UDC 621.37/39(075.8)

FIBER-OPTIC COMMUNICATION LINE RECEIVERS

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This article discusses the application of fiber-optic receivers used in fiber-optic communication systems. The characteristics of the optical network have been studied. The reasons for the occurrence of reverse optical losses are analyzed.

The main task of the optical receiver is to convert the modulated light flux coming from the optical fiber into a copy of the original electrical signal sent to the transmitter. Usually, a PIN or avalanche photodiode mounted on an optical connector (similar to that used for light sources) is used as a detector in the receiver. Photodiodes usually have a fairly large sensor element (several micrometers in diameter), so the requirements for the positioning accuracy of the optical fiber are not as strict as for transmitters.

The actual sensitivity of the receivers is determined by many factors: the normalized value of the error coefficient, the shape of the pulse, the speed of information transmission, the bandwidth of the receiver, and the noise of optical radiation. Therefore, practically, in the specifications the sensitivity of the receiver is set only for a well-defined transmitter, the transmission rate of binary signals and their shape.

With an increase in the data transfer rate, the sensitivity deteriorates (i.e. increasing) in linear units approximately proportional to the speed B, bit/s. The sensitivity of modern digital high-speed receivers based on PT-photodiodes is determined by the thermal noise of a transimpedance amplifier [1].

Networks built on the basis of fiber-optic cable have the following advantages in comparison with networks based on coaxial cable:

- less signal attenuation;
- less exposure to interference;
- greater broadband and, therefore, capacity;
- a single optical cable can contain a large number of fibers, each of which carries a high-speed information flow and provides an independent information service (or a group of services).

All this allows you to deliver a signal over long distances with high quality and, in addition, to build integrated networks based on a single fiber network. Such an integrated network can provide a subscriber with television services (analog, digital, high-definition), high-speed data transmission, and telephony.

An important parameter of the optical network is the wavelength used. For cable television networks, the wavelength ranges of 1310 and 1550 nm are used. Transmitting equipment for a wavelength of 1310 nm is significantly cheaper, but the attenuation in the fiber is higher here. The optical cable lengths of equal attenuation for the wavelengths of 1310 and 1550 nm are approximately related as 5:8, that is, a 5 km length of optical fiber at a wavelength of 1310 nm has the same attenuation as an 8 km length at a wavelength of 1550 nm. However, in small-scale networks, it is usually preferable to work at a wavelength of 1310 nm.

The reverse optical loss represents the total power of the light reflected back to the source from the optical gap which includes the back-scattered light from the fiber, expressed in decibels, defined as:

$$\mathrm{ROL}=10\mathrm{Log}\frac{\mathrm{Pip}}{\mathrm{Prl}} \tag{1}$$

Where P_{ip} is the input power and P_{rl} is the reflected light power, Watts.

A high level of ROL will reduce the performance of some transmission systems. For example: high back-reflection can distort the quality of the analog video signal, resulting in poor video quality.

The higher the OOP is estimated and the lower the reflected power is, the smaller the effect of reflection will be. This means that the ROL = 40 dB is better than the OOP = 30 dB. The ROL is expressed as a positive decibel value, while the connector reflection is expressed as a negative value [2].

If the ROL value is too high, the light may resonate in the cavity of the laser diode, causing it to become unstable. As a result:

- Increased transmitter noise reduction of the optical signal-to-noise ratio in analog video transmission systems and an increase in the ratio of the number of mistakenly received bits to the total number of received bits in digital transmission systems;

– Increase in light source interference change in the wavelength and output power of the central laser;
– Higher probability of damage to the transmitter.

And if the ROL value is too small, then we use:

– low reflection connectors;
– optical isolators near the laser to reduce back reflection.

The FOCL receiver can be used in various receiving television antennas, and will be in demand in both wireless and cellular communications, radio broadcasting, GPS, ground stations and VSAT data networks.

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