10 Gigabit Ethernet Consortium
Clause 52 Optical PMD Test Suite version 0.1

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Vendor X
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June 5, 2008
Report Rev. 1.0

Mr. X:

Enclosed are the results from the Clause 52 Optical PMD Conformance testing performed on:

Device Under Test (DUT):	10Gigabit NIC
Transceiver Manufacturer:	Company X
Transceiver Type:	10GBASE-SR SFP+
Transceiver Model:	XXXXXX-XX-XXX-XX-X
Transceiver S/N:	0123456789
Hardware Version:	N/A
Firmware Version:	N/A
Software Version:	N/A
Miscellaneous:	Port 0 was used throughout testing

The test suite referenced in this report is available at the UNH-IOL website.

ftp://ftp.iol.unh.edu/pub/10gec/testsuites/Clause_52_optical_pmd_testsuite_v0.1.pdf

It should be noted that all measurements were made at test point TP2 using a short MMF (MultiMode Fiber) and an air gap attenuator (when necessary). The attenuator was necessary to place the transmitter's power levels just below the maximum acceptable limit of the test equipment's input port used for testing, however a calibration was performed to compensate for the effects of the attenuation. Data was gathered using an Agilent 86100C optical communications analyzer with the use of a clock recovery module. Receiver sensitivity measurements were not measured during this time due to unavailability of test devices.

Please feel free to contact me at johnqtester@iol.unh.edu if you have any questions regarding the contents of this report.

Testing Completed 06/05/2008

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Result Key

The following table contains possible results and their meanings:

Result	Interpretation
PASS	The Device Under Test (DUT) was observed to exhibit conformant behavior.
PASS with Comments	The DUT was observed to exhibit conformant behavior however an additional explanation of the situation is included, such as due to time limitations only a portion of the testing was performed.
FAIL	The DUT was observed to exhibit non-conformant behavior.
Warning	The DUT was observed to exhibit behavior that is not recommended.
Informative	Results are for informative purposes only and are not judged on a pass or fail basis.
Refer to Comments	From the observations, a valid pass or fail could not be determined. An additional explanation of the situation is included.
Not Applicable	The DUT does not support the technology required to perform these tests.
Not Available	Due to testing station or time limitations, the tests could not be performed.
Borderline	The observed values of the specified parameters are valid at one extreme, and invalid at the other.
Not Tested	Not tested due to the time constraints of the test period.

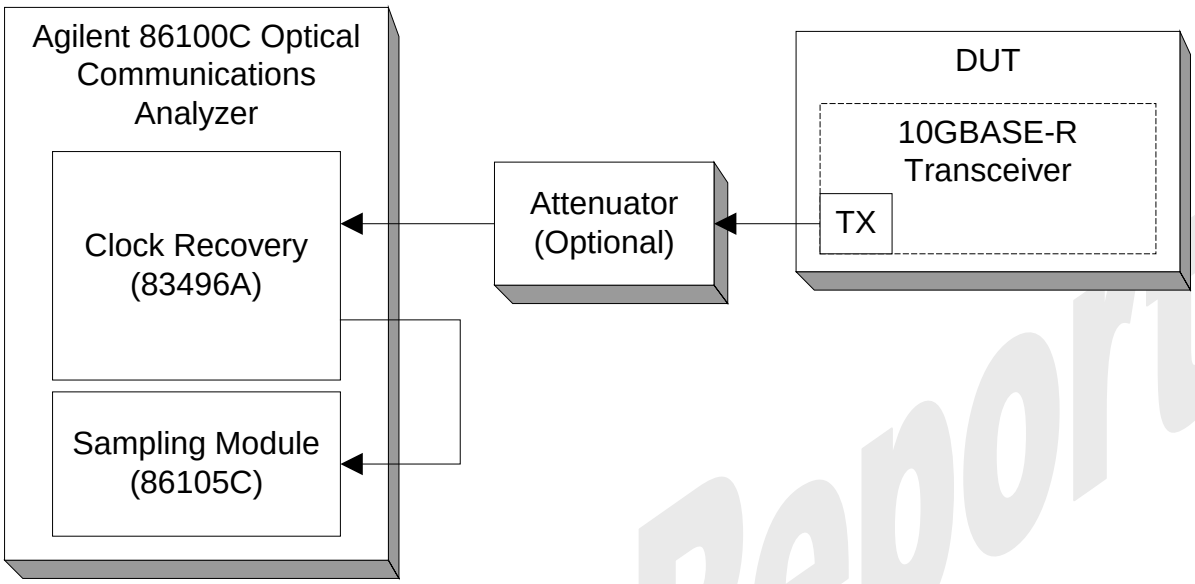


Figure 1: Test Configuration #1

Figure 1 above depicts the test setup employed for the majority of the testing. The test system consists of the Agilent 86100C optical communications analyzer, a clock recovery module (83496A), a sampling module (86105C), an air-gap attenuator, and the Device Under Test (DUT).

- The DUT is setup to transmit a valid signal to the clock recovery module. An air-gap attenuator was used, when necessary, to allow the transmitted signal to be just within the maximum limit of the testing device. Attenuation was measured to compensate both for the loss in the air-gap attenuator and for the loss in the clock recovery module.
- Depending on the test case, the clock recovery module will either lock on the data pattern or pass the data through.
- The sampling module is used to sample the waveforms over a period of time to gather an estimate of the desired measurement.

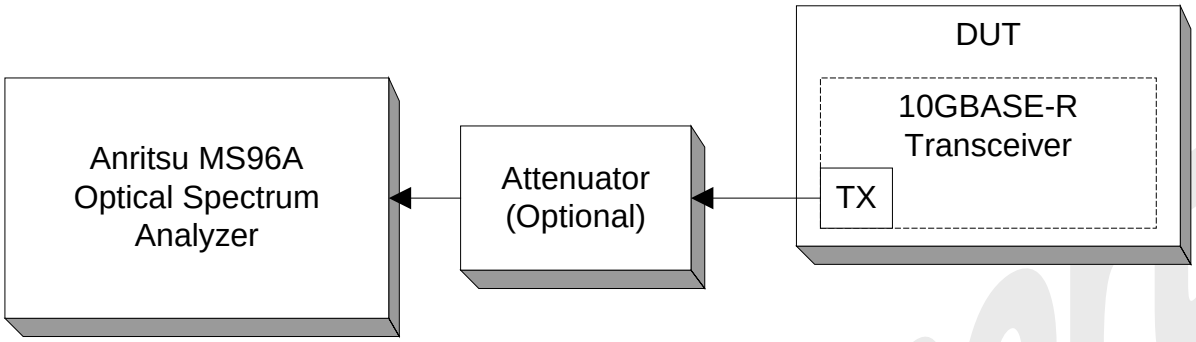


Figure 2: Test Configuration #2

Figure 2 above depicts the test setup employed for measuring the center wavelength and spectral width of the optical signal as required for 10GBASE-SR optics. The test system consists of the Anritsu Optical Spectrum Analyzer (MS96A), an air-gap attenuator, and the Device Under Test (DUT).

- The DUT is setup to transmit a valid signal to the spectrum analyzer. An air-gap attenuator was used, when necessary, to allow the transmitted signal to be just within the maximum limit of the testing device.
- The spectrum analyzer is used to measure the spectral width and center wavelength of the DUT to determine the 10GBASE-SR OMA criterion.

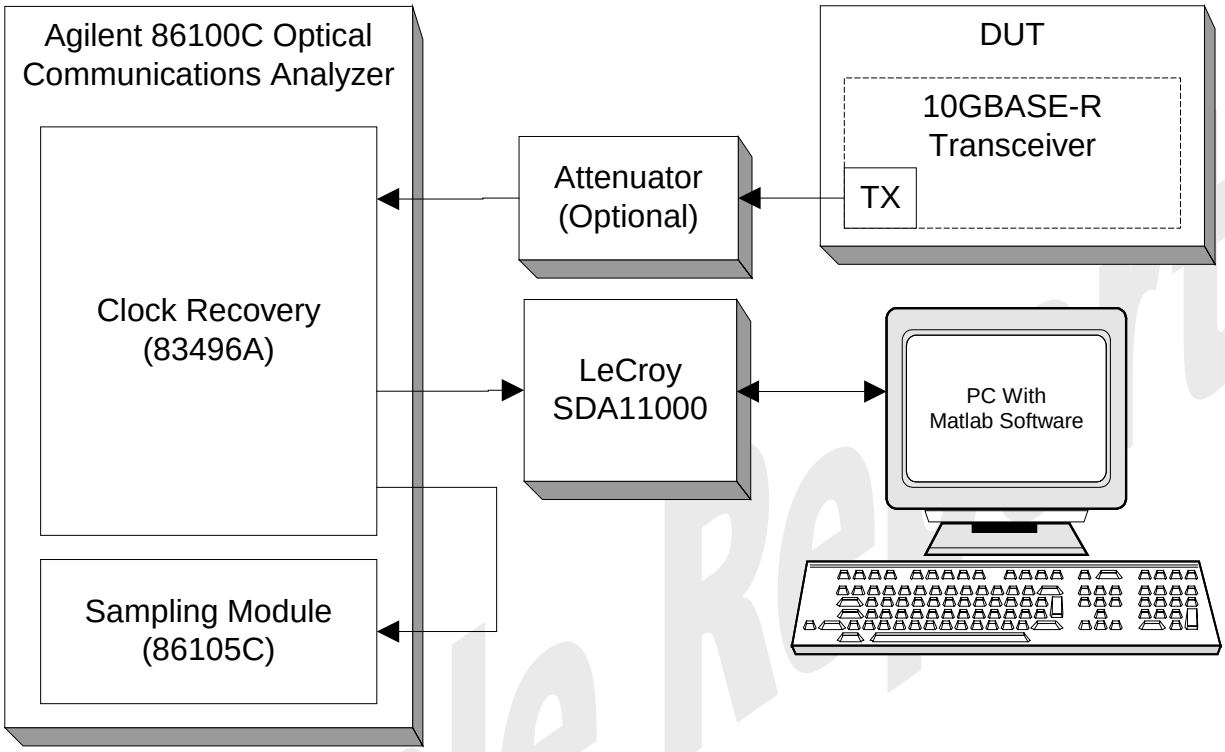


Figure 3: Test Configuration #3

Figure 2 above depicts the test setup employed for test case 52.1.1. The test system consists of the Agilent 86100C optical communications analyzer, a clock recovery module (83496A), a sampling module (86105C), a LeCroy SDA11000, a PC with MATLAB software installed, an air-gap attenuator, and the Device Under Test (DUT).

- The DUT is setup to transmit a valid signal to the clock recovery module. An air-gap attenuator was used, when necessary, to allow the transmitted signal to be just within the maximum limit of the testing device. Attenuation was measured to compensate both for the loss in the air-gap attenuator and for the loss in the clock recovery module.
- The clock recovery module was used to provide an output clock source.
- Using the clock output provided by the clock recovery module the SDA11000 was used to capture the waveform.
- Custom MATLAB software was used to determine the zero crossings and determine the deviation of the nominal signaling speed defined in Tables 52-7, 52-12, and 52-16 of the IEEE Standard 802.3-2005 (Section Four).

Test # and Label	Part(s)	Result(s)
Test #52.1.1: 10GBASE-R Signaling Speed Range	**a**	**PASS**

Expected results and procedural comments

Purpose: To verify that the baud rate of the DUT is within the conformance limits.

a. The DUT shall transmit at a signaling speed of 10.3125GBd with an acceptable variation of 100ppm.

The test setup depicted in Figure 2: Test Configuration #2 was used. This test is designed to measure the transmitter's signaling speed range as specified in IEEE Standard 802.3-2005, Section Four in Figure 52-2, Tables 52-7, 52-12, and 52-16.

Procedure:

1. Configure the DUT to transmit a valid signal at the appropriate speed and wavelength.
2. Measure the average TX signaling speed. The measurement can be obtained from an eye-diagram obtained in the scope or by other means. When an eye diagram is used, the histograms should include at least 10, 000 hits.

Comments on Test Results

Transmit characteristic	Nominal Value Table 52-7	Max. Variation from Nominal Table 52-7	Measured Deviation
Signaling Speed	10.3125GBd	+/- 100ppm	174.8kBd

The DUT's transmit signaling speed was observed to have properly remained within the maximum variation limits defined in Table 52-7.

Test # and Label	Parts	Result(s)
52.1.2: Average optical launch power	**a,b**	**PASS**
52.1.3: Extinction ratio	**c**	**PASS**
52.1.5: Transmitter eye mask	**d**	**PASS**

Expected results and procedural comments

Purpose: To determine if the DUT complies with the 10GBASE-SR/LR/ER transmitter optical specifications.

a. The average launch power of the DUT should fall between the appropriate maximum and minimum limits shown in the table below.
b. The average OFF launch power of the DUT should be less than –30dBm.
c. The measured extinction ratio should fall above the limit shown in the table below.
d. The captured waveform should have no mask violations.

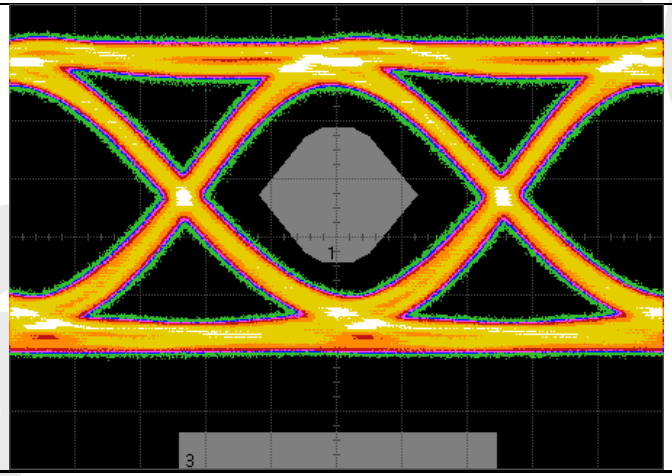
The test setup depicted in Figure 1: Test Configuration #1 was used. This test is designed to measure the transmitter optical waveform as specified in IEEE Standard 802.3-2005, Section Four in Figure 52-2, Tables 52-7, 52-12, and 52-16.

Procedure:

1. Configure the DUT to transmit test pattern 3 (PRBS31) or an appropriate alternative test pattern (see table 52-22 of the standard).
2. Using a short SMF/MMF connect the DUT to the testing device and perform the corresponding measurements.

Comments on Test Results

Transmit eye



Transmit characteristic	Table 52-7 limits	Measured value
Average optical launch power (ON)	-1dBm max -7.3dBm min	-2.18dBm
Average optical launch power (OFF)	-30dBm max	<-75dBm[1]
Extinction ratio	3dB min	4.31dB
Eye Mask Hits	0 hits	0 hits

Notes: For the tests listed above the DUT was set to transmit test pattern 3 (PRBS31). Also, the color grading of the eye diagrams indicates sample density, the hotter the color the greater the number of hits for that particular pixel location.

[1] A Fluke Optical Power Meter was used to determine the relative power being transmitted. This device is limited to a sensitivity down to –75dBm, thus the DUT's true power level cannot be determined beyond –75dBm.

Test # and Label	Parts	Result(s)
52.1.4: Optical modulation amplitude	**a**	**PASS**

Expected results and procedural comments

Purpose: To determine if the DUT complies with the 10GBASE-SR/LR/ER transmitter optical specifications.

a. The measured OMA should fall above the limits shown in Figure 52-3 of the Test Suite for the appropriate center wavelength.

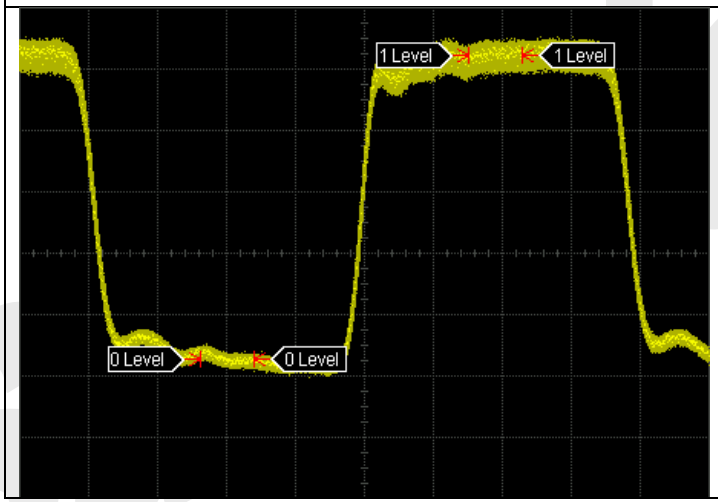
The test setup depicted in Figure 1: Test Configuration #1 was used. This test is designed to measure the transmitter optical waveform as specified in IEEE Standard 802.3-2005, Section Four in Figure 52-2, Tables 52-7, 52-12, and 52-16.

Procedure:

1. Configure the DUT to transmit the square wave pattern, as described in the IEEE Standard 802.3-2005, Section Four, Subclause 52.9.1.
2. Configure the oscilloscope to capture the transmissions from the DUT.
3. Process the captured waveform, measuring the OMA.

Comments on Test Results

Transmit eye



Transmit characteristic	Table 52-7 limits	Measured value
Optical modulation amplitude	-3.8dBm min	-3.08dBm
Spectral width	---	0.285nm
Center wavelength	---	850nm

Notes: For the test above, the DUT was set to transmit a square wave pattern defined in 52.9.1.2. The spectral width and center wavelength measurements were measured as described in Test Configuration #2.

Test # and Label	Parts	Result(s)
52.2.1: Stressed Receiver	**a**	**Not Tested**

Expected results and procedural comments

Purpose: To determine if the DUT complies with the 10GBASE-R stressed and unstressed receiver specifications.

This test is designed to measure the stressed and unstressed receiver sensitivity as defined in IEEE Standard 802.3ae-2002 in subclauses 52.9.8 and 52.9.9, and Tables 52-10 and 52-17. For these tests, a Circadiant Optical Standards Tester (OST) was used to create the stressed signals, and measure the sensitivity of the DUT. For the purposes of this test, the DUT is considered to be an XFP module that was placed within the Intel board. The test was then run on multiple 10GBASE-LR and 10GBASE-ER modules.

In this procedure, the 10GBASE-R signal was transmitted from the OST to the receiver of the DUT. The transmit power was increased or decreased in small increments, and the resulting BER was recorded. The straight-line BER vs OMA plots shown below interpolate/extrapolate to low BER regions where data may not have been taken because of time constraints. The sensitivity of the receiver under stressed and unstressed conditions are indicated in the plots below.

Comments on Test Results

This test could not be performed as there is no test equipment currently available that can perform this measurement.