INTERNATIONAL STANDARD

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Information technology –
Fibre distributed data interface (FDDI) –

Part 20:
Abstract test suite for FDDI physical medium dependent conformance testing (PMD ATS)

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INFORMATION TECHNOLOGY – FIBRE DISTRIBUTED DATA INTERFACE (FDDI) –

Part 20: Abstract test suite for FDDI physical medium dependent conformance testing (PMD ATS)

FOREWORD

1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

3) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 9314-20 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A and B form an integral part of this standard.

Annex C is for information only.

This publication must be read in conjuntion with ISO/IEC 9314-3:1990.

ISO/IEC 9314 consists of the following parts, under the general title *Information technology – Fibre Distributed Data Interface (FDDI):*

- *Part 1: Token Ring Physical Layer Protocol (PHY)*
- *Part 2: Token Ring Media Access Control (MAC)*
- *Part 3: Physical Layer Medium Dependent (PMD)*
- *Part 4: Single Mode Fibre Physical Layer Medium Dependent (SMF-PMD)*
- *Part 5: Hybrid Ring Control (HRC)*
- *Part 6: Station Management (SMT)*
- *Part 7: Physical Layer Protocol (PHY-2)*
- *Part 8: Media Access Control-2 (MAC-2)*
- *Part 9: Information technology – Fibre Distributed Data Interface (FDDI) – Part 9: Low-cost fibre physical layer medium dependent*
- *Part 13: Conformance Test Protocol Implementation – Conformance Statement (CT-PICS) Proforma*
- *Part 21: Abstract Test Suite for FDDI – Physical Layer Protocol Conformance Testing (PHY-ATS)* [1)]
- *Part 25: Abstract test suite for FDDI – Station Management Conformance Testing (SMT-ATS)*
- *Part 26: Abstract Test Suite for FDDI – Media Access Control Conformance Testing (MAC-ATS)* [1)]

[1)] To be published.

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INTRODUCTION

The Fibre Distributed Data Interface (FDDI), ISO/IEC 9314, is intended for use in a high performance general purpose multistation network and is designed for efficient operation with a peak data rate of 100 Mbit/s. It uses a Token Ring Architecture with optical fibre as the transmission medium. FDDI provides for hundreds of stations operating over an extent of tens of kilometres.

The FDDI Physical Media Dependent (PMD) standard, ISO/IEC 9314-3, specifies the lower sublayer of the Physical Layer for the FDDI, including the optical interface for multimode fibre FDDI stations. This part of ISO/IEC 9314 is an abstract test suite (ATS) conformance test for FDDI PMD. ISO/IEC 9314-3 specifies the optical interface of FDDI stations. ISO/IEC 9314-3 is not a protocol standard and this part of ISO/IEC 9314 requires the measurement of physical quantities such as optical power, wavelength and signal jitter. The intent of this part of ISO/IEC 9314 is to specify the tests as broadly as possible to allow measurement by various detailed test implementations. The ATS in this part of ISO/IEC 9314 differs from the methodology of higher level protocol conformance tests written using the Tree and Tabular Combined Notation (TTCN) because TTCN does not provide for Physical Layer testing, where there is no concept of a protocol data unit and where physical quantities must be measured.

Four other ISO/IEC standards provide a complete conformance test of an FDDI station:

a) An ATS for the FDDI Physical Layer Protocol (PHY) that provides a conformance test for FDDI PHY, ISO 9314-1. ISO 9314-1 specifies the upper sublayer of the Physical Layer for the FDDI, including the data encode/decode, framing and clocking, as well as the elasticity buffer, smoothing and repeat filter functions. FDDI PHY, however, does contain several state machines and implements a protocol at the level of FDDI code symbols. The only physical quantity that is measured in this conformance test is frequency. The PHY ATS cannot use the TTCN notation and a notation is developed in the PHY ATS for specifying test patterns and expected results in terms of FDDI code symbol strings.

b) An ATS for FDDI Media Access Control (MAC), ISO 9314-2, that provides a conformance test for FDDI MAC. ISO 9314-2 specifies the lower sublayer of the Data Link Layer for FDDI. It specifies access to the medium, including addressing, data checking and data framing. ISO 9314-2 also specifies the receiver and transmitter state machines. Since MAC is primarily with complete PDUs, the TTCN language is used to specify MAC protocol tests. Provisions of ISO/IEC 9314-2, however, require high resolution timing that may be difficult to achieve in commercial protocol testers.

c) An ATS for FDDI Station Management (SMT), ISO/IEC 9314-6, that provides a conformance test for FDDI SMT. ISO/IEC 9314-6 specifies the local portion of the system management application process for FDDI, including the control required for proper operation of an FDDI station in an FDDI ring. SMT provides services such as connection management, station insertion and removal, station initialization, configuration management and fault recovery, communications protocol for external authority, scheduling policies and the collection of statistics. SMT interacts with PMD, PHY and MAC. Therefore, an ATS for portions of SMT that use MAC PDUs can be specified in TTCN, while other portions require other approaches.

d) A Conformance Test Protocol Implementation Conformance Statement (PICS) Proforma, ISO/IEC 9314-13, for FDDI that provides a statement of the mandatory and optional requirements of each of the four FDDI base standards. The PICS proforma is used to identify requirements for conformance testing and to specify optional functionality requirements, particularly by workshops for functional standards and profiles.

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INFORMATION TECHNOLOGY – FIBRE DISTRIBUTED DATA INTERFACE (FDDI) –

Part 20: Abstract test suite for FDDI physical medium dependent conformance testing (PMD ATS)

1 Scope

This part of ISO/IEC 9314 specifies a series of tests in order to verify conformance of FDDI stations to the requirements of ISO/IEC 9314-3:1990.

NOTE ISO/IEC 9314-3 specifies the requirements for the optical input/output port of FDDI stations as well as for cable plants. It states that a bit error rate for a station-to-station link should not exceed $2{,}5 \times 10^{-10}$ for conforming stations connected to each other through a conforming cable plant.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9314. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 9314 are encouraged to investigate the possibility of applying the most recent edition of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 9314-1:1989, *Information processing systems – Fibre Distributed Data Interface (FDDI) – Part 1: Token Ring Physical Layer Protocol (PHY)*

ISO 9314-2:1989, *Information processing systems – Fibre Distributed Data Interface (FDDI) – Part 2: Token Ring Media Access Control (MAC)*

ISO/IEC 9314-3:1990, *Information processing systems – Fibre Distributed Data Interface (FDDI) – Part 3: Physical Layer Medium Dependent (PMD)*

ISO/IEC 9314-6:1998, *Information technology – Fibre Distributed Data Interface (FDDI) – Part 6: Token Ring Station Management (SMT)*

3 Definitions

The specialized FDDI terms used in this part of ISO/IEC 9314 are defined in the FDDI base standards ISO 9314-1 (PHY), ISO 9314-2 (MAC), ISO/IEC 9314-3 (PMD) and ISO/IEC 9314-6 (SMT).

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4 Conventions and abbreviations

The following acronyms and abbreviations are used in this ATS:

BER:	Bit Error Rate (PMD)
BERT:	Bit Error Rate Tester (PMD)
CMS:	Cladding Mode Stripper (ISO/IEC 60793-1)
DCD:	Duty Cycle Distortion (PMD)
DDJ:	Data Dependent Jitter (PMD)
FDDI:	Fibre Distributed Data Interface
HLS:	Halt Line State (PHY)
ILS:	Idle Line State (PHY)
IUT:	Implementation Under Test
MAC:	Media Access Control
MIC:	Media Interface Connector (PMD)
NA:	Numerical Aperture (ISO/IEC 60793-1)
PCM:	Physical Connection Management (SMT)
PHY:	Physical Layer Protocol (PHY)
PMD:	Physical Medium Dependent (PMD)
PTF/PTCP:	Precision Test Fibre/Precision Test Connector Plug (PMD)
QLS:	Quiet Line State (PHY)
RJ:	Random Jitter (PMD)
SME:	Source Monitoring Equipment (ISO/IEC 60793-1)
SMT:	Station Management (SMT)
TTRT:	Target Token Rotation Time (MAC).

The terms SMT, MAC, PHY and PMD, when used without modifiers, refer specifically to the local entities.

5 Specification breakdown

Table 1 summarizes the requirements of ISO/IEC 9314-3. It identifies those requirements that are tested in this test specification and the specific test suite where they are tested.

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Table 1 – Specification breakdown

Name	PICS Item No.	ISO/IEC 9314-3 reference	Test reference
Active output interface			
Center wavelength	PMD1.1	8.1.1 Table 1	8.2.4
Average power	PMD1.2	8.1.1 Table 1	8.2.1
Source FWHM spectral width	PMD1.3	8.1.1 Figure 9	8.2.4
Rise time	PMD1.4	8.1.1 Table 1	8.2.2
Fall time	PMD1.5	8.1.1 Table 1	8.2.2
Duty cycle distortion	PMD1.6	8.1.1 Table 1	8.2.5
Random jitter	PMD1.7	8.1.1 Table 1	8.2.6
Data dependent jitter	PMD1.8	8.1.1 Table 1	8.2.6
Extinction ratio	PMD1.9	8.1.1 Table 1	8.2.3
Pulse envelope		8.1.2 figures 10 and 11	8.2.2
Active input interface			
Sensitivity threshold	PMD2.1	8.2.2 Table 2	8.3.4
BER $<10^{-12}$ at 2 dB above threshold		8.0	8.3.5
Saturation power level	PMD2.1	8.2.2 Table 2	8.3.6
Station bypass interface signal	–	–	–
Bypass attenuation	PMD3.1	8.3, Table 3 and Figure 12	8.4.1
Interchannel isolation	PMD3.2	8.3, Table 3 and Figure 12	8.4.2
Switching time	PMD3.2	8.3, Table 3 and Figure 12	Not testable
Media interruption time	PMD3.3	8.3, Table 3 and Figure 12	8.4.3
Interface signals			
Signal_Detect threshold	PMD4.1 & PMD4.2	9.1.1.1	9.2.1
Signal_Detect hysteresis	PMD4.3	9.1.1.1	9.2.1
MIC receptacle			
Receptacle keying	PMD6.1	7.2.2, Figure 8	7.2
Receptacle dimensions		7.2, Figure 5 and Figure 6	Not tested

6 General

6.1 Test environment

The FDDI standards do not specify an operating environment. All tests specified in this document shall be performed with temperature and atmospheric conditions consistent with the environmental operating specifications of the IUT.

For FDDI stations which are directly powered (either wholly or partly) from the a.c. power line, all tests shall be carried out within 0,5 % of the nominal operating voltage. If the equipment is powered by other means and those means are not supplied as a part of the apparatus (e.g. batteries, stabilized a.c. supplies, d.c.) all tests shall be carried out within the power supply limit declared by the supplier. If the power supply is a.c., the tests shall be conducted within 4 % of the normal operating frequency.

All optical power measurements shall be made with a calibrated power meter traceable to a recognized primary standard.

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6.2 Measurement error

Physical quantities are measured in this ATS (particularly optical power levels). There are measurement errors associated with the calibration and tolerance of the measurement instruments. Moreover, it is known that measurements of optical output power are not necessarily precisely repeatable due to differences in the way connectors mate each time they are inserted. Where measurement repeatability is a concern, it is common in test standards to require a number of measurements and to add a safety factor of three times the standard deviation of those measurements to the mean. This ATS follows that convention.

Bit error rates (BER) are measured in this ATS. At the rates specified in PMD practical tests are statistical tests of the hypothesis that IUT meets the PMD requirements with a limited sample size. Associated with these tests is a confidence level. The confidence level chosen in this ATS is 90 %. Tests that establish this confidence level may have varying duration. However, the shorter the test, the larger the safety margin required of the IUT if it is to have a high probability of passing the test.

It is the burden of the conformance test laboratory to verify that an IUT does conform to the standard. Therefore, measurement errors due to calibration, repeatability and statistical sampling are added to the requirement being tested so that the greater the error, the more difficult it becomes to pass the conformance test.

7 Media attachment

7.1 MIC Requirements

An FDDI station is attached to the fibre optic medium by a Media Interface Connector (MIC). Clause 7 of ISO/IEC 9314-3:1990 specifies the dimensions of the MIC plug and the receptacle in the station. This clause defines tests of station MIC requirements.

7.2 Receptacle keying

7.2.1 Purpose

Every FDDI port is designated either A, B, S or M and Figure 8 of ISO/IEC 9314-3:1990 specifies the keying required for a receptacle for each type of port. This test case verifies the receptacle keying.

7.2.2 Equipment

FDDI connector plugs with keying for A, B, S and M ports.

7.2.3 Procedure

Attempt to insert the four plugs in each port of the IUT and record which plugs are successfully inserted.

7.2.4 Pass_fail criteria

Only the following plugs can be inserted:

a) A port: S or A plugs can be inserted;

b) B port: S or B plugs can be inserted;

c) M port: S or M plugs can be inserted;

d) S port; S plug can be inserted.

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8 Media signal interface

8.1 Media signal test cases

The following test cases verify the requirements for the media signal interface specified in clause 8 of ISO/IEC 9314-3:1990.

8.2 Active output interface

The test cases in this group validate the requirements of 8.1 of ISO/IEC 9314-3:1990, which specifies the characteristics of the station output signal.

8.2.1 Average optical output power

8.2.1.1 Purpose

To verify that the average optical power coupled from the IUT into a PTF/PTCP is more than –20,0 dBm, and less than –14,0 dBm when a data pattern of Halt symbols is transmitted as specified in Table 1 of ISO/IEC 9314-3:1990.

8.2.1.2 Equipment

An optical power meter is used. The power meter shall be calibrated between –14 dBm and –31 dBm in the wavelength range 1 250 nm to 1 400 nm.

8.2.1.3 Configuration

See Figure 1.

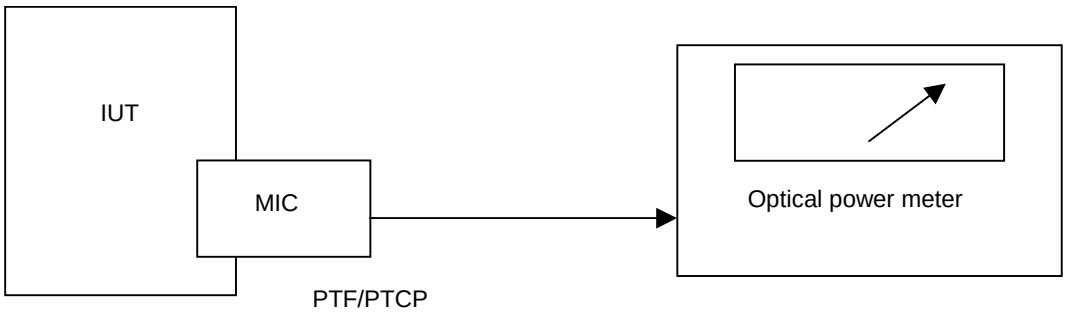

Figure 1 – Optical power test configuration

8.2.1.4 Procedure

The optical power meter is connected to the IUT using a PTF/PTCP. The IUT is turned on but its input is dark; this will result in the IUT entering the Physical Connection Management (PCM) Connect State and transmitting Halt Line State (HLS). The measurement shall be repeated ten times with the PTF/PTCP reinserted in the IUT between measurements. The connector plug shall be cleaned before each insertion. The PTF/PTCP shall not be manipulated manually to control the power measurement. Obvious outlying data points shall be excluded. The mean of the 10 measurements shall be computed with the sample standard deviation, *s*.

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8.2.1.5 Pass_fail criteria

Let C be the calibration uncertainty of the power meter expressed in dB (for example, suppose, the uncertainty were 5 %, then C = 10 log (1,05) = 0,211 9). Let $\bar{P}$ be the mean of the power measurements. Let s be the sample standard deviation.

The IUT passes if

$$(20 + C + 3 \times s) \leq \bar{P} \leq (-14 - C - 3 \times s) \quad \text{dBm} \tag{1}$$

The IUT fails if

$$\bar{P} \geq (-14 + C + 3 \times s) \quad \text{dBm} \tag{2}$$

or

$$\bar{P} \leq -(20 + C + 3 \times s) \quad \text{dBm} \tag{3}$$

Otherwise the results are inconclusive.

8.2.2 Output waveform

8.2.2.1 Purpose

To verify that the output optical pulse rise time and fall time, conform to Table 1 of ISO/IEC 9314-3:1990, and the overshoot and undershoot are within the limit shown in figures 10 and 11 of ISO/IEC 9314-3:1990. The rise and fall times to be used in the spectral width test (test suite 4.1.3) are computed in this test.

8.2.2.2 Equipment

– Sampling oscilloscope or waveform analyzer

– Optical to electrical converter

The combined bandwidth range of the optical to electrical converter and the Waveform Recorder or Waveform Analyzer shall be greater than 100 kHz to 750 MHz.

A waveform analyzer is a device which samples the input waveform and automates the measurement and calculation of rise time, fall time, overshoot, and undershoot, of the signal, but does not necessarily record or display a complete trace of the waveform. To satisfy the requirements of this test the analyzer shall be capable of:

– detecting peak and minimum signal points;

– determining the high and low signal values of the pulse by averaging at least three values taken from the intervals shown in Figure 3;

– measuring the 10 % and 90 % signal level crossing points.

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8.2.2.3 Configuration

See Figure 2.

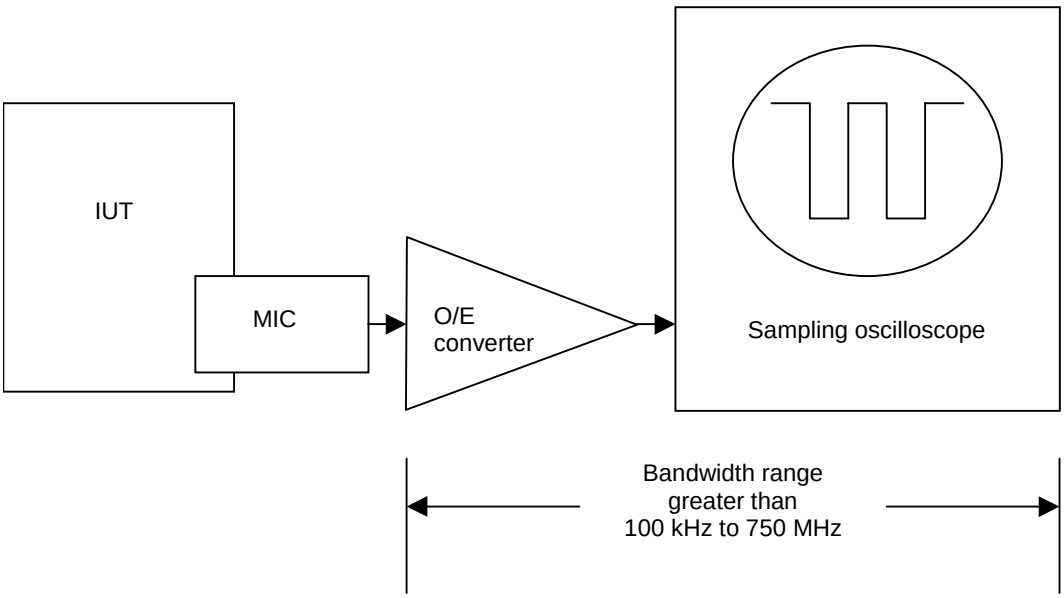

Figure 2 – Pulse envelope test configuration

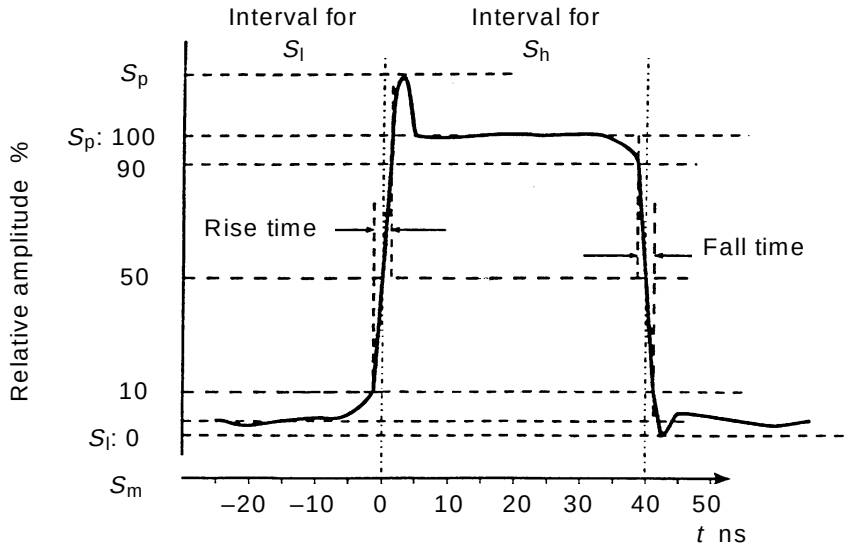

Figure 3 – Output waveform measurement

8.2.2.4 Procedure

With a dark input the IUT will transition to the PCM Connect State and send HLS. When an oscilloscope is used, the various power levels and times specific below are measured manually by the operator by visual inspection of the oscilloscope waveform display. When a waveform analyzer is used the parameters specified below are measured automatically by electronic circuits such as peak detectors and comparitors, or by programmed analysis of a sampled waveform.

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Refer to Figure 3. Measure the 0 % signal level, S_l, and 100 % signal levels, S_h, as the average level in the 10 ns intervals indicated in Figure 3.

Determine the 10 % signal level as follows:

$$10\ \%\ \text{level} = S_l + (S_h - S_l) \times 0{,}10 \tag{4}$$

Determine the 90 % signal level as follows:

$$90\ \%\ \text{level} = S_l + (S_h - S_l) \times 0{,}90 \tag{5}$$

Determine the rising and falling 10 % and 90 % signal points and the corresponding rise and fall times as illustrated in Figure 3.

Find the peak signal point, S_p. Compute the overshoot as follows:

$$\text{Overshoot} = \frac{S_p - S_h}{S_h - S_l} \times 100 \quad \% \tag{6}$$

Find the minimum power point, S_m, on the waveform trace. Compute the undershoot as follows:

$$\text{Undershoot} = \frac{S_t - S_m}{S_h - S_t} \times 100 \quad \% \tag{7}$$

8.2.2.5 Pass_fail criteria

a) The rise time shall be greater than 0,6 ns and less than 3,5 ns;

b) The fall time shall be greater than 0,6 ns and less than 3,5 ns;

c) Overshoot shall be less than 25 %;

d) Undershoot shall be less than 5 %.

8.2.3 Extinction ratio

8.2.3.1 Purpose

To verify that the extinction ratio conforms to PMD Table 1.

8.2.3.2 Equipment

Refer to 8.2.2.2. The test equipment for this clause is similar, except that the combined bandwidth range of the optical to electrical converter and the waveform recorder or waveform analyzer shall extend from d.c. to at least 75 MHz.

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