MythBusters
In the land of PLC, epilogue

PLC splitters are passive devices for optical power distribution, manufactured using planar processing methods and used as main components in fiber-optic access networks such as PON. Until recently considered rather exotic, PLC splitters are now gaining popularity among operators and installers due to the spreading of PONs. The popularisation of PLC splitters is caused mostly by the decrease in their pricing as well as the increase of the suppliers introducing these splitters to their offer. At the moment, PLC splitters became so popular that many operators began to consider them as mass-produced and widely accessible devices, so simple they cannot be malfunctioning. With such an approach the only matter that should be taken into account when selecting the supplier is obviously the price. Is this justified? We have explained the most important myths regarding PLC splitters. Now, having in mind countless requests from our fans, we decided to present how the high quality splitters should be manufactured.

EPILOG

Your childhood heroes, **PLC Mythbusters, are back**! In response to many pleading mails sent to our team, we decided to add an epilogue to our acclaimed *"In the land of PLC"* trilogy (already almost as famous as the original Star Wars series). This time we are coming with a positive message, as we have been accused of too much criticism. It may indeed be more difficult to propose something constructive, but let us show how these things should be done – Ladies and Gentlemen, hereby we present the most important arcana of the production of high quality PLC splitters!

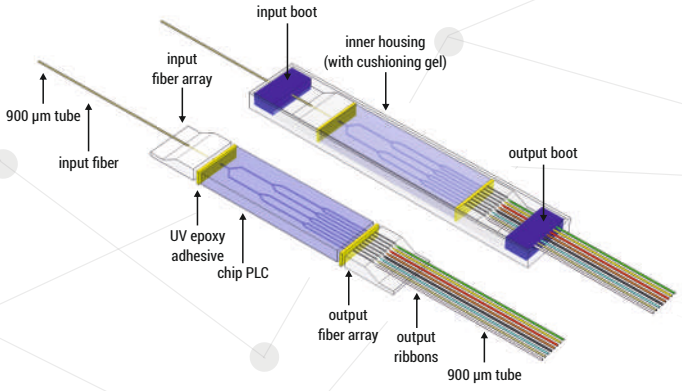

FIGURE 1 – Components of a PLC splitter

SECRET 1 – CLEANLINESS, CLEANLINESS, CLEANLINESS

As we have been saying repeatedly, cleanliness is the key factor in the production of PLC splitters. Waveguides in PLC chips are about 7-8 µm in size, which is more or less the size of the mode field in single-mode optical fiber (for comparison, it is approx. 25 times less than human hair's). As we already know, **a PLC splitter consists of many elements (shown in Fig. 1) and even the smallest particle is not allowed to get between the chip and the fiber array**. The presence of such a particle usually leads to the increase in attenuation and the deterioration in uniformity, and always results in worse resistance to climate conditions and accelerated ageing. Hence, it is absolutely crucial to precisely **clean the elements** just before positioning the splitter, to maintain **cleanliness control** of the prepared elements and to conduct the manufacturing process in the so called *cleanrooms*. The cleanroom is necessary for the process, because even in a seemingly clean office there are hundreds of thousands of particles floating in the air, invisible to a human eye, and most of them larger than 8 µm. The most cleanly swept garage in the low cost Far East mini-factory will not provide the required air purity.

SECRET 2 – EQUIPMENT AND ACCESSORIES

Let's assume that the abovementioned garage has been cleaned so precisely that it became a cleanroom. Is it enough to produce good quality splitters? What more is needed is **the equipment of an appropriate class**. Firstly, as we have mentioned before, a proper cleaning and cleanliness controlling equipment is required. Secondly, we need a proper measuring equipment – multichannel power meter for IL, PDL and RL measurements for at least 3 wavelengths costs tens of thousands euro and, most certainly, the archetypical low-cost producer will not have it. Without such a device the producer cannot reliably control his products (and most likely would make up their test reports, which is easy enough to check by comparing the values from the test report with actual measurements).

Finally, to maintain manufacturing consistency the use of automated positioning stations is needed – manual stations require great operational skills, thus their usage results in poor repetitiveness of splitters' quality (especially when a dedicated operator quits, is absent or not feeling well. Or had a birthday party last nigtht).


AUTO
DOWN
POWER
UP
MENU

SECRET 3 – CONTROL, CONTROL, CONTROL

No PLC splitters' producer manufacture all required components by themselves, e.g. every one buys PLC chips or UV epoxy adhesives and most of them also order cable tubes and *fiber array* elements. For Fibrain splitters, we use our own 900 µm and 2.0 mm tubes, thus it is easier for us to make sure we have consistent and stable raw materials. Nevertheless, **all components must be controlled upon every single delivery**, which is time- and money-consuming. And, obviously, to carry out this control requires proper measuring equipment. Even the most reliable supplier may have sometimes a glitch and their mistakes ought to be detected as soon as possible by the quality control system of the PLC splitters manufacturer. Perfection knows no limits – during our quality control procedures we measure e.g. roughness of fiber array surface or the size of the mode field to make sure that fiber in the splitter is fully compliant with G.652D (the fact that we also test the pitch of waveguides in PLC chip or the minimal bending radius as well goes without saying).

SECRET 4 – EVEN MORE CONTROL

Even when we achieve the ideal state when every supplier hates us for being troublemakers and panics seeing a new order from us for a new batch of PLC chips, it may not be enough to assure the proper quality of final product. For until this moment, we did not mention anything about **the control of our internal processes and the final products**. In fact, this is an absolute key matter for the quality assurance system. With regards to the Fibrain splitters, we have implemented **a four-level internal control**, and each level is performed by independent departments:

1. Production technologists check the compatibility of the process with workstation instructions.
2. Measurement department tests every piece using unique multichannel IL, RL and PDL meters, measuring the losses at 5 different wavelengths.
3. Quality assurance department checks the final product before shipping – to evaluate the splitters visually for any defects or damages that may have occurred during packaging and they verify if the batch matches a purchase order. Also to perform spot checks to confirm the results from previous levels.
4. Finally, the laboratory collects random samples of splitters and performs full tests, e.g. for changes in attenuation in low temperatures (-40°C), water resistance (submerging splitters in acidic water) or impact resistance.

All this to minimise the risk that potential failure is detected by the user, e.g. during the final game of the next football world championship. Instead it needs to be detected and corrected by the manufacturer.

Because it would be very unfortunate if your subscriber missed the match because of a defective PLC splitter, wouldn't it?