---	---
2	x	---	Fast blinking	---	---	---
3	x	---	---	---	---	---
4	x	---	x	x	x	x
5	x	---	x	x	---	x
6	x	---	x	x	x	x
x : LED is lit / --- : LED is not lit The sub cycle times may vary. The entire boot cycle time [1→6] takes approximately 2 minutes.							

Table 3 LED Indications In Normal Operation

LED	Color	Status
PI (=Power Input)	Not lit, dark	+12V power input to the board not OK
	Green	+12V power input to the board OK
PF (=Power Failure)	Not lit, dark	power generation on the board itself is OK
	Red	power generation on the board itself is erroneous
W	Not lit, dark	All ports on the module are configured as LAN ports
	Green	All ports on the module are configured as WAN ports (currently not supported)
FLT (=FauLT)	Not lit, dark	no other fault or error situation, different from PF, is active on the module
	Red	a fault or error situation, different from PF, is active on the module
L<port n°>	Not lit, dark	Link down on port <port n°>
	Yellow, slow blinking	Link is starting up, auto negotiation phase1 between CPE (=Customer Premises Equipment) and CO (=Central Office)
	Yellow, fast blinking	Link is starting up, auto negotiation phase2 between CPE and CO
	Yellow, lit	Link is up on port <port n°>
ERR<port n°>	Not lit, dark	- Port<port n°> has been disabled or not programmed in HiProvision - Port<port n°> has been enabled or programmed in HiProvision, the link is up and running without errors.
	Red, lit	Port<port n°> has been enabled or programmed in HiProvision but the link has errors and might be down.

2.1.3 SHDSL RJ-45 Ports and Cables

The 4-DSL-LW module provides four of these ports and each port connector has 8 pins. The two middle pins, pin 4 and 5, are used. See Table 4 below for an overview and description. Use CAT5E shielded cables to connect these ports.
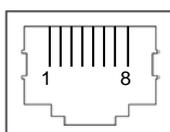
Figure 3 SHDSL RJ-45 Connector

Table 4 SHDSL RJ-45 Connector: Pin Assignments

Pin Number	Description
1,2,3	Not Used
4	Data Pair1 Tip (+) including Wetting Current (see §2.2.9) if configured in HiProvision
5	Data Pair1 Ring (-) including Wetting Current (see §2.2.9) if configured in HiProvision
6,7,8	Not Used

2.2 Functional Operation

The 4-DSL-LW performs following major tasks:

2.2.1 Device Mode: CO/CPE

In a general SHDSL link setup between a customer and network side, one link partner must act as the CO (=Central Office) and the other link partner must act as the CPE (=Customer Premises Equipment). Within the Dragon PTN solution, the 4-DSL-LW module is by default configured as CO. See Figure 1 for a general example. See §2.3.2b to configure CO/CPE.

If both SHDSL link partners are configured in the same device mode, the SHDSL link will not synchronize and as a result will not come up.

In the Figure 4 below, a more detailed setup is shown. A LAN1 network interfaces with the Dragon PTN node via a SHDSL LAN port on the 4-DSL-LW module. The 4-DSL-LW converts this traffic into Ethernet traffic on the backplane. The Central Switching Module (= CSM, see Ref. [4],[4b] in Table 1) converts this Ethernet traffic into MPLS-TP packets and transmits it via an Ethernet IFM (e.g. 4-GC-LW) onto the Dragon PTN MPLS-TP network. Each 4-DSL-LW port can be configured in LAN or WAN (=currently not supported) mode via HiProvision.
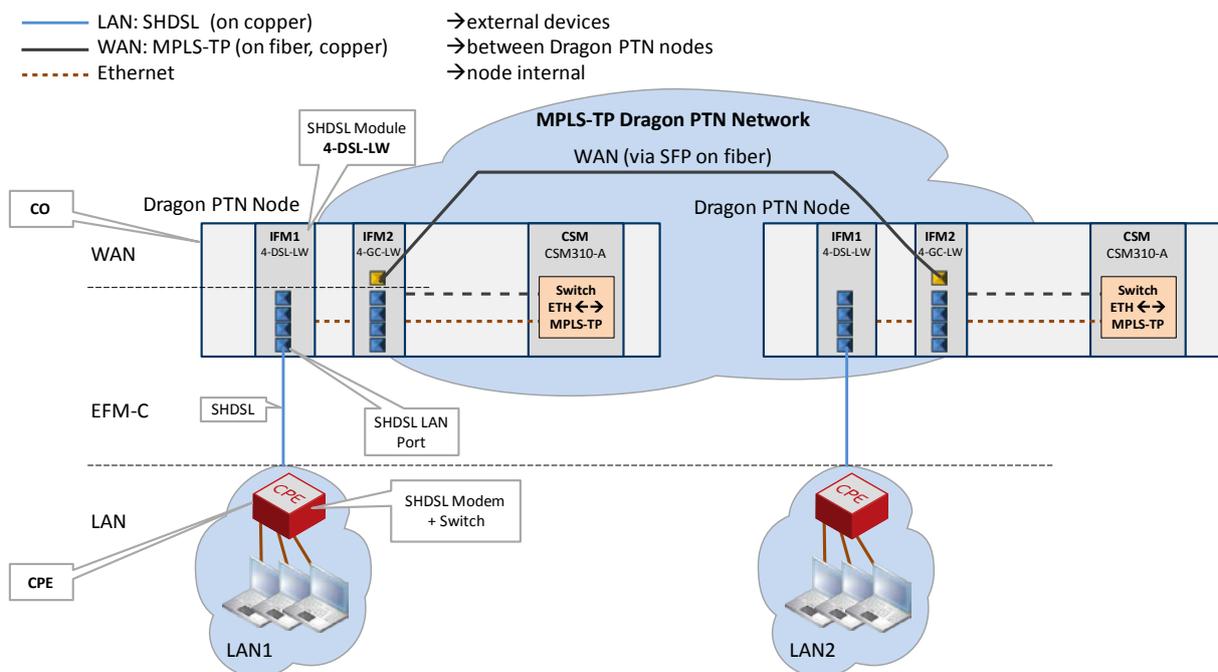
Figure 4 Detailed Functional Setup

2.2.2 SHDSL Link Bring Up

Based on some IFM settings and IFM port settings in HiProvision, the SHDSL link can be brought up. Basically, perform following settings to bring up the SHDSL link:

▶ IFM setting: Unit Type: Configure the device mode CO(=LT unit)/CPE(=NT unit) via the 'Unit Type' parameter in HiProvision;

▶ Always make sure that one link partner is CO and the other CPE;

▶ IFM port setting: Line Probing: enable the parameter 'Line Probing'. As a result, the port will automatically check the quality of the SHDSL link. The port will automatically decide which is the best possible bandwidth or Line rate for the available SHDSL link;

▶ IFM port status: SNR: as a result of the line probing, the signal-to-noise ratio (=SNR) will be filled out automatically in dB. SNR is an indication of the quality of the signal on the SHDSL link. If the quality or the SNR is too poor, the SHDSL link will not come up. The longer the SHDSL link, and the higher the automatically selected line rate due to line probing, the lower the SNR will be. Make sure that the SNR is at least 6dB or higher. If the measured SNR is lower than 6dB, disable 'Line Probing' and set the Maximum Line Rate lower, until SNR is higher than 6dB.

▶ IFM port status: Link Status: The link should come up. As a result, the link status should indicate 'up'.

▶ Furthermore, PAF or Bonding of links can be configured, see §2.2.3.

2.2.3 PAF or Bonding

▶ PAF: PME Aggregation Function;
▶ PME: Physical Medium Entities.

PAF or Bonding is a technique where multiple SHDSL links, connected to the 4-DSL-LW module, are combined into one logical link. This results in redundancy and a higher bandwidth for the resulting combined link.

Within the SHDSL link, bonding must be configured on either the CO or the CPE, see Table 5. The link partner without bonding configured will slave and negotiate with the link partner that has bonding configured. After the bonding has been negotiated between the CO and CPE, the bonded SHDSL links come up.

Different line rates are possible within the bonded links, but the difference between the fastest and slowest link must be less than 4 Mbps.

SHDSL ports can be combined or bonded in HiProvision as indicated in Table 5.

NOTE: When using the SHDSL link as LAN, make sure to configure the local and the remote LAN SHDSL links with the same bonding or PAF mode;

Table 5 Bonding Combinations

Bonding Mode	PAF Mode in HiProvision	Must be Configured on	Port1	Port2	Port3	Port4
No Bonding	No PAF (=default)	---	Single	Single	Single	Single
2 links	34	CO (or LT)	Single	Single		Bonding (P4)
3 links	234	CO (or LT)	Single			Bonding (P4)
4 links	1234	CO (or LT)				Bonding (P4)
2 + 2 links	12 and 34	CPE (or NT)	Bonding (P2)			Bonding (P4)
Single: No bonding is active on this port; Bonding (Px): The bonding aggregation is internally mapped on 'Port x'; Only 'Port x' must be used when configuring the service in HiProvision;						

When changing the bonding or PAF mode, in some cases the bonded SHDSL links will go down until the new mode has been negotiated again between the CO and CPE.

▶ Changing the bonding from '2 + 2 links' to another mode;
▶ Changing the bonding from '4 links' to '3 links' or '2 links';
▶ Changing the bonding from '3 links' to '2 links';

2.2.4 Ethernet Service

a. General

SHDSL end points communicate over the Dragon PTN network via an Ethernet service. This service must be configured via HiProvision. This service can operate port or VLAN based. An optional E-Tree can be configured as well on this Ethernet service.

b. Port Based / VLAN Based

▶ Port based: Use this mode if all the traffic on a port must be transported transparently in one and the same service;

▶ VLAN based/VLAN ID: Use this mode if each VLAN (ID) on a port must have its own service. Ethernet packets with the configured VLAN ID will be forwarded in this service, other VLAN IDs and untagged packets will be dropped. This behavior can be overruled by a more advanced VLAN processing in the 'VLAN Tagging/Untagging' feature in HiProvision. This feature also supports VLAN translation which replaces VLAN ID 'x' into VLAN ID 'y'.

c. E-Tree

An E-Tree is a rooted (not routed) point-to-multipoint partial service within a programmed Ethernet service. E-Tree can be used as a security precaution to separate different customers (=leafs) using the same Ethernet service while accessing one or more ISPs (=roots).

When an E-Tree is used, each service endpoint is designated as either **leaf** or **root**. A leaf can only communicate with a root. A root can communicate with all the roots and leafs.

2.2.5 SHDSL Bandwidth and Distances

The SHDSL bandwidth that can be used strongly depends on the SHDSL link distance, the cable diameter, the cable quality, the noise on the cable….

▶ The longer the link, the smaller the bandwidth;

▶ The more noise, the smaller the bandwidth;

▶ The smaller the diameter, the smaller the bandwidth;

▶ ….

In the table below, find some possible combinations for a 0.4 mm diameter SHDSL cable, without any noise. Noise within a cable pair under test, refers to crosstalk interference coming from surrounding cable pairs within multi-cable-pair SHDSL cable.

NOTE: The possible link distances in the table below are only target values. The possible link distances strongly depend on noise, cable quality and TC-PAM line encoding (TC-PAM = Trellis-coded Pulse Amplitude Modulation: TC-PAM 16/32 are advanced (=Trellis Coded) SHDSL line coding techniques based on the basic PAM encoding in the figure below. 16 and 32 refers to the amount of special codes used.
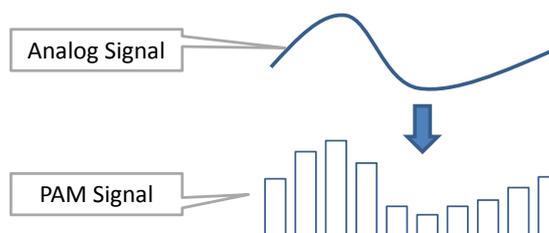

Figure 5 Basic PAM Encoding

Table 6 SHDSL Bandwidth and Link Distance

SHDSL Bandwidth, Line Rate (kbps)	Possible Link Distance, Cable Length (km)
0.4 mm diameter cable, no noise	
5696 (maximum line rate)	2.0
2048	3.5
192 (minimum line rate)	6.5
0.8 mm diameter cable: the possible link distance will be approximately 2.5 times the distance of the 0.4 mm diameter cable for the same line rate. Example: within a 0.8 mm diameter cable and a line rate of 5696 kbps, a possible link distance of 2.0 * 2.5 = 5.0 km can approximately be reached; **Noise**: The more noise, the less link distance can be reached for a same line rate;	

2.2.6 I/O with the Central Switching Module (=CSM)

The 4-DSL-LW module receives traffic (SHDSL) via its front panel ports and converts this into Ethernet traffic which is forwarded to the CSM via the backplane. The CSM does all the processing on this data (synchronization, CRC checks, conversions, switching…). The CSM converts this data into MPLS-TP packets and transmits it via a WAN port (on an IFM that supports WAN) onto the WAN. On the destination side, the same processing occurs in reverse order.

2.2.7 Synchronization / Clock Distribution / Network Timing

The Dragon PTN network provides a number of mechanisms to perform synchronization / clock distribution / network timing. The CSM makes sure that all the included IFMs in the node are synchronized. See the table below for an overview of the mechanisms that are supported on the 4-DSL-LW module.

It means that the front ports of the 4-DSL-LW module can be used to recover a clock from an incoming data stream and redistribute this clock via an outgoing data stream;

Following two clock types are important during this synchronization process:

▶ Primary Reference Clock = PRC: a very stable high quality clock that can be used as a reference;

▶ Service Clock: clock rate at which the data packets are sent in a service;

Table 7 Synchronization / Clock Distribution / Network Timing Overview

Mechanism	Domain	What is Synchronized?	Purpose
SyncE	Network wide	Clock Frequency	Distribute a synchronous clock, based on a PRC, network wide over all the nodes that need it.

a. SyncE (=Synchronous Ethernet)

See the manuals in Ref.[1] and Ref.[4],[4b] for more detailed information;

2.2.8 Ethernet First Mile – Copper (=EFM-C) (currently not supported)

EFM-C is a specific Ethernet protocol between the CO and the CPE over the SHDSL which allows the 4-DSL-LW module to monitor the SHDSL link. The configuration of EFM-C and the monitoring of this link status can be done in HiProvision.

2.2.9 Wetting Current (currently not supported)

a. General

Wetting Current is the minimal current needed (approximately 2 mA) through an electrical contact to prevent oxidation of that contact. A more humid environment increases the chances of oxidation. The Wetting Current does not switch or activates the contact, it just prevents oxidation.

b. Configuration

The activation of the Wetting Current can only be done on the CO side. As a result, the CO will send this current on the DSL. The CPE side has a resistor in its circuit to allow the Wetting Current to flow.

The Wetting Current can be configured per front port in HiProvision. Once it has been enabled for a port, it will flow continuously.

2.2.10 Loopback Selftests

Loopback selftests can be performed on the Ethernet service on the 4-DSL-LW IFM, e.g. when configuring or troubleshooting the service. The loopback can be configured on the front ports towards the line (=application) or network.

CAUTION: enabling selftests disables or disturbs normal service traffic on a port!

For more information and configuration settings, see 'Test and Loopback' in Ref.[1] in Table 1.

2.3 Onboard Interfaces
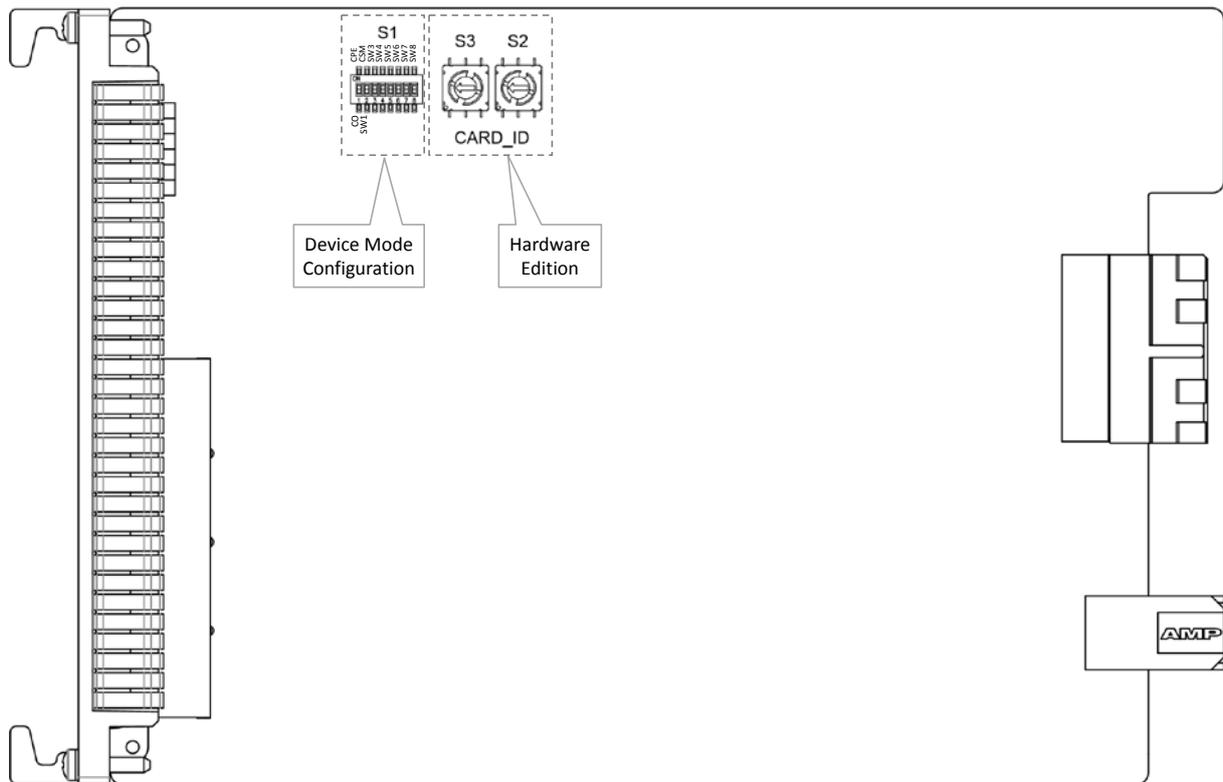
Figure 6 4-DSL-LW: Side View

2.3.1 Straps

No user relevant straps.

2.3.2 DIP Switches

a. Hardware Edition

The Hardware Edition (labeled as CARD_ID) (see Figure 7) is set in decimal code using rotary switches S2 to S3 (=most significant). It can be read out as well via HiProvision. This edition has been factory set and MUST NOT BE CHANGED!

Example: Setting S3='0' and S2='5' indicates Hardware Edition '5' (dec).

Interface Module PTN-4-DSL-LW
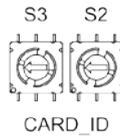
Figure 7 Hardware Edition

b. Device Mode (CO/CPE) Configuration

The 'Device Mode' (CO or CPE) of the 4-DSL-LW module depends on the configuration in HiProvision and some DIP switch settings in Figure 6. Figure 8 shows this DIP switch into detail.

The 'Device Mode' configuration in HiProvision will always be the master setting. In HiProvision, configure the 'Unit Type' parameter on IFM level as follows:

▶ CO: Unit Type = 'LT Unit'; (LT = Line Termination);

▶ CPE: Unit Type = 'NT Unit'; (NT = Network Termination);

Only when there is nothing configured in HiProvision for this IFM, the DIP switch settings on the board itself come into play. The possible configurations on the board are shown in Table 8.

**NOTE:**   Other switches on the DIP switch are spare switches
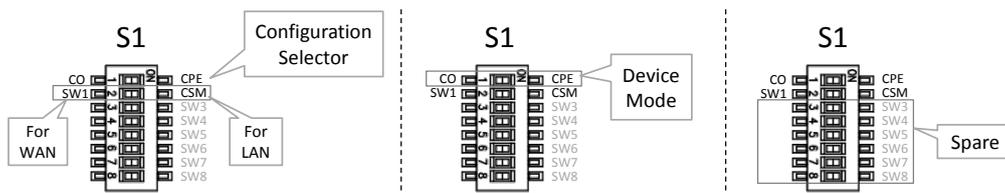
Figure 8 Device Mode Configuration

Table 8 Device Mode (CO/CPE) Configuration

Switch: Configuration Selector	Switch: Device Mode	Description
SW1 (=default) (for WAN=currently not supported)	CO (=default)	The Device Mode will be as configured in HiProvision. If nothing has been configured yet in HiProvision, the Device Mode will fall back to the Device Mode switch setting on the board and start up as CO. As a result, the SHDSL link can come up spontaneously, if the other SHDSL link partner is CPE. This behavior is required in the discovery phase of a new network or node when the nodes are interconnected via a WAN SHDSL link.
	CPE	The Device Mode will be as configured in HiProvision. If no configuration has been done in HiProvision, the Device Mode will fall back to the Device Mode switch setting on the board and start up as CPE. As a result, the SHDSL link can come up spontaneously, if the other SHDSL link partner is CO. This behavior is required in the discovery phase of a new network or node when the nodes are interconnected via a WAN SHDSL link.
CSM (for LAN)	CO (=default)	The Device Mode will be as configured in HiProvision (=CSM is driven by HiProvision). If no configuration has been done in HiProvision yet, the 4-DSL-LW module will start up UNCONFIGURED and the LAN SHDSL link will not come up! The module will not be operational and just wait for a configuration in HiProvision. This behavior is required for LAN SHDSL links because the HiProvision operator only wants the link to come up in a controlled way.
	CPE	

3. MODULE SPECIFICATIONS

3.1 General Specifications

For general specifications like temperature, humidity, EMI ... see Ref.[5] in Table 1.

3.2 Other Specificiations

Table 9 Other Specifications

Description	Value
Weight	0.25 kg / 0.6 lb
MTBF	104 years at 25°C/77°F
Power Consumption	7.3W (measured at 25°C/77°F, with data transport)
Module Size	width: 20.32 mm / 0.8 inches height: 126 mm / 4.96 inches depth: 195 mm / 7.68 inches
Power Consumption	27W (measured at 25°C/77°F, with data transport)

3.3 Ordering Information

PTN-4-DSL-LW: 942 236-007

4. ABBREVIATIONS

CE	Conformité Européenne
CO	Central Office
CPE	Customer Premises Equipment
CSM	Central Switching Module
DSL	Digital Subscriber Line
EFM-C	Ethernet in the First Mile Over Point-to-Point Copper
EMI	Electromagnetic Interference
ERR	Error
FLT	Fault
IEEE	Institute of Electrical and Electronics Engineers
IFM	InterFace Module
ISP	Internet Service Provider
LAN	Local Area Network
LVD	Low Voltage Directive
LT	Line Termination
MTBF	Mean Time Between Failures
NT	Network Termination

PAF   PME Aggregation Function

PF   Power Failure

PI   Power Input

PME   Physical Medium Entities

PTN   Packet Transport Network

SHDSL   Single-Pair High Speed DSL

SNR   Signal-to-Noise Ratio

SyncE   Synchronous Ethernet

TC-PAM   Trellis-coded Pulse Amplitude Modulation

WAN   Wide Area Network