Application Note

Anritsu Advancing beyond

High-Speed Transceiver Testing Solutions

Signal Quality Analyzer-R MP1900A
BERTWave MP2110A
Optical Signal Analyzer MS9740B
Network Master Pro MT1040A

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1. Overview

Modern digital telecommunications technologies have become significantly developed over the last 20 years. In the new digital world, there is a constant race between hardware manufacturers and users for higher data rates, today 400G, tomorrow 800G and above. This race is driven by increased traffic across the network, from data centers to mobile access, due to the growing demand for cloud services and computing, 4K video streaming and gaming.

All these services require more and more bandwidth and access to new digital applications that require fast access to digital networks. To maintain these services at a high-quality level, it is necessary to use high-speed data transmission interfaces. Developers of such interfaces or optical transceivers are constantly working to improve efficiency and performance. Telecommunication equipment and optical transceivers manufacturers have entered a Multi-Source Agreement (MSA), which allows them to develop interoperable products and make them more efficient and widespread. This agreement defines not only the performance, size, efficiency standards, but also the methods for testing the performance of optical transceivers as well as the specifications defined by the working group of The Institute of Electrical and Electronics Engineers (IEEE).

Verification of the characteristics and performance of optical transceivers requires testing for interoperability with standards and with other products. Anritsu offers measurement solutions for testing the performance and compatibility of high-speed optical transceivers from R&D to Validation, Production, Installation and Maintenance.

2. Types of Interfaces

At the moment, there is a large variety of optical transceivers and interfaces with data rates up to 400G. The most popular form factors for optical transceivers are variations from Small Form-Factor Pluggable (SFP) with various bit rates and channel counts. Below is a summary of the most common, types of interfaces, optical and electrical, as well as those in the process of standardization, see Table 1.

Table 1. Optical and electrical types of interfaces

Optical Interface		Distance	Data Rate	Lanes	Baud Rate	Format
400G	400GBASE-ER8	40 km	425 Gbps	8	26.5625 GBd	PAM4
	400GBASE-LR4	10 km	425 Gbps	4	53.125 GBd	PAM4
	400GBASE-LR8	10 km	425 Gbps	8	26.5625 GBd	PAM4
	400GBASE-LR4-6	6 km	425 Gbps	4	53.125 GBd	PAM4
	400GBASE-FR4	2 km	425 Gbps	4	53.125 GBd	PAM4
	400GBASE-FR8	2 km	425 Gbps	8	26.5625 GBd	PAM4
	400GBASE-DR4	500 m	425 Gbps	4	53.125 GBd	PAM4
	400GBASE-SR4	100 m	425 Gbps	4	26.5625 GBd	PAM4
	400GBASE-SR8	100 m	425 Gbps	8	26.5625 GBd	PAM4
	400GBASE-SR16	100 m	412.5 Gbps	16	25.78125 GBd	NRZ
200G	200GBASE-ER4	40 km	212.5 Gbps	4	26.5625 GBd	PAM4
	200GBASE-LR4	10 km	212.5 Gbps	4	26.5625 GBd	PAM4
	200GBASE-FR4	2 km	212.5 Gbps	4	26.5625 GBd	PAM4
	200GBASE-DR4	500 m	212.5 Gbps	4	26.5625 GBd	PAM4
	200GBASE-SR2	100 m	212.5 Gbps	2	53.125 GBd	PAM4
	200GBASE-SR4	100 m	212.5 Gbps	4	26.5625 GBd	PAM4
100G	100GBASE-ER4	40 km	103.125 Gbps	4	25.78125 GBd	NRZ
	100GBASE-LR1	10 km	106.25 Gbps	1	53.125 GBd	PAM4
	100GBASE-LR4	10 km	103.125 Gbps	4	25.78125 GBd	NRZ
	100GBASE-FR1	2 km	106.25 Gbps	1	53.125 GBd	PAM4
	100G-CWDM4	2 km	103.125 Gbps	4	25.78125 GBd	NRZ
	100GBASE-DR	500 m	106.25 Gbps	1	53.125 GBd	PAM4
	100G-PSM4	500 m	103.125 Gbps	4	25.78125 GBd	NRZ
	100G-SWDM2	100 m	106.25 Gbps	2	26.5625 GBd	PAM4
	100G-SWDM4	100 m	103.125 Gbps	4	25.78125 GBd	NRZ
	100GBASE-SR1	50 m	106.25 Gbps	1	53.125 GBd	PAM4
	100GBASE-SR2	100 m	106.25 Gbps	2	26.5625 GBd	PAM4
	100GBASE-SR4	100 m	103.125 Gbps	4	25.78125 GBd	NRZ
50G	50GBASE-ER	40 km	53.125 Gbps	1	26.5625 GBd	PAM4
	50GBASE-LR	10 km	53.125 Gbps	1	26.5625 GBd	PAM4
	50GBASE-FR	2 km	53.125 Gbps	1	26.5625 GBd	PAM4
	50GBASE-SR	100 m	53.125 Gbps	1	26.5625 GBd	PAM4
25G	25GBASE-ER	40 km	25.78125 Gbps	1	25.78125 GBd	NRZ
	25GBASE-LR	10 km	25.78125 Gbps	1	25.78125 GBd	NRZ
	25GBASE-SR	100 m	25.78125 Gbps	1	25.78125 GBd	NRZ

Electrical Interface		Baud Rate	Format
400G	400GAUI-4	53.125 GBd	PAM4
	400GAUI-8	26.5625 GBd	PAM4
	400GAUI-16	26.5625 GBd	NRZ
200G	200GAUI-2	53.125 GBd	PAM4
	200GAUI-4	26.5625 GBd	PAM4
100G	100GAUI-1	53.125 GBd	PAM4
	100GAUI-2	26.5625 GBd	PAM4
	100GAUI-4	26.5625 GBd	NRZ
50G	50GAUI-1	26.5625 GBd	PAM4
	50GAUI-2	26.5625 GBd	NRZ
25G	25GAUI	25.78125 GBd	NRZ

Backplane & Cable Interface		Baud Rate	Format
400G	400GBASE-KR4	53.125 GBd	PAM4
	400GBASE-CR4	53.125 GBd	PAM4
200G	200GBASE-KR2	53.125 GBd	PAM4
	200GBASE-KR4	26.5625 GBd	PAM4
	200GBASE-CR2	53.125 GBd	PAM4
	200GBASE-CR4	26.5625 GBd	PAM4
100G	100GBASE-KR1	53.125 GBd	PAM4
	100GBASE-KR2	26.5625 GBd	PAM4
	100GBASE-KR4	25.78125 GBd	NRZ
	100GBASE-CR1	53.125 GBd	PAM4
	100GBASE-CR2	26.5625 GBd	PAM4
	100GBASE-CR4	25.78125 GBd	NRZ
50G	50GBASE-KR	26.5625 GBd	PAM4
	50GBASE-KR2	25.78125 GBd	NRZ
	50GBASE-CR	26.5625 GBd	PAM4
	50GBASE-CR2	25.78125 GBd	NRZ
25G	25GBASE-KR	25.78125 GBd	NRZ
	25GBASE-CR	25.78125 GBd	NRZ

As we can see from the table, it can be conditionally distinguished into several groups of interfaces that differ in the number of lanes (1, 2, 4, 8, 16), per lane symbol rate (25.78125 GBaud, 26.5625 GBaud, 53.125 GBaud) and the type of output signal modulation (NRZ, PAM4).

Today's main symbol rates can be considered 25.78125 Gbps and 26.5625 Gbps, from which, by increasing the number of channels, we can get speeds up to 425 Gbps. As an example, below is Figure 1, which schematically shows the currently most popular 100G QSFP28 optical transceiver.

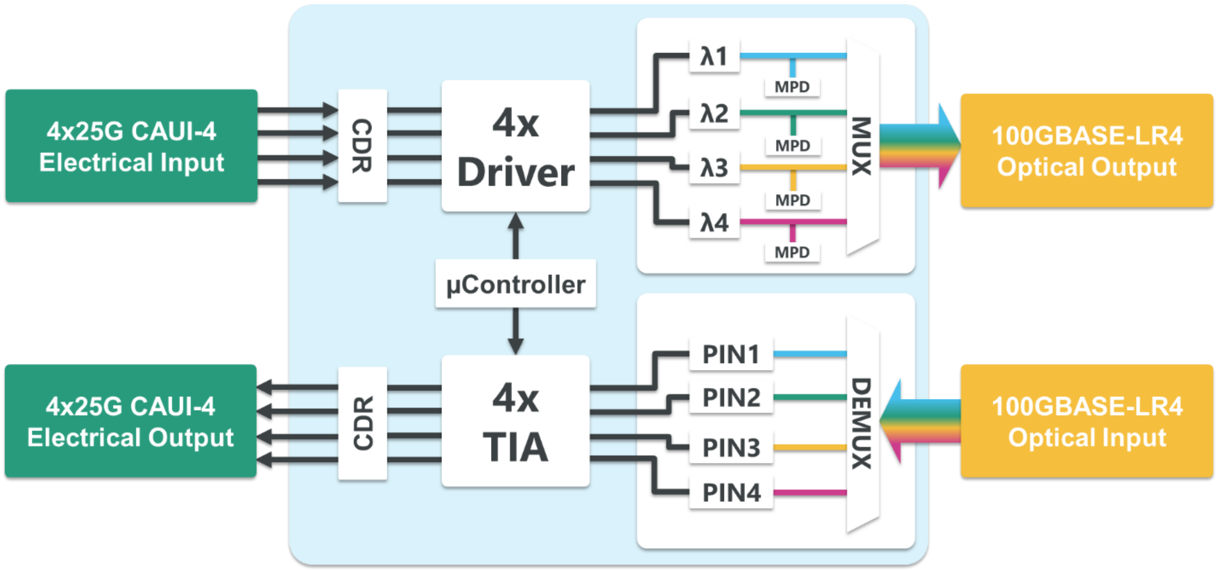


Figure 1. QSFP28 100GBASE-LR4 scheme

However, the most interesting are high-speed optical transceivers with 400G speeds, which use a different signal modulation method than previous generations. High throughput is achieved both through the integration of drivers, amplifiers and through modern digital signal processing circuits, which allow the use of multi-level signal modulation.

Traditionally, optical transceivers use NRZ (Non-Return to Zero) signal modulation, but to ensure high speed, the increase in the number of channels is insufficient. To achieve data transfer rates of 400G and higher, PAM4 (Pulse Amplitude Modulation 4 level) multi-level signal modulation is used. PAM4 is a modulation technique that uses 4 levels of pulse amplitude for data transmission, instead of 2 levels for NRZ (PAM2), see Figure 2. Amplitude levels 0, 1, 2, and 3 are represented by two bits 00, 01, 11 and 10, respectively, and each pair of bits is referred to as a "symbol".

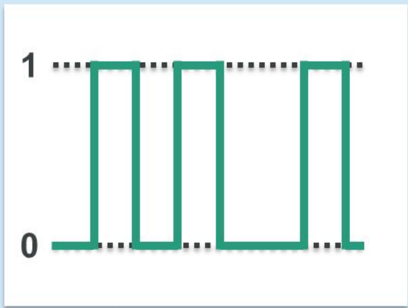
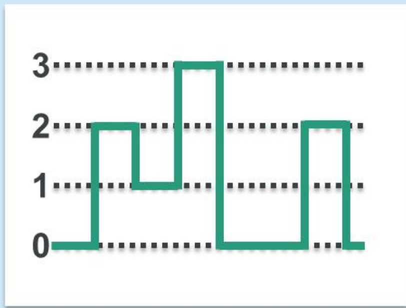
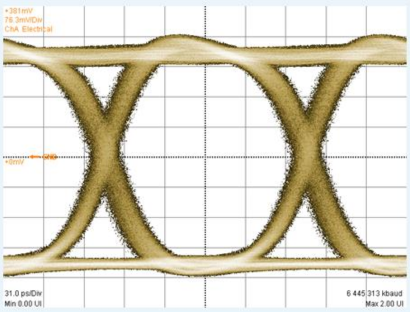
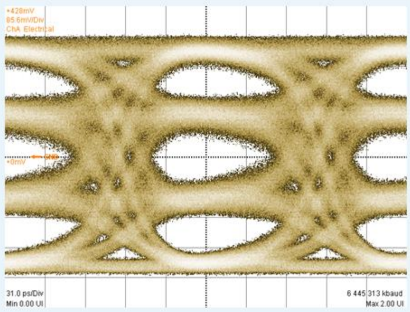
Comparison	NRZ	PAM4
Density	1 bit / time slot	2 bits / time slot
Speed	10 GBaud = 10 Gbit/s	10 GBaud = 20 Gbit/s
Bit Pattern		
Eye Diagram		

Figure 2. Differences in signal modulation types NRZ and PAM4

To transmit, for example, 8 bits, when using NRZ modulation, 8 zeros or ones are required, since each amplitude level contains one bit of information, 0 or 1. When using PAM4 modulation, where one symbol contains two bits of information, it is possible to transmit 8 bits of information by 4 symbols. Thus, if information is transmitted at the same frequency, we can achieve twice the speed, i.e., a PAM4 modulated signal is twice as efficient as an NRZ modulated signal.

This is the main advantage of the PAM4 signal modulation type, but there is also a drawback. The PAM4 signal is much weaker than the NRZ signal. This refers to the difference between two adjacent amplitude levels, i.e., the difference between "0" and "1" levels in the NRZ signal are 3 times greater than the difference between "0" and "1" levels in the PAM4 signal, which greatly complicates the detection task. The probability of error when receiving a PAM4 signal is much higher than when receiving an NRZ signal. As a result, with modulation of the PAM4 signal, it is possible to transmit information at a double rate, but there is a greater chance that the signal will be with errors.

The signal-to-noise ratio (SNR) of the PAM4 signal is worse than that of the NRZ signal, which is an obstacle when trying to achieve natural error-free data transmission. In this regard, methods of data transmission using FEC (Forward Error Correction) have been proposed. Let's consider two types of forward error correction RS-FEC (Reed Solomon) specified by the IEEE: RS (528, 514) for NRZ signals and RS (544, 514) for PAM4 signals. It should be noted that at 400G speeds and above, the use of RS-FEC is mandatory, therefore testing of optical transceivers is extremely important.

Sequences for PAM4 test signals are different from those used for NRZ signals. The IEEE standards describe test patterns PRBS13Q, PRBS31Q, SSPRQ, which differ from the usual PRBS13 or PRBS31. For example, PRBS13Q test pattern is a repeating 8191-symbol sequence formed by Gray coding pairs of bits from two repetitions of the PRBS13 pattern into PAM-4 symbols.

In general, there are 3 different approaches to test optical transceivers, which differ in technical complexity, degree of integration and labor costs:

- Production physical layer testing
- R&D physical layer testing
- Validation Ethernet Layer Testing

Each of the approaches implies its own set of tests and measurements, in accordance with the level and depth of verification. Measurement methods and procedures for each approach will be described below.

3. Production physical layer testing

As stated earlier, optical transceivers testing is an important step in the development and manufacture of transceivers. The use of a new type of modulation in optical transceivers requires new test methods. The main test parameters of optical transceivers are given below.

Optical Average Power

It is a very important parameter since it directly affects the performance of the transmission line and the quality of communication. Measurement of the optical average power is carried out using optical power meters based on photodetectors. Long distance optical transceivers have higher optical average output power.

Extinction Ratio (Outer Extinction Ratio for PAM4)

This is the ratio of the optical power of the high level "1" and low level "0" of the laser source of the optical transceiver. The correct setting of the operating point of the laser source and the modulation efficiency are tested. The higher the Extinction Ratio and the relative amplitude, the stronger the optical signal, which means the easier the receiver detection. In addition, the higher the Extinction Ratio, the lower the optical power of the laser source. For PAM4 signals, it is customary to consider level "0" as a low level, and level "3" as a high level, this is how the Outer Extinction Ratio is characterized.

Optical Modulation Amplitude (Outer Optical Modulation Amplitude for PAM4)

Used to measure the difference between two optical power levels generated by a laser source. It is high level when light source is “On”” and low level when light source is “Off”. This parameter helps to determine the effectiveness of signal modulation in case the Extinction Ratio is not high. For PAM4 signals, it is customary to consider high level equal to the high signal level "3", this is how Outer Optical Modulation Amplitude is characterized.

Eye Diagram Mask Margin

To ensure the quality of the optical transceiver, it is very important to check the eye diagram. An eye diagram is formed by superimposing and accumulating all captured signals. The bit sequence is the transition of all possible variations between the levels from the test sequence. The digital signal quality of an optical transceiver can be seen from the eye diagram test results. The performance of an optical transceiver is evaluated against a special "mask" that is defined for each type of transceiver with an NRZ modulation. In general, the wider the eye width, the less crosstalk between bits, which means that the optical transceiver have better performance.

Eye Crossing (Linearity for PAM4)

It is determined by the average value of the vertical histogram window centered at the point of intersection of the eye diagram and is calculated as a percentage. If the cross-eye percentage is high, this indicates a distorted duty cycle or signal symmetry problems. Linearity for PAM4 signals is defined as a function of the average level for each symbol transmitted.

TDECQ (Transmitter Dispersion Eye Closure Quaternary)

This is the ratio of the amount of noise added to the DUT transmitter signal to achieve the target SER (Symbol Error Ratio) and the amount of noise to be added to a virtual ideal transmitter analogue of the DUT, expressed in dB. In other words, the lower the TDECQ value, the better the DUT transmitter. For optical transceivers with PAM4 signal modulation, unlike the NRZ signal, Mask Margin testing is not suitable because of the very small difference between adjacent amplitude levels. Therefore, the TDECQ method was developed, which replaced the usual Mask Margin test, as shown in Figure 3.

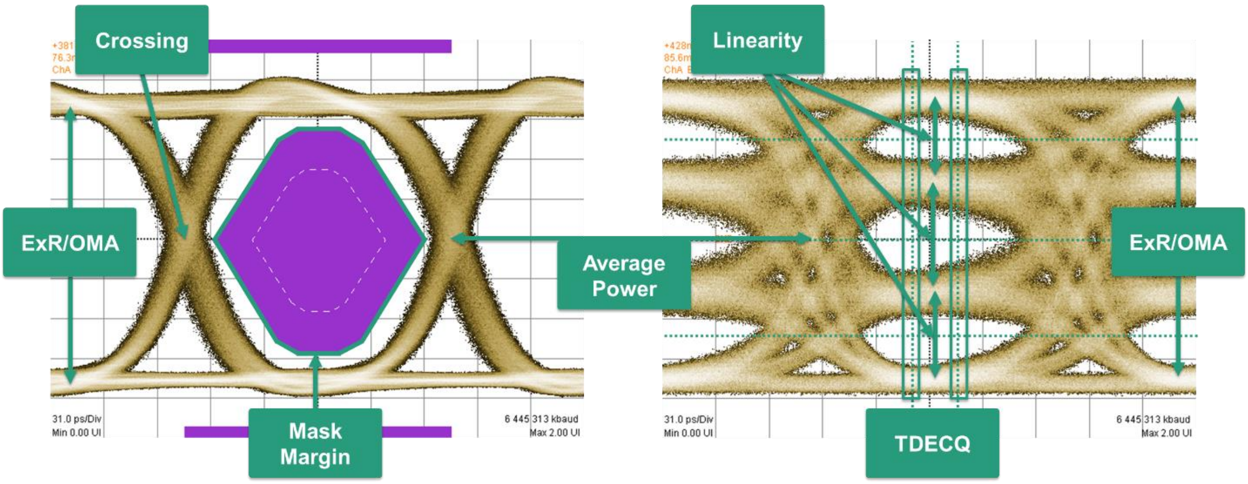


Figure 3. Differences in testing NRZ and PAM4

Jitter Analysis

Is performed to determine the constituent components of transmitter jitter. Jitter includes random jitter and deterministic jitter. Because deterministic jitter is predictable as opposed to random jitter, optical transceivers are designed to minimize jitter components. Often, jitter testing is performed in conjunction with eye diagram analysis to speed up verification of optical transceiver performance. The Jitter Tolerance is also being tested, this is more of an R&D test that allows to determine the amount of jitter at which the receiver stops working correctly and determines the signal levels. An example of measuring jitter components is shown in Figure 4.

Bit Error Rate

It is one of the parameters characterizing the performance of data transmission channels. It is used to measure the number of bit errors that occur for a given number of transmitted bits in the test sequence. If the BER is higher than expected, it means that there is a bad connection quality. To verify the stability and reliability of data transmission, the optical transceiver must pass the BER test, as shown in Figure 4.

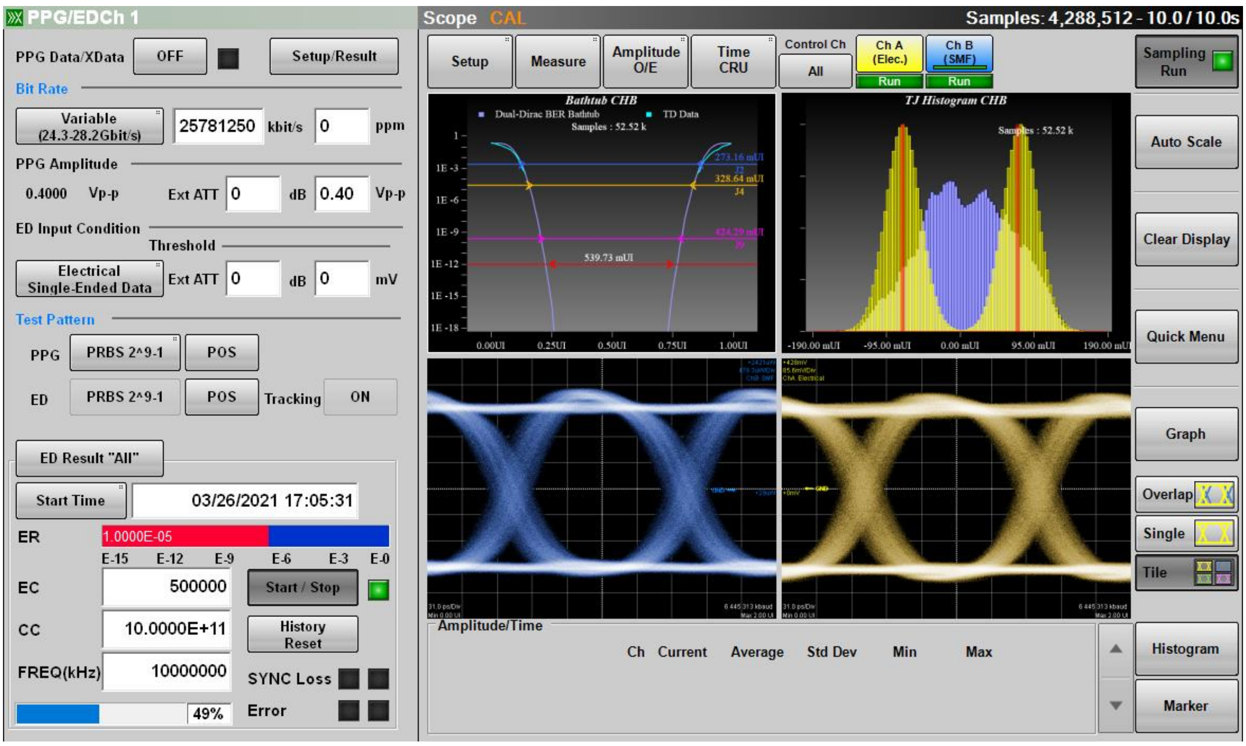


Figure 4. BER and Jitter Analysis

Sensitivity

Receiver sensitivity is defined as the optical power of a signal required to achieve a given BER. The better the sensitivity, the lower the minimum possible received optical power. Sensitivity measurements are made using an optical attenuator connected between the transmitter and receiver of the optical transceiver.

Measurement schemes for production physical layer testing

The physical layer tests to be performed in the manufacture of optical transceivers can be divided into Rx (Receiver) tests and Tx (Transmitter) tests. In other words, tests are performed on electrical signals at the electrical Rx input or optical signals at the optical Tx output. Depending on the number of channels, we can test each channel separately or all channels in parallel.

On Figure 5 there is the measurement scheme for parallel testing of 4 electrical Rx/Tx channels of the QSFP28 100GBASE-LR4 optical transceiver. To carry out such measurements, a multichannel BERT (Bit Error Rate Tester) is used, for example, **Anritsu MP2110A BERTWave**, which allows testing up to 4 channels simultaneously at speeds up to 28.2 Gbps. In this case, the test signal is fed from the PPG (Pulse Pattern Generator) to the Evaluation Board on which the DUT (optical transceiver) is attached. The optical transceiver is usually set to Loopback mode (the optical Tx output is connected to the optical Rx input using an optical patch cord). Then the signal goes to the ED (Error Detector). As a result, changes in original test signal waveform that passed through the DUT are measured.

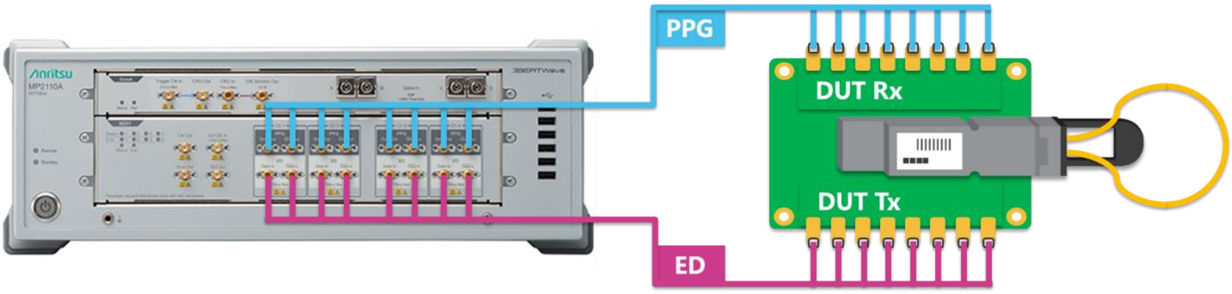


Figure 5. Electrical Rx signal measurement scheme

In case of optical Tx testing, see Figure 6, the test signal is also fed from the PPG output to the DUT via the Evaluation Board. Then the optical signal at the optical Tx output of the transceiver passes through a filter or DEMUX (Demultiplexer), which allows each of the wavelengths to be separated and fed to the corresponding scope input. At the input of the scope, which is an electrical device, there is an O/E converter that converts the optical signal into an electrical signal. In addition, special BT4 filters (4th order Bessel-Thomson filter) are used at the input of the scope, which have a bandwidth in accordance with the frequency of the input signal.

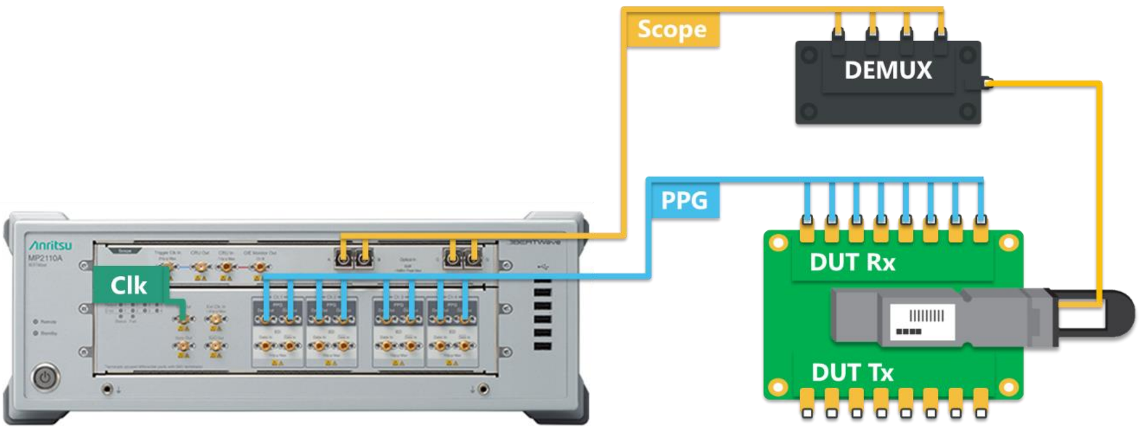


Figure 6. Optical Tx signal measurement scheme

Sampling scopes also require a trigger input that is synchronized with the data signal to test the input waveform. Often, optical transceiver signals do not have a separate trigger output. This corresponds to the model of optical transceivers, since the signal transmitted by optical Tx can be received at several hundred meters, for example, in data centres, and at several tens of kilometres in field, which greatly complicates the transmission of the trigger signal. Using a CRU (Clock Recovery Unit) to test optical transceivers in the most realistic conditions helps to simulate real working conditions. It is a device that allows the trigger signal to be restored directly from the input optical signal. The CRU can be used as a stand-alone module in the MP2110A, as shown in Figure 7. It allows to test optical transceivers without using an external trigger signal.
In addition, the sampling oscilloscope function can measure the PAM4 optical signal from 200/400GbE QSFP-DD transceivers without an external trigger by using the built-in CRU (option 055).
MP2110A's CRU supports not only 26.5625GBaud but also 53.125GBaud SMF.

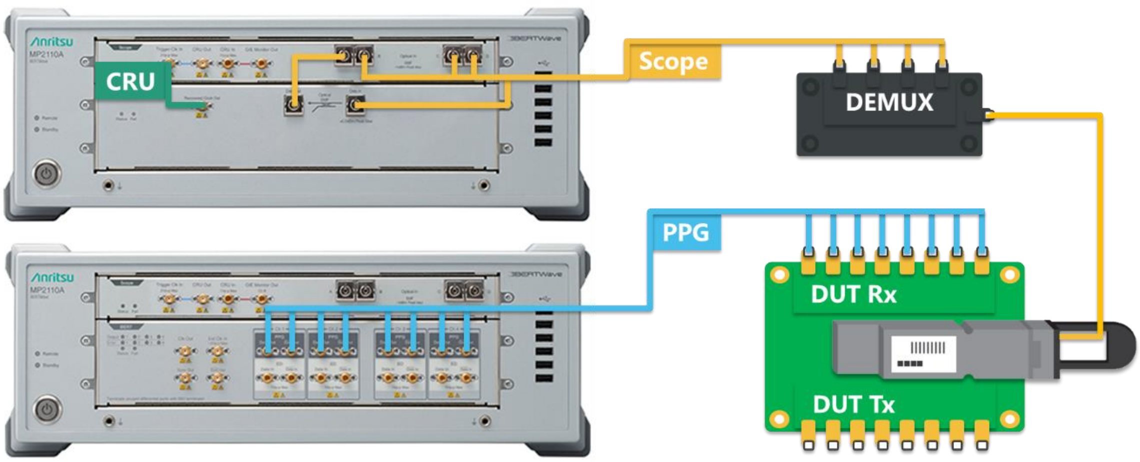


Figure 7. Using CRU as trigger signal source

Optical Spectrum Analyzers are also often used to evaluate the optical signal. The OSA allows to evaluate the characteristics of the optical signal at the optical Tx output, such as Center Wavelength, Spectral Width or SMSR (Side Mode Suppression Ratio). Optical transceivers on two opposite ends must operate at the same wavelength, so it is necessary to check if the wavelength of the output signal is in the range. Usually, the center wavelength fluctuates. The same applies to the characteristics of the Spectral Width and SMSR, if they go beyond the permissible values, the optical transceiver under test is deemed unsuitable. Figure 8 shows the measurement scheme using the **Anritsu MS9740B Optical Signal Analyzer**, which allows to measure all necessary optical parameters.

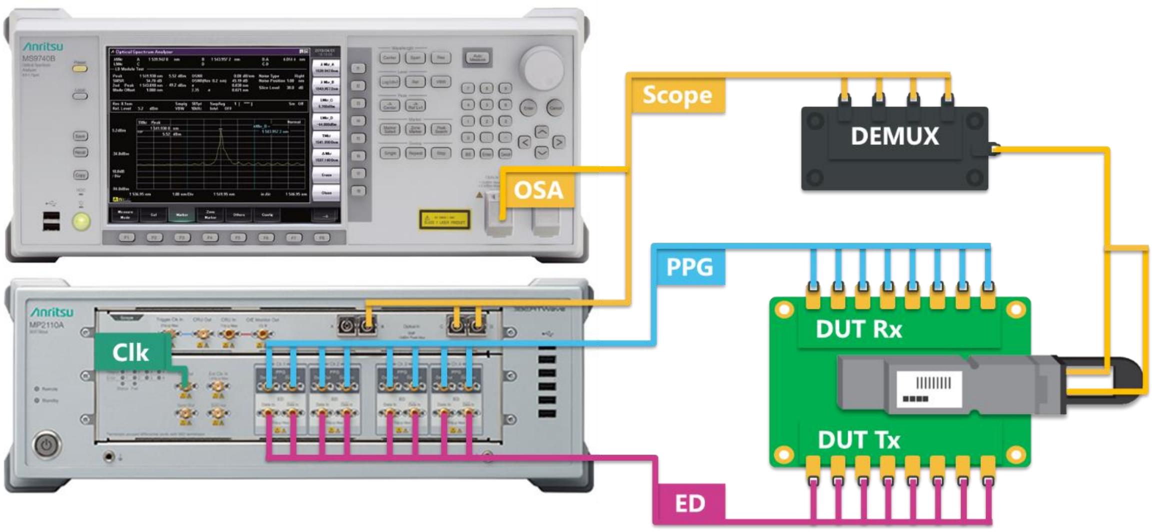


Figure 8. Complex optical transceiver testing

4. R&D physical layer testing

Physical testing in specialized scientific laboratories or optical transceiver development laboratories is carried out at a deeper level. In this case, various external influences, stresses, properties of the transmission channel, etc. must be taken into account. Each of these effects can make a significant contribution to the signal quality, usually degrading it. The main parameters of R&D testing of optical transceivers are shown below.

Emphasis

The fact is that any transmission channel (optical or electrical) introduces its own distortions into the signal that passes through it, due to its imperfection. When it comes to pre-emphasis, this usually means changing the signal before the transmission channel in such a way as to bring it closer to the maximum ideal after passing the transmission channel, as shown in Figure 9.

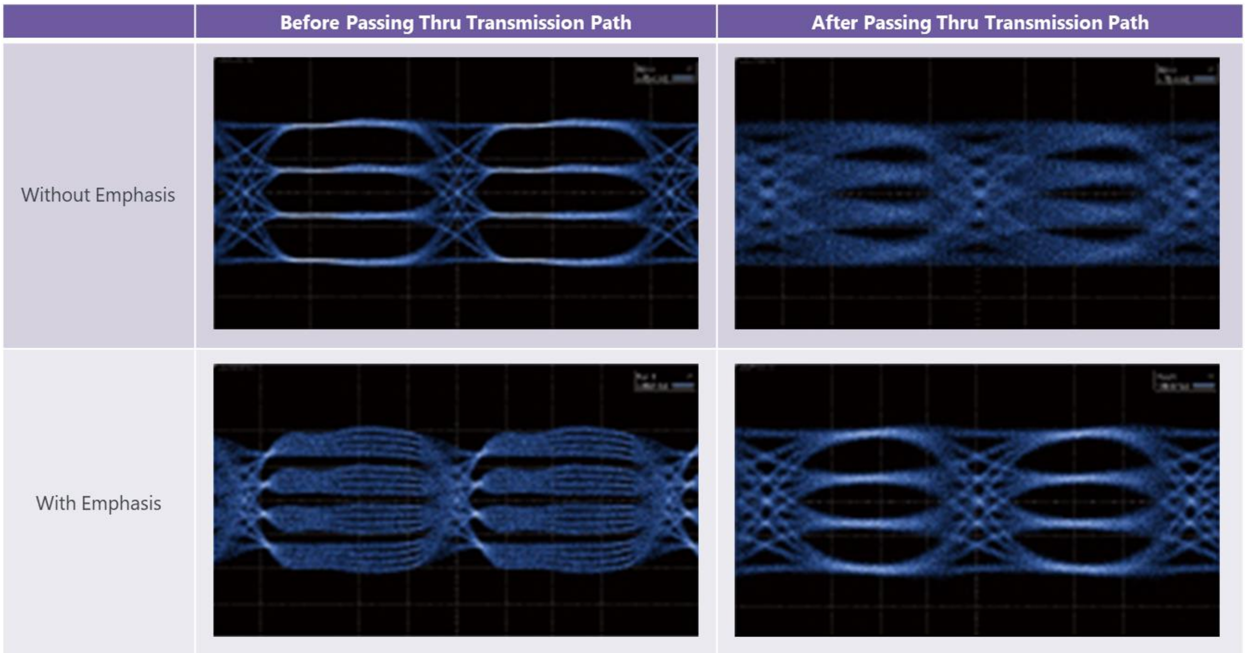


Figure 9. An influence of emphasis on transmitting the signal thru transmission path

Linearity

Another parameter that can be used to adjust the output signal for efficient transmission is the ratio between the eyes or RLM (Ratio of Level Mismatch). This helps to adjust the output signal so that after passing through the transmission channel, its shape is close to ideal. Example of Linearity control of PAM4 output signal, i.e., output levels of each eye separately, is shown on Figure 10.

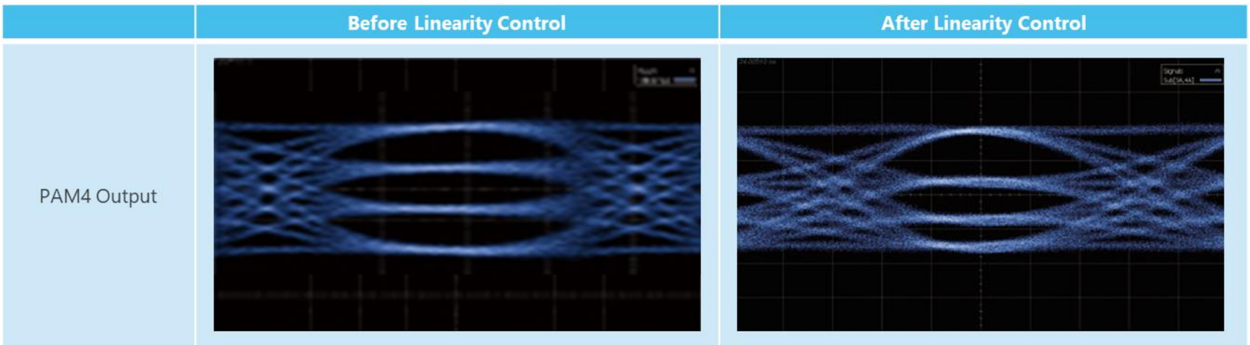


Figure 10. Linearity control of outputted signal

Crosstalk

Often, in optical transceivers, data transmission channels are near each other or even have one physical carrier, for example, an optical fiber. In this case, there is a possibility of distortions associated with the impact of one signal on another. The parameter that describes such signal distortions that occur during data transmission is Crosstalk. Inter-lane Skew Adjustment is often used to simulate a stressed signal. This allows to change the signal in such a way that Crosstalk distortion appears in it. Thus, the operation of optical transceivers is checked in real operating conditions.

Jitter Tolerance

It is one of the most important parameters because it allows to determine the amount of jitter at which the optical transceiver is not able to perceive the signal and distinguish symbols from each other. In such a test, SJ (Sinusoidal Jitter), RJ (Random Jitter), BUJ (Bounded Uncorrelated Jitter), SSC (Spread Spectrum Clocking) are used as artificially created jitter. A CRU is required to run the test. The graph that shows testing of Jitter Tolerance is shown below in Figure 11.

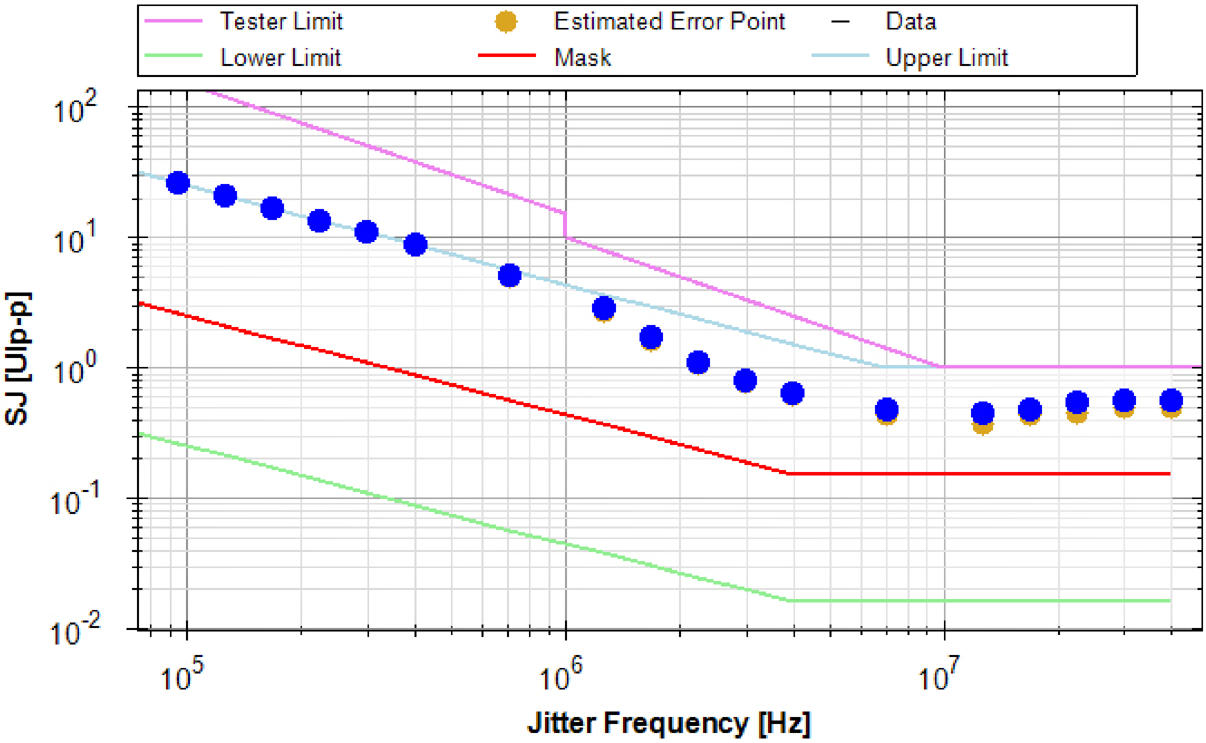


Figure 11. Jitter Tolerance testing

Real-time FEC Analysis

In addition to the Jitter Tolerance test, real-time FEC analysis is performed using special RS-FEC test sequences, since FEC is mandatory in modern 400G optical transceivers. FEC adds a predetermined number of redundant bits to the transmission data, which are error check bits, and encodes them along with the data. The error check bits are then used at the receiver to decode and correct the errored bits. FEC allows data to be transmitted on a very noisy transmission channel, enabling error-free transmission of data on a 400G channel. In FEC analysis, it is very important to be able to measure the number of uncorrected FEC codewords and symbols in real-time. An example of FEC error distribution measurement is shown on Figure 12.

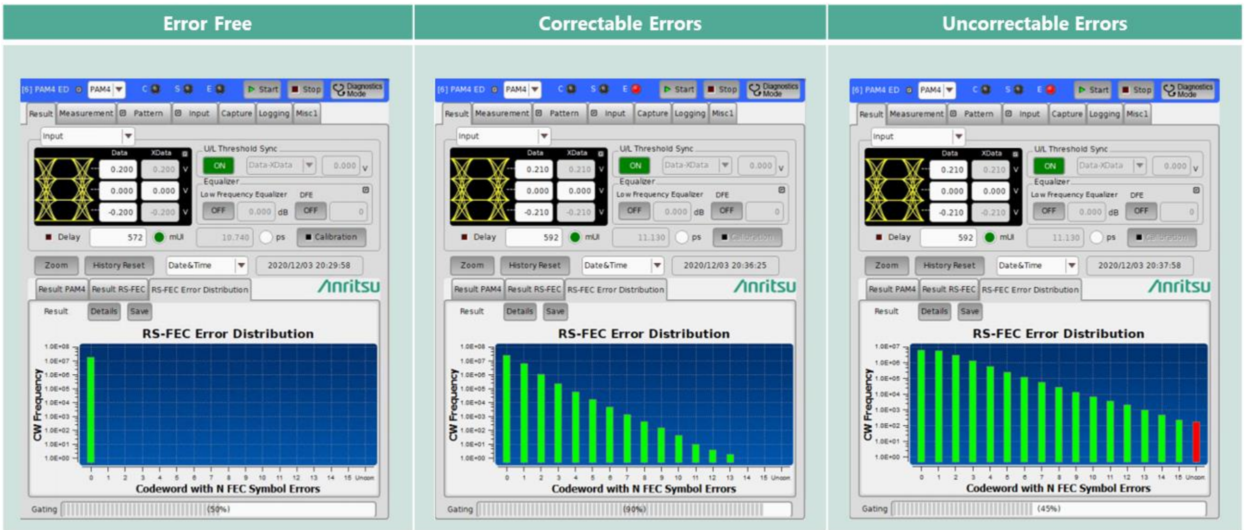


Figure 12. Real-time FEC error analysis

Measurement schemes for R&D physical layer testing

Thus, there are several important parameters and characteristics that need to be tested at the R&D level when developing optical transceivers. Figure 13 shows the measurement scheme for one data transmission channel. The measurement circuit uses the R&D bit error rate tester **Anritsu MP1900A Signal Quality Analyzer-R**, this is a modular 8-slot measurement equipment that allows to carry out all the necessary R&D tests of optical transceivers with NRZ/PAM4 signal modulation and at speeds up to 32/64 GBaud per channel.

For correct testing, the original clock signal is fed from the output of the synthesizer module to the input of the jitter module to create stress effects in the form of SJ, RJ, BUJ, etc. This jittered clock signal is then used for the PPG module, which generates a test pattern output signal. This signal is then fed to the noise module, which adds noise to the output signal. Thus, a signal with predistortion, stress, jitter, etc. is fed to the DUT. After passing through the DUT, the signal is fed to the ED, where the characteristics of the signal are evaluated in comparison with the original signal.

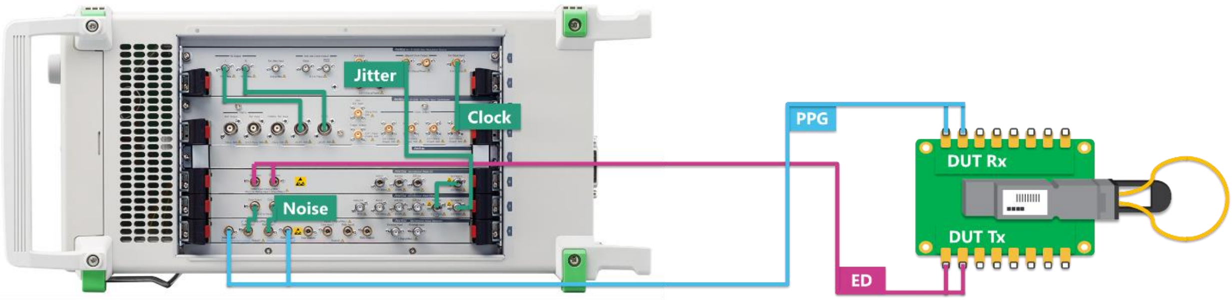


Figure 13. Optical transceiver stress test

To test modern OSFP, QSFP-DD optical transceivers, two MP1900A can be used in pairs, synchronized, as signal generators with two MP2110A as oscilloscopes. In this case, it is possible to test up to 8 channels in parallel, for optical transceivers up to 800G, as shown in Figure 14.

Each MP1900B has 4 PPGs, which generate a total of 8 synchronous stressed signals with test sequences that are fed to the DUT. The output of the optical transceiver is then fed to the MP2110A to analyse the characteristics of the optical waveforms, using the CRU integrated into the sampling scopes.

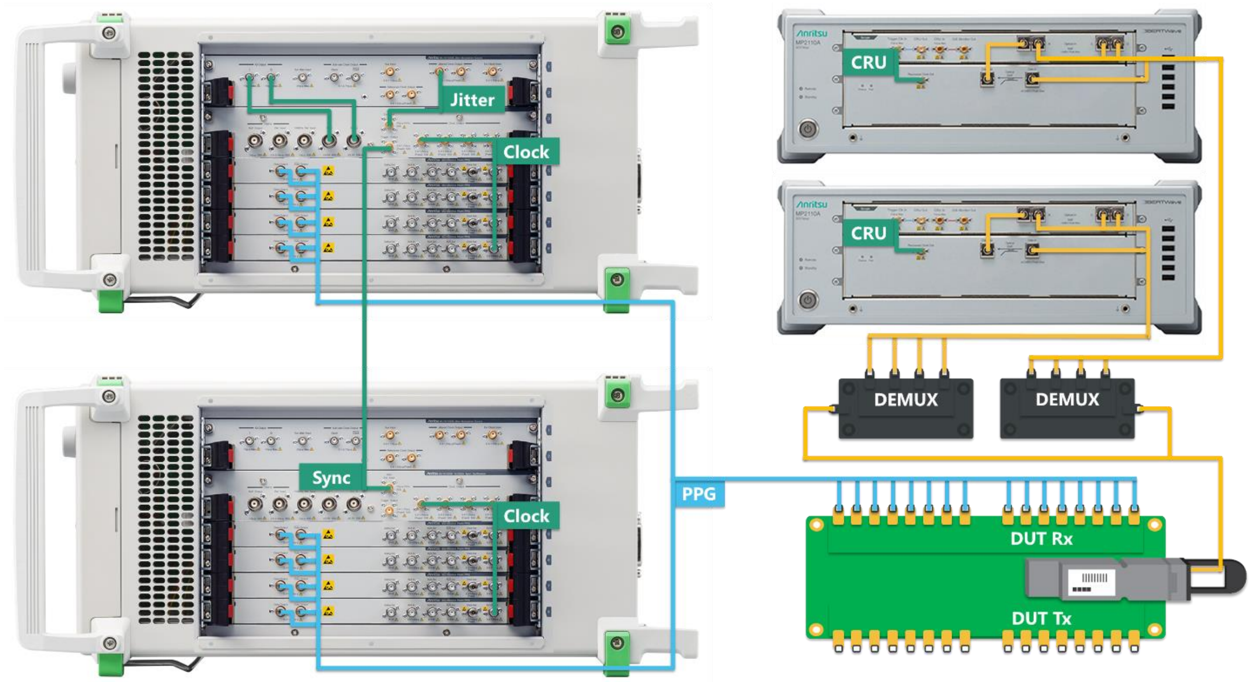


Figure 14. QSFP-DD/OSFP optical transceiver parallel 8 channels 53 GBaud testing

5. Validation Ethernet Level layer testing

With the advent of a new type of signal modulation PAM4, which is becoming more popular and used in 400G, it becomes necessary to test optical transceivers at a higher level. Another type of instruments that allow validation testing of optical transceivers is the protocol analyzer.

As already mentioned, FEC is a technology that can correct errors that may occur during signal transmission and is used to ensure reliable communication. However, FEC has its limitations, if there are too many consecutive errors in the signal, the FEC algorithm will not be able to correct them, and the transmission quality will drop dramatically.

Measurement schemes for high-level validation at the Ethernet frame layer

To make sure that the data is transmitted without errors, or the number of errors is within the FEC algorithm correctable range, the **Anritsu MT1040A Network Master Pro** protocol analyzer has a special FEC Distribution function that allows to analyze the characteristics of an optical transceiver in real-time, as shown in Figure 15. Moreover, tests can also be performed using two 400G measurement modules installed in a single MT1040A.

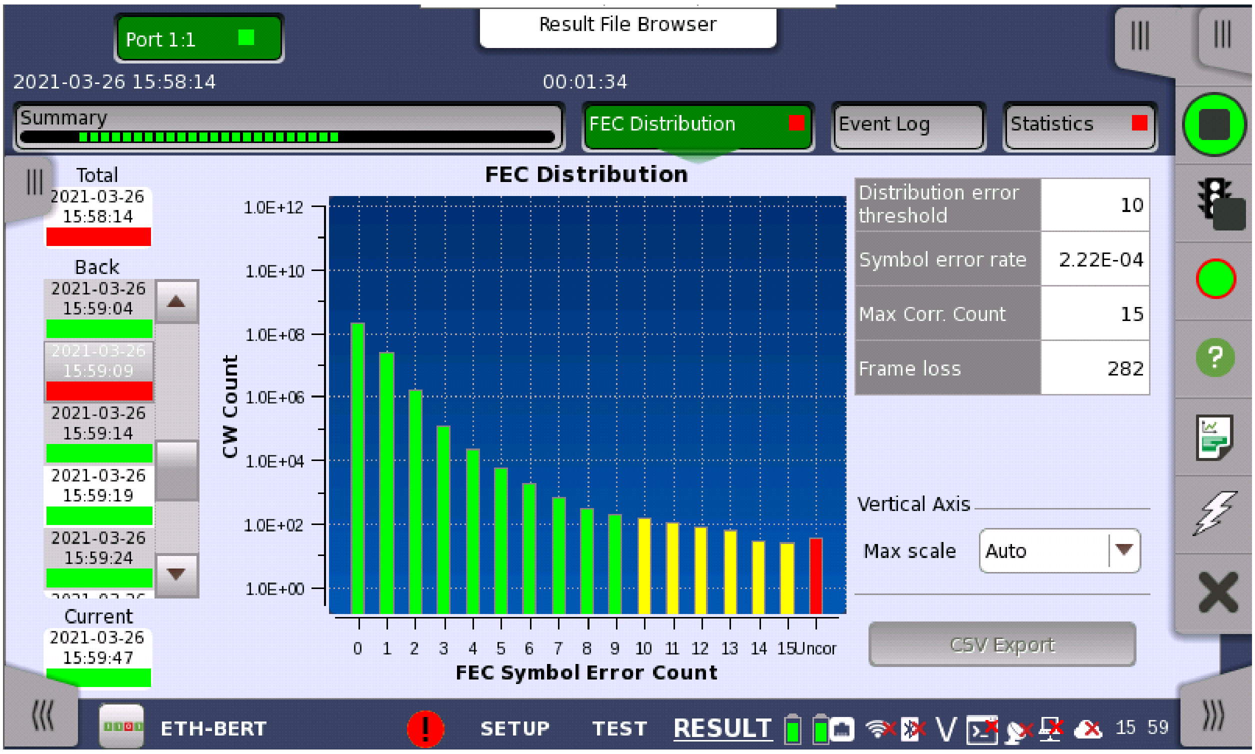


Figure 15. FEC distribution measurement

For Ethernet level testing of optical transceivers, a measurement scheme as shown in Figure 16 can be used. The optical transceiver in Loopback mode must be connected to the protocol analyzer. Then ports setting should be configured as well as test setting and a test should be started. This test allows to identify FEC Codeword Errors and describe the CW error distribution across the received FEC codewords. The user can set the preferred Symbol Error Thresholds to get the green/yellow/red color-coding conditions while monitoring the results on the graph in real-time.

Figure 16. Loop-backed optical transceiver validation

To simplify and speed up validation testing, Anritsu has developed a custom **xCVR Quick Check Scenario** that automates this process, see Figure 17. The script for automatic diagnostics and testing of optical transceivers was developed in free of charge **Anritsu MX100003A SEEK** (Scenario Edit Environment Kit) software. This program allows to create automated tests with setting various thresholds, pass/fail thresholds, adding dialog boxes to simplify interaction with the instrument and adhere to the test sequence, saving reports, etc.

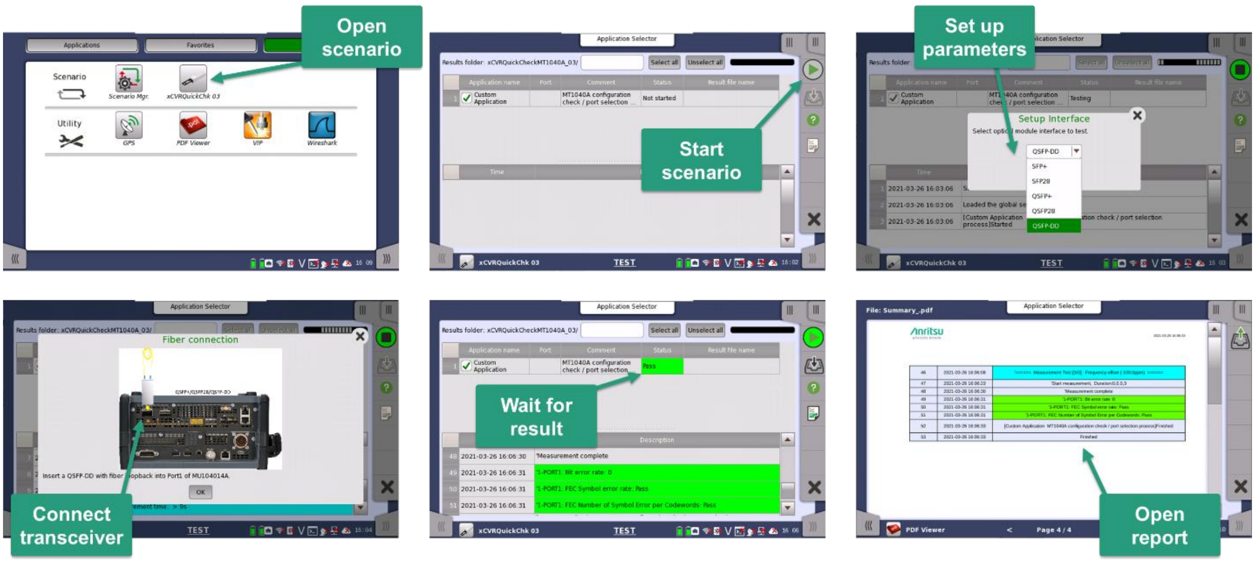


Figure 17. Dialog windows in automated xCVR Quick Check Scenario

The xCVR Quick Check Scenario uses dialog boxes and annotated pictures to simplify the workflow. During testing, the SER (Symbol Error Ratio) is measured and the values of the internal registers of the optical transceiver are read and verified, and for 400G transceivers the FEC margin is measured in real-time.

6. Conclusion

As shown above, there are several different approaches to test optical transceivers, which differ in level and degree of complexity. It is also necessary to conduct testing for compatibility with standards and with other products. Anritsu offers measurement solutions for testing the performance and compatibility of high speed 1G to 800G optical transceivers.

In the future, Anritsu plans to continue offering customers always up to date measurement solutions for assuring the quality of networking products and services.

Advancing beyond

Specifications are subject to change without notice.

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