

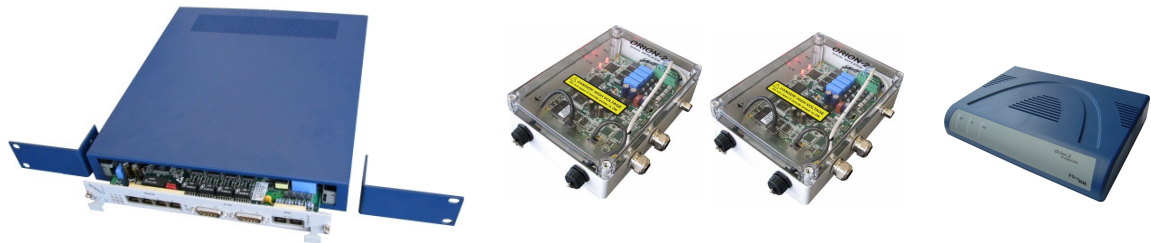
## Orion2+ SHDSL.bis Solution with 11Mbit/s and 15Mbit/s per Copper Pair

### Good to Know about Orion's

Orion1 and Orion2 Modems from FlexDSL have always some more features than corresponding products from competitors. Here again the most important points, that are of prime importance for the application described in this paper:

- Components have industrial temperature range (-40°C to +85°C)
- Components never run on the limit because of better specification
- Programmable, flexible and intelligent design, using High-class chipsets
- Complete solution design, including repeaters, including remote power
- Best performance and low power, long life, high quality design

Example: CO/LTU (with Remote Power) ————— Repeaters ————— CPE/NTU



The **FlexDSL** Orion1 and Orion2 DSL modems and systems are based on the G.SHDSL standard (ITU Rec. G.991.2), what represents the best of several symmetric DSL technologies that have been combined into a single industry standard providing rate adaptation, greater reach and performance, spectral compatibility, lower power and application flexibility. The new line code technology, as a result out of the G.SHDSL standard, encode more data within the frequency spectrum and is called TC-PAM (Trellis Coded Pulse Amplitude Modulation).

### What is Orion2+

Orion2+ is a seamless upgrade of the current famous **FlexDSL** Orion2 DSL Modems. Orion2 models were able to transmit a payload of 5.7Mbit/s per copper pair. Now Orion2+ is able to **transmit up to 11.4Mbit/s or even 15.2Mbit/s**, depending on internal DSL-chipset version, **over one copper pair**.

This brilliant product operates with line coding **TC-PAM-64/128** and provides better transmission distance than VDSL/ADSL. Therefore the transmission performance and quality will be clear better than VDSL, having less disturbances on the copper line due to better **spectral compatibility with other xDSL applications**. Another exciting point is the realisation of real high speed with the extended G.SHDSL standard, based on TC-PAM. So far G.SHDSL is the only standard that allows, define and **promote the use of repeaters**.

**Conclusion: Orion2+ is the only possible solution for a long distance transmission of 15.2Mbit/s data over a one pair copper cable!**

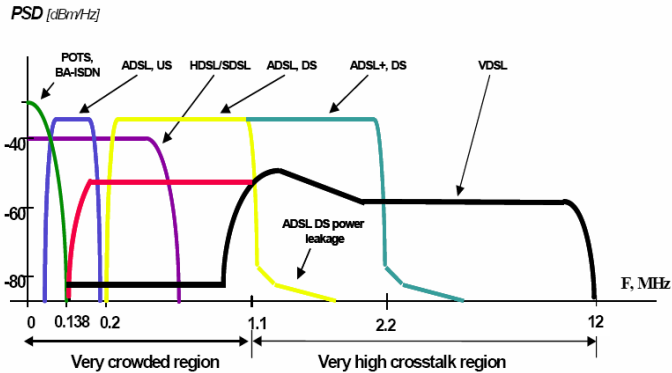
## Importance of Spectral Compatibility

The spectral compatibility of two DSL transmission systems is defined by the effect of the crosstalk that one system has on another in the same cable. Cables are made up of many copper wire pairs that are bundled together. With this close proximity, some signal energy being transmitted on one pair is going to be induced into pairs that are in the adjacent area. Because DSL service is not introduced to all customers simultaneously, over time and as technology matures and standards emerge, it is possible to have a mix of DSL techniques in use even in the same bundle. From experience, it is known that some techniques generate more interference or crosstalk than others.

Different types of DSL in a cable utilize different bandwidth. Depending on the energy of the signals and the spectral placement, the different types of DSL systems may or may not be compatible with each other. The crosstalk effect that one DSL system has on another in the cable defines the spectral compatibility.

In the design of DSL systems, spectral compatibility is important because the deployment of any new DSL services should not degrade the performance of other services in the cable. Likewise, the existing services in the cable should not prevent the new DSL from meeting its performance objectives.

The SHDSL standard was developed not only to address interoperability issues but also took into consideration the spectral characteristics of the existing line coding and transmission techniques in common use within the existing networks. SHDSL or G.991.2 is based on modifications to HDSL2 and uses TC-PAM, providing improving spectral efficiency.



Unlike VDSL, G.SHDSL is spectrally compatible with ADSL, causing little noise or crosstalk between cables, which means G.SHDSL can be mixed in the same cable bundles with ADSL, HDSL, HDSL2, and IDSL without much, if any, interference. This maximizes the deployment options available to service providers, allowing G.SHDSL and ADSL to be deployed from the same platform.

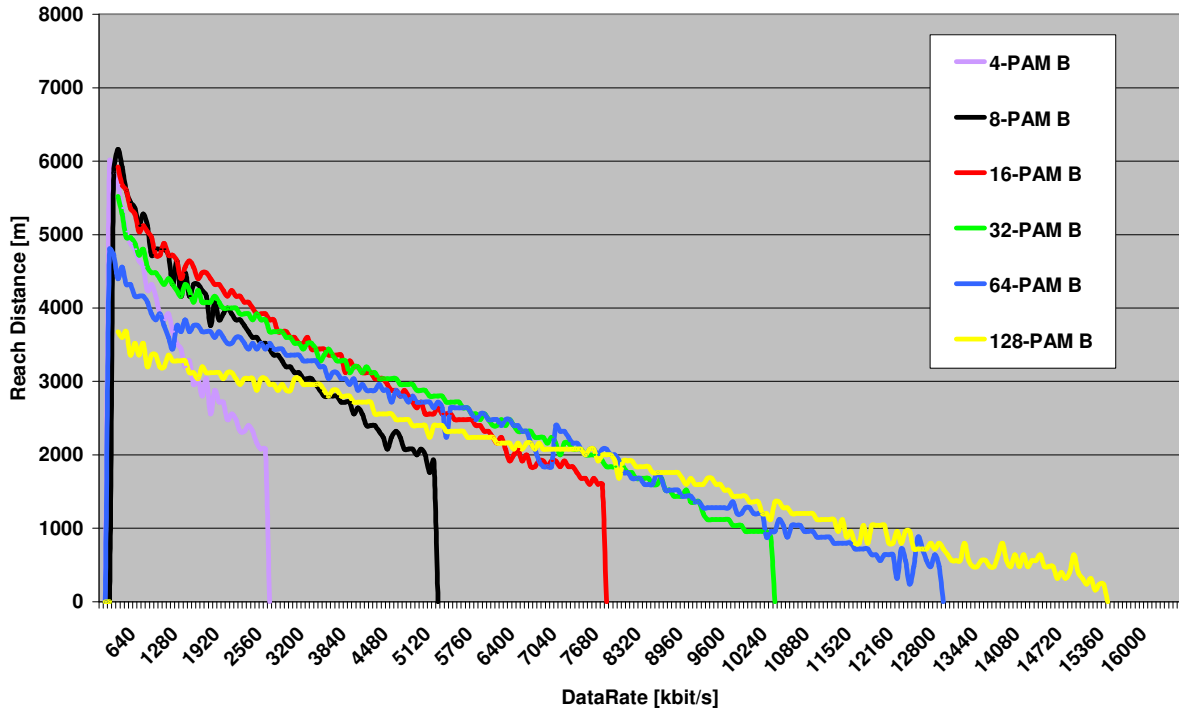
## Speed, Distance and Power Spectral Density

The following table give you an overview about the possible datarates using Orion2 and Orion2+, dependant on TC-PAM coding.

TC-PAM	Orion2		Orion2+ Standard DSL Chipset		Orion2+ Extended DSL Chipset		Speed Hint Best Selection
	Baserate	DataRate [kbit/s]	Baserate	DataRate [kbit/s]	Baserate	DataRate [kbit/s]	DataRate [kbit/s]
4	-	-	2- 35	128- 2240	2- 39	128- 2496	128
8	-	-	3- 71	192- 4544	3- 79	192- 5056	192- 1152
16	3-60	192-3840	4-106	256- 6784	4-119	256- 7616	192- 4160
32	12-89	768-5696	4-142	256- 9088	4-159	256-10176	2048- 8960
64	-	-	2-178	128-11392	2-199	128-12736	5440-12736
128	-	-	-	-	4-238	256-15232	7040-15232

About Speed Hints: Usually if possible it is better to choose a lower TC-PAM coding, it will lead to a better immunity to interference. But sometimes the filter characteristic of the copper cable affect the data transmission and a change to higher TC-PAM coding can help to get better performance.

The next diagram shows the reach against the data rate with different TC-PAM coding. This diagram is measured on 0.4mm (AWG 26) real copper cable (please do not compare it to the perfect PE 0.4mm cable). You also can read out of this diagram for different data rates the optimum PAM coding. Again, this can change depending on the characteristic of the used cable.



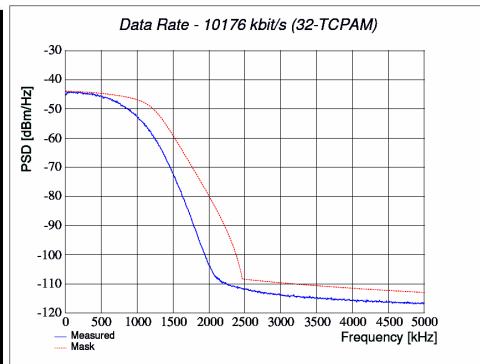
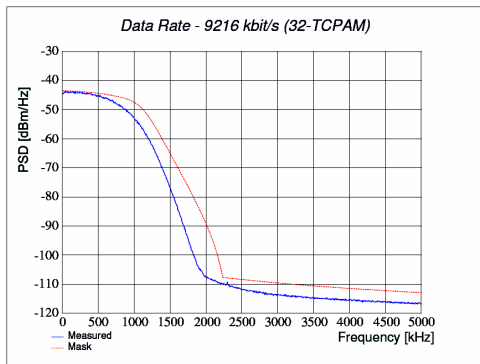
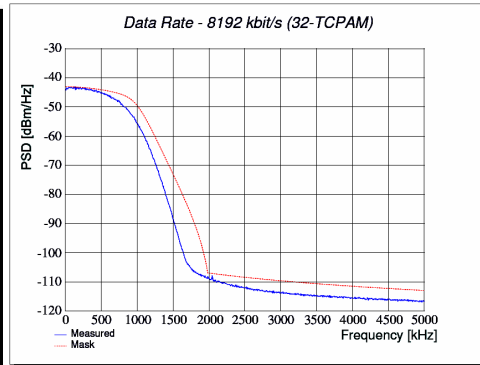
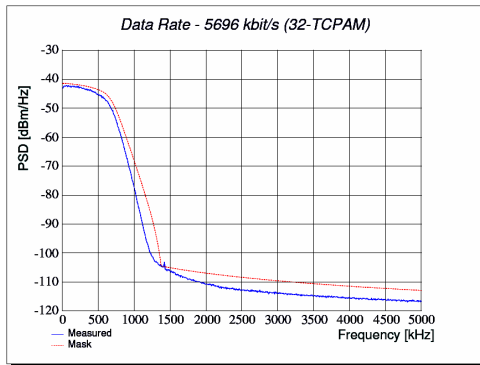
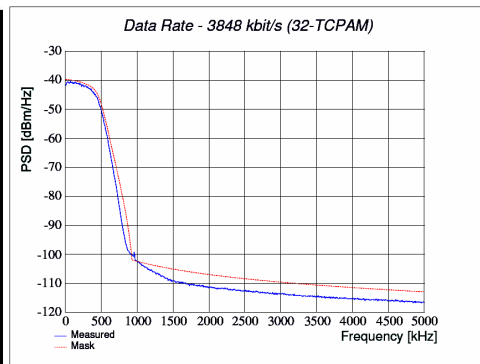
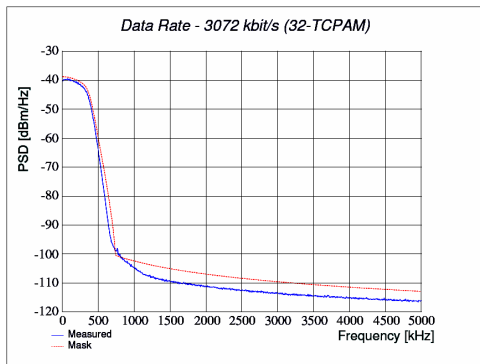
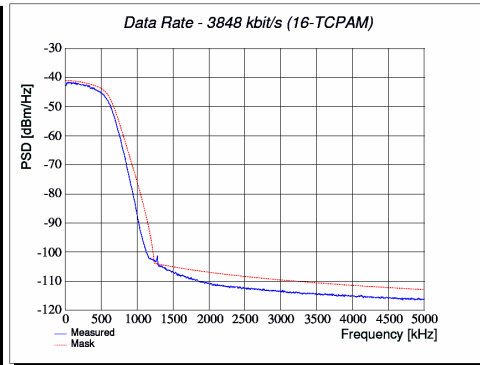
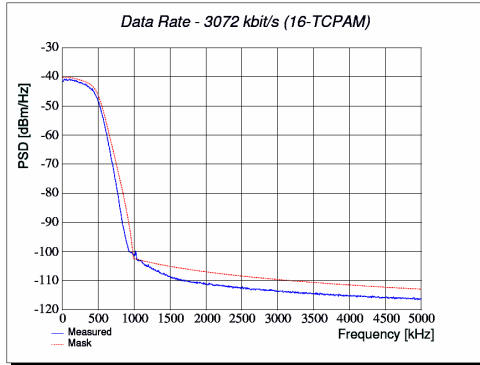
Error Free Distances on 0.4mm cable, measured with a line simulator:

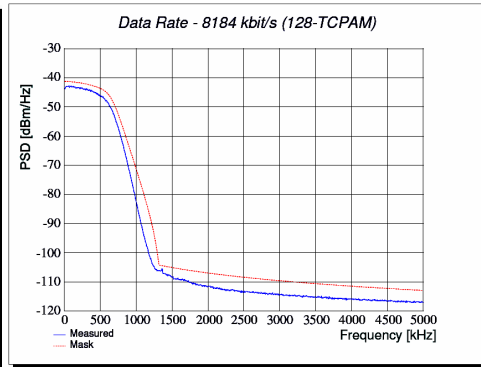
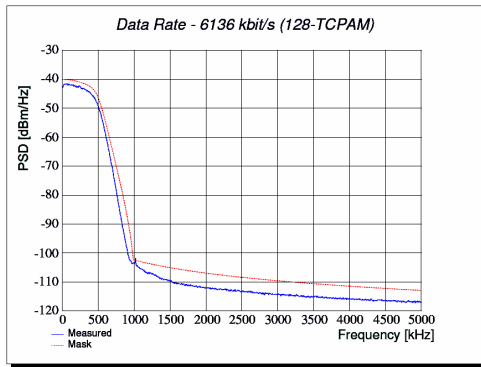
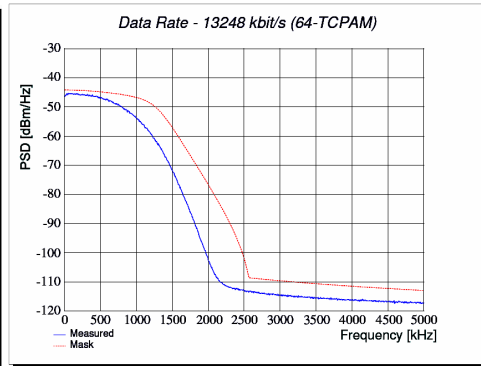
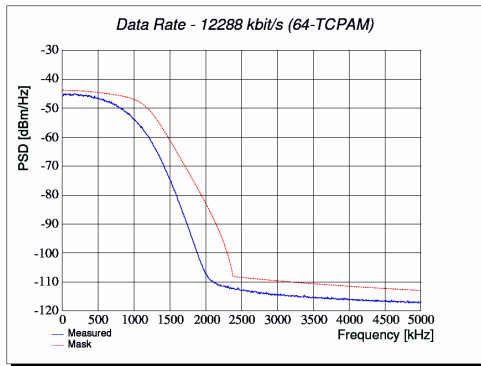
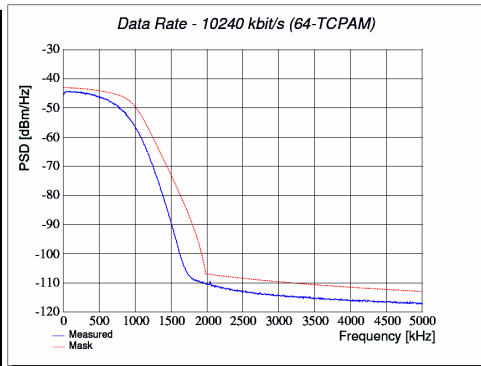
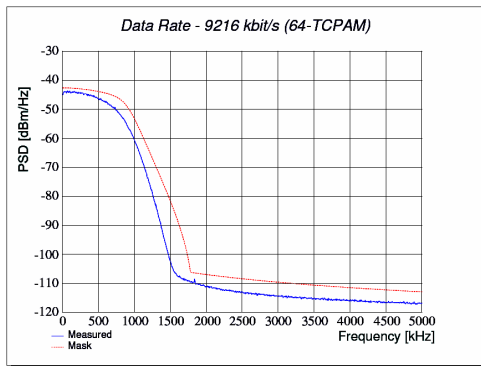
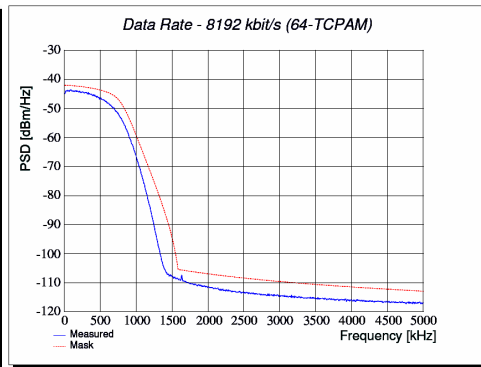
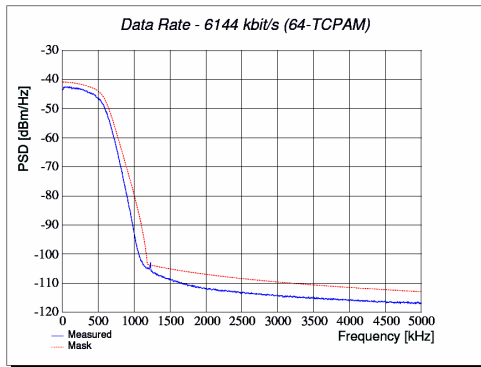
0.4mm Cable PAM-16		0.4mm Cable PAM-32		0.4mm Cable PAM-64		0.4mm Cable PAM-128	
DataRate [kbit/s]	Reach [m]	DataRate [kbit/s]	Reach [m]	DataRate [kbit/s]	Reach [m]	DataRate [kbit/s]	Reach [m]
10184	-	10184	-	10184	1350	10184	1500
8000	-	8000	1750	8000	1700	8000	1900
5696	2400	5696	2600	5696	2100	5696	2100
4096	3000	4096	3100	4096	2500	4096	2400
2048	4400	2048	4300	2048	3650	2048	3100

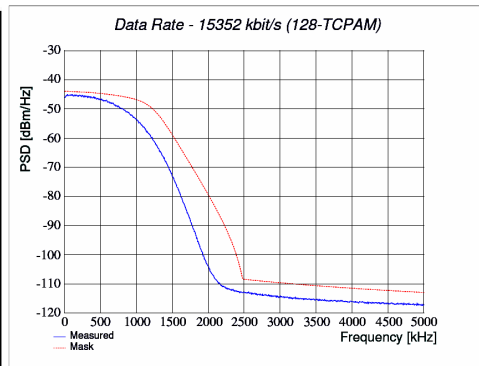
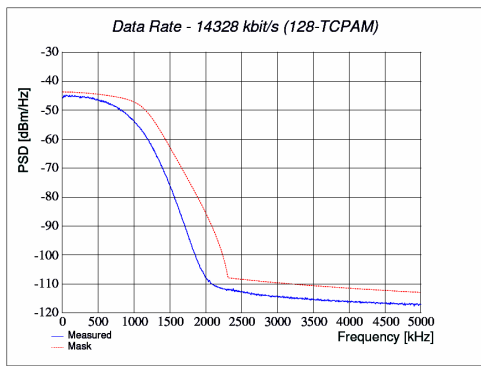
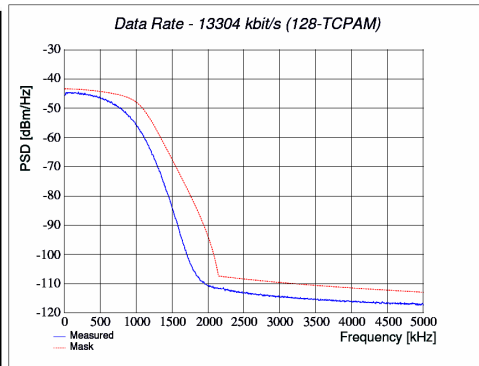
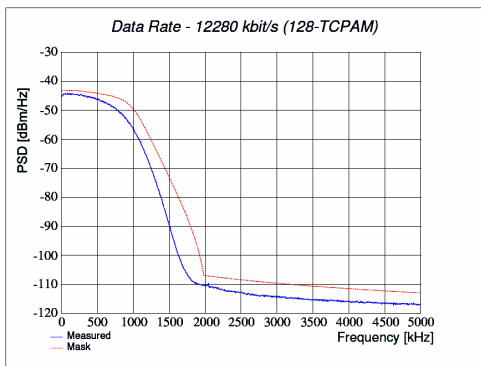
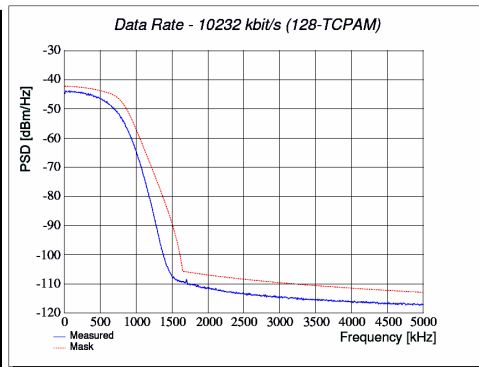
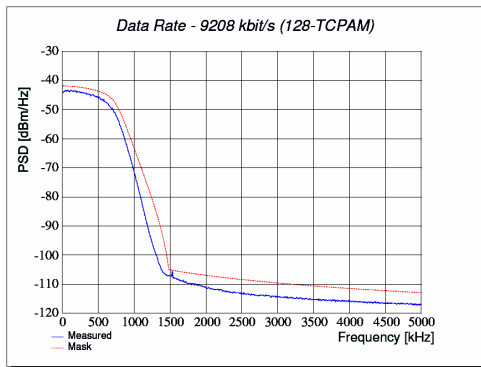
Error Free Distances on 1.2mm cable, measured on real thick cable:

1.2mm Cable PAM-16		1.2mm Cable PAM-32		1.2mm Cable PAM-64		1.2mm Cable PAM-128	
DataRate [kbit/s]	Reach [m]	DataRate [kbit/s]	Reach [m]	DataRate [kbit/s]	Reach [m]	DataRate [kbit/s]	Reach [m]
5056	7200	5632	7200	5120	7200	3840	7200
1600	13800	2048	13800	1600	13800	896	13800
768	19200	576	19200	320	19200	-	19200

Next diagrams illustrate the Power Spectral Density (ITU Rec. G.991.2 Annex G) with different line speeds and different TC-PAM coding. As higher as the value of TC-PAM is, as smaller is the bandwidth used in the cable. But remember to choose a lower TC-PAM coding will lead to a better immunity to interference.







Call +41 44 741 5290 today or send an e-mail to [info@flexdsl.ch](mailto:info@flexdsl.ch) for further information.