# 100G CFP Health Check

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As the deployment of 100G links continues to gather steam, the demand for increased bandwidth is at an all-time high and network operators must face significant challenges. Some of these challenges have been well-documented in the past and are now understood by most. However, there is one aspect of 100G technology that is too often overlooked when discussing link deployment: the CFP optical interface.

The optical interface is based on parallel optics transmission through which a number of wavelengths (usually 4 or 10) is combined on the same fiber pair to form the 100G rate. This functionality is handled by the CFP optics at both ends of the link. This is very different from 10G transmission, which uses serial transmission with a single wavelength to carry the full line rate. At the moment, the technology behind the pluggable XFP optics used for 10G interfaces is very mature and stable, resulting in a product that is extremely reliable and quite inexpensive. By contrast, 100G CFP technology, which is much more complex than 10G XFP, is still in its early stages and does not yet produce consistently reliable optical interfaces.

Based on our experience with multiple carriers around the world, the likelihood of having a faulty or unreliable CFP is quite considerable. If this is not detected by the carrier as the link is being turned up, the results will be very significant in terms of schedule delays, or worse, poor link performance. Furthermore, the cost of CFP interfaces today remains extremely high and their availability is still somewhat limited. Consequently, it is neither practical nor economically feasible for carriers to keep spares of these CFP optics readily available for all 100G links and replace them when they are suspected of poor performance.

In order to ensure the proper deployment and optimal performance of 100G links, it is imperative that carriers use the right tool to test the stability and reliability of every CFP being used.  In the remainder of this application note, we will present EXFO's 100G test solution and how it offers a unique set of functionalities specifically designed for CFP qualification, making it the tool of choice for 100G field deployment. It will also detail the benefits of such tests as well as highlight other tests for lab qualification. There may be cases where some errors will appear intermittently on the network making the link unstable. Thanks to the CFP health check, these errors can be quickly identified through an easy to use graphical user interface and a suite of applications.

## CFP TECHNOLOGY OVERVIEW

The 100G CFP uses a specific converter module, called the gearbox, to translate the 10 electrical CAUI lanes into 4x25G optical lanes. However, this is not the case for the 40G CFP, where the 4 XLAUI lanes are simply and directly translated into 4x10G optical lanes. To properly qualify a CFP, the gearbox, thermal stability, synchronization circuitry, host electrical channel as well as the optical channel laser Tx/Rx power and supported voltage will all need to be tested. This is really different from the tests that were done on the lower rate transceivers, where most of the time a loopback BERT test was sufficient. EXFO's FTB/IQS-85100G offers a suite of integrated tools, under the CFP health check, that support the above tests and provide the end user with quick and clear test results.

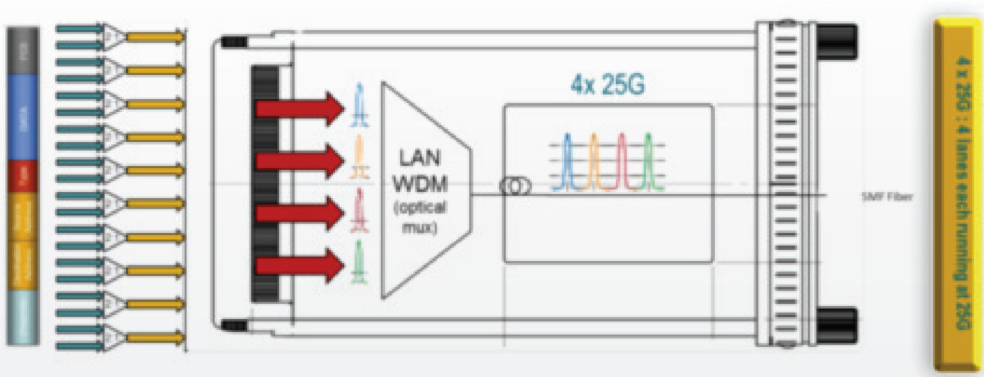



*Figure 1. The 4x25G CFP internal structure*

## LASER, FREQUENCY AND POWER MONITORING INTERFACE

Unlike the single wavelength transceiver that was used for legacy 2.5G and 10G, each CFP optical parallel lane must be monitored for power and frequency. There may be instances where one wavelength will report an out of range value, which could damage the receiver's optical input or cause timing issues. Figure 2 below shows received power and frequency measurements as reported by the CFP. These pages provide information on the CFP status, which is key when troubleshooting a network. Network components, like switches and amplifiers, can also have some effect on the timing and optical power.

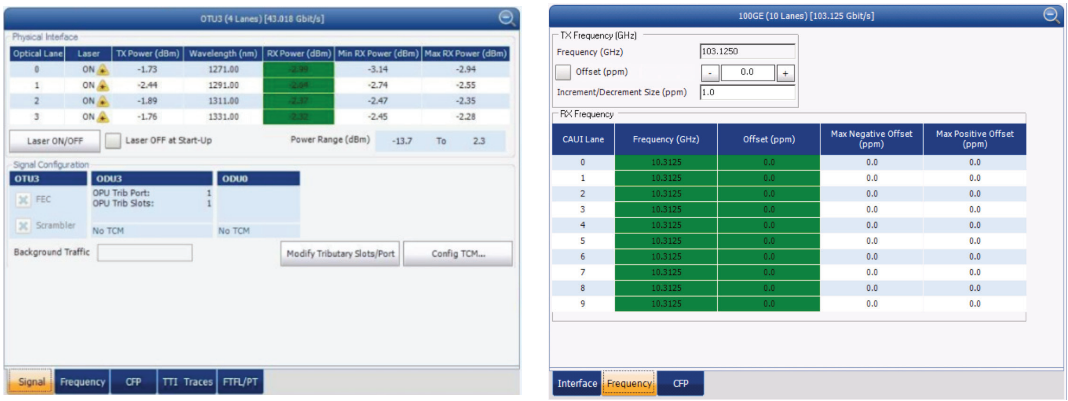



*Figure 2. The FTB/IQS-85100G offers multiple, physical diagnostic tools integrated into the user interface, providing a quick sanity check on each parallel CFP lane.*

## CFP IDENTIFICATION AND MDIO INTERFACE

The CFP information page provides detailed information on the module ID, vendor name and supported rates through the CFP control page, thus no longer requiring the removal of the CFP to read the CFP module details. This information is also included in the report, which also simplifies CFP tracking. Furthermore, this information is needed in the field, as multiple Job IDs are performed throughout the day and depending of the application, a different type of CFP may be used. Figure 3 below shows one of the CFP GUIs available on the FTB/IQS-85100G. These interfaces allow the user to verify and manipulate the CFP electrical pins, indicating the CFP status and any available alarms. On the same line, a complete MDIO (Management Data Input/Output) interface allows the user to verify the management interface in the CFP through a registered read and write access defined by the CFP MSA (Multi-Source Agreement). The MDIO section can be used to read the CFP temperature, enable advanced CFP functions and even set the CFP to troubleshooting mode.

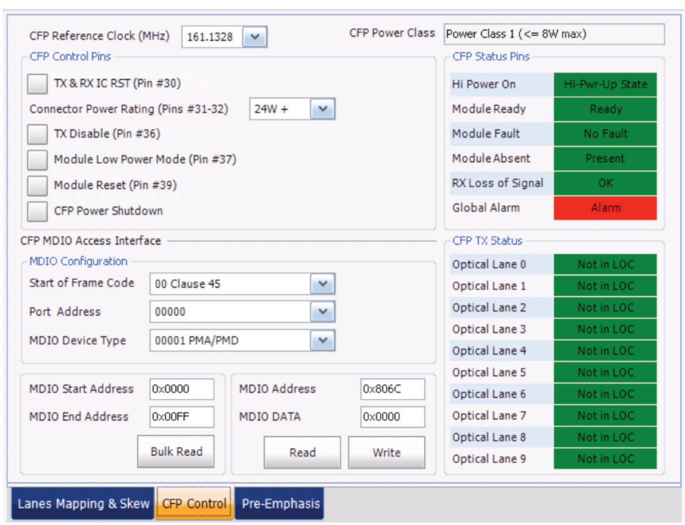



*Figure 3. CFP status and MDIO access interface.*

## ADVANCED SIGNAL CONDITIONING INTERFACE

The advanced signal conditioning interface in Figure 4 provides a quick and easy access to the electrical parameters of each lane, unlike other tools that will only support one value for all lanes. The user can compensate for signal integrity issues or modify specific electrical parameters to stress and verify the CFP electrical tolerance. The interface provides the ability to modify signal parameters with a wide dynamic range of amplitudes, pre-emphasis and equalization controls.

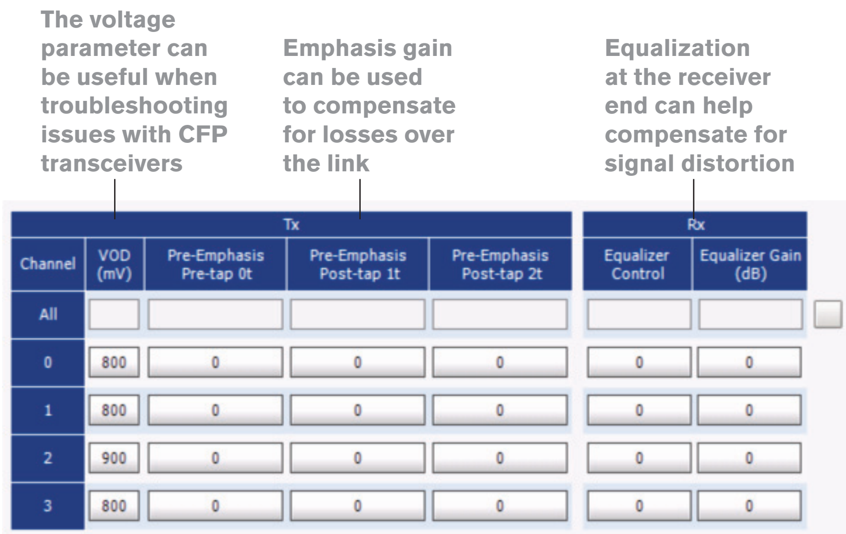



*Figure 4. Voltage and emphasis Interface.*

As an add-on, the FTB/IQS-85100G includes a 100G stress test application that can be run locally or remotely. This tool, which focuses more on lab qualifications, will be useful during transmission tolerance tests like static skew measurement, crosstalk, electrical amplitude and pattern dependency.

The next section will examine some of the tests that can be done automatically, using the CFP health check application, removing any manual intervention and minimizing the chance for errors.  The CFP health check applications menu in Figure 5 supports predefined, but configurable OTN and Ethernet tests; one or several tests can be selected at once, thus optimizing and reducing test time.

In a typical 100G network, all delays must be minimized, because each component of the network, including the CFP itself, can add a significant level of skew. Skew is the delay between parallel lanes (PCS or OTL ). It is important to qualify the skew that is embedded from the CFP during lab qualifications. The IEEE 802.3ba standard defines tolerance skew points with specific values for 100G and 40G. These thresholds need to be tested since the skew between the lanes must be kept within specific limits, so that the transmitted information on the lanes can be reassembled by the receiver

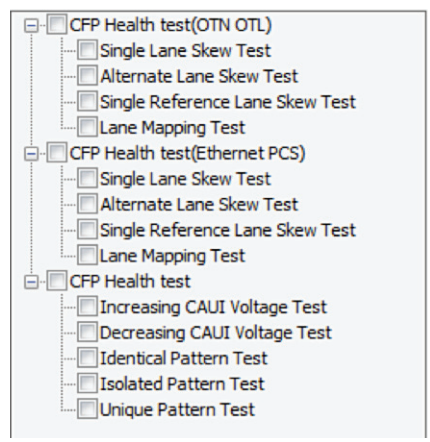
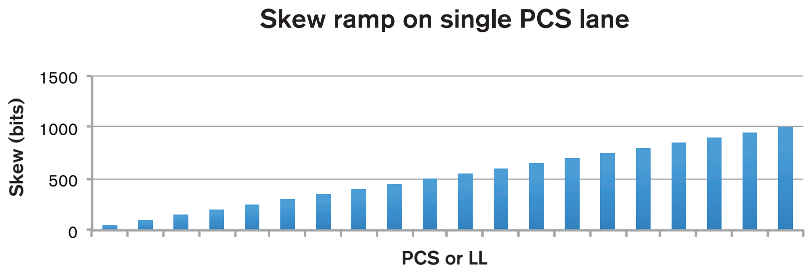
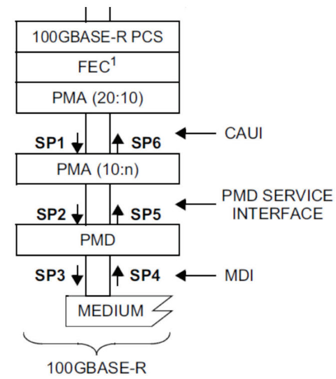



*Figure 5. CFP health check menu interface.*

## SKEW TESTING

The skew fonction of the CFP stress testing troubleshooting tool, which is shown in Figure 6, can be used to inject different skew levels into one or multiple lanes. In the ramp function, whether alternate or lane per lane, these different tests will help verify the far-end receiver buffer tolerance level to skew, based on the standardized skew points of the 802.3ba standard.




| Skew Points | Maximum Skew (ns) | Maximum Skew for 40GBASE-R PCS lane (UI) | Maximum Skew for 100GBASE-R PCS lane (UI) |
|---|---|---|---|
| SP1 | 29 | ≈ 299 | ≈ 150 |
| SP2 | 43 | ≈ 443 | ≈ 222 |
| SP3 | 54 | ≈ 557 | ≈ 278 |
| SP4 | 134 | ≈ 1382 | ≈ 691 |
| SP5 | 145 | ≈ 1495 | ≈ 748 |
| SP6 | 160 | ≈ 1649 | ≈ 824 |
| At PCS receive | 180 | ≈ 1856 | ≈ 928 |

*Figure 6. Skew points testing.*

## CROSSTALK TESTING AND UNFRAMED PARALLEL PRBS TESTING

The CFP health check application also provides crosstalk tests using specific PRBS patterns (PRBS 9 –PRBS 31). This important test will verify any signal integrity issue in the CFP that could cause bit errors. This can be detected when a adjacent pattern is detected on a none testing lane. Figure 7 belowoutlines the PRBS insertion on each channel.

| | Test Iteration | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CAUI Lane | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| PRBS Pattern | 1 | **31** | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| PRBS Pattern | 2 | 23 | **31** | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| PRBS Pattern | 3 | 23 | 23 | **31** | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| PRBS Pattern | 4 | 23 | 23 | 23 | **31** | 23 | 23 | 23 | 23 | 23 | 23 |
| PRBS Pattern | 5 | 23 | 23 | 23 | 23 | **31** | 23 | 23 | 23 | 23 | 23 |
| PRBS Pattern | 6 | 23 | 23 | 23 | 23 | 23 | **31** | 23 | 23 | 23 | 23 |
| PRBS Pattern | 7 | 23 | 23 | 23 | 23 | 23 | 23 | **31** | 23 | 23 | 23 |
| PRBS Pattern | 8 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | **31** | 23 | 23 |
| PRBS Pattern | 9 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | **31** | 23 |
| PRBS Pattern | 10 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | **31** |

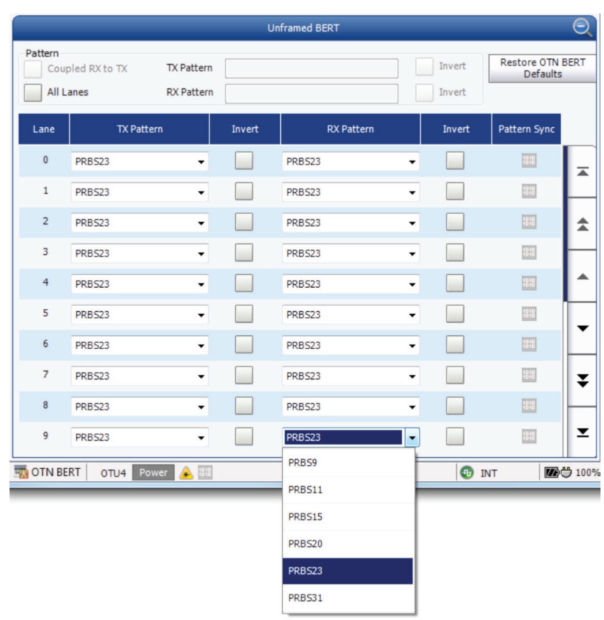



*Figure 7. PRBS Pattern crosstalk test table.*

## CONCLUSION

In contrast to pluggable XFP optics used in lower speed networks, service providers face complex challenges in 100G networks that span from optics all the way to the protocol layer. Since this technology is still in its early stages, the CFP optical interface is often overlooked. The optical interface is based on parallel optics transmission and in order to ensure the proper deployment and optimal performance of 100G links, it is imperative that carriers use the right tool to test the stability and reliability of every CFP used.

The FTB/IQS-85100G Packet Blazer now includes a CFP health check, which can be used to validate the entire network, making it mission critical to 100G link deployment. The modular FTB-500 platform also includes optical physical tools, specifically a visual fault locator and a fiber inspection probe, which provide field technicians with everything they need to commission 40G/100G networks in a single portable solution.



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APNOTE274.1AN

Printed in Canada 12/11

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