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**Measuring methods of transmitting
and receiving modules for low speed
fiber optic transmission**

ICS 33.180.20

Descriptors : data transmission, fibre optic cables, telecommunication links, transmitters, receivers, modules, testing, optical communication systems, circuits

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently JIS C 6111:1990 is replaced with JIS C 6111:1997.

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Measuring methods of transmitting and receiving modules for low speed fiber optic transmission

Introduction This Standard specifies measuring methods of transmitting and receiving modules for low speed fiber optic transmission with 2 R (waveform reproducing and reshaping) functions which are used for transmission of NRZ digital signal at a bit rate not exceeding 10 Mb/s through a multimode optical fiber, in response to the requirement of early establishment of national Standard in such backgrounds that the market of fiber optic transmission link inside and outside of this country is spreading and the international standardizing activity is promoted.

1 Scope This Japanese Industrial Standard specifies measuring methods of transmitting and receiving modules for low speed fiber optic transmission with waveform reproducing and reshaping functions which are used for transmission of NRZ digital signal at a transmission rate not exceeding 10 Mb/s through a multimode optical fiber.

Remarks: The transmitting and receiving module for low speed fiber optic transmission dealt with here means a module composed of a transmitter consisting of a light emitting diode as the light emitting element, an electric circuit and a joint with the optical fiber, and a receiver consisting of a light receiving element, and electronic circuit and a joint with the optical fiber. It is the generic name of modules of the following three kinds in construction:

- a) Transmitting module in which the above transmitter is employed as an individual module.
- b) Receiving module in which the above receiver is employed as an individual module.
- c) Transmitting and receiving module in which the above transmitter and receiver are employed to form a module.

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards indicated below shall be applied.

JIS C 1102 *Electrical indicating instruments*

JIS C 6110 *General rules of transmitting and receiving modules for low speed fiber optic transmission*

3 Definitions For the purpose of this Standard, in addition to the definitions stated in JIS C 6110, the following principal definitions apply:

- a) **measurement optical fiber** Such an optical fiber that its structural parameters and the structural parameters of the plug attached to it have respective values which satisfy the requirements of measurements.

- b) **reference transmitter and reference receiver** Such transmitter and receiver that their electrical and optical characteristics have respective values which satisfy the requirements of measurements of each item in the relevant Standard.

4 Atmospheric conditions for measurement

4.1 Standard conditions Unless otherwise specified, the measurements shall be carried out under the conditions of a temperature 15 °C to 35 °C, a relative humidity 25 % to 85 %, and an air pressure 860 hPa to 1 060 hPa. If any doubt arises on the decision of measured value under this standard conditions or if especially required, the conditions of 4.3 shall be employed.

If conversion to the reference conditions is necessary, the conditions of 4.2 shall be employed.

If it is difficult to carry out the tests under the standard conditions, the test may be carried out under the conditions other than the standard conditions, unless any doubt arises on the decision.

4.2 Reference conditions The reference conditions shall be those of temperature 25 °C, relative humidity 45 %, and an air pressure 860 hPa to 1 060 hPa. However, only the temperature may be employed as the reference condition.

4.3 Referee conditions The referee conditions shall be temperature (25 ± 2) °C, a relative humidity 45 % to 55 % and an air pressure 860 hPa to 1 060 hPa.

5 Measuring apparatus and equipment

5.1 Measuring power supply In the d.c. power supply, the voltage fluctuation shall not exceed ± 5 % or 10 mV whichever is the larger, and in the a.c. power supply, the higher harmonic content shall not exceed 5 %. If commercial power supply is used, the higher harmonic content shall not exceed 10 %.

Further, in the test of measuring a.c. output, the ripple content of d.c. power supply, higher harmonic content of a.c. power supply and a.c. impedance of the d.c. supply circuits through which a.c. current flows shall have small values so that they will not affect the measurement.

The power supply shall be enough protected against ingress of surges.

5.2 Instruments and measuring apparatus Unless otherwise specified, the instruments shall be those of class index 0.5 or better specified in JIS C 1102, and the measuring apparatus shall have an accuracy at least equivalent thereto, and their impedances shall be of such values that the influence on the measuring system can be ignored.

Remarks: If there is no instrument of class index 0.5 or better or measuring apparatus of equivalent accuracy, as standard products, the provision of 5.2 does not apply.

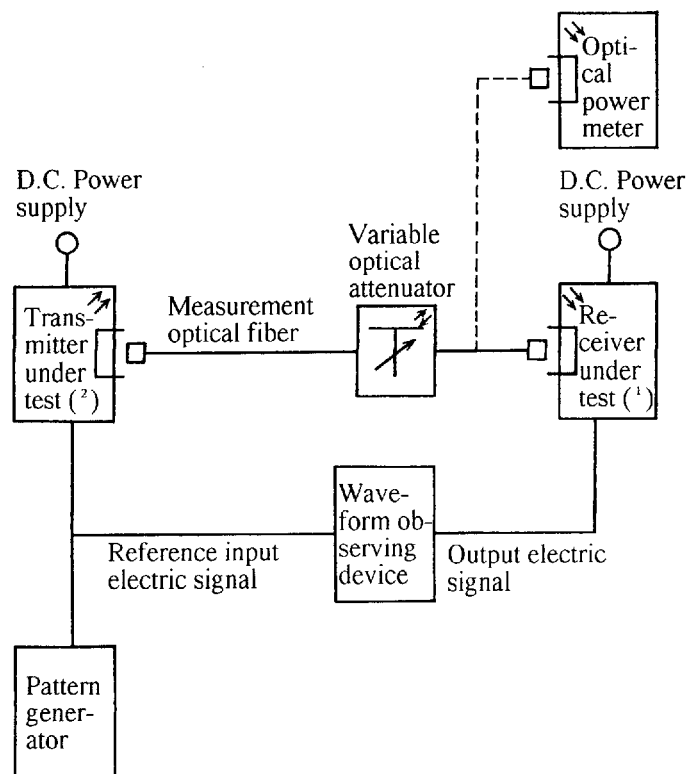
5.3 Optical power meter The optical power meter to be used for measurements shall be calibrated at the appropriate wavelength and the sensitivity distribution of light receiving plane shall be sufficiently flat.

6 Measuring method of electrical and optical characteristics

6.1 Transmission delay time (composite test, transmitter individual test and receiver individual test)

6.1.1 Purpose The purpose is to measure the transmission delay time of modules under specified conditions.

6.1.2 Measuring circuit The measurement of transmission delay time shall be carried out as illustrated in Fig. 1.



Notes (1) In the case of transmitter individual test, reference receiver is used.

(2) In the case of receiver individual test, the reference transmitter is used.

Remarks 1 The dash line shows the connection state in procedure 6.1.3 c).

2 The optical delay of measurement optical fiber, variable optical attenuator, etc. and the delay in signal line of measuring circuit shall be previously calibrated.

Fig. 1 Measuring circuit of transmission delay time

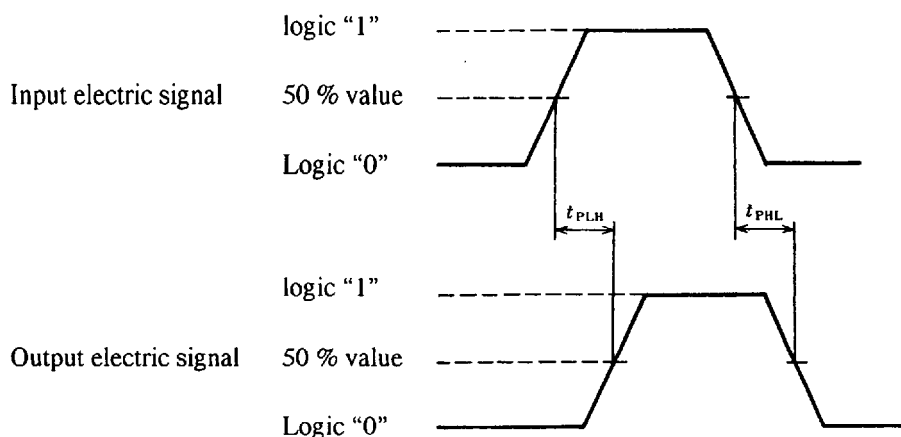
6.1.3 Measuring procedures

- Drive the transmitter and receiver under the specified conditions.
- Apply the specified continuous input electric signal of NRZ 1010... (mark density 50 %) input the transmitter from the pattern generator.
- Input the optical output signal so prepared to the receiver through measurement optical fiber and variable optical attenuator.

Adjust the variable optical attenuator so that the specified optical power is inputted into receiver.

- Observe the waveforms of the output from the pattern generator and of the output from the receiver by means of such a waveform observing device as an oscilloscope, and measure the time differences t_{PLH} , t_{PHL} between the said two waveforms at their 50 % amplitude value shown in Fig. 2.

The optical delay in the measurement optical fiber, variable optical attenuator etc. and the delay in the signal line of the measuring system shall be previously calibrated. If there is a pulse width jitter in the output electric signal, carry out the measurement at the maximum value of the jitter.



Remarks: This figure shows the case of positive logic and in the case of negative logic, the "logic 1" in the figure should be read as "logic 0" and "logic 0" as "logic 1".

Fig. 2 Transmission delay time

- Calculate transmission delay time t_d from formula (1), formula (2) or formula (3):

For composite transmitter and receiver test

$$t_d = \max(t_{PLH}, t_{PHL}) \quad \dots \quad (1)$$

For transmitter individual test

$$t_d = \max(t_{PLH}, t_{PHL}) - t_{dr} \quad \dots \quad (2)$$

For receiver individual test

$$t_d = \max(t_{PLH}, t_{PHL}) - t_{ds} \quad \dots \quad (3)$$

where, $\max(a, b)$: The larger value among the values a and b . The value when they are equal.

t_{dr} : transmission delay time of reference receiver

t_{ds} : transmission delay time of reference transmitter

- f) In the case of composite test and receiver individual test, adjust the variable optical attenuator so that the minimum received optical power and the maximum received optical power are attained at the receiver, repeat the measurement of t_d over the above range and take the maximum measured value as transmission delay time. In the case of composite test where a transmitter and a receiver are combined, use the test specimens as the transmitter and receiver under test. In the case of transmitter individual test use the reference receiver in lieu of the specimen receiver and in the case of receiver individual use the reference transmitter in lieu of the specimen transmitter.

6.1.4 Items to be specified in detail specifications

- a) Operating temperature
- b) Transmission delay time, rise time, fall time, distortion of pulse width random jitter, maximum received optical power and minimum received optical power of reference receiver (the random jitter shall be sufficiently smaller than that of the transmitter under test.)
- c) Transmission delay time, rise time, fall time, distortion of pulse width random jitter and output optical power of reference transmitter (pulse width jitter shall be sufficiently smaller than that of the receiver under test.)
- d) Conditions for driving transmitter and receiver (supply voltage)
- e) Input signal for transmitter (transmission bit rate, waveform)
- f) Measurement optical fiber
- g) Maximum received optical power and minimum received optical power of receiver

6.2 Distortion of pulse width (composite test, transmitter individual test and receiver individual test)

6.2.1 Purpose The purpose is to measure the distortion of pulse width of modules under specified conditions.

6.2.2 Measuring circuit The measurements of pulse width distortion shall be carried out as illustrated in Fig. 3.