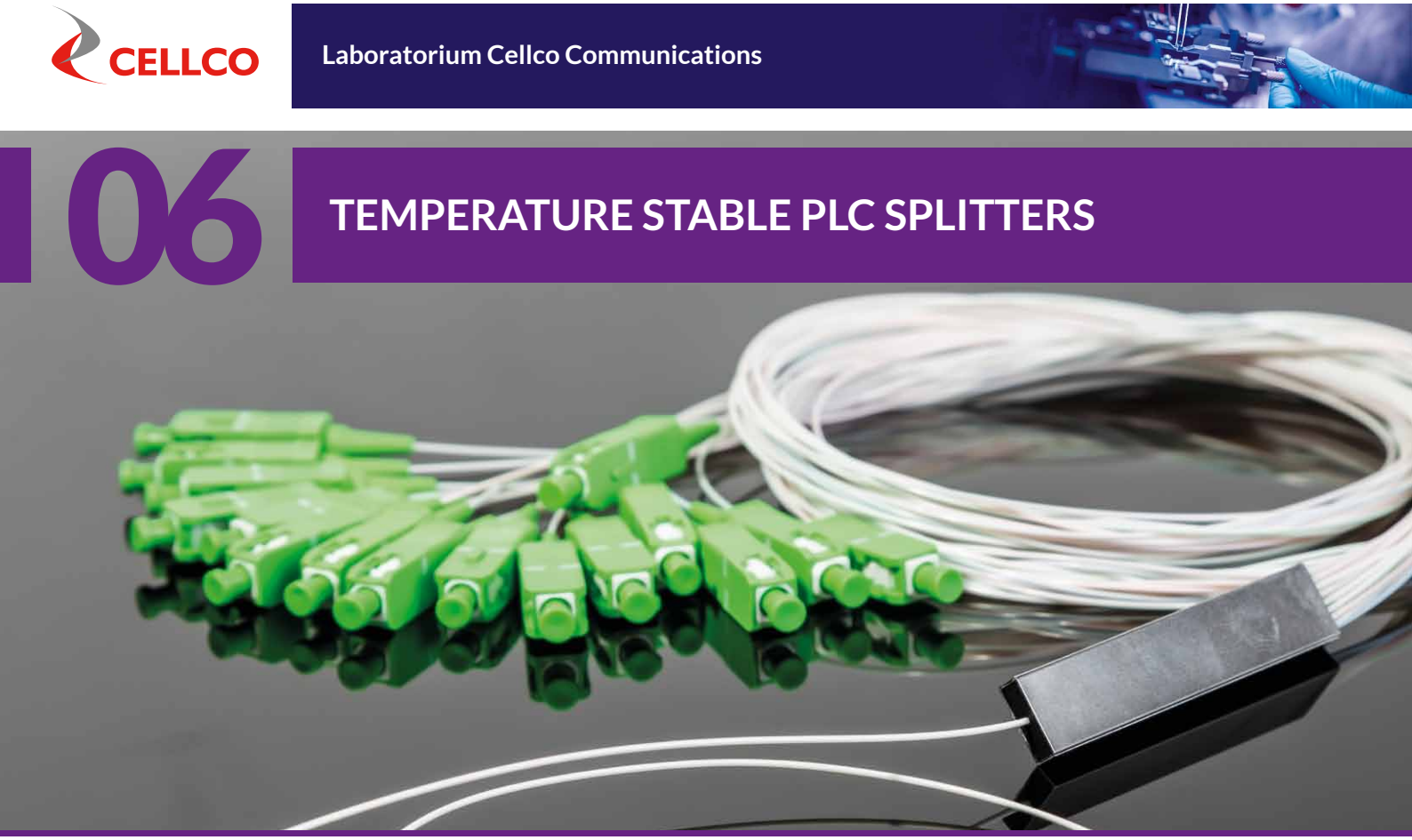


06 TEMPERATURE STABLE PLC SPLITTERS

PLC Splitters

PLC splitters are commonly used components of fiber optic technology in networks such as FTTx and PON. The enormity of market offer, differences in price and declared parameters, cause the operators to face a difficult choice. Which splitter is the most appropriate to fulfil the planned investment? Usually fitters and operators make their decision upon the manufacturer's declaration of technical specifications and technical reports.

These reports usually concerns parameters of bare fiber, without all the connectors. Should be emphasize fact that assumption of connectors is increasing the attenuation of 0,15dB for premium splitters and 0.3dB for a splitter standard for each connector. In addition to these variables it deserves special attention the issue of temperature resistance splitter with assumed connectors. The most offered splitters on the market declared thermal stability only for the splitter without connectors, whereas a procedure of connectorisation causes a noticeable narrowing the range of temperature resistance.

This issue has been analysed in details by the engineers of Cellco Tech Group. The results of research is PLC splitter housing in MetalBox with connectors, which meets the performance declared in the temperature range from -40 to + 85 ° C.

PLC technology

PLC splitters are built in planar technology. Main element of splitter is chip (Figure 1), and for the proper functioning corresponds to the precise matching of components. The indoor module PLC Cellco splitter (Fig.1) is produced in ultra-modern laboratory (Clean Room) allows positioning with an accuracy of 50 nanometers. In clean room is maintained ISO 7 the level of cleanliness, while under the device that combines quartz elements is using of highly efficient laminar air flow and maintained cleanliness class ISO 4. The final thermal expansion of the product is significantly affected by the use of high-quality quartz and specialty adhesives. UV epoxy adhesive provides stability and durability of the connection between array and chip, which has an important effect on product life.

The indoor module protects absorbing substance, ensuring resistance to mechanical damage, preventing moisture and providing temperature stability.

PLC Splitters - configuration

Cellco Communications specializes in the production of symmetrical PLC splitters in various configurations, from 2x2 to 2x64 and from 1x2 to 1x128, including divisions 1x3, 1x6, 1x12, 1x24. Beside symmetrical splitters we were specialized in production asymmetrical splitters, which providing an uneven distribution of the optical input signal into several output channels
PLC technology provides very high stability with a range of supported wavelength 1250-1650 nm. In standard fiber used G.657.A2 is a guarantee of low damping and high mechanical strength.

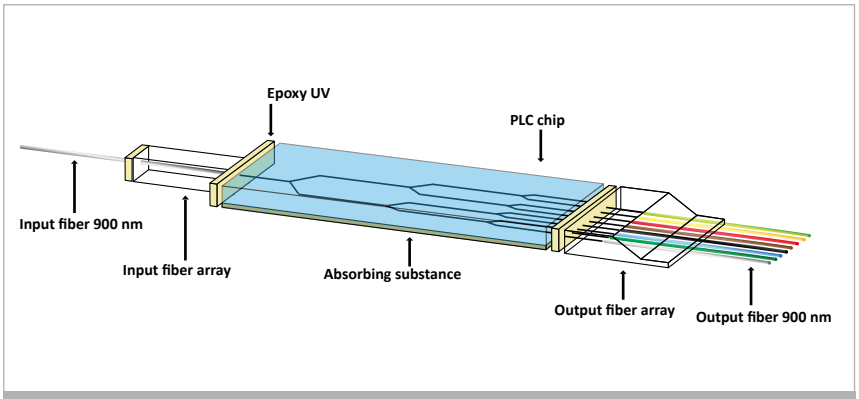
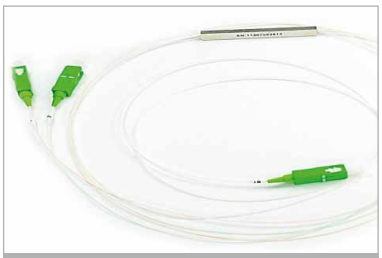


Fig. 1. Construction of PLC splitter



Fot. 1. Splitter in the METALBOX husting and with 900 µm tube

Unique technologie

Cellco Communications research department, using long-term experience in installing connectors on patchcords and pigtails, as a pioneer in the industry, has developed a unique technology to install connectors on splitters in metalbox housing with 900 µm tube (photo 1), maintaining the stability of product parameters over a temperature range from -40 to + 85 ° C. In the production process is used an innovative device designed by Cellco engineers to install the connectors, it allows to maintain constant and repeatable parameters. Thermal stability is confirmed by a number of tests carried out in a climate chamber. In addition, Cellco splitters retain the declared low value of Polarization Dependent Loss (PDL) measured in the climate chamber.
This ensures that the lack of tension in the planar structure of the inner module, which provides mechanical stability. The unique production technology of splitters and conducted tests on them showed that the PDL parameter, which is maintaining a constant low level is resistant to temperature changes in the range of Telcordia norm.

To bridle extreme temperatures

Built fiber networks involve more than ten years maintenance-free operation . In the networks overhead (AIR) and earth (Residence) for connecting subscribers , operators are increasingly using splitters with installed connectors . Stability of the network components parameters in the temperature range over the entire operation has a decisive effect on its functioning, occurence of breakdowns and the operation on the current connection. The main line of fiber optic network is mostly bulit from spring to fall.

Connecting new subscribers , operators perform throughout the full year, often in extreme weather conditions , cold winters or hot summers . During one winter temperature changes occur several times , so the temperature stability plays a key role.

In Cellco the tests of temperature influence on the splitters are performed in a climate chamber (fot.2) which allows to engage each time a programmable test of humidity in the range of 20-98 % in dedicated temperatures and their changes in the range from -40 to to + 85 °C. Tests are performed at every stage of production. The test is performed according to Telcordia GR- 1209 and GR -1221.

Fot. 2. Temperature chamber

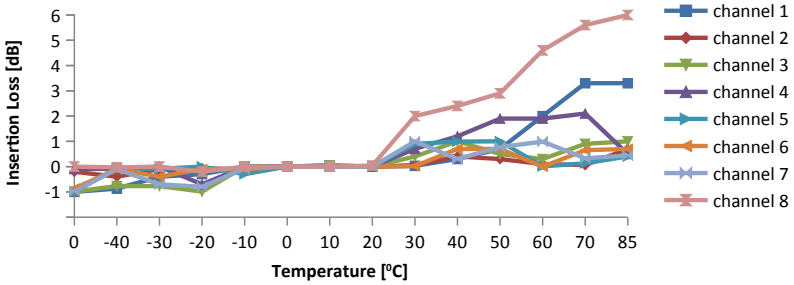
Comparative Tests

Engineers of Cellco Tech Group conducted a test to compare two PLC splitter in terms of temperature resistance.

The object of the test was a Cellco production 1x8 PLC splitter in the Metalbox housing with installed connectors and an identical splitter made in China, widely available on the Polish market. In the climat chamber, measurements were performed according to Telcordia standard (in the temperature range from -40 to + 85 °C), splitters were tested in the same temperatures. To the test were taken splitters with Metalbox housing (photo 1) most often used in overhead and earth network installations. Metalbox is yet the smallest housing but also is the best mechanically and thermally resistant casing type used in PLC splitters. The compact size allows easy implementation in small FTTH modules such as hermetical Mufs.

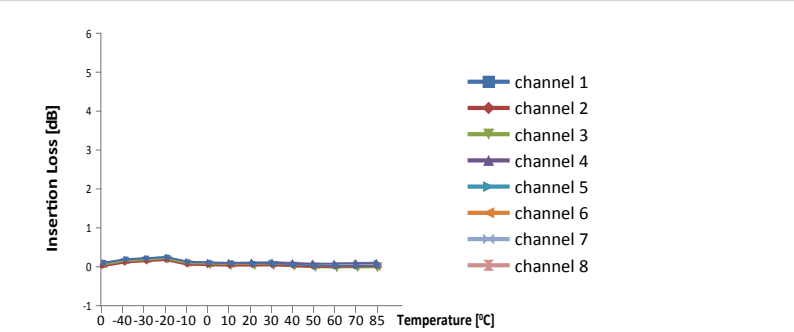
This casing gives us the opportunity to implement a splitter with tube or without it. The test results are show the graphs below . Graph 1 presents the changes in insertion loss under the temperature influence of „eastern „ splitter, Graph 2 shows the changes in insertion loss under the temperature influence of Cellco splitter.

Changing the attenuation [dB] including the impact of temperature [C] – splitter "chinese" production (wavelength 1550 nm)



Graph 1. Changes in attenuation due to temperature for PLC splitter 1x8 „chinese" production

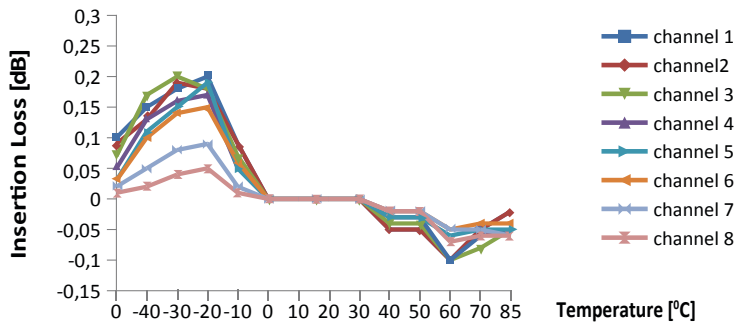
Changes in insertion loss [dB], taking into account the effect of temperature [° C] - splitter Cellco production (wavelength 1550 nm)



Graph 2. Changes in insertion loss due to temperature for PLC splitter 1x8 production

For comparative purposes, Figure 2 shows that uses the same scale, which illustrates the parameters of a graph 1 - from -1 to 6 dB. Changes of insertion loss are noticeable. The graph shows the stable distribution parameters. To bring changes in distribution - specific parameter variable insertion loss is a graph 3, where smaller scale of 0.15 to 0.3 dB.

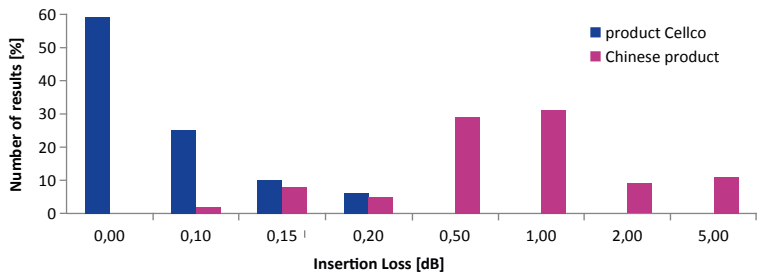
Insertion loss parameter [dB], taking into account the effect of temperature [° C] - splitter Cellco production (wavelength 1 550 nm)



Graph 3. Changes in insertion loss due to temperature for PLC splitter 1x8 Cellco production (range -0.15 to 0.3 dB)

It was observed that the value of the PLC splitter insertion loss for the production of „chinese" change significantly, reaching 6 dB. The change in this parameter for Cellco splitter is a maximum only 0.2 dB (graph 4). The Cellco splitter indoor module is made with extreme precision, breaks down all the stress associated with large fluctuations in temperature.

Comparison of changes in insertion loss for PLC splitters exposed to temperature differences for wavelength 1550 nm.

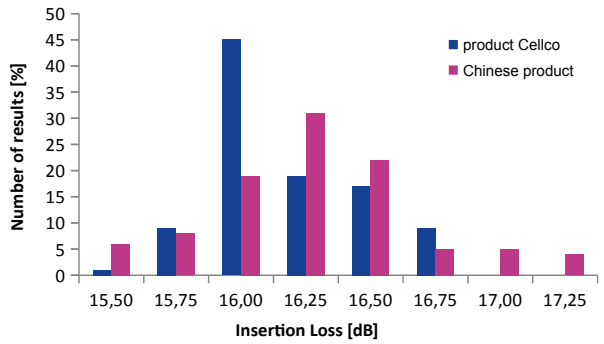


Graph 4. Comparison of changes in insertion loss for PLC splitters exposed to temperature differences according to standard Telcordia

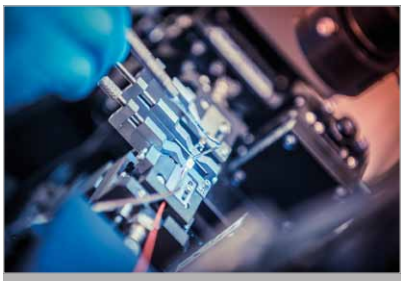
HIGHEST QUALITY OF PLC SPLITTERS

The average value of insertion loss for PLC splitters manufactured by Cellco are very stable, repeatable and reproducible. Comparing insterion loss parameter in examinated spliters of the "East" and "Cellco" production. The chart below illustrates how low are dispersions of insertion loss in the case of products from Cellco compared with the test sample PLC splitters of the „East„ production (Graph 5).

Comparison of insertion loss fot PLC splitters 1x8



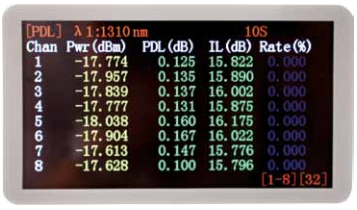
Graph 5. Comparison of insertion loss fot PLC splitters 1x8



Fot. 3. High precision

Fot. 4. Fully automatic machine

Fot. 5. Quality control



Fot. 6. Example of measurements

Fot. 7. Clean Room

Restrictive standards

Cellco Clean Room manufactures PLC splitters in accordance with they own internal standards, even more restricts than Telcordia standards. The values uniformity for the product with connectors

PARAMETERS FOR SPLITTERS 1XN with connectors

Type	1x2		1x3		1x4		1x6		1x8		1x12		1x16		1x24		1x32		1x64		1x128	
Version S-standard P-premium	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P
Operating wavelenght [nm]	1250 nm – 1650 nm																					
Insertion Loss [dB]	<4.8	<4.2	<7.1	≤6.3	<8.1	<7.3	<10.1	<9.3	<11.1	<10.3	<12.6	<11.8	<14.35	<13.55	<16.6	<15.8	<17.6	<16.8	<22.1	<20.8	<24.1	<23.3
Uniformity [dB]	<0.6	<0.5	<0.8	<0.6	<0.8	<0.6	<0.8	<0.6	<1.0	<0.8	<1.4	<1.0	<1.4	<1.2	<1.5	<1.4	<1.6	<1.4	<2.2	<2.0	<2.5	<2.5
PDL [dB]	<0.2	<0.2	<0.2	<0.2	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.4	<0.4
Return Loss [dB]	>55																					
Directivity [dB]	>55																					
Operating temperature [°C]	- 40~+85																					
Storage temperature [°C]	- 40~+85																					
Fiber type	G.652.D, G.657.A1, **G.657.A2**																					

Tab. 1. Parameters for Splitters 1xN with connectors

PARAMETERS FOR SPLITTERS 2XN with connectors

Type	2x2		2x4		2x8		2x16		2x32		2x64	
Version S-standard P-premium	S	P	S	P	S	P	S	P	S	P	S	P
Operating wavelenght [nm]	1250 nm – 1650 nm											
Insertion Loss [dB]	< 5,1	< 4,6	< 8,2	< 7,5	< 11,6	< 10,8	< 15,1	< 14,3	< 18,1	< 17,3	< 22,6	< 21,8
Uniformity [dB]	< 1,0	< 1,0	< 1,2	< 1,2	< 1,4	< 1,4	< 2,0	< 2,0	< 2,5	< 2,5	< 3,0	< 3,0
PDL [dB]	< 0,3	< 0,3	< 0,3	< 0,3	< 0,3	< 0,3	< 0,3	< 0,3	< 0,3	< 0,3	< 0,4	< 0,4
Return Loss [dB]	>55											
Directivity [dB]	>55											
Operating temperature [°C]	- 40~+85											
Storage temperature [°C]	- 40~+85											
Fiber type	G.652.D, G.657.A1, **G.657.A2**											

Tab. 2. Parameters for Splitters 2xN with connectors

Conclusions

Production of PLC splitter in Cellco Communications is a unique technology prepared by qualified staff confirmed with a number of studies. Constant cooperation with research centers and universities in the development and research of splitter in extreme conditions allows us to continuously improve the production process. Development work is supported by the highest quality components, repeatability of production and quality control at various stages of the manufacturing process allow the production of PLC splitters with connectors in the Metalbox housing, characterized by high stability and minimal variation of results over a wide temperature range from -40 to + 85 °C, according the Telcordia standard 1209 & 1221, which is confirmed with each tests in a the climate chamber.

Literature

Y. Hibino, F. Hanawa, M. Ishii, H. Nakahome, N. Takato “High reliability optical splitters composed of silica-based planar lightwave circuits”

Splitters PLC/FBT
– www.cellcofibers.com

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