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TECHNICAL CHARACTER OF TERAHERTZ AND LASER WAVES IN SATELLITE TELECOMMUNICATIONS

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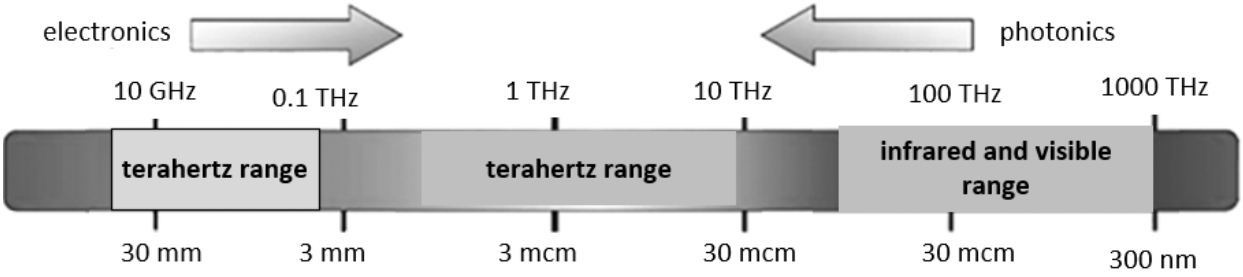
ТЕХНІЧНІ ВЛАСТИВОСТІ ТЕРАГЕРЦОВИХ ТА ЛАЗЕРНИХ ХВИЛЬ В СУПУТНИКОВИХ ТЕЛЕКОМУНІКАЦІЯХ

Терагерцові і лазерні хвилі використовуються для бездротової передачі даних. Порівняні типи хвиль мають великий потенціал для їх використання в телекомунікаціях. В даній роботі проведено аналіз особливостей і властивостей терагерцових і лазерних хвиль, їх потенціалу для використання в супутникових телекомунікаціях.

Terahertz and laser waves are used for wireless data transmission. Comparable types of waves have great potential for their use in telecommunications. In this study an analysis of the features and properties of terahertz and laser waves is carried out. Their potential for use in satellite telecommunications.

Terahertz waves transmit information via radio waves which spectrum of frequencies is located between infrared and ultrahigh-frequency ranges. In this frequency range it was difficult to apply methods, ideas and technical solutions which fully justified themselves in the development of adjacent ranges.

Thus, the terahertz frequency range from 100 GHz to 10 THz (1 THz = 103 GHz) lies at the boundary between electronics and photonics. Below it is determined by the frequency-time constraints (over 100 GHz) of electronic transitions in semiconductor structures, and above – by the maximum wavelength of quantum transitions of laser structures. This wavelength range is on the scale of the electromagnetic waves between the microwave range and the infrared and visible range and partially overlays the high frequency part of the extremely high frequency (HF) band (100 ... 300 GHz) and the low frequency part of the infrared range.



The interaction of terahertz waves with atmospheric gases, fluids, various solid media and materials has its own specificity, which manifests itself in the essential difference in attenuation, permeability, dissipation, reflection and radiation of these waves compared with optical waves.

The line of the optical system of communication between the two points consists of two receiving and transmitting devices located within the line of sight at both ends of the line and directed to each other. In the transmitter, the generator-laser and the modulator of its optical radiation are transmitted by a signal. The modulated laser beam of the optical system is directed toward the receiver. In the receiver, the radiation focuses on the photodetector, where its detection and selection of transmitted information is performed.

The scheme of one version of the receiver-transmitting device of the optical system of communication with the semiconductor laser is given in Fig. 1

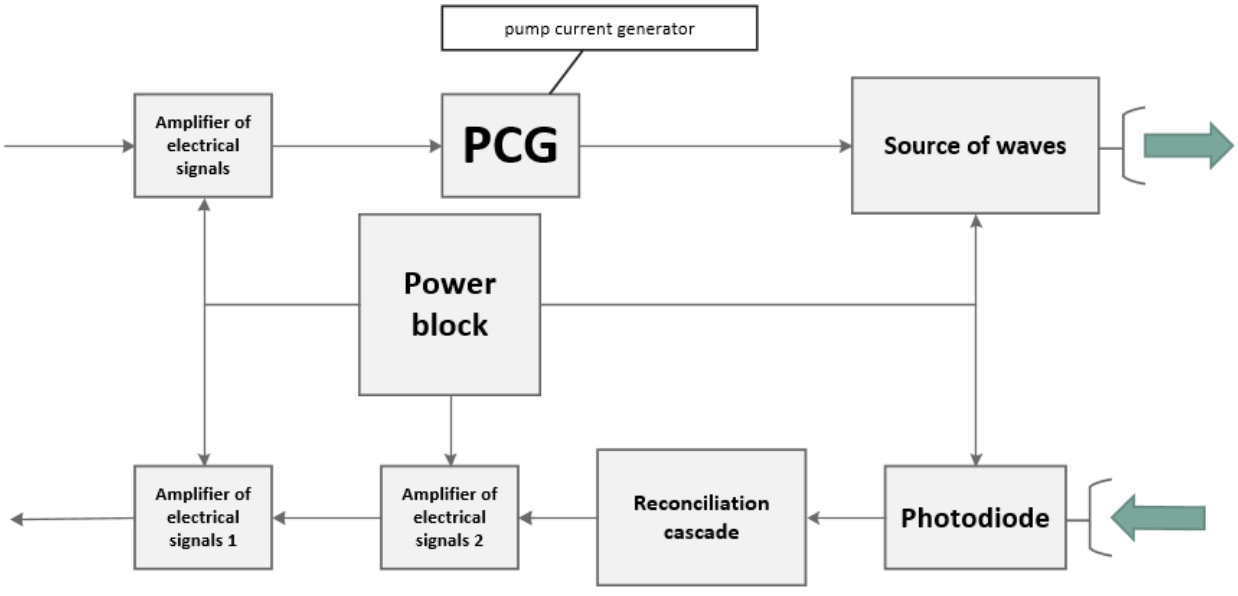


Fig.1 Scheme of the receiver-transmitting device
of the optical communication system

The optical radiation is focused on the antenna. The receiving part contains an antenna, focusing radiation at the reception area of the photodiode.

The atmosphere is a mechanical mixture of gases, steam, liquid droplets and solid particles. In it there is always a variable quantity of dust, smoke, ice crystals. Therefore, the atmosphere is an aerosol, the composition of which constantly changes due to mixing.

Technical characteristics of the atmospheric communication lines are given in Table.1.

Table 1 European Space ACL

Parameter	**Value**
Working wavelengths, microns	0,81—0,87
Average radiated power, mW	50
Information transfer speed, Mbps / channel	1—120
Diameter of antenna of geostationary satellite, cm	35
Diameter of antenna of low-orbit satellite, cm	20
Dynamic aiming/guidance error, microrads	20
Static aiming/guidance error, microrads	0,5
Probability of false reception of a symbol	10^{-6}
Estimated communication distance, km	45000

Thus, the communication on the laser beam via the atmosphere provides today the transfer of large volumes of information with high reliability at distances per kilometer in the earth's atmosphere and in the space in the tens of thousands of kilometers.

The terahertz and laser waves have many differences but can successfully complement each other in one communication system.

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